Final Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

January 5, 2018

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Water Quality Program
Washington State Department of Ecology
Olympia, Washington

Publication and Contact Information

This report is available on the Department of Ecology's website at:
https://www.ecology.wa.gov/burrowingshrimp

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Memorandum

January 5, 2018

Final Supplemental Environmental Impact Statement: Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

Environmental Review. Notice of availability of this Final Supplemental Environmental Impact Statement (FSEIS) is being sent to agencies, Tribes, organizations, land owners and lessees, and individuals who have expressed an interest in the Willapa-Grays Harbor Oyster Growers Association (WGHOGA) application to the Washington State Department of Ecology (Ecology) for a permit under the National Pollutant Discharge Elimination System (NPDES) to use the insecticide imidacloprid for the control of ghost shrimp (*Neotrypaea californiensis*) and mud shrimp (*Upogebia pugettensis*), collectively referred to as burrowing shrimp. The proposal is to apply imidacloprid on up to 500 acres per year of commercial shellfish beds within Willapa Bay (up to 485 acres per year) and Grays Harbor (up to 15 acres per year), between the tidal elevations of -2 feet mean lower low water (MLLW) and +4 feet MLLW.

The FSEIS, is available in electronic format on Ecology's website: www.ecology.wa.gov/burrowingshrimp.

Washington State Department of Ecology Action Required. There is no proposed action at this point. Ecology has not made a decision on whether or not to issue a NPDES State Waste Discharge Permit or authorize Sediment Impact Zones.

Public meetings were held in South Bend, WA on October 7, 2017 and Lacey, WA on October 10, 2017.

A 45-day comment period was provided for the Draft SEIS. Comments were due no later than 5:00 PM on **November 1, 2017**, addressed to:

Derek Rockett, Permit Writer
Washington State Department of Ecology
Water Quality Program
PO Box 47775
Olympia, WA 98504-7775
360-407-6697
e-mail: burrowingshrimp@ecy.wa.gov

Response to comments and comments submitted within the 45-day comment period (September 18, 2017 through November 1, 2017) are included in the FSEIS.

Availability of the Final SEIS. A limited number of printed copies of the FSEIS are available for review at Ecology's Water Quality Program office.

Permits and Approvals Required. State and Federal permits and registrations required for the chemical control of burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor include: an NPDES Individual Permit/State Waste Discharge Permit, pesticide registration of the imidacloprid products to be issued by the Washington State Department of Agriculture, Federal registration of the imidacloprid products to be used (conditional registration issued by the U.S. Environmental Protection Agency, June 6, 2013), and applicators will also be required to obtain a license for aquatic application of registered pesticides from the Washington State Department of Agriculture. The FSEIS will be used by Ecology and other governmental agencies, along with other relevant considerations and documents, prior to taking action on the WGHOGA application.

Alternatives Considered. The FSEIS evaluates three alternatives for implementing the proposed action to control burrowing shrimp on oyster and clam beds in Willapa Bay and Grays Harbor: 1) No Action: No Permit for Pesticide Applications, 2) Imidacloprid Applications with Integrated Pest Management (IPM) on up to 2,000 Acres per Year, 3) Imidacloprid Applications with Integrated Pest Management (IPM) on up to 500 Acres per Year.

No preferred alternative was identified.

Key Environmental Issues. Ecology's NPDES permit decision must comply with the regulations of the Washington State Surface Water Quality Standards. These standards were used to guide the selection of elements of the environment to be addressed in the Imidacloprid FSEIS: sediments, air quality, surface water, plants, animals, human health, land and shoreline use, recreation, and navigation. The FSEIS Table of Contents includes a detailed list of the plant and animal groups for which potential impacts and mitigation measures are evaluated. The FSEIS Chapter 1 includes a section that lists Areas of Controversy and Uncertainty, and Issues to be Resolved.

Ecology's Water Quality Program appreciates your interest in this proposal. If you would like more information about the burrowing shrimp control proposal and/or the environmental review that has been conducted, please contact Rich Doenges, Southwest Region Water Quality Manager, rich.doenges@ecy.wa.gov. Additional information regarding the environmental review process and public involvement opportunities is provided in Final SEIS Chapter 1, Section 1.3.

Thank you.

Heather R. Bartlett
Water Quality Program Manager

Date: January 5, 2018

Fact Sheet

Project Title:

Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

Brief Description of the Proposed Action:

Two native species of burrowing shrimp (ghost shrimp, *Neotrypaea californiensis* and mud shrimp, *Upogebia pugettensis*) have caused impacts to Pacific Coast commercial clam and oyster production since at least the 1940s by disrupting the structure and composition of the substrate, causing these shellfish to sink and suffocate. Commercial shellfish growers in Willapa Bay and Grays Harbor, Washington used the N-methyl carbamate insecticide carbaryl for burrowing shrimp population control between 1963 and 2013. Ecology began to regulate carbaryl applications in the 1990s, and issued a NPDES permit for the use of carbaryl in 2002. This permit was terminated in May of 2015.

The Willapa Grays Harbor Oyster Growers Association (WHGOGA) and the Washington State University Long Beach Research and Extension Unit began testing imidacloprid (a neonicotinoid insecticide) in 1996 as an alternative to carbaryl for the control of burrowing shrimp populations. WGHOGA applied to Ecology in 2014 for a NPDES Individual Permit to authorize use of imidacloprid combined with Integrated Pest Management (IPM) practices to suppress burrowing shrimp populations on up to 2,000 acres per year (total) of commercial clam and oyster beds in Willapa Bay and Grays Harbor. Proposed application methods included aerial spraying from helicopters. Ecology issued a 5-year NPDES Individual Permit (WA0039781) on April 16, 2015, following a SEPA environmental review process. On May 3, 2015, WGHOGA asked Ecology to withdraw the permit in response to strong public concerns. Ecology agreed and cancelled the permit on May 4, 2015, prior to the close of the appeal period and before the permit was active.

This Supplemental EIS (SEIS) addresses a WGHOGA 2016 NPDES permit application to Ecology for a reduced-scope proposal for the use of imidacloprid to treat commercial clam and oyster beds on up to 500 acres per year (total) in Willapa Bay and Grays Harbor. The 2016 application also commits to making spray and granular applications from boats and/or ground equipment rather than aerial applications from helicopters.

This SEIS supplements the environmental review and analysis of alternatives in the 2015 FEIS. The FEIS is adopted and incorporated by reference in this SEIS, in accordance with WAC 197-11-600(4). The 2016 application is evaluated as Alternative 4, in the context of additional research that has been performed, and additional literature that has been published on the environmental effects of imidacloprid since the 2015 FEIS was issued.

Purpose and Objectives:

The WGHOGA 2016 application is a request for an Individual NPDES permit to authorize chemical applications of imidacloprid on up to approximately 485 acres *per year* of commercial clam and oyster beds within Willapa Bay, and up to 15 acres *per year* within Grays Harbor. The proposed action covers only these two geographic areas within Washington State, and only commercial shellfish beds on which oysters and clams are grown. While it is possible that over the 5-year term of the permit, the total acreage to be treated within Willapa Bay could range from 485 to 2,485 acres, and within Grays Harbor could range from 15 to 75 acres, growers would apply imidacloprid within the annual acreage limits in each bay based on shellfish grower plans for their seed beds, grow-out sites, and fattening grounds; the efficacy of prior treatments; and the density of burrowing shrimp populations.

Imidacloprid applications would be made using adaptive management principles, as described in an IPM Plan and Annual Operations Plan subject to review and approval by Ecology. The objectives of the proposed action are to:

Preserve and maintain the viability of shellfish commercially grown in Willapa Bay and Grays

Harbor by controlling populations of two species of burrowing shrimp on commercial oyster and clam beds.

Preserve and restore selected commercial oyster and clam beds in Willapa Bay and Grays Harbor that are at risk of loss due to sediment destabilization caused by burrowing shrimp.

Principal Alternatives:

Commercial shellfish growers have been investigating mechanical means, alternative shellfish culture methods, various chemical applications, and biological controls for burrowing shrimp population control since the 1950s. Only pesticide applications of carbaryl and imidacloprid administered with adaptive management principles were found to be effective, reliable, and economical on a commercial scale, with sufficient species-specific efficacy.

The 2015 FEIS evaluated three alternatives for the control of burrowing shrimp populations:

ALTERNATIVE 1: No Action – No Permit for Pesticide Applications.

ALTERNATIVE 2: Continue Historical Management Practices – Carbaryl Applications with Integrated Pest Management (IPM).

Note: Alternative 2 is no longer being considered as an alternative since Ecology denied the application for extension of the carbaryl NPDES permit (No. WA0040975) in May 2015.

ALTERNATIVE 3: Imidacloprid Applications with IPM on up to 2,000 acres per year in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

This SEIS evaluates a fourth alternative in the context of the current scientific understanding of imidacloprid effects in the environment:

ALTERNATIVE 4: Imidacloprid Applications with IPM on up to 500 acres per year in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Both the 2015 FEIS and the 2017 Draft SEIS include a section that describes Alternatives

	Considered and Eliminated from Detailed Evaluation.
Project Proponent:	Willapa-Grays Harbor Oyster Growers Association P.O. Box 3 Ocean Park, WA 98640
Schedule for Implementation:	The target date for completion of the Supplemental EIS and Ecology's decision on the NPDES Individual Permit is Winter 2018.
Lead Agency:	Washington Department of Ecology Water Quality Program 300 Desmond Drive P.O. Box 47775 Olympia, WA 98504-7775
SEPA Responsible Official:	Heather Bartlett, *Program Manager* Water Quality Program
Project Information Contact Person, And Person to Whom Comments are to be Directed:	Rich Doenges, *Southwest Region Water Quality Section Manager* 360.407.6271 e-mail: rdoe461@ecy.wa.gov
Ecology File No.	WA0039781
Permits and Registrations Required:	The list below identifies State and Federal permits and registrations required for the chemical control of burrowing shrimp populations on commercial oyster and clam beds in Willapa Bay and Grays Harbor, Washington. Local government requirements may vary for a particular commercial shellfish site or operation.
Washington Department of Ecology	NPDES Individual Permit/State waste discharge permit and Sediment Impact Zone authorization
Washington Department of Agriculture	State registration of the imidacloprid products Protector 0.5G (granular form) and Protector 2F (flowable form) under the requirements of the Washington Pesticide Control Act (RCW 15.58). Applicators' licenses for aquatic application of registered pesticides.

U.S. Environmental Protection Agency	Federal registration of imidacloprid products Protector 0.5G (granular form) and Protector 2F (flowable form) under the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Conditional FIFRA registrations issued June 6, 2013; see 2015 FEIS Appendix A.
Local Government(s):	Shoreline Permit (possible in some locations, though not usually required under local Shoreline Master Programs)
Final SEIS Authors and Principal Contributors:	**Ecology** Rich Doenges, Southwest Region Water Quality Section Manager Barry Rogowski, Toxics Cleanup Program Land and Aquatic Land Section Manager Leonard Machut, Toxics Cleanup Program Aquatic Land Supervisor Donna Podger, Toxics Cleanup Program Environmental Engineer Laurie Niewolny, Nonpoint Pollution and TMDL Implementation Specialist Derek Rockett, Solid Waste Facilities Inspector
Draft SEIS Authors:	**GeoEngineers**, SEIS Prime Consultant Jeff Barrett, *Principal Scientist* *Project Manager and Co-Author* **DOWL** Adrienne Stutes, *Marine Scientist and Co-Author* **Vicki Morris Consulting Services** Vicki Morris, *SEPA Specialist and Co-Author*
Draft SEIS Date of Issue:	September 18, 2017
Draft SEIS Comment Period:	September 18, 2017 through November 01, 2017
Date of Public Meetings:	*October 07, 2017 South Bend Washington* *October 10, 2017 Lacey Washington*
Comment Period deadline:	5:00 PM, November 01, 2017

Availability of Copies of the Draft SEIS:	*Everyone on the Distribution List was sent a Notice of Availability of the Draft SEIS.* *The document is posted on Ecology's website for review:http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid*
Address Comments to:	*Rich Doenges, Southwest Region Water Quality Section Manager* Ecology, Water Quality Program P.O. Box 47775 Olympia, WA 98504-7775 e-mail: ECY RE WQ Burrowing Shrimp Permit burrowingshrimp@ECY.WA.GOV
Next Steps in the SEIS Process:	Following the close of the Draft SEIS comment period, Ecology will review and respond to all comments received. Comments and responses will be published in the Final SEIS and published on Ecology's website. Everyone on the Draft SEIS Distribution List and aquatic pesticide listserve will receive Notice of Availability of the Final SEIS.

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List of Symbols, Acronyms, and Units of Measure

>	greater than
<	less than
a.i./ac	active ingredient per acre
a.i./L	active ingredient per liter
AA-EQS	Annual Average Environmental Quality Standard
ALS	acetolactate synthesis
AOP	Annual Operations Plan
ATV	All-terrain vehicle
BMPs	Best Management Practices
cfm	cubic feet per meter
cm	centimeter
CSI	Compliance Services International
CWA	Clean Water Act
EC	Maximal Effective Concentration
ECY/Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FOIA	Freedom of Information Act
gpm	gallons per minute
HQ	hazard quotient
IPM	Integrated Pest Management
kg	kilogram
lbs/a.i./ac	pounds of active ingredient per acre
LC50	Median Lethal Dose
LOAEC	Lowest Observable Adverse Effects Concentration
LOC	Levels of Concern
m	meter
m^2	square meter

mg	milligram
μg	microgram
μg/L	micrograms per liter
MLLW	Mean Lower Low Water
MAC-EQS	Maximum Acceptable Concentration in Ecosystems
NAAQS	National Ambient Air Quality Standards
nAChR	nicotinergic acetylcholine receptors
NOAEC	No Observed Adverse Effects Concentration
NOEC	No Observed Effects Concentration
NPDES	National Pollutant Discharge Elimination System
PMRA	Pesticide Management Regulatory Agency
ppb	parts per billion
PPE	personal protective equipment
psi	pounds per square inch
PVC	polyvinylchloride
RCW	Revised Code of Washington
RA	Risk Assessment
RQ	Risk Quotient
SAP	Sampling and Analysis Plan
SEIS	Supplemental Environmental Impact Statement
SEPA	Washington State Environmental Policy Act
SIZ	Sediment Impact Zone
SMS	Sediment Management Standards
SSD	species sensitivity distributions
TOC	total organic carbon
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife
WFD	Water Framework Directive
WGHOGA	Willapa-Grays Harbor Oyster Growers Association
WQC	Water Quality Certification
WQS	Water Quality Standards
WSU	Washington State University

1.0 Summary

1.1 Introduction and Problem Formulation

Since the 1940s, two native species of burrowing shrimp (ghost shrimp, *Neotrypaea californiensis*, and mud shrimp, *Upogebia pugettensis*) have caused impacts to Pacific Coast commercial clam and oyster production by disrupting the structure and composition of the substrate, causing these shellfish to sink and suffocate. The primary burrowing shrimp management practice used by Willapa Bay and Grays Harbor shellfish growers between 1963 and 2013 was chemical treatment with the n-methylcarbamate insecticide carbaryl. In 2014, the Willapa Grays Harbor Oyster Growers Association (WGHOGA) applied to the Department of Ecology (Ecology) for a National Pollutant Discharge Elimination System (NPDES) Individual Permit to authorize use of the neonicotinoid pesticide imidacloprid[1] combined with Integrated Pest Management (IPM) practices to suppress burrowing shrimp populations on up to 1,500 acres per year of commercial shellfish beds in Willapa Bay and up to 500 acres per year of commercial shellfish beds in Grays Harbor (up to 2,000 acres per year, total). Ecology reviewed the potential impacts of the proposed action in a Draft and Final Environmental Impact Statement in 2014 and 2015, respectively. The *Final EIS for Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington* (Ecology 2015; hereafter referred to as the 2015 FEIS) was prepared based on scientific studies and information available at that time. Ecology issued a 5-year National Pollutant Discharge Elimination System (NPDES) Individual Permit (WA0039781) on April 16, 2015, with an effective date of May 16, 2015. On May 3, 2015, WGHOGA asked Ecology to withdraw the permit in response to strong public concerns. Ecology agreed and cancelled the permit on May 4, 2015. The 2015 permit was cancelled prior to the close of the appeal period and before the permit was active.

On January 8, 2016, WGHOGA, on behalf of a group of about a dozen growers, applied to Ecology for a new pesticide permit for the use of imidacloprid to control burrowing shrimp on commercial clam and oyster beds in Willapa Bay and Grays Harbor. The 2016 proposal requests authorization to treat a reduced amount of commercial shellfish bed acreage (up to 500 acres per year, total, in the two estuaries), and commits to making spray and granular applications from boats and/or ground equipment rather than aerial applications from helicopters. The 2016 application for the use of imidacloprid, including the revised scope, is evaluated in this SEIS in the context of additional research that has been performed, and additional literature that has been published on the environmental effects of imidacloprid since the 2015 FEIS was issued. A summary of the Literature Review that was conducted for the SEIS is provided in Appendix A of the DEIS.

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[1] Neonicotinoids are a class of neuro-active insecticides chemically similar to nicotine. Neonicotinoids were developed in large part because they show reduced toxicity compared to previously used organophosphate and carbamate insecticides. Most neonicotinoids show much lower toxicity in birds and mammals than insects, but some breakdown products are toxic (e.g., Frew 2015, EPA 2017). However, there may be impacts to non-target invertebrates (e.g., Morrissey et al. 2015). The neonicotinoid imidacloprid is currently the most widely used pesticide in the world (Goulson et al. 2013 – EPA, van Dijk et al. 2013).

The history and background of commercial clam and oyster aquaculture in Willapa Bay and Grays Harbor was previously described in the 2015 Final EIS (Chapter 2, Section 2.4, pages 2-3 through 2-8). Also described in FEIS Chapter 2, Section 2.4 was the history of the impacts of the two burrowing shrimp species that are the subject of this SEIS, and treatment methods tested and used since the 1950s to attempt to control burrowing shrimp populations on commercial shellfish beds. The 2015 FEIS is incorporated by reference in the SEIS, in accordance with WAC 197-11-600 and -635.

1.2 Purpose and Objectives of the Proposed Action

The objectives of the 2016 proposed action are the same as those proposed in the prior WGHOGA permit application in 2014:

- Preserve and maintain the viability of clams and oysters commercially grown in Willapa Bay and Grays Harbor by controlling populations of two species of burrowing shrimp on commercial shellfish beds.
- Preserve and restore selected commercial shellfish beds in Willapa Bay and Grays Harbor that are at risk of loss due to sediment destabilization caused by burrowing shrimp.

1.3 SEPA Procedures and Public Involvement

As described above in Section 1.1, Ecology previously conducted environmental review of a 2014 WGHOGA application for use of the pesticide imidacloprid, under the regulations and guidelines of the Washington State Environmental Policy Act (SEPA). Ecology invited and received public and agency comments on the *Draft EIS for Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington* (Ecology 2014), and on the 2015 draft permit between October 24 and December 8, 2014. Ecology responded to the comments in the *Final EIS for Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington* (Ecology 2015), and issued a 5-year NPDES Individual Permit (WA0039781) on April 16, 2015, with an effective date of May 16, 2015. On May 3, 2015, WGHOGA asked Ecology to withdraw the permit in response to strong public concerns. Ecology agreed and cancelled the permit on May 4, 2015, effectively terminating commercial use of imidacloprid on shellfish beds in Willapa Bay and Grays Harbor. The 2015 permit was cancelled prior to the close of the appeal period and before the permit was active.

WGHOGA, on behalf of a group of about a dozen members, submitted an application to Ecology in 2016 for an Individual NPDES Permit and two Sediment Impact Zone (SIZ) authorizations to apply imidacloprid on a reduced acreage of tidelands in Willapa Bay and Grays Harbor (up to 500 acres per year, total), using ground-based methods that would not include aerial applications by helicopter. Ecology issued a public notice by e-mail to interested parties of record on June 23, 2017 to announce that it was evaluating this new application, and that a Supplemental EIS (SEIS) was being prepared. The purpose of the SEIS is to analyze the 2016 WGHOGA proposal for application of imidacloprid to commercial shellfish beds in Willapa Bay and Grays Harbor using both relevant information and analyses from the 2015 FEIS, and new research and information not previously available to the Department when the 2015 Final EIS was completed. The June 23, 2017 announcement invited public comments during the SEIS process, and noted that a formal, 45-day public comment period would be offered on the Draft SEIS, when issued. The June 23, 2017 notice also indicated that several public meetings on the Draft SEIS will be held at key locations across western Washington (dates and times to be announced). Two public meetings, each including an open house and formal public hearing were held: October 7, 2017 in South Bend and October 10, 2017 in Lacey. Transcribed public comments and testimony from the two hearings are in Appendix B. The public comment period ended on November 1, 2017 and 8,287 comments were submitted by the public, federal & state agencies and environmental organizations. These comments and Ecology's responses are in Appendix A and B, respectively. Information obtained through public comments has been used by Ecology to finalize the SEIS prior to making its decision on the applications for an Individual NPDES permit and two SIZ authorizations.

1.4 Description of the Proposed Action

The 2016 WGHOGA proposal for the use of imidacloprid with Integrated Pest Management (IPM) practices to control burrowing shrimp on commercial shellfish beds[2] would occur on a limited number of acres in each estuary: up to 485 acres *per year* within Willapa Bay (1.1% of total tideland acres exposed at low tide), and up to 15 acres *per year* within Grays Harbor (0.04% of total tideland area exposed at low tide). Over the 5-year term of a potential permit, the total tideland acreage to be treated within Willapa Bay could range from 485 to 2,425 acres, and in Grays Harbor could range from 15 to 75 acres. Ecology would approve operations in any given year through its review of an Annual Operations Plan (AOP) that WGHOGA would be required to submit. In addition, monitoring required by Ecology would be used to track the environmental effects of imidacloprid treatments, and to determine where applications would be allowed. It would be a condition of the permit, if issued, that authorization for the use of imidacloprid would include using adaptive management principles, to be described in an Integrated Pest Management (IPM) Plan.

The 2016 WGHOGA proposal requests flexibility in how the 485 acres per year are to be selected for treatment within Willapa Bay. In any given year, specific locations for imidacloprid treatment would be determined based on shellfish grower plans for their seed beds, grow-out sites, and fattening grounds; the efficacy of prior treatments; and the density of burrowing shrimp populations. The application also requests flexibility in being able to only partially spray some plots. WGHOGA would submit an Annual Operations Plan (AOP), and a Sampling and Analysis Plan (SAP), to Ecology each year for review, modification, and approval. It is anticipated that all applications would be made between the tidal elevations of -2 ft mean lower low water (MLLW) and +4 ft MLLW.

The 2016 application specifically excludes aerial applications of imidacloprid using helicopters. Rather, spray and granular applications would be made from boats and/or ground equipment,

[2] As used throughout this SEIS, the term "commercial shellfish beds" refers to a specified amount of tideland acreage within Willapa Bay and Grays Harbor on which oysters and clams are commercially grown. The requested NPDES permit would not extend to other geographical areas, and would not authorize treatment on other species of commercially-grown shellfish (e.g., geoducks or mussels).

such as all-terrain vehicles equipped with a spray boom, backpack reservoirs with hand-held sprayers, and/or “belly grinders.” Applicators who may receive coverage under the Imidacloprid NPDES Individual Permit and SIZ authorizations (if issued) would need to comply with the terms and conditions of those permits.

1.5 Alternatives Considered

The 2015 FEIS evaluated the No Action Alternative, and two action alternatives for the control of burrowing shrimp: one using carbaryl with Integrated Pest Management (IPM) practices, and one using imidacloprid with IPM. These were identified as Alternative 1, 2 and 3, respectively. The 2015 FEIS alternatives analysis is incorporated by reference in this SEIS. Use of carbaryl for the control of burrowing shrimp populations on Willapa Bay and Grays Harbor commercial shellfish beds (FEIS Alternative 2) is no longer being considered by Ecology or other agencies. The Washington Special Local Need Registration was cancelled by the Department of Agriculture in January 2014, and Ecology denied the application for administrative extension of the NPDES permit for carbaryl applications (No. WA0040975) in May 2015. For these reasons, the potential effects of the 2016 WGHOGA proposal (Alternative 4) are not compared to FEIS Alternative 2 in SEIS Chapter 3.

The SEIS alternatives analysis in Chapter 3 compares the 2016 WGHOGA proposal (Alternative 4) to Alternatives 1 and 3 previously evaluated in the 2015 FEIS, in the context of additional field trial results and research that has been performed, and additional literature that has been published on the environmental effects of imidacloprid since the 2015 FEIS was issued. Ecology will use the SEIS to inform their decision regarding whether to issue the permit, and if so, appropriate conditions or mitigation requirements to impose.

1.5.1 Alternative 1, No Action: No Permit for Pesticide Applications

The 2015 FEIS evaluated a No Action Alternative in which there would be no permit authorizing pesticide applications to treat a limited acreage of commercial oyster beds in Willapa Bay and Grays Harbor for the control of burrowing shrimp populations. Commercial shellfish growers would only be able to utilize mechanical methods and alternative shellfish culture practices. Studies performed since the 1950s, and particularly from about the year 2000, have failed to find a non-chemical approach to controlling burrowing shrimp that was both effective, and economically feasible on a commercial scale. Some mechanical treatments also had large impacts on non-target animal species (e.g., dredging and deep harrowing). Off-bottom culture techniques, such as long-line or bag culture, are feasible in some areas with burrowing shrimp, such as areas protected from strong waves or currents. But these culture techniques would not support the shucked meat market that is the focus of most oyster culture in Willapa Bay and Grays Harbor, and would require large changes in the culture, harvest, processing, and marketing of oysters from these estuaries. Therefore, under Alternative 1, it was expected that most productive commercial clam and oyster grounds would decline over the subsequent 4- to 6-year period. The economic impacts of a decline in shellfish productivity on the order of 60 to 80 percent or more were discussed in FEIS Section 2.6 (pages 2-16 through 2-18). Ecosystem changes that would result from a significant increase in burrowing shrimp populations and significant reductions in shellfish (bivalve) populations were evaluated in FEIS Chapter 3. Reviewers interested in the analysis of the No Action Alternative are referred to the 2015 FEIS.

1.5.2 Alternative 3, Imidacloprid Applications with Integrated Pest Management (IPM) on Up to 2,000 Acres per Year in Willapa Bay and Grays Harbor

FEIS Alternative 3 described and evaluated the effects of a new NPDES Individual Permit that would authorize chemical applications of the neonicotinoid insecticide imidacloprid for burrowing shrimp population control on up to 2,000 acres total per year (1,500 acres per year in Willapa Bay[3] and 500 acres per year in Grays Harbor[4]). It was possible over the 5-year term of the 2015 Imidacloprid NPDES Individual Permit that the total tideland acreage to be treated within Willapa Bay could range from 1,500 to 7,500 acres, and in Grays Harbor could range from 500 to 2,500 acres under Alternative 3.

WGHOGA would be required to prepare an IMP Plan for the use of imidacloprid, and to submit Annual Operations Plans, and Sampling and Analysis Plans, for proposed treatments, subject to review and approval by Ecology. The 2013 conditional Federal registrations for the imidacloprid products Protector 2F (flowable) and Protector 0.5G (granular) limited the application rate to 0.5 (one-half) pound of active ingredient per acre (a.i./ac), to be applied between April 15 and December 15 in any year for which all required permits and approvals were in-place. A preferred method of application under Alternative 3 was aerial spraying using a helicopter. Reviewers interested in a more detailed description of Alternative 3 are referred to FEIS Chapter 2, Section 2.8.3 (pages 2-32 through 2-48). Analysis of the impacts of Alternative 3 compared to the No Action Alternative and Alternative 4 is provided throughout Chapter 3 of the 2015 FEIS.

1.5.3 Alternative 4, Imidacloprid Applications with Integrated Pest Management (IPM) on Up to 500 Acres per Year in Willapa Bay and Grays Harbor, with No Aerial Applications by Helicopter

The 2016 WGHOGA proposal for the use of imidacloprid combined with IPM practices to control burrowing shrimp on commercial clam and oyster beds would authorize chemical applications to up to 485 acres per year within Willapa Bay (1.1 percent of total tideland acres exposed at low tide), and up to 15 acres per year within Grays Harbor (0.04 percent of total tideland area exposed at low tide). It is possible over the 5-year term of the permit (if issued) that the total tideland acreage to be treated within Willapa Bay could range from 485 to 2,425 acres, and in Grays Harbor could range from 15 to 75 acres. This is a reduced-impact alternative compared to FEIS Alternative 3 in that the acreage that may be treated under the requested permit is approximately two-thirds less (64 percent) compared to the acreage of the 2014 WGHOGA proposal evaluated in the 2015 FEIS. The other distinguishing factor about Alternative 4 is the proposal to use equipment such as scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, backpack reservoirs with hand-held sprayers, belly grinders, and/or subsurface injectors. The 2016 WGHOGA proposal specifically excludes aerial applications using helicopters. This may result in smaller plot sizes for individual treatments. The application rate of 0.5 pound a.i./acre for any treatment scenario is the same as the rate of application evaluated in FEIS Alternative 3.

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[3] Under Alternative 3, the imidacloprid treatment area would constitute approximately 3.3 percent of total tideland area exposed at low tide.

[4] Under Alternative 3, the imidacloprid treatment area would constitute approximately 1.5 percent of total tideland area exposed at low tide.

The Imidacloprid NPDES Individual Permit and SIZ authorizations, if issued, would be subject to all applicable State and Federal regulations, and would require annual monitoring in application areas to record and document environmental effects. Applicable regulations administered by Ecology include Clean Water Act (CWA) water quality certification (WQC), regulation of aquatic pesticide applications under a NPDES waste discharge permit, and compliance with Washington State Sediment Management Standards (SMS). Permittees (including applicators) would also be required to comply with Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) registration requirements for the use of imidacloprid (provided in FEIS Appendix A). The NPDES permit (if issued) would have a duration of up to 5 years. Monitoring results would be reviewed during the 5-year term of the permit, with provisions for Ecology to alter permit conditions if necessary for the protection of the environment. Ecology does not yet have an approved final monitoring plan at the time of this writing.

1.5.4 Other Alternatives Considered and Eliminated from Detailed Evaluation

The 2015 FEIS Chapter 2, Section 2.8.4 (pages 2-48 through 2-56) description of Alternatives Considered and Eliminated from Detailed Evaluation was derived from personal communications with Dr. Kim Patten (Director, WSU Long Beach Research and Extension Unit), and from documents he provided of studies performed over several years on mechanical control methods, physical control methods, alternative culture methods, alternative chemical control methods, and biological controls. The 2016 WGHOGA application to Ecology includes *A Review of the Past Decade of Research on Non-Chemical Methods to Control Burrowing Shrimp* (Miller Nash Graham & Dunn, February 13, 2017, Exhibit C, prepared by Dr. Patten) that summarizes many of the same experiments. Additional methods not previously described in the 2015 FEIS, and results obtained with these methods, are described in the Draft SEIS Chapter 2, Section 2.8.5.

A combined physical/mechanical method described by Dr. Patten in 2017 (Miller Nash Graham & Dunn, February 13, 2017, Exhibit C) demonstrated relatively high efficacy and could be considered on a commercial scale. Spikewheel injection of imidacloprid improves chemical contact at the sediment-water interface, particularly in areas where flowing water or heavy eelgrass is present. The 2016 WGHOGA application requests authorization under the NPDES permit (if issued) for small-scale, experimental use of subsurface injectors in order to continue to test the effectiveness of this adaptive management method of application. If small trials identify application methods that would increase efficacy, and/or that would reduce imidacloprid use for a given level of efficacy, WGHOGA may request a modification to the NPDES permit (if issued) to allow commercial-scale use of subsurface injectors in the latter part of the 5-year duration of this permit.

1.6 Summary of Impacts and Mitigation Measures

1.6.1 Literature Review

The 2015 FEIS included a review of more than 100 scientific reports and papers that evaluated the ecology of burrowing shrimp, physical and biological conditions in Grays Harbor and Willapa Bay, and effects of imidacloprid on invertebrate and vertebrate animals, including species listed under the Endangered Species Act (ESA). Information derived from that literature review was incorporated in a number of sections of the FEIS, and was the basis for much of the summary of expected effects of imidacloprid applications under the permit conditions analyzed in 2015. In general, the FEIS concluded that the application of imidacloprid would have minor to moderate effects on non-target invertebrates (e.g., polychaete worms, honey bees), minor effects on vertebrate species, including birds, and minor or insignificant effects on ESA-listed species.

Since the FEIS was published, a number of new studies on the effects of imidacloprid have been published. These new studies include three very large and comprehensive literature surveys. Health Canada (2016) conducted a comprehensive review of the toxicology literature on imidacloprid and published a report summarizing the expected effects of agricultural uses of imidacloprid on the environment based on that review, and on modeled and field data-based estimates of imidacloprid concentrations. The document included evaluation of toxicity to birds, mammals, and terrestrial and aquatic insects, and assessed exposure pathways and possible effects to humans. The U.S. Environmental Protection Agency (EPA) issued two large literature reviews. The EPA (2015) review assessed the effects of imidacloprid on pollinators, with some emphasis on honeybees. The EPA (2017) review was similar to the Health Canada study in that it included a comprehensive literature review and assessment of imidacloprid toxicity in the environment. The EPA (2017) literature review differed from the Health Canada study in that it only focused on aquatic ecosystems and species, and also used a different approach to estimating imidacloprid toxicity to various groups of animals.

Other published studies relevant to WGHOGA's proposed use of imidacloprid were reviewed for the SEIS. These included unpublished studies obtained from EPA through a Freedom of Information Act (FOIA) request. Most of these studies are also reviewed in the Health Canada and EPA documents described above. Many of the reviewed studies addressed potential impacts to freshwater ecosystems, particularly aquatic insects, while fewer focused on marine systems. Extrapolating the results of these studies to marine environments is therefore challenging. Several studies on vertebrates, and on food-web effects of imidacloprid are reviewed in the SEIS, but these areas have received less analysis in comparison to studies on invertebrates. Ecology is currently unaware of studies on the effects of imidacloprid on air quality, land use, recreation, or navigation.

Collectively, the studies considered in the SEIS literature review build and modify general conclusions of the literature review conducted for the 2015 FEIS. Most importantly, imidacloprid is highly toxic to many freshwater invertebrates, particularly insects, and reported concentrations of imidacloprid in surface waters are high enough to conclude that the chemical is negatively affecting invertebrate communities in many freshwater ecosystems, and may be impacting animals that feed on these communities. The more limited studies of imidacloprid in marine environments, including the multiple field trials in Willapa Bay, document that imidacloprid is also toxic to marine invertebrates, but at higher concentrations or longer exposures compared to sensitive freshwater invertebrates. And with the exception of seed-eating birds that may be exposed to agriculturally-treated seeds, imidacloprid is expected to have low toxicity to humans, birds, mammals, fish, and aquatic amphibians.

The 2014 data from the field trials in Willapa Bay, when combined with prior field trials, provide a basis to evaluate probable effects to invertebrates from spraying of commercial shellfish beds with imidacloprid.

- *Water*: The surface water data indicate there will be on-plot environmental impacts to surface waters, and a strong pattern of high on-plot (up to 1,600 parts per billion [ppb]) and off-plot concentrations during the first rising tide. Imidacloprid was detected at considerable distances off-plot (up to 1,640 feet), but the different sites demonstrated highly variable concentrations ranging from undetected at 0.04 ppb to 4200 ppb (in 2012). These varying results suggest that site-specific differences in how tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot. Flushing is expected to dilute imidacloprid to undetectable levels within 2 to 3 tidal cycles.
- *Sediment*: Imidacloprid concentrations in the sediment and sediment porewater indicate that there will be on-plot environmental impacts to sediment and pore water that will decline following application. A subset of sites still had toxic concentrations after 14 days, but most sites showed undetectable or below the screening value levels at 28 days. Dilution rates were slower in some sediments, especially those with high organic carbon levels, with detectable concentrations still present in some samples at 56 days after treatment. However, there is uncertainty associated with sub-lethal, chronic, and cumulative effects of imidacloprid application to sediment in the marine environment.
- *Animals*: Imidacloprid treatment will cause on-plot impacts to zooplankton and benthic invertebrates through either death or tetany (paralysis). These impacts could extend to adjacent off-plot areas, particularly those closest to the treated plot that would be exposed to the highest concentrations of imidacloprid as it is carried off-plot by the incoming tide. The field trials have shown that benthic invertebrate populations recover over 14 to 28 days following treatment. As with sediments, areas with high organic carbon levels showed more limited invertebrate recovery or recolonization. However, marine monitoring results for benthic invertebrates are highly variable and statistically weak, which increases the uncertainty of the monitoring results. In addition, there is uncertainty associated with sub-lethal, chronic, and cumulative effects of imidacloprid application on animals in the marine environment.

The literature review conducted for the SEIS provides new information on the potential toxicity to Dungeness crab of imidacloprid treatments in Willapa Bay and Grays Harbor. These studies support the conclusion that application of imidacloprid to control burrowing shrimp populations will result in death of planktonic and juvenile Dungeness crab on-plot. Dungeness crab in off-plot areas may also experience mortality, particularly in those areas closest to the sprayed plots where water concentrations of imidacloprid are highest. Monitoring has shown juvenile crab losses could range from 2 to 18 crab/acre sprayed depending on survey methods and crab densities. An unknown number of planktonic forms of Dungeness crab may be killed, but estimating losses is difficult, especially when compared to the abundance of planktonic forms of the species estimated in the bays, and the large size of the bays.

The literature review conducted for the SEIS supports the 2015 FEIS conclusion that imidacloprid spraying of commercial shellfish beds in Willapa Bay and Grays Harbor will have limited or no direct adverse effects on birds and fish. That conclusion extends to bird and fish species listed under the Endangered Species Act. Several new studies on green sturgeon, a species of concern in the FEIS, appear to demonstrate that this species would not be adversely affected directly by imidacloprid treatments, however there could be indirect effects from reduced prey availability. And additional studies on imidacloprid toxicity to birds confirm that under the potential exposure pathways in these estuaries, no direct impacts are expected. However, imidacloprid treatments will reduce invertebrate availability, at least in the short-term, in sprayed plots and in immediately surrounding areas. Indirect effects to birds and fish that feed on invertebrates are therefore possible, but are expected to be minor given both the small acreage that would be sprayed in comparison to the size of Willapa Bay and Grays Harbor, and due to the recovery of invertebrate populations on treated plots.

The SEIS literature review notes some scientific data gaps, including effects of imidacloprid to marine invertebrates from chronic exposure, the long-term persistence of imidacloprid in marine sediments, and indirect effects to species or food chains due to reductions in invertebrate numbers following imidacloprid exposure.

1.6.2 Summary of Impacts of and Mitigation Measures: Alternatives 1, 3 and 4

The full text of the Affected Environment, Potential Impacts, and Mitigation Measures analysis of the 2016 proposed action and alternatives is presented in SEIS Chapter 3. A summary matrix of potential impacts and mitigation measures is provided in Table 1.6-2, below. In some cases, the tabular descriptions are considerably abbreviated from the full discussion in SEIS Chapter 3, and lack explanations of terminology and background information. Summary statements of potential impacts in the table also appear in the absence of the context of existing environmental conditions (the Affected Environment discussions in SEIS Chapter 3). For these reasons, readers are encouraged to review the more comprehensive discussion of issues of interest in the SEIS (and the cross-referenced 2015 FEIS) to develop the most accurate understanding of potential impacts and mitigation measures for the 2016 proposed action and alternatives.

The potential impacts of Alternative 1: No Action, were previously described and evaluated in the 2015 FEIS. That information is unchanged at the time of this writing, and is incorporated by reference in this Supplemental EIS. Summary statements from FEIS Table 1.6-2 have been included in the table below for ease of reference.

The potential impacts of and mitigation measures for Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year with aerial applications by helicopter, were also previously described and evaluated in the 2015 FEIS (incorporated by reference). Because the types of impacts and mitigation measures would be very similar to those described in this SEIS for Alternative 4, cross-reference is made in Table 1.6-2 below to the summary of Alternative 4 impacts and mitigation, except where distinctions are noted between these two alternatives.

The SEIS impact analysis included identification of potential on-plot impacts, and localized short-term impacts. These are summarized in Table 1.6-2 below for Alternatives 3 and 4.

Significant unavoidable adverse impacts of Alternative 4 were identified to on-plot sediment, surface water, and invertebrates. WAC 197-11-794 defines "significant" as used in SEPA as "a reasonable likelihood of more than a moderate adverse impact on environmental quality… The severity of an impact should be weighted along with the likelihood of its occurrence. An impact may be significant if its chance of occurrence is not great, but the resulting environmental impact would be severe if it occurred." The determination that a proposed action will (or may) have a significant adverse impact involves context and intensity, and does not lend itself to a formula or quantifiable test. Context may vary with the physical setting. Intensity depends on the magnitude and duration of an impact.

There are two contexts for imidacloprid applications on commercial shellfish beds in Willapa Bay and Grays Harbor. Overall (bay-wide), the proposal is to treat up to 485 acres per year in Willapa Bay (approximately 1.1% of total tideland area exposed at low tide), and up to 15 acres per year in Grays Harbor (approximately 0.04% of total tideland area exposed at low tide), in estuarine environments that experience two 10-ft+ tidal exchanges per day that would result in dilution and flushing following applications of imidacloprid. From a permitting perspective related to the request for Sediment Impact Zone authorizations, on-plot impacts are also taken into consideration by Ecology. Some of the on-plot impacts of imidacloprid applications would result in environmental impacts. These are identified below and in SEIS Chapter 3.

Table 1.6-2. Summary of environmental impacts and mitigation measures associated with alternatives for burrowing shrimp population control in Willapa Bay and Grays Harbor, WA.

Sediments

Alternative 1: No Action[5]

No chemical control of burrowing shrimp populations. Attempts at mechanical control of burrowing shrimp populations are less effective than chemical treatments and would likely result in high density of shrimp and a benthic habitat on commercial shellfish beds that is lower in diversity and productivity than that found on shellfish beds with lower densities of shrimp (Ferraro and Cole 2007).
. The activities of burrowing shrimp may influence sediment biogeochemistry by increasing carbon and nitrogen cycling within the sediment-water interface (D'Andrea and DeWitt 2009). This can counter the effects of eutrophication by supplying nutrients necessary for primary and secondary production, and thus decrease the likelihood of the occurrence of hypoxic or anoxic conditions.
. Burrowing shrimp can re-suspend up to 50% of the sediment they occupy, creating a sediment character similar to quicksand (Posey 1985). . Oysters and clams sink and suffocate in softened sediments created by the activity of burrowing shrimp (Dumbauld et al. 2001; DeFrancesco and Murray 2010; and personal communication with WGHOGA members, various dates).

[5] Under the No Action Alternative, there would be no permit application, and thus no mechanism for requiring mitigation measures.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	***Mitigation Measures***
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be treated, and application methods that could include aerial spraying from helicopters under Alternative 3.	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as distinguished for aerial applications of imidacloprid using helicopters. New information that has become available since 2015 is analyzed in Alternative 4, and is also applicable to Alternative 3. Effects are greater in Alternative 3 due to the greater area of imidacloprid application.
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, there are significant adverse effects to the sediment within a treated plot. Application of imidacloprid results in initial high concentrations of imidacloprid in sediment porewater that exceed EPA acute toxicity endpoints for marine invertebrates. At 14 and 28 days after treatment, the sediment porewater continues to exceed the EPA chronic toxicity endpoint for marine invertebrates. Significant mortality of benthic invertebrates is expected after the application. Significant mortality of Dungeness crab on the plot has been documented. Due to transport off the plot, there is risk of sediment impacts and toxicity to crabs from shorter duration exposure outside of the treated area, but effects have not been evaluated. A new NPDES permit, if issued for Alternative 3, would include expanded and revised sediment monitoring requirements to confirm the effects of imidacloprid applications. Adjustments to permit conditions could be made during the 5-year term of the permit.	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	***Mitigation Measures***
. Imidacloprid would be applied on up to 485 acres *per year* on commercial shellfish beds in Willapa Bay and up to 15 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 1.1% per year of total tideland acres within Willapa Bay and approximately 0.04% per year of total tideland acres within Grays Harbor.	. IPM practices would be implemented to continue experimenting with alternative physical, biological, or chemical control methods that are as species-specific as possible, economical, reliable, and environmentally responsible. An IPM Plan acceptable to Ecology would be a condition of the NPDES permit, if issued. NPDES PERMIT REQUIREMENTS: The proposed action would require authorization of two Sediment Impact Zones (SIZs) to comply with Washington State Water Quality Standards (WQS) and Sediment Management Standards (SMS). A NPDES permit may only be issued if the proposed use, as conditioned, would comply with all applicable SMS. . The SMS establish sediment quality standards for marine surface sediments, sediment source control standards with which point source discharges must comply, and an antidegradation policy (WAC 173-204-120, -300 through -350, and -400 through -450).

Potential Impacts	Mitigation Measures
	. Sediment quality criteria for marine surface sediments include criteria establishing maximum concentrations of specified chemical pollutants, biological effects criteria, and criteria for benthic abundance (WAC 173-204-320). . Applicators would be required to follow all insecticide label instructions to prevent spills on unprotected soil. . A potential NPDES Permit would include sediment monitoring requirements to confirm the effects of pesticide applications. That monitoring would include long-term sampling to evaluate any potential persistence of imidacloprid in sediments. Adjustments to permit conditions could be made during the 5-year term of the permit based on the results of that sampling. . A Spill Control Plan would be prepared to address the prevention, containment, and control of spills or unplanned releases, and to describe the preventative measures and facilities that will avoid, contain, or treat spills of imidacloprid, oil, and other chemicals that may be used, processed or stored at the facility that could be spilled into State waters (if any). The Plan would be reviewed at least annually and updated as needed.
Field trials conducted in 2012 and 2014 confirm that imidacloprid persists in sediment after application (Hart Crowser 2013 and 2016). Both the 2012 and 2014 results confirm that imidacloprid concentrations in sediment porewater exceed, and remain above EPA chronic marine toxicity endpoints after 14 days, and in some cases at 28 days. The 2012 results documented detectable concentrations of imidacloprid at 56 days for two of five sampled locations.	As of the time of this publication, Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has not proposed any mitigation to address this impact to sediment and sediment porewater.
For the SEIS, Ecology has compared the 2014 sediment porewater results against the EPA (2017) acute and chronic marine endpoints for surface water. One day post treatment, concentrations in porewater ranged from 4.7 ppb to 100 ppb, and three of eight samples exceeded the acute marine endpoint of 16.5 ppb, and all samples exceeded the chronic marine endpoint. Although concentrations (range 0.09 to 3.1 ppb) declined over 14 days, 6 of 8 (75%) samples exceeded the EPA chronic marine endpoint of 0.16 ppb. At 28 days post treatment, concentrations (range 0.11 to 1.2 ppb) continued to exceed the EPA chronic marine endpoint in 5 of 8 (63%) samples. No data were collect after 28 days so it is uncertain as to when sediment porewater declined to below the EPA chronic marine endpoint.	Same as above.
. The 2016 WGHOGA permit application requests authorization to apply imidacloprid in both north and south Willapa Bay, locations known to contain sediments with higher organic carbon levels. Field and laboratory studies have documented that imidacloprid levels in sediments decline more slowly over time as organic carbon levels increase (Grue and Grassley 2013). This could lead to prolonged exposure and	Same as above.

Potential Impacts	*Mitigation Measures*
higher toxicity risk to benthic organisms than in sediments where imidacloprid dissipates quickly.	
. Minor (if any) sediment disturbance would occur at the time of treatment with methods of application using land-based equipment suitable for the chemical formulation (i.e., liquid or granular imidacloprid), such as scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, backpack reservoirs with hand-held sprayers, and/or belly grinders.	No mitigation would be required for minor sediment disturbance during application.
At the North Willapa Bay experimental trial site (Cedar River) Ecology and WGHOGA did not see adequate recovery of the benthic invertebrate population 14 days after treatment. Specifically, mean crustacean abundance showed an 86% decline after fourteen days, while there was little change in the control plot. After 28 days, while there was more than a 40% increase in crustaceans at the control plot, there was a 60% decrease in crustaceans on the treatment plot. Ostracods, noted as susceptible in the EPA (2017) risk assessment, reflected this trend. After 28 days, six out of nine subgroups showed more than 60% decrease compared to before treatment numbers. Similar to the crustaceans, a 44% increase in polychaetes at the control plot after 14 days was matched by a 72% decrease at the spray site. At 28 days, a 75% increase in polychaetes at the control site compares to a 55% decrease at the spray site. In conclusion, mortality was greater than 50% and did not recover to less than 50% in 14 days.	As of the time of this publication, Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has not proposed any mitigation to address this impact to the benthic invertebrate population.
Significant Unavoidable Adverse Impacts: There are significant adverse effects to the sediment within a treated plot. Application of imidacloprid results in initial high concentrations of imidacloprid in whole sediment that can lead to sediment porewater exceeding EPA acute and chronic toxicity saltwater endpoints for marine invertebrates. The EPA chronic toxicity endpoints are exceeded in 75% of porewater samples 14 days after treatment, and 62% of samples 28 days after treatment. Because no data were collected after 28 days it is unknown how long imidacloprid persists in the sediment porewater above the EPA chronic toxicity endpoint. Significant mortality of benthic invertebrates is expected after the application and the benthic community data at Cedar River showed significant reductions in several invertebrate groups at 14 and 28 days after treatment. Significant mortality of Dungeness crab on the plot has been documented. The requested Ecology NPDES permit, if issued, would include expanded and revised sediment monitoring requirements to confirm the effects of pesticide applications. That monitoring would include long-term sampling to evaluate and address any potential persistence of imidacloprid in sediments. Adjustments to permit conditions could be made during the 5-year term of the permit based on the results of that sampling.	

Air Quality

Alternative 1: No Action

. There would be gasoline or diesel exhaust emissions to the air associated with the transport and operation of mechanical and shellfish culture equipment if these methods were used to attempt to control burrowing shrimp populations. . No significant adverse air quality impacts would be expected due to consistent wind circulation within Willapa Bay and Grays Harbor.
. There would be no insecticide applications to commercial shellfish beds under the No Action Alternative, and thus no risk of airborne dispersion.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	***Mitigation Measures***
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be treated, and application methods that could include aerial spraying from helicopters under Alternative 3.	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as distinguished for aerial applications of imidacloprid using helicopters: FIFRA REGISTRATION REQUIREMENTS: . WGHOGA would be responsible for posting signs at least 2 days prior to aerial treatment [using helicopters], and maintain these signs in-place for at least 30 days after treatment.
Localized, Short-Term Impacts. Impacts to air quality on or in the vicinity of plots treated with imidacloprid would be similar under Alternative 3 or 4, and these would likely be localized and short-term. Sources of emissions to the air would include vehicles (e.g., ATVs or boats) operating immediately over a plot during treatment. Under Alternative 3, helicopters could also be used to make aerial spray applications.	
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, no significant unavoidable adverse impacts to air quality would be expected with Alternative 3, based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations (including disclosure of application dates and locations).	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	***Mitigation Measures***
. Emissions to the air under Alternative 4 would be lower than those projected to occur with Alternative 3, which included the use of helicopters for aerial applications of imidacloprid. Alternative 4 specifically excludes aerial applications using helicopters. Imidacloprid may be applied using suitable vessels or land-based equipment, such as scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, backpack reservoirs with hand-held sprayers, and/or belly grinders. . Vehicular and boat trips associated with imidacloprid applications would be added to existing trips for	No mitigation measures would be required for vehicle or vessel exhaust emissions to the air.

Potential Impacts	*Mitigation Measures*
shellfish planting, rearing and harvest activities. Boat application of imidacloprid, if approved and used, would also contribute to emissions. . Emissions associated with Alternative 4 would not be expected to impair attainment of air quality standards in Pacific or Grays Harbor counties.	
. The liquid formulation of imidacloprid (Protector 2F) is considered to be non-volatile, but slightly toxic by inhalation. . The granular formulation of imidacloprid (Protector 0.5G) is also considered to be non-volatile and is relatively non-toxic by inhalation.	FIFRA REGISTRATION REQUIREMENTS: . It would be the responsibility of the applicator to select appropriate application equipment and treat commercial shellfish beds only during appropriate environmental conditions when wind speed, temperature, and tidal elevation would minimize the risk of spray drift, to avoid off-target dispersion. . Average wind speed at the time of application shall not exceed 10 mph. . Persons handling the granular form of imidacloprid (Protector 0.5G) would be required to wear a respirator or dust mask.
. Applications of imidacloprid on commercial shellfish beds should pose little risk of exposure to the public or other bystanders due to lack of proximity to public gathering places.	FIFRA REGISTRATION REQUIREMENTS: WGHOGA would be responsible for implementing the public notification requirements listed below under Alternative 4, Human Health: Mitigation Measures. 2014 WGHOGA PROPOSAL FOR THE USE OF IMIDACLOPRID: . The WGHOGA IPM Coordinator would be responsible for posting, maintaining and removing public notice signs. . A website would be used in lieu of newspaper announcements for public notification of specific dates and locations of proposed imidacloprid applications within Willapa Bay and Grays Harbor. The website would include a link for interested persons to request direct notification.
. Both the liquid (Protector 2F) and granular (Protector 0.5G) forms of imidacloprid have only a slight odor, and most or all applications would be made away from the public and during periods of low wind. Therefore, it is unlikely that the odor would be detectable to off-site observers.	No mitigation measures would be required for odors associated with the use of imidacloprid.
Localized, Short-Term Impacts. Potential impacts to air quality for treated plots under Alternative 4 would likely be localized and short-term. Sources of emissions to the air would include vehicles (e.g., ATVs or boats) operating immediately over a plot during treatment. There would be no use of helicopters under Alternative 4.	
Significant Unavoidable Adverse Impacts: Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations (including disclosure of application dates and locations), no significant unavoidable adverse impacts to air quality would be expected as a result of implementing Alternative 4. Pesticide applications for burrowing shrimp population control would be implemented in compliance with FIFRA Registration restrictions and NPDES permit conditions that specify appropriate application equipment and spray drift management techniques to avoid or minimize off-target exposures. FIFRA Registration and NPDES permit conditions also include public notification requirements to inform landowners, adjacent landowners, lessees,	

Potential Impacts	Mitigation Measures
interested individuals, recreational users and others of proposed application dates and locations so that potential direct exposure could be avoided.	

Surface Water

Alternative 1: No Action

If mechanical means of burrowing shrimp population control were utilized, there would be localized occurrences of turbidity due to sediment destabilization. It is unlikely that any water quality exceedances would occur due to shallow water depth, naturally turbid water, and the fact that Willapa Bay and Grays Harbor are intertidal environments that often go dry.
If alternative shellfish culture methods were used, such as bag culture or long-line culture, potential impacts to surface water quality may include the introduction of anthropogenically-derived waste such as plastics, mesh bags, and ropes that may be dislodged during storm events.
No pesticides would be discharged to Willapa Bay or Grays Harbor under the No Action Alternative for the purpose of burrowing shrimp population control.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	Mitigation Measures
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be treated, and application methods that could include aerial spraying from helicopters under Alternative 3.	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as distinguished for aerial applications of imidacloprid using helicopters: FIFRA REGISTRATION REQUIREMENTS: . Make aerial [i.e., helicopter] applications of imidacloprid on beds exposed at low tide [as opposed to other stages of the tidal cycle].
New information that has become available since 2015 is analyzed in Alternative 4, and is also applicable to Alternative 3. Effects are greater in Alternative 3 due to the greater area of imidacloprid application.	See Alternative 4 for the new analysis.
Localized, Short-Term Impacts. Impacts to surface water quality on plots treated with imidacloprid would be similar under Alternative 3 or 4. Experimental trials conducted in 2012 and 2014 confirm that imidacloprid dissolves in surface water and may persist in the water column during the first or second tidal cycle. See additional information in the description of impacts to surface water under Alternative 4, below.	
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, imidacloprid has been documented in the surface water on the treatment plots that significantly exceed the EPA acute toxicity endpoint, and is likely to result in mortality to any aquatic invertebrates on the treatment plot. When the tide moves onto the treatment plot, much of the imidacloprid will be transported off the plot in the water column resulting in exposure to non-target organism over a larger area. Concentrations of imidacloprid above the EPA acute toxicity endpoint have been found up to ¼ mile away from the treatment plot. Modeling of imidacloprid movement of plots shows an area of up to eight times the size of the treated plot may be impacted. Imidacloprid transport off the treatment plot will depend on a number of site-specific factors. A new NPDES permit, if issued for Alternative 3, would include conditions that limit the maximum annual tideland acreage for pesticide applications; specify treatment methods;	

Potential Impacts	*Mitigation Measures*
require buffers from sloughs, channels, and shellfish to be harvested; and require discharge monitoring to evaluate the effects of applications. Adjustments to permit conditions could be made during the 5-year term of the permit.	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
. Imidacloprid and the degradation byproducts of imidacloprid would enter Willapa Bay and Grays Harbor following treatment of commercial shellfish beds. . The imidacloprid application rate authorized by the conditional FIFRA Registration for Protector 2F and Protector 0.5G (the liquid and granular forms of imidacloprid, respectively) is 0.5 (one-half) pound of active ingredient per acre (a.i./ac). . The application period authorized by the conditional FIFRA Registration for the liquid and granular forms of imidacloprid is April 15 through December 15.	NPDES PERMIT REQUIREMENTS: . Alternative 4 would require issuance of a NPDES individual permit conditioned to ensure compliance with Washington State WQS and other applicable regulations, including USEPA registration requirements for the use of imidacloprid in the estuarine environment for the purpose of burrowing shrimp population control. . Discharge monitoring and data reporting would be required. . The imidacloprid water quality monitoring plan would take into account the treatment plan proposed, and current information regarding this proposal would be used to condition the permit (if issued). . The discharge of imidacloprid authorized by an NPDES permit (if issued) would be limited to waters of the State of Washington; specifically, to the waters of Willapa Bay and Grays Harbor for the purpose of burrowing shrimp population control on commercial shellfish beds. . A Spill Control Plan (SCP) would be required. . An NPDES permit, if issued, would include conditions that limit the maximum annual tideland acreage for pesticide applications; specify treatment methods; require buffers from sloughs, channels, and shellfish to be harvested; and require discharge monitoring to evaluate the effects of applications. Adjustments to permit conditions could be made during the five-year term of the permit.
. The maximum annual treatment acreage proposed under Alternative 4 is 500 acres (up to 485 acres *per year* within Willapa Bay, and up to 15 acres *per year* within Grays Harbor); therefore, imidacloprid applications would occur on approximately 1.1% per year of total tideland acres within Willapa Bay and approximately 0.04% per year of total tideland acres within Grays Harbor. . It is possible that the total tideland acreage to be treated over the 5-year term of the NPDES permit could range from 485 to 2,425 acres within Willapa Bay, and from 15 to 75 acres within Grays Harbor.	FIFRA REGISTRATION REQUIREMENTS: . Restrict imidacloprid treatments so that the insecticide would not be applied on beds where shellfish are within 30 days of harvest. . Make aerial applications of imidacloprid [from vessels or land-based equipment] on beds exposed at low tide. Protector 0.5G applications made from a floating platform or boat may be applied to beds under water using a calibrated granular applicator. . Maintain buffer zones between the imidacloprid treatment area and the nearest shellfish to be harvested within 30 days: a 100-ft buffer for aerial applications, or a 25-ft buffer for applications made by hand. . It is recommended that a properly designed and maintained containment pad be used for mixing and loading imidacloprid into application equipment. . If a containment pad is not used, a minimum distance of 25 feet should be maintained between mixing and

Potential Impacts	***Mitigation Measures***
	loading areas and potential surface to groundwater conduits.
. Hydrolysis, photolysis, and microbial degradation would be the primary means of imidacloprid breakdown the aquatic environment. Factors such as water chemistry, temperature, adsorption to sediment, water currents, and dilution can all have significant effects on the persistence of imidacloprid (CSI 2013). There is uncertainty related to the persistence and environmental fate of imidacloprid breakdown products in this environment. Only one imidacloprid degradation product was able to be measured during the monitoring.	Same as all entries in the Alternative 4, Surface Water: Mitigation Measures column above.
. Data from studies conducted in Willapa Bay in 2012 and 2014 show that imidacloprid dissolves readily in surface water and moves off treated areas with incoming tides and in drainage channels. This is likely to allow imidacloprid to impact non-treated areas through surface water conveyance, particularly as tidal waters first pass over off-plot areas. However, as tidal waters continue to flow onto off-site areas, imidacloprid is expected to dilute.	Same as above.
In addition, multiple application events on different plots over consecutive days may create multiple exposures throughout local surface waters. It is not known what duration of exposure is needed to create an acute effect and whether a short "pulse" of high concentrations is less likely to create an effect than a sustained exposure of hours. Therefore impacts from surface water exposure has uncertainty that is likely to be biased towards not detecting toxicity in the water column. Experimental imidacloprid application monitoring has not measured for water column invertebrate mortality.	As of the time of this publication, Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has not proposed any mitigation to address this impact to the surface water.
. Laboratory studies have shown that the half-life of imidacloprid at pH 5 and pH 7 can be greater than one year, while the half-life of imidacloprid at pH 9 is approximately one year (CSI 2013). (The pH of seawater is more alkaline, tending to range from 7.5 to 8.4.) . Other laboratory studies of photo-degradation of imidacloprid in water suggest that it has a half-life of approximately 4.2 hours in water and degrades under natural sunlight (CSI 2013). However, field conditions may vary greatly from lab conditions due to turbidity and cloudy weather which will interfere with the rate of photo-degradation. . Further laboratory experiments have shown varied results with a half-life ranging from 14 to 129 days (Spitteller 1993 and Henneböle 1998 as cited in CSI 2013).	. Imidacloprid that is not degraded by environmental factors would be diluted by tidal flows in the Willapa Bay and Grays Harbor estuaries.

<table>
<tr><th>Potential Impacts</th><th>Mitigation Measures</th></tr>
<tr><td>All of the on-plot surface water samples immediately after treatment significantly exceed the EPA acute toxicity endpoint of 16.5 ppb, with averages of 796 ppb (Taylor and Coast plots 2014) and 290 ppb (Nisbet plot 2014), and 800 ppb (Cedar River 2014). Maximum concentrations on-plot were measured up to 1,600 ppb, which is approximately 100 times the acute toxicity endpoint published by EPA. Based on this information, the on-plot surface water is very highly toxic to marine invertebrates and likely to cause significant unavoidable impacts to marine invertebrates in surface water of the treatment plots.</td><td>As of the time of this publication, Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has not proposed any mitigation to address this impact to the surface water.</td></tr>
<tr><td>Much of the imidacloprid is dissolved and transported off the plot in the first incoming tide resulting in transport and exposure that extends significantly beyond the boundaries of the treated plot. Water samples off-plot showed many exceedances of the EPA acute toxicity endpoint (16.5 ppb imidacloprid), including one sample with 200 ppb of imidacloprid 480 m (about ¼ mile) from the treated plot (Hart Crowser 2014). While many samples were below the threshold, and it is expected that dilution would be the dominant fate mechanism, a number of plots, such as in the 2012 monitoring, showed a broad spatial extent above the EPA acute marine endpoint. The duration of toxic imidacloprid concentrations that extend off the treatment plot is unknown. Given the high solubility of imidacloprid, the uncertainty about its half-life, and the highly dynamic hydrology of the estuary, it is difficult to measure or model the extent of imidacloprid in the estuary as a result of this application. There is also uncertainty of imidacloprid toxicity to marine organisms, particularly with sublethal effects, delayed mortality, and the limited number of organisms that have been evaluated in the literature to date.</td><td>Same as above.</td></tr>
<tr><td colspan="2">Localized, Short-Term Impacts. Under Alternative 4, surface water on plots that have been treated with imidacloprid would likely show short-term impacts due to the application of imidacloprid. Experimental trials conducted in 2012 and 2014 confirm that imidacloprid dissolves in surface water and may persist in the water column during the first tidal cycle.

Results of the 2012 commercial-scale experimental trials conducted in Willapa Bay (described in the 2015 FEIS, Chapter 3, Section 3.2.3, pages 3-23 through 3-24) documented that detectable concentrations of imidacloprid were observed, in some cases at up to 1,575 feet from the edge of the sprayed plots, on the leading edge of the rising tide. Results from the 2014 field trials in Willapa Bay documented detectable concentrations of imidacloprid at up to 2,316 feet from the edge of sprayed plots (SEIS Chapter 3, Section 3.3.3).</td></tr>
<tr><td colspan="2">Significant Unavoidable Adverse Impacts: Similar to Alternative 3, and based on the new information about imidacloprid toxicity (EPA 2017), surface water on plots that have been treated with imidacloprid would likely show significant impacts due to the application of imidacloprid. Experimental trials conducted in 2012 and 2014 confirm that imidacloprid dissolves in surface water and is likely to be present in the water column during the first tidal cycle at concentrations that far exceed the acute toxicity endpoint published by EPA to protect marine invertebrates. The concentrations of surface water exceed the EPA acute toxicity endpoint of 16.5 ppb imidacloprid in all of the on-plot water samples. The maximum concentration of on-plot surface water sample (1,600 ppb) exceeds the EPA acute toxicity endpoint by 100 times.</td></tr>
</table>

Potential Impacts	Mitigation Measures

Much of the imidacloprid is dissolved and transported off the plot in the first incoming tide resulting in transport and exposure that extends significantly beyond the boundaries of the treated plot. Water samples off-plot showed many exceedances of the EPA acute toxicity endpoint (16.5 ppb imidacloprid), including one sample with 200 ppb of imidacloprid 480 m (about ¼ mile) from the treated plot (Hart Crowser 2014). Modeling of imidacloprid movement of plots shows an area of up to eight times the size of the treated plot may be impacted. While many samples were also below the threshold, and it is expected that dilution would be the dominant fate mechanism, a number of plots, such as the 2012 monitoring, show a broad spatial extent above the EPA acute marine endpoint. The duration of toxic imidacloprid concentrations that extend off the treatment plot is unknown.

The requested Ecology NPDES permit, if issued, would include conditions that limit the maximum annual tideland acreage for pesticide applications; specify treatment methods; require buffers from sloughs, channels, and shellfish to be harvested; and require discharge monitoring to evaluate the effects of applications. Adjustments to permit conditions could be made during the five-year term of the permit.

Plants

Alternative 1: No Action

. Mechanical disturbance of oyster and clam beds for burrowing shrimp population control would temporarily affect flora within the treatment areas: microalgae, the upper elevations of eelgrass (both *Zostera marina* and *Z. japonica*), and salt marsh species in their lower elevation locations.

. Since mechanical methods of burrowing shrimp control are less effective than chemical methods of control, untreated areas would be affected by burrowing shrimp over time.
. Sediment disturbance caused by burrowing shrimp can inhibit eelgrass growth and density (Dumbauld and Wyllie-Echeverria 2003; Hosack et al. 2006).

. Mechanical methods of burrowing shrimp control (e.g., boats grounding on sand and mudflats, harrowing, raking and other activities) would have localized and temporary effects on marine and salt marsh vegetation.
. Damaged plants would be suppressed for a period of time before re-growth; plant seeds may germinate during the same or following season; roots, rhizomes and seeds disrupted in one location may be distributed by the tide to other sites, potentially enhancing dispersion of affected plants.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	Mitigation Measures
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be treated, and application methods that could include aerial spraying from helicopters under Alternative 3.	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as distinguished for aerial applications of imidacloprid using helicopters: FIFRA REGISTRATION REQUIREMENTS: . Implementing spray drift management techniques (as described above under Alternative 4, Air Quality: Mitigation Measures) would be effective at avoiding potential impacts to off-site non-target plants.

Localized, Short-Term Impacts. It is unlikely there would be any localized, short-term impacts to plants under Alternative 3, since plants lack the nervous system pathway through which imidacloprid impacts some organisms.

Potential Impacts	Mitigation Measures
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, no significant unavoidable adverse impacts to plants would be expected with Alternative 3, based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations (including Washington State WQS and SMS). The FIFRA Registration specifies spray drift management techniques, and a new NPDES permit (if issued for Alternative 3), would include conditions that specify treatment methods; require buffers from sloughs and channels; and require discharge monitoring. Adjustments to permit conditions could be made during the 5-year term of the permit.	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	Mitigation Measures
. Imidacloprid applications may have localized, temporary, and negligible impacts on plants within Willapa Bay and Grays Harbor if the requested NPDES permit is issued. Imidacloprid is a systemic insecticide that is taken up from the soil (or sediments) by plants and is present in the foliage of plants. . Rooted plants such as eelgrass and salt marsh plants could uptake the insecticide in these areas and small concentrations of imidacloprid have been found in eelgrass for limited periods of time (Grue & Grassley 2013; Hart Crowser 2013). Also, if applicators failed to employ effective spray drift management techniques, imidacloprid might stray from the application zone to adjacent aquatic or shoreline plants that are occasionally inundated by tidal waters.	FIFRA REGISTRATION REQUIREMENTS: . Implementing spray drift management techniques (as described below under Alternative 4, Animals [Pollinators]: Mitigation Measures) would be effective at avoiding potential impacts to off-site non-target plants. . Maintaining buffers from sloughs and channels (as described above under Alternative 4, Surface Water: Mitigation Measures) would also be effective at avoiding potential impacts to off-site non-target plants. . Maintaining small application areas for short periods of time would be effective at minimizing potential impacts to plants. . Preparing and implementing a Spill Control Plan (as described above under Alternative 4, Surface Water: Mitigation Measures) would also be protective of plants. 2014 WGHOGA PROPOSAL FOR THE USE OF IMIDACLOPRID: . WGHOGA would implement measures over time to minimize the frequency and quantity of imidacloprid applications necessary for the effective control of burrowing shrimp populations.
. The EPA (2017) reviewed for SEIS preparation notes that: *"[a]quatic plants will not be assessed as available data for vascular and non-vascular aquatic plants indicate toxicity endpoints that are several orders of magnitude above the highest estimated environmental concentrations in surface waters."* Imidacloprid toxicity derives from its ability to bind to specific sites on nerves (nicotinic acetylcholine receptors – nAChRs), causing them to malfunction (e.g., excessive nervous stimulation, blockage of the receptor sites). Plants lack a nervous system, thus making it unlikely that imidacloprid would negatively affect marine plant species.	. No additional mitigation measures for imidacloprid applications that may come into contact with plants are proposed beyond the FIFRA Registration requirements since plants lack a nervous system pathway through which imidacloprid impacts some organisms.
Localized, Short-Term Impacts. It is unlikely there would be any localized, short-term impacts to plants under Alternative 4, since plants lack the nervous system pathway through which imidacloprid impacts some organisms.	
Significant Unavoidable Adverse Impacts: Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations,	

Potential Impacts	Mitigation Measures
permits and regulations, no significant unavoidable adverse impacts to estuarine or terrestrial plants would be expected as a result of implementing Alternative 4. FIFRA Registration specify spray drift management techniques and the requested Ecology NPDES permit, if issued, would include conditions that specify treatment methods; require buffers from sloughs and channels; and require discharge monitoring. Adjustments to permit conditions could be made during the 5-year term of the permit.	

Animals

Alternative 1: No Action

MARINE ZOOPLANKTON . Alternative 1 would be unlikely to adversely affect marine zooplankton because, in the absence of insecticide applications for the control of burrowing shrimp populations, there would be no potential insecticide effect to zooplankton from this source.
BENTHIC INVERTEBRATES (BURROWING SHRIMP, CLAMS AND OYSTERS, DUNGENESS CRAB) Due to the limited amount of tideland acreage proposed for treatment with imidacloprid, the No Action Alternative would be unlikely to have either a significant beneficial or adverse effect on benthic invertebrates, including burrowing shrimp, clams and oysters, and Dungeness crab (as described in Draft SEIS Chapter 2, Section 2.8.4.3).
FORAGE FISH AND GROUNDFISH . The No Action Alternative would be unlikely to have a significant beneficial or adverse effect on forage fish or groundfish in Willapa Bay and Grays Harbor due to the relatively small proportion of tidelands within each estuary that have been or would be treated with an insecticide for the control of burrowing shrimp populations.
BIRDS . The No Action Alternative would be unlikely to have a significant beneficial or adverse effect on birds in Willapa Bay or Grays Harbor due to the relatively small proportion of tidelands within each estuary that have been or would be treated with an insecticide for the control of burrowing shrimp populations.
POLLINATORS . The No Action Alternative would be unlikely to have either a beneficial or adverse effect on honey bees (or other pollinators) as no insecticides would be sprayed on commercial clam or oyster beds in Willapa Bay or Grays Harbor. . In addition, potential impacts from this alternative would be limited because honey bees are not attracted to sandflats or mudflats, and bumble bees and similar pollinators prefer terrestrial flowering plants that are not found in the bays (Macfarlane and Patten 1997).
MAMMALS . The No Action Alternative would be unlikely to have either a beneficial or adverse effect on mammals in Willapa Bay or Grays Harbor due to the small size of these areas in relation to the total tideland area of Willapa Bay and Grays Harbor.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	***Mitigation Measures***
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar but likely greater to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as distinguished for aerial applications of imidacloprid using helicopters: FIFRA REGISTRATION REQUIREMENTS: . Helicopters used to apply Protector 2F should be equipped to minimize spray drift. The best drift management strategy and most effective way to reduce drift potential is to apply large droplets that provide sufficient coverage and control. Droplet size can be

<table>
<tr><th>Potential Impacts</th><th>Mitigation Measures</th></tr>
<tr><td>treated, and application methods that could include aerial spraying from helicopters under Alternative 3.</td><td>controlled by using high flow-rate nozzles, selecting the number and type of nozzles, nozzle orientation, and controlling pressure appropriate for the nozzle type.
. Application of the liquid form of imidacloprid (Protector 2F) by helicopter and hand-held equipment would tend to flush birds from the target area (personal communication with Dr. Kim Patten, WSU Pacific County Extension Director).
. Application events and flushing (i.e., scaring) birds from application sites would be short-term and temporary. It is unclear how quickly birds would return to feed. Comments from Audubon cited studies that waterfowl disturbed from feeding areas frequently return after the disturbance has passed.
. Aerial dispersal of imidacloprid limited by spray drift management techniques would minimize potential exposure to non-target species, and therefore would be unlikely to adversely affect bird populations within Willapa Bay or Grays Harbor.
. Application methods and spray drift management techniques required by the conditional FIFRA Registrations would minimize the potential for direct exposure to migratory birds during the imidacloprid seasonal application period between April 15 and December 15.

2014 WGHOGA PROPOSAL FOR THE USE OF IMIDACLOPRID:

. The 2014 WGHOGA proposal to avoid aerial (i.e., helicopter) applications of Protector 0.5G or 2F within 200 feet of the Ordinary High Water Line (OHWL) adjacent to shoreline areas would be protective of pollinators.</td></tr>
<tr><td>New information that has become available since 2015 is analyzed in Alternative 4, and is also applicable to Alternative 3. Effects are greater in Alternative 3 due to the greater area of imidacloprid application.</td><td>See Alternative 4 for the new analysis.</td></tr>
<tr><td colspan="2">Localized, Short-Term Impacts. The localized short-term impacts of Alternative 3 on zooplankton and benthic invertebrates would be similar to those described below for Alternative 4. These impacts would be expected to occur within the boundaries of the treatment plots as imidacloprid is applied directly to the substrate or in shallow water, and could extend to adjacent off-plot areas, particularly those closest to the treated plot that would be exposed to the highest concentrations of imidacloprid as it is carried off-plot by the incoming tide.

Dungeness crab juveniles and planktonic forms are likely to be killed by the application of imidacloprid on shellfish beds. Planktonic forms of Dungeness crab off-plot may also be impacted by rising tidewaters carrying imidacloprid. See additional information in the summary of localized short-term impacts to Animals of Alternative 4, below.</td></tr>
<tr><td colspan="2">Significant Unavoidable Adverse Impacts: Similar to Alternative 4, there is a low probability of adverse effects to birds, fish or other vertebrates. Invertebrates, including Dungeness crab would likely be killed or displaced from treatment areas.

Alternative 4 would be expected to cause on-plot impacts to zooplankton and benthic invertebrates through either death or paralysis. These impacts would be expected within the boundaries of the treatment plots as imidacloprid is applied directly to the substrate or in shallow water, and could extend to adjacent off-plot areas, particularly those</td></tr>
</table>

Potential Impacts	*Mitigation Measures*
closest to the treated plot that would be exposed to the highest concentrations of imidacloprid as it is carried off-plot by the incoming tide. The spatial extent and duration of off-plot exposure and toxicity are unknown at this time. The two reviewed crab studies (Patten and Norelius 2017, Osterberg et al. 2012), and in particular the field observations of affected crab after field-spraying in Patten and Norelius, confirm that Dungeness crab juveniles and planktonic forms are likely to be killed by the proposed application of imidacloprid on shellfish beds. Given the concentrations of imidacloprid required to produce tetany in crabs, and the limited exposure of off-plot areas due to the rapid dilution by rising tide waters, it is likely that most impacts to juvenile crab would be limited to on-plot areas, or areas adjacent to plots sprayed directly with imidacloprid during low tide conditions (as shown in 2014 field trials). Planktonic forms of Dungeness crab off-plot may also be impacted by rising tidewaters carrying imidacloprid.	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
MARINE ZOOPLANKTON ON-PLOT IMPACTS Imidacloprid applications at the concentration being proposed (0.5 lb active ingredient per acre) would be expected to cause on-plot impacts to zooplankton through either death or paralysis from surface water exposure. All of the on-plot surface water samples immediately after treatment significantly exceed the EPA acute toxicity endpoint of 16.5 ppb, with averages of 796 ppb (Taylor and Coast plots 2014) and 290 ppb (Nisbet plot 2014), and 800 ppb (Cedar River 2014). Maximum concentrations on-plot were measured up to 1,600 ppb, which is approximately 100 times the acute toxicity endpoint published by EPA. Based on this information, the on-plot surface water is very highly toxic to marine invertebrates and likely to cause significant unavoidable impacts to marine invertebrates in surface water of the treatment plots.	. Imidacloprid would be applied in-water during out-going tides or on the exposed sand or mudflats of commercial shellfish beds when densities of zooplankton would be low due to limited water depth.
MARINE ZOOPLANKTON OFF-PLOT IMPACTS Much of the imidacloprid is dissolved and transported off the plot in the first incoming tide resulting in transport and exposure that extends significantly beyond the boundaries of the treated plot. Water samples off-plot showed many exceedances of the EPA acute toxicity endpoint (16.5 ppb imidacloprid), including one sample with 200 ppb of imidacloprid 480 m (about ¼ mile) from the treated plot (Hart Crowser 2014). While many samples were also below the threshold, and it is expected that dilution would be the dominant fate mechanism, a number of plots, such as the 2012 monitoring, show a broad spatial extent of marine surface waters with concentration exceeding the EPA acute marine endpoint. The duration of toxic imidacloprid concentrations that extend off the treatment plot is unknown. Given the high solubility of imidacloprid, the uncertainty about its half-life, and the	As of the time of this publication, Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has not proposed any mitigation to address this impact to the marine zooplankton off-plot.

Potential Impacts	*Mitigation Measures*
highly dynamic hydrology of the estuary, it is difficult to predict the extent of imidacloprid exposure in the estuary as a result of this application. There is also uncertainty of imidacloprid toxicity to marine organisms, particularly with sublethal effects, delayed mortality, and the limited number of organisms that have been evaluated in the literature to date.	
BENTHIC INVERTEBRATES (BURROWING SHRIMP, CLAMS AND OYSTERS, DUNGENESS CRAB) . Imidacloprid applications at the concentration being proposed (0.5 lb active ingredient per acre) would be expected to cause on-plot impacts to benthic invertebrates through either death or paralysis. Sediment porewater exceeds EPA acute toxicity endpoint after application, and exceeds the EPA chronic toxicity criteria at some locations for at least 28 days. Benthic abundance monitoring was conducted during 2011, 2012, and 2014 as part of experimental imidacloprid applications. During all three years, statistical power was low, requiring Ecology to make determinations based on best professional judgement. Abundances values are highly variable, subsequently a large number of samples would be needed to obtain required statistical power to determine differences between plots (TerraStat, January 2, 2018). . Imidacloprid applications at the concentration being proposed would not decrease biodiversity other than to temporarily reduce burrowing shrimp populations within application areas (CSI 2013). . There is a potential for imidacloprid to persist in certain sediment types (Grue and Grassley 2013), and toxic effects to benthic infauna are likely in sediments with elevated organic carbon concentrations. The Cedar River site (2011) had high organic carbon and the monitoring showed that the imidacloprid persisted in sediment and porewater longer than other sites. The Cedar River site also had significant decline in the abundance of polychaete and crustacean invertebrates, compared to the control site and that the decline lasted for at least 28 days. Monitoring was discontinued after 28 days, so it is unknown how long imidacloprid persisted in the sediment and how long until the invertebrates recolonized the treatment plot with populations similar to the control site. . Studies have found that the use of imidacloprid at the proposed concentration would have some effects on polychaete worms or molluscs (bivalves, snails), including oysters and clams (Hart Crowser 2016). Sediment porewater persists above EPA chronic toxicity endpoints for several weeks or longer, and field studies have shown that benthic invertebrate abundance	If the NPDES permit were to move forward, a new, more rigorous analytical monitoring approach would be needed to meet power, to make a statistical conclusion of "no negative effects." WGHOGA has not proposed any mitigation other than those listed here. NPDES PERMIT REQUIREMENTS: . NPDES permit, if issued, would include conditions that limit the maximum annual tideland acreage for pesticide applications; specify treatment methods; require buffers from sloughs, channels, and shellfish to be harvested; and require discharge monitoring to evaluate the effects of applications. Adjustments to permit conditions could be made during the five-year term of the permit. FIFRA REGISTRATION REQUIREMENTS: . Spray drift management techniques and treatment site requirements specified in the conditional FIFRA Registrations for the liquid and granular forms of imidacloprid would be implemented under Alternative 4. These state that aerial applications must occur on beds exposed at low tide, and granular applications may be applied to beds under water using a calibrated granular applicator, operating from a floating platform or boat. . Application of the granular form of imidacloprid during periods of shallow standing water would limit the potential for crabs to be affected.

Potential Impacts	*Mitigation Measures*
may be significantly diminished compared to a control site for at least 28 days, such as at the Cedar River site. Commensal species that co-exist with burrowing shrimp may be impacted by imidacloprid directly, and may also be indirectly impacted by the loss of burrowing shrimp due to burrow collapse. . Imidacloprid causes a temporary tetanus (paralysis) reaction in copepods (small crustaceans) and shrimp, creating a situation for predation by fish and birds that feed on copepods and shrimp flushed from their burrows. While organisms may recover from tetany (paralysis) in the laboratory, in the field it is most likely to result in death due to predation or smothering.	
. Application of imidacloprid to control burrowing shrimp populations will result in tetany and death of planktonic and juvenile Dungeness crab on-plot, and adjacent to treated plots (Osterberg et al. 2012; Patten and Norelius 2017). Effects on Dungeness crab were documented in the 2014 field trials, where 137 crab were dead or paralyzed out of a total of 141 crab observed in and around the treatment area. Paralyzed crab are unlikely to recover in the field environment due to predation.	WGHOGA has not proposed any mitigation other than those listed above.
Off-plot impacts. Much of the imidacloprid is dissolved and transported off the plot in the first incoming tide resulting in transport and exposure that extends significantly beyond the boundaries of the treated plot. Water samples off-plot showed many exceedances of the EPA acute toxicity endpoint (16.5 ppb imidacloprid), including one sample with 200 ppb of imidacloprid 480 m (about ¼ mile) from the treated plot (Hart Crowser 2014). While many samples were below the threshold, and it is expected that dilution would be the dominant fate mechanism, a number of plots in 2012 monitoring, indicated a broad spatial extent of water concentrations above the EPA acute marine endpoint. The duration of toxic imidacloprid concentrations that extend off the treatment plot is unknown. Given the high solubility of imidacloprid, the uncertainty about its half-life, and the highly dynamic hydrology of the estuary, it is difficult to predict the extent of imidacloprid exposure in the estuary as a result of this application. It is possible that benthic organisms, and epibenthic organisms such as crabs (juvenile and planktonic) could be affected by the imidacloprid transported off the plot, but the actual exposure and effects are unknown.	WGHOGA has not proposed any mitigation other than those listed above.
FORAGE FISH AND GROUNDFISH . Imidacloprid has very low toxicity to vertebrates (CSI 2013).	WGHOGA has not proposed any mitigation other than those listed.

Potential Impacts	*Mitigation Measures*
. It is unlikely that there would be adverse effects to forage fish or groundfish from imidacloprid in water (CSI 2013) due to dilution, adsorption of the chemical onto sediment, and due to applications being made during low tide conditions. . Indirect impacts to forage fish may potentially occur due to loss of invertebrate prey, but have not been quantified (Sanchez-Bayo et al 2016).	FIFRA REGISTRATION REQUIREMENTS: . Aerial dispersal of imidacloprid limited by spray drift management techniques (described below) would minimize the potential for exposure to non-target species, and therefore would be unlikely to adversely affect fish populations within Willapa Bay or Grays Harbor.
BIRDS . Concentrations of imidacloprid below 150 mg/kg are generally non-toxic to birds (Gervais et al. 2010), and CSI (2013) found that imidacloprid application was unlikely to adversely affect birds in Willapa Bay or Grays Harbor, based on an application concentration of approximately 3.34 mg/kg.[6] . Although ingestion of imidacloprid pellets could lead to toxicity to birds (Health Canada 2016; Gibbons et al. 2015), the use of imidacloprid pellets in Willapa Bay or Grays Harbor is unlikely to impact birds because pellets would dissolve on contact with water from the incoming tide or are present on the tidelands for a short period of time. . Although imidacloprid toxicity in birds is not likely, imidacloprid toxicity to invertebrates could have food chain effects that could indirectly affect birds. Reduction in invertebrates could reduce the levels of food for bird species, at least locally, particularly for shorebirds that feed exclusively on invertebrates. Although this is a matter of uncertainty, reductions are not expected to be significant because of the small area that would receive imidacloprid applications each year relative to the total area available for such foraging in Willapa Bay and Grays Harbor.	FIFRA REGISTRATION REQUIREMENTS: . Application of the liquid form of imidacloprid (Protector 2F) disperses quickly, and granular (Protector 0.5G) application dissolves readily in shallow water. In addition, application methods would tend to flush birds from the target area (personal communication with Dr. Kim Patten, WSU Pacific County Extension Director). . Application events and flushing (i.e., scaring) birds from application sites would be short-term and temporary. It is unclear how quickly birds would return to feed. Comments from Audubon cited studies that waterfowl disturbed from feeding areas frequently return after the disturbance has passed. . Aerial dispersal of imidacloprid limited by spray drift management techniques would minimize potential exposure to non-target species, and therefore would be unlikely to adversely affect bird populations within Willapa Bay or Grays Harbor. . Application methods and spray drift management techniques required by the conditional FIFRA Registrations would minimize the potential for direct exposure to migratory birds during the imidacloprid seasonal application period between April 15 and December 15. Peak abundance of red knot and many shorebirds occurs in April and May, in relation to the imidacloprid application period authorized by the conditional FIFRA Registration: April 15 through December 15.
POLLINATORS . Imidacloprid is toxic to bees in direct contact or as a residual on flowering plants (EPA 2013b). . The proposed rate of application of imidacloprid (0.5 lb active ingredient per acre) would be below concentrations that would impact honey bees (EPA 2013b). . The potential for direct exposure to pollinators or their associated plant species would be negligible since honey bees are not attracted to sandflats or mudflats; bumble bees and similar pollinators prefer terrestrial flowering plants that are not found in the bays; and	FIFRA REGISTRATION REQUIREMENTS: FIFRA Registration spray drift management techniques would become conditions of the NPDES permit (if issued) for the use of imidacloprid: . Average wind speed at the time of application shall not exceed 10 mph when either Protector 0.5G or 2F is applied by air. Further, aerial applications shall not occur during gusty conditions, or during temperature inversions. Temperature inversions begin to form as the sun sets and often continue into the morning.

[6] Based on an assumption of imidacloprid being present in the top one centimeter of the sediment and a sediment density of 1.5 grams per cubic centimeter (g/cc).

Potential Impacts	Mitigation Measures
neither are likely to be present over estuarine waters that cover commercial shellfish beds (CSI 2013). . In the professional opinion of the Washington State Department of Agriculture, Special Pesticide Registration Program Coordinator consulted during preparation of the 2015 FEIS, there is no risk to bees from the application of imidacloprid (either granular or flowable formulation) to tidal flats due to the spray drift management techniques and buffers required by the FIFRA Registrations described in the Mitigation Measures column at right (personal communication with Erik Johansen, March 19, 2014).	. Applications of imidacloprid shall be made at the lowest possible height that is safe to operate ground equipment or barges, and that would reduce exposure of the granules to wind. . When applications of Protector 0.5G (the granular formulation) are made crosswind, the applicator must compensate for displacement by adjusting the path of the application equipment upwind. Swath adjustment distance should increase with increasing drift potential. . No direct treatment on blooming crops or weeds shall occur.
MAMMALS . Imidacloprid has very low toxicity to vertebrates (Health Canada 2016; CSI 2013). . Imidacloprid exposure for mammals would be related to direct ingestion. . Terrestrial mammals are unlikely to be present on shellfish beds during daylight hours when imidacloprid would be applied. A reduction in invertebrates could reduce the level of prey items for these species, at least locally. However, any such reductions are not expected to be significant because of the small area that would be treated relative to the total area available in these estuaries for such foraging. . Harbor seals and gray whales are present in Willapa Bay and Grays Harbor, but generally do not use the high intertidal sand and mudflats where clam and oyster farming occurs. It is unlikely that any impacts to invertebrate prey species would be large enough to impact these marine mammals.	FIFRA REGISTRATION REQUIREMENTS: . Aerial dispersal of imidacloprid limited by spray drift management techniques (described above) would minimize the potential for exposure to non-target species, and therefore would be unlikely to adversely affect mammal populations within Willapa Bay or Grays Harbor. . No specific mitigation measures would be required for marine or terrestrial mammals.

Significant Unavoidable Adverse Impacts:

There is a low probability of adverse effects to birds, fish or other vertebrates. However, there will be adverse effects to invertebrates, including Dungeness crab, which would likely be killed or displaced from treatment areas. Recent literature has indicated there could be indirect impacts to the food web due to loss of invertebrate prey, and has documented such impacts in terrestrial food webs. Indirect impacts to fish, birds, and mammals due to loss of invertebrate prey has not been studied for this action.

Alternative 4 would be expected to cause on-plot impacts to zooplankton and benthic invertebrates through either death or paralysis. These impacts would be expected within the boundaries of the treatment plots as imidacloprid is applied directly to the substrate or in shallow water, and is likely to extend to adjacent off-plot areas, particularly those closest to the treated plot that would be exposed to the highest concentrations of imidacloprid as it is carried and dissolved in surface waters off-plot by the incoming tide. The full spatial extent and duration of off-plot exposure and toxicity are unknown at this time. Imidacloprid persists in sediment for several weeks, or longer in areas of high organic carbon, and can result in decline in abundance in some benthic invertebrate species. At Cedar River, the decline in abundance for polychaetes and crustacean was still significant at 28 days after treatment compared to a control site, and it is not known how long until it recovered to populations similar to the control site.

The two reviewed crab studies (Patten and Norelius 2017, Osterberg et al. 2012), and in particular the field observations of affected crab after field-spraying in Patten and Norelius, confirm that Dungeness crab juveniles and planktonic forms are likely to be killed by the proposed application of imidacloprid on shellfish beds. Given the concentrations of imidacloprid required to produce tetany in crabs, and the limited exposure of off-plot areas due to the rapid dilution by rising tide waters, it is likely that most impacts to juvenile crab would be limited to on-

Potential Impacts	*Mitigation Measures*
plot areas, or areas adjacent to plots sprayed directly with imidacloprid during low tide conditions (as shown in 2014 field trials). Planktonic forms of Dungeness crab off-plot are likely to be impacted by rising tidewaters carrying imidacloprid.	

Threatened, Endangered and Protected Species

Alternative 1: No Action

SALMONIDS INCLUDING BULL TROUT . The No Action Alternative would be unlikely to have either a significant beneficial or adverse effect on salmonids in Willapa Bay or Grays Harbor due to the small size of these areas in relation to the total tideland area of Willapa Bay and Grays Harbor. . To the extent that a reduction in eelgrass habitat and prey availability were to occur in untreated areas due to an increase in the density of burrowing shrimp, shelter and food sources could be reduced during the juvenile salmonid out-migration in these limited areas. . Increased turbidity due to mobilized sediments caused by mechanical control efforts and/or by the burrowing activity of shrimp could locally reduce foraging efficiency for short periods of time, resulting in reduced presence of juvenile salmon in untreated areas.
GREEN STURGEON . The No Action Alternative would be unlikely to have either a beneficial or adverse effect on green sturgeon in Willapa Bay or Grays Harbor due to the relatively small proportion of tidelands within each estuary that have been or would be treated with pesticide for the control of burrowing shrimp. . The green sturgeon diet may seasonally consist of up to 50% burrowing shrimp (Dumbauld et al. 2008). Prey availability may increase on untreated commercial shellfish beds; however, this effect would be highly localized relative to the full extent of the bays.
MARBLED MURRELET . The No Action Alternative would be unlikely to have either a beneficial or adverse effect on marbled murrelet, their habitat, or prey availability in Willapa Bay or Grays Harbor. . Marbled murrelet critical habitat is designated upland from these two bays.
WESTERN SNOWY PLOVER . The No Action Alternative would be unlikely to have either a beneficial or adverse effect on western snowy plover in Willapa Bay or Grays Harbor. Most snowy plover use of the area is restricted to coastal beaches that are physically separated from proposed sites where imidacloprid would be used (see Figures 2.3-2 and 2.3-3 in SEIS Chapter 2). . Snowy plover prefer to forage on invertebrates in wet sand. Decreased prey diversity and softened substrate caused by increased burrowing shrimp activity on untreated commercial shellfish beds could indirectly affect snowy plover foraging success in limited areas as a result of less effective control measures; however, the area of affect would be small in relation to total tideland acreage in the two bays.
STREAKED HORN LARK . The No Action Alternative would be unlikely to have either a beneficial or adverse effect on streaked horn lark because they do not forage on or near shellfish beds. . Streaked horned lark critical habitat is centered on nesting beaches along the coast. Nests are established on bare ground, well above MHHW.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as

Potential Impacts	*Mitigation Measures*
beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be treated, and application methods that could include aerial spraying from helicopters under Alternative 3.	distinguished for aerial applications of imidacloprid using helicopters.
Localized Short-Term Impacts. There would be no localized, short-term impacts to threatened, endangered, and protected species due to the application of imidacloprid under Alternative 3.	
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, no significant unavoidable adverse impacts to threatened, endangered, or protected species would be expected with Alternative 3, based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations (including Washington State Department of Agriculture General Pesticide Rules). With the exception of some salmonid life stages, it is unlikely that these species would be present on treatment sites at the time of imidacloprid applications. There is a low probability of adverse effect to birds or other vertebrates.	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
SALMONIDS INCLUDING BULL TROUT . Imidacloprid would be unlikely to adversely directly affect salmonids because fish are not very sensitive to imidacloprid toxicity, and concentrations from this action are not likely to exceed current toxic endpoints for fish (EPA 2017) or their critical habitat (CSI 2013). Juvenile salmonids travel through the nearshore habitat during out-migration, feeding on copepods and zooplankton. Since crustaceans and molluscs do not bioaccumulate imidacloprid in their tissues, there would be no expectation of exposure to juvenile salmonids from consumption of these organisms. . No studies have been found that document the retention of imidacloprid in the tissue of burrowing shrimp. Therefore, no affect to salmonids would be expected if they were to consume some life stage of burrowing shrimp from a treatment site after an imidacloprid application. . It is possible that fish could be indirectly affected by the loss of invertebrate prey due to imidacloprid treatment if there are significant declines in invertebrate abundance in location and timing that are important to fish.	. Mitigation measures described above for Alternative 4: Surface Water would be protective of salmonids and their critical habitat within Willapa Bay and Grays Harbor. . Imidacloprid applications would occur during low and out-going tides, when salmon would not be present over commercial shellfish beds. This would limit the potential for salmon exposure during feeding. The granular form of imidacloprid (Protector 0.5G) dissolves before salmon could potentially return to treatment sites.
GREEN STURGEON	No specific mitigation measures would be required for green sturgeon.

. Imidacloprid has a limited effect on this species as documented in new studies from the University of Washington (reviewed in the SEIS).	
MARBLED MURRELET . Marbled murrelet critical habitat and foraging habitat do not overlap with areas where imidacloprid applications would occur on commercial shellfish beds in Willapa Bay or Grays Harbor. These birds forage on the outer coast for forage fish, and are not well documented inside the bays. Therefore, imidacloprid would be unlikely to adversely affect marbled murrelet (CSI 2013).	No specific mitigation measures would be required for marbled murrelet.
WESTERN SNOWY PLOVER . Imidacloprid applications under Alternative 4 would be unlikely to adversely affect western snowy plover because they are rare or absent on commercial shellfish beds within Willapa Bay or Grays Harbor. . The imidacloprid Risk Assessment (CSI 2013) found imidacloprid toxicity exposure for snowy plover to be "minimal acute," and "low likelihood of indirect effects."	No specific mitigation measures would be required for western snowy plover.
STREAKED HORN LARK Imidacloprid applications under Alternative 4 would be unlikely to adversely affect streaked horn lark or their nest sites because they do not occur on commercial shellfish beds within Willapa Bay or Grays Harbor.	No specific mitigation measures would be required for streaked horn lark.

Localized Short-Term Impacts. There would be no localized, short-term impacts to threatened, endangered, and protected species due to the application of imidacloprid under Alternative 4.

Significant Unavoidable Adverse Impacts: Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with pesticide registrations and regulations (including Washington State Department of Agriculture General Pesticide Rules), no significant unavoidable adverse impacts to threatened, endangered or protected species would be expected with Alternative 4. With the exception of some salmonid life stages and green sturgeon, it is unlikely that these species would be present on treatment sites at the time of imidacloprid applications. There is a low probability of adverse effect to birds or other vertebrates. Permit conditions and mitigation measures protective of surface water quality would also be protective of salmonids. The NPDES Individual Permit, if issued, would include conditions that limit the maximum annual tideland acreage for pesticide applications; specify treatment methods; require buffers from sloughs, channels, and shellfish to be harvested; and require discharge monitoring to evaluate the effects of pesticide applications. The requested Ecology NPDES Permit, if issued, would require discharge monitoring to be conducted to evaluate the effects of imidacloprid applications. Adjustments to permit conditions could be made throughout the 5-year term of the permit.

Human Health

Alternative 1: No Action

. No human population would be exposed to insecticides in estuarine sediments or water under the No Action Alternative.
. Applicators and shellfish harvesters would have no potential exposures to imidacloprid under the No Action Alternative.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be treated, and application methods that could include aerial spraying from helicopters under Alternative 3.	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as distinguished for aerial applications of imidacloprid using helicopters: FIFRA REGISTRATION REQUIREMENTS: . Application equipment specified for the liquid form of imidacloprid (Protector 2F) includes: helicopters equipped with a boom three-quarters as long as the rotor diameter, backpack sprayers, and ground-based vehicles with a boom. . Helicopter pilots must use an enclosed cockpit in a manner that is consistent with the WPS for Agricultural Pesticides. 2014 WGHOGA PROPOSAL FOR THE USE OF IMIDACLOPRID: . A WGHOGA representative would be present at the time of application at each treatment site scheduled for aerial (i.e., helicopter) applications to provide line-of-sight supervision.
Localized, Short-Term Impacts. Localized and short-term impacts to human health due to the application of imidacloprid would be similar under Alternative 3 or 4, and these would only apply to the small number of people who handle and apply the chemicals. Required safety measures for applicators, including personal protective equipment (e.g., gloves, long sleeved shirts), are expected to prevent adverse effects during application.	
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, no significant unavoidable adverse impacts to human health would be expected with Alternative 3 (if a new NPDES permit were to be issued for Alternative 3), based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations (including Washington State Department of Agriculture General Pesticide Rules). Applicators and handlers would be required to use appropriate application equipment and wear specified Personal Protective Equipment. Public notification requirements would inform landowners, adjacent landowners, lessees, interested individuals, recreational users and others of proposed application dates and locations so that potential direct exposure could be avoided. As a dietary precaution, avoidance and waiting periods are specified between dates of pesticide application and shellfish harvest for consumption.	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
. Use of imidacloprid would potentially affect only a very small number of people, primarily pesticide handlers and applicators. . Imidacloprid is a systemic insecticide of the chemical class of chloronicotinyls-neonicotinoids; specifically, it is a chloronicotinyl nitroguanidine. The compound acts on the nicotinergic acetylcholine receptors (nAChR) in the nervous system of insects, blocking the transmission of nervous signals in the post-synaptic region, resulting in paralysis and death. Vertebrates, including humans,	FIFRA REGISTRATION REQUIREMENTS: . To mitigate potential exposure for persons applying imidacloprid, applicators, mixers, loaders, and handlers are advised to wear approved Personal Protective Equipment (PPE), and would be trained in pesticide applications. The following PPE would be required of all imidacloprid applicators and handlers: . Long-sleeved shirt and long pants;

Potential Impacts	*Mitigation Measures*
are much less sensitive to imidacloprid than certain aquatic invertebrates because of differences in the nAChR receptors in vertebrates. . Imidacloprid is not considered acutely toxic to humans via dermal or inhalation exposure routes even though it is designated an acute oral toxicant. The 2015 FEIS discusses in detail potential impacts to humans (Chapter 3, Section 3.2.6, pages 3-58 through 3-60). . Health Canada (2016) reviewed case reports of attempted suicides through ingestion of imidacloprid. Based on this work they identified that imidacloprid toxicity *"symptoms in humans consist of nausea, vomiting, headache, dizziness, abdominal pain, and diarrhea."* Of 56 attempted suicides, *"recovery was seen in all 56 patients reported."*	. Chemical-resistant gloves made of any waterproof material such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene, polyvinylchloride (PVC) or Viton; . Shoes and socks; . Protective eyewear; and . Dust masks when using Protector 0.5 G, the granular formulation of imidacloprid. . Manufacturer's instructions must be followed for cleaning and maintaining PPE. . As a dietary precaution, the conditional FIFRA Registration for imidacloprid specifies that no commercial shellfish bed may be treated with this pesticide if the crop is within 30 days of harvest. WASHINGTON STATE DEPARTMENT OF AGRICULTURE GENERAL PESTICIDE RULES (WAC 16-228-1231[1]): . Applications would be made by a State-licensed applicator with an aquatic endorsement.
. The maximum annual treatment acreage proposed under Alternative 4 is 500 acres (up to 485 *per year* acres within Willapa Bay, and up to 15 acres *per year* within Grays Harbor); therefore, imidacloprid applications would occur on approximately 1.1% per year of total tideland acres within Willapa Bay and approximately 0.04% per year of total tideland acres within Grays Harbor.	FIFRA REGISTRATION REQUIREMENTS: WGHOGA would be responsible for implementing the following public notification requirements: . Notify the public prior to imidacloprid applications through signs, website postings, and e-mail to interested parties. . Post public access areas within 0.25 mile and all public boat launches within a 0.25-mile radius of any bed scheduled for treatment with imidacloprid. Signs shall say *"Imidacloprid will be applied for burrowing shrimp control on [date] on commercial shellfish beds. Do not Fish, Crab or Clam within one-quarter mile of the treated area."* Include the location of the treatment area on the sign. . Post signs at 500-ft intervals, at least 2 days prior to aerial treatments [using vessels or land-based equipment], and maintain signs in-place for at least 30 days after treatment. . Do not treat a commercial clam or oyster bed if it contains shellfish within 30 days of harvest. . Maintain buffer zones between the imidacloprid treatment area and the nearest shellfish to be harvested within 30 days: a 100-ft buffer for aerial applications, or a 25-ft buffer for applications made by hand. . Do not apply imidacloprid on commercial shellfish beds during Federal holiday weekends. . It would be the responsibility of the applicator to select appropriate application equipment and treat commercial shellfish beds only during appropriate environmental conditions. [Boats would need to use a hopper, hopper loaders, and possibly a large barge to hold additional chemical, equipment and personnel.]

Potential Impacts	*Mitigation Measures*
	2014 WGHOGA Proposal for the Use of Imidacloprid: . Public notification procedures proposed by WGHOGA would be implemented as described above under Air Quality (Alternative 4): Mitigation Measures.
Localized, Short-Term Impacts. Localized and short-term impacts to human health due to the application of imidacloprid under Alternative 4 would only apply to the small number of people who handle and apply the chemicals. Required safety measures for applicators, including personal protective equipment (e.g., gloves, long sleeved shirts) are expected to prevent adverse effects during application.	
Significant Unavoidable Adverse Impacts: Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with pesticide registrations and regulations (including Washington State Department of Agriculture General Pesticide Rules), no significant unavoidable adverse impacts to human health would be expected as a result of implementing Alternative 4. Applicators and handlers would be required to use appropriate application equipment and wear specified Personal Protective Equipment. Public notification requirements would inform landowners, adjacent landowners, lessees, interested individuals, recreational users and others of proposed application dates and locations so that potential direct exposure could be avoided. As a dietary precaution, avoidance and waiting periods are specified between dates of pesticide application and shellfish harvest for consumption.	

Land Use

Alternative 1: No Action

There would be no direct or indirect impact to upland land uses from the use of mechanical methods of burrowing shrimp population control or alternative shellfish culture practices on commercial clam and oyster beds in Willapa Bay and Grays Harbor.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be treated, and application methods that could include aerial spraying from helicopters under Alternative 3.	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as distinguished for aerial applications of imidacloprid using helicopters: FIFRA Registration Requirements: . Helicopters used to apply Protector 2F should be equipped to minimize spray drift. The best drift management strategy and most effective way to reduce drift potential is to apply large droplets that provide sufficient coverage and control. Droplet size can be controlled by using high flow-rate nozzles, selecting the number and type of nozzles, nozzle orientation, and controlling pressure appropriate for the nozzle type. . When applications of Protector 0.5G (the granular formulation) are made crosswind, the applicator must compensate for displacement by adjusting the path of the application equipment upwind. Swath adjustment distance should increase with increasing drift potential.

Potential Impacts	*Mitigation Measures*
	2014 WGHOGA PROPOSAL FOR THE USE OF IMIDACLOPRID: . Avoid aerial (i.e., helicopter) applications of Protector 0.5G or 2F within 200 feet of the Ordinary High Water Line (OHWL) adjacent to shoreline areas.
Localized, Short-Term Impacts. There would be no localized, short-term impacts to land or shoreline use due to the application of imidacloprid under Alternative 3.	
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, no significant unavoidable adverse impacts to land or shoreline use would be expected with Alternative 3, based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations.	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
There would be no direct or indirect impact to upland land uses from implementation of Alternative 4.	FIFRA REGISTRATION REQUIREMENTS: . Public notification requirements at public and private shoreline access sites would be the same as those described above for Human Health (Alternative 4): Mitigation Measures.
Due to the distance between existing cranberry farms and the nearest commercial clam and oyster beds adjacent to Willapa Bay and Grays Harbor, and the proposal under Alternative 4 to apply spray applications only at ground level (i.e., no use of helicopters) it is expected that spray drift management requirements for imidacloprid applications would avoid risk of exposure to pollinators present at these farms during the approximate period of April 15 through December 15 each year.	FIFRA REGISTRATION REQUIREMENTS: . FIFRA Registration spray drift management techniques (described above under Alternative 4, Animals [Pollinators]: Mitigation Measures) would become conditions of the NPDES permit (if issued) for the use of imidacloprid.
Localized, Short-Term Impacts. There would be no localized, short-term impacts to land or shoreline use due to the application of imidacloprid under Alternative 4.	
Significant Unavoidable Adverse Impacts: Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations and regulations, no significant unavoidable adverse impacts to land or shoreline use would be expected as a result of implementing Alternative 4.	

Recreation

Alternative 1: No Action Alternative

. Under the No Action Alternative, persons engaged in recreation in Willapa Bay and Grays Harbor would have no risk of exposure to chemical applications for the purpose of burrowing shrimp population control.
. Ongoing attempts at mechanical control of burrowing shrimp populations, and alternative shellfish culture practices would likely constitute no detectable change from existing conditions to persons using Willapa Bay and Grays Harbor for recreational purposes due to the small size of these areas in relation to the total tideland area of Willapa Bay and Grays Harbor.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	***Mitigation Measures***
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be sprayed, and application methods that could include aerial spraying from helicopters under Alternative 3.	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4, except as distinguished for aerial applications of imidacloprid using helicopters: 2014 WGHOGA PROPOSAL FOR THE USE OF IMIDACLOPRID: . Avoid aerial (i.e., helicopter) applications of Protector 0.5G or 2F within 200 feet of the Ordinary High Water Line (OHWL) adjacent to shoreline areas.
Localized, Short-Term Impacts. There would be no localized, short-term impacts to recreation due to the application of imidacloprid under Alternative 3.	
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, no significant unavoidable adverse impacts to recreation would be expected with Alternative 3 (if a new NPDES permit were to be issued for Alternative 3), based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations.	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	***Mitigation Measures***
. The maximum annual treatment acreage proposed under Alternative 4 is 500 acres (up to 485 acres *per year* within Willapa Bay, and up to 15 acres *per year* within Grays Harbor); therefore, imidacloprid applications would occur on approximately 1.1% per year of total tideland acres within Willapa Bay and approximately 0.04% per year of total tideland acres within Grays Harbor. These small areas of application each year would minimize the potential for exposure of persons using exposed tide flats for recreation in Willapa Bay or Grays Harbor. . As described above in the Human Health section, based on the relatively low acute toxicity and short half-life of imidacloprid in sediment and surface water, there is a very low likelihood of possible human health impacts from imidacloprid exposure to the general population engaging in recreational activities (e.g., shellfish gathering, fishing, swimming). Further, imidacloprid is classified as a "Group E" carcinogen indicating *"no evidence of carcinogenicity in humans"* (EPA 1999a, 1999b, 2003). . As discussed in the Animals section above, impacts to birds, fish, and mammals (vertebrates) from imidacloprid applications are not expected, and therefore no impacts to recreation involving these animal groups are expected.	FIFRA REGISTRATION REQUIREMENTS: . Public notification requirements at public and private shoreline access sites would be the same as those described above under Alternative 4, Human Health: Mitigation Measures. . Imidacloprid would not be applied to commercial clam or oyster beds during Federal holiday weekends. 2014 WGHOGA PROPOSAL FOR THE USE OF IMIDACLOPRID: . Public notification procedures proposed by WGHOGA would be implemented as described above under Air Quality (Alternative 4): Mitigation Measures.

Potential Impacts	*Mitigation Measures*
.	
. Most commercial shellfish beds are distant from public access areas. The potential for exposure of recreationists to imidacloprid in Willapa Bay and Grays Harbor would be limited by proximity and by the maximum annual treatment area.	Same as above.
Localized, Short-Term Impacts. There would be no localized, short-term impacts to recreation due to the application of imidacloprid under Alternative 4.	
Significant Unavoidable Adverse Impacts: Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, regulations, and public notification requirements, no significant unavoidable adverse impacts to recreation would be expected as a result of implementing Alternative 4.	

Navigation

Alternative 1: No Action

There would be no significant impacts to navigation as a result of mechanical methods of burrowing shrimp population control or alternative shellfish culture practices on commercial clam and oyster beds in Willapa Bay and Grays Harbor.

Alternative 3: Imidacloprid with IPM on up to 2,000 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
. Imidacloprid would be applied on up to 1,500 acres *per year* of commercial shellfish beds in Willapa Bay and up to 500 acres *per year* of commercial shellfish beds in Grays Harbor between April 15 and December 15 each year. These areas would constitute approximately 3.3% per year of total tideland acres within Willapa Bay and approximately 1.5% per year of total tideland acres within Grays Harbor. . The impacts of Alternative 3 were previously described in the 2015 FEIS, and would be similar to those described below for Alternative 4. The distinguishing factors between Alternatives 3 and 4 are the number of tideland acres that could be treated, and application methods that could include aerial spraying from helicopters under Alternative 3.	Mitigation measures for Alternative 3 were previously described in the 2015 FEIS and would be the same as those described below for Alternative 4.
Localized, Short-Term Impacts. There would be no localized, short-term impacts to navigation due to the application of imidacloprid under Alternative 3.	
Significant Unavoidable Adverse Impacts: Similar to Alternative 4, no significant unavoidable adverse impacts to navigation would be expected with Alternative 3 (if a new NPDES permit were to be issued for Alternative 3).	

Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year of commercial shellfish beds in Willapa Bay and Grays Harbor, with no aerial applications by helicopter.

Potential Impacts	*Mitigation Measures*
There would be no significant impacts to navigation as a result of imidacloprid treatments for burrowing shrimp population control. Commercial shellfish beds are staked for various purposes at various times of the year. For this reason, stakes placed to identify beds for	Public notification requirements at marinas and boat launch sites would be the same as those described above under Alternative 4, Human Health: Mitigation Measures.

Potential Impacts	Mitigation Measures
applications of imidacloprid under Alternative 4 would not constitute a new or different obstruction to watercraft that navigate the shallow areas of Willapa Bay or Grays Harbor where these shellfish beds are located. No stakes or obstructions would be placed in the main navigation channels of either bay.	
Localized, Short-Term Impacts. There would be no localized, short-term impacts to navigation due to the application of imidacloprid under Alternative 4.	
Significant Unavoidable Adverse Impacts: No significant unavoidable adverse impacts to navigation would be expected as a result of implementing Alternative 4.	

1.7 Areas of Controversy and Uncertainty, and Issues to be Resolved

Chapter 1, Section 1.7 of the 2015 FEIS (pages 1-34 through 1-37) described areas of controversy and uncertainty about the use of imidacloprid for burrowing shrimp population control in the marine aquatic environment of Willapa Bay and Grays Harbor. This SEIS section updates those issues, and describes new information identified by Ecology during preparation of the SEIS.

Areas of Controversy. Imidacloprid is a neonicotinoid pesticide. There is controversy over the use of neonicotinoid pesticides in the environment. Much of this controversy is likely due to the widespread distribution (e.g., newspaper and magazine articles) of the results of studies examining the impacts of this class of pesticides on honey bees, other pollinators, and freshwater aquatic insects. Consequently, a number of countries, states, and local municipalities have banned or significantly restricted the use of neonicotinoid pesticides. A segment of the public is also opposed to the use of chemical pesticides, particularly on food crops, including oysters. Conservation groups are often concerned with the use of pesticides which may have impacts to mammals, birds and fish, or the ecosystems on which these animals depend. Conversely, many oyster growers, public and business members of the communities in which they operate feel strongly that chemical control of burrowing shrimp is essential to the long-term operational and economic survival of the industry. Some growers report feeling they are being unfairly targeted, or that the public does not recognize that they have used chemical control of burrowing shrimp since at least the 1960s without, from their perspective, adverse human or environmental effects. For these and other reasons, consideration by Ecology of a potential permit to apply imidacloprid to commercial shellfish grounds in Willapa Bay and Grays Harbor will be controversial, as the Department learned when it reviewed and approved a 2015 permit (since terminated at the request of WGHOGA).

Another area of controversy involves whether enough scientific information is available to adequately address the potential effects of a proposed permit to apply imidacloprid to commercial shellfish grounds. Neonicotinoid pesticides, and imidacloprid specifically, have been the focus of hundreds of scientific studies, and more recently (e.g., EPA 2017) risk assessments based on reviews of those studies. The majority of data regarding the effects of imidacloprid have been obtained from dose-response studies performed within laboratory settings to determine toxicity over periods ranging from 24 hours to 28 days, or longer. Other published studies have focused on freshwater ecosystems, particularly potential impacts to sensitive freshwater insects. Elements of these studies may not be directly transferrable to aquatic invertebrate organisms in an estuarine environment due to how organisms are exposed to imidacloprid. In freshwater studies, imidacloprid enters the aquatic environment from runoff or less commonly, overspray. The proposed action would directly apply imidacloprid to sediments and benthic invertebrates. Tidal exchange and dilution would occur within a few hours of application, although some imidacloprid is likely to persist in sediments. A number of field studies of imidacloprid and its effects in these specific estuarine environments have been conducted, and they inform much of the analysis of effects in this SEIS. The information that has been gathered is limited and important data gaps remain regarding significant direct and indirect impacts from imidacloprid applications within an estuarine environment both on and off the treatment plot.

Previously, some commenters raised concerns about how eradication of burrowing shrimp could affect the ecosystems where these animals are present. However, the WGHOGA application for the permit is not a proposal to eradicate burrowing shrimp in Willapa Bay and Grays Harbor. The proposal is for the control of burrowing shrimp populations on a limited acreage of commercial shellfish beds. However, as imidacloprid will drift off plot, the area impacted by applications would be greater than the treated plot. Not all of the tideland acres owned, leased, or currently farmed for commercial clams and oysters would be treated with imidacloprid over the term of the permit. Ghost shrimp populations in the majority of tidelands in Willapa Bay and Grays Harbor would not be treated with imidacloprid, and are expected to continue functioning normally as components of the ecosystems within these estuaries. Remaining mud shrimp populations are currently declining due to a parasitic isopod and cumulative impacts from imidacloprid applications are likely to increase this decline. This is an area of considerable uncertainty.

Areas of Uncertainty and Issues to be Resolved.
The Toxicology Review that accompanies the WSDA registration of the granular and liquid forms of imidacloprid (Protector 0.5G and Protector 2F, respectively) identified the following areas of uncertainty based on WSDA's assessment of the preliminary nature of the environmental fate and effects data presented in the studies submitted with the application (Tuttle 2014). This review is attached in Appendix C.

The results of multi-year studies (> 2 years) are not yet available to affirm whether imidacloprid accumulates in sediments, and if so, the "worst-case" scenario of such accumulation.

- Long-term data on sediment and sediment pore-water concentrations of imidacloprid after treatment are still absent.
- Previous field trials with imidacloprid in Willapa Bay indicate that imidacloprid concentrations decrease following treatment, with concentrations in sediments falling below laboratory detection limits in most samples within 28 days. However, these data also demonstrate that imidacloprid remained at detectable levels in some samples on the last sampling date of the trials (28 days or 56 days), particularly in sediments with higher organic carbon levels (e.g., the 2011 Cedar River trials).
- It is possible that imidacloprid residues may remain in some treatment areas at the time that imidacloprid is again applied to the site. Such a circumstance would constitute a cumulative effect, over time, such that imidacloprid concentrations could occur at higher levels than those expected where no residual imidacloprid remains.
- To test for this possibility, Ecology would (if the permit is issued) require that WGHOGA, as part of its mandatory Monitoring Plan, conduct long-term persistence monitoring of imidacloprid in sediments. This sampling would continue through time to determine when no imidacloprid is detectable in sediment pore water or whole sediments,and to confirm whether a cumulative buildup of imidacloprid would occur over time.

The effects of bioaccumulation (chemical concentration within an organism) and biomagnification (chemical magnification through the food web) in the food web is assumed to be negligible. Imidacloprid's log octanol/water coefficient (log Kow) is 0.57, which below the threshold of five, indicates or assumes it is not likely to bioaccumulate. Because of this fact, EPA waived the need for bioconcentration studies (SERA 2005). There are no studies to date that have confirmed this assumption in marine or estuarine species. Ding et al. 2004 identified no bioaccumulation in the freshwater fish, Danio rerio. Ashauer et al. (2010) noted that the elimination time in studies with the freshwater amphipod, Gammarus pulex was particularly long (11d) for imidacloprid. This finding lead the authors to suggest their bioaccumulation model could lead to an underestimation of bioaccumulation potential when using a classical risk assessment method that does not consider toxicokinetics.

Although the EPA risk assessment (2017) does state, "imidacloprid is unlikely to bioaccumulate in living tissue," this should not be mistaken for cumulative or additive toxicity which may occur. Both Rondeau et al. (2014) and Tennekes and Sanchez-Bayo (2013) describe the molecular relationship of imidacloprid to insect nervous systems. The authors state that neonicotinoid insecticides (e.g. imidacloprid) "bind virtually irreversibly" to receptors in the insect's nervous system. Toxic effects can be "reinforced with chronic exposure". Review of the WGHOGA's 2012 imidacloprid experimental trials reported that, "the Cedar River site had 2-5 ppb of imidacloprid bound to sediment at 56 days after treatment, which was the last date monitored." In 2014, monitoring for imidacloprid persistence was performed at 14 and 28 days post spray for whole sediment and pore water. There is no definitive relationship established between sediment and pore water concentrations and surface water chronic endpoints. However, imidacloprid persistence in sediments, at concentrations less than acute concentrations but greater than chronic endpoints established by EPA in surface water, have the potential to cause adverse or sublethal impacts to benthic invertebrates.

Ecology has determined that there are areas of high total organic carbon (TOC) in southern Willapa Bay and the Cedar River area. Distribution of high TOC sediments is variable at bay-wide and plot scales. Therefore, it is uncertain which areas or shellfish beds within central Willapa Bay and Grays Harbor also contain areas of high TOC. Areas of high TOC have been shown to have persistence in sediments and have had significant impacts to invertebrates in those areas.

Although direct impacts to marine vertebrates, i.e. fish and marine mammals, from acute exposure to imidacloprid may be low, indirect impacts to marine vertebrates should be examined. Indirect impacts include impacts to prey resources which may be more susceptible to imidacloprid than vertebrates. The EPA 2017 clearly states, "**the potential exists for risks to fish indirectly** through reductions in aquatic invertebrates that comprise their prey base" (EPA bolded). Chronic impacts to invertebrates might migrate through the food chain to important ecological guilds of ecological and economic value such as forage fish, salmonids, and sturgeon. The chronic endpoint proposed by the EPA 2017 aims to address these impacts by protecting against sub-lethal impacts, e.g. reductions in reproduction, growth, and changes to predator avoidance and feeding.

Due to the preliminary nature of research data available at the time of this writing, there is uncertainty regarding whether imidacloprid may have long-term sediment toxicity effects on benthic and free-swimming invertebrate communities, the species that utilize them as food sources, and the ability of the Willapa Bay and Grays Harbor estuary ecosystems to maintain homeostasis, as a whole.

- The duration of persistence of imidacloprid toxicity in areas of high TOC, such as the 2011 Cedar River site, is unknown as monitoring occurred only for 28 days. At 28 days there was no recovery of benthic abundance. There is uncertainty as to whether or when recovery occurred.

- This SEIS includes a review of additional field studies of the effects of imidacloprid on invertebrate communities conducted in 2014. These studies confirmed previous work that showed that invertebrate communities on treatment and control plots were generally similar within 14 to 28 days after treatment, although the conclusion is not statically significant. They also demonstrated that imidacloprid is carried for long distances off-plot, by rising tidewaters and are likely to pose some impact, particularly to sensitive species, or in those areas closest to the treatment plots that are most likely to experience high concentrations of imidacloprid. Modeling of data from field studies demonstrates that the transport of imidacloprid at acute concentrations is greater than previously predicted.

- This SEIS also includes results from new scientific studies, including studies of possible impacts to Dungeness crab. This work documents that Dungeness crab would be killed or immobilized on-plot, and there is uncertainty as to how far off plot impact may occur. Modeling of off plot concentrations and spatial extent raises uncertainty regarding the impact to Dungeness crab from acute and chronic exposure. Additionally, toxicity and mortality to crab megalopae have not been adequately quantified.
- As with potential sediment impacts, Ecology would (if the permit is issued) require that WGHOGA conduct additional and expanded monitoring of off plot impacts to Dungeness crab and continue monitoring the effects of imidacloprid applications on invertebrates.

Uncertainty has been expressed as to whether the results of experimental trials using imidacloprid on treatment plots up to ten acres in size can be assumed to correlate directly when acreage of the treatment area is increases under the NPDES permit for commercial purposes.

- The 2016 WGHOGA application requests authorization to treat up to 485 acres *per year* in Willapa Bay, and up to 15 acres *per year* in Grays Harbor. Given the reduced acreage, and the elimination of aerial spraying from helicopters from the 2016 WGHOGA application, treated plots are now expected to be 10 acres or less in size, consistent with most of the prior field studies. Dependent on the number of repeated applications, and overall ground where imidacloprid is applied, expanded monitoring would likely be required to evaluate transport off plot.

Efficacy has fluctuated greatly, partly due to the many associated variables such as timing, sediment type, vegetative cover, formulation of imidacloprid, temperature, tidal inundation, and method of application. Efficacy information provided by WGHOGA show highly variable and inconsistent results about the effectiveness of imidacloprid to control burrowing shrimp populations in Willapa Bay. Studies finalized in 2016 by WGHOGA on commercial scale application show anywhere from a reduction of over 90% of shrimp burrows to an increase of over 400% in the number of shrimp burrows (efficacy). And within three months, burrowing shrimp populations may have returned to or exceeded pre-spray levels.

Earlier studies conducted by WGHOGA on smaller scale plots indicated a range of shrimp burrow reduction from 27% to 97 %. Dr. Kim Patten summarized many years of field trials and lab studies ranging between 0% to >95% efficacy. Dr. Patten reports that the more likely range is between 40% and 80% efficacy under better conditions (SIZ Application submitted by WGHOGA, February 13, 2017, and March 21, 2017 revised).

A consequence of highly varied results is that spray plots may need to be treated the following year(s) which may lead to persistence in the sediments and potential build up. A well-defined method for determining the treatment threshold to ensure efficacy of the product on the target species of burrowing shrimp (*Neotrypaea californiensis* and *Upogebia pugettensis*) has not yet been formulated from the preliminary research data on imidacloprid. It is not yet known whether the target species of burrowing shrimp may become resistant to the effects of imidacloprid over time.

Several commenters have provided peer reviewed journal articles documenting the development of imidacloprid resistance in target species from terrestrial applications. Also identified by commenters was a lack of understanding the long-term spatial and temporal scale of impact to the estuarine ecosystem in Willapa Bay and Grays Harbor. They commented that the draft SEIS did not provide adequate analysis of cumulative or ecosystem perturbation and the significance of negative responses. Pesticide use can result in target pest resistance, especially when treatment efficacy is low or variable. Typically, pest resistance results in increased frequency in pesticide usage and thus increase in adverse environmental impacts.

Other areas of uncertainty were identified during the original EIS scoping process, in subsequent meetings and communications with Ecology, and during preparation of the FEIS. These are listed below.

Research on the effects of burrowing shrimp on commercial shellfish beds has been done where oysters are the primary crop. Field research data are lacking regarding how burrowing shrimp affect clams, and the threshold for damage to clam beds.

- WGHOGA growers have provided information that indicates, based on their field observations, there is no biological basis for making a distinction between the effects of burrowing shrimp on tidelands primarily used for the production of commercial clams versus areas primarily used for the production of commercial oysters. The adverse effect is on the substrate, not the crop (see FEIS Chapter 2, Section 2.8.3, page 2-34).

The proposed permit would allow imidacloprid treatments from April to December. Some studies have documented seasonal or temperature related effects on imidacloprid toxicity, specifically that the pesticide has greater efficacy at higher temperatures. There is uncertainty whether imidacloprid treatments during periods of low water temperature will have successfully reduced burrowing shrimp populations.

The effects of imidacloprid on zooplankton species are largely unstudied.

- Under the proposed action, imidacloprid would be applied on selected commercial shellfish beds under low tide conditions when large numbers of zooplankton would not be present (see FEIS Chapter 3, Section 3.2.5). However, those communities on the leading edge of the incoming tide could be exposed to imidacloprid during the first flood tide. Applications that would be done in standing water would likely impact zooplankton when toxicity levels exceed the EPA marine acute toxicity threshold.
- The SEIS reviews two recent scientific studies that examined the effects of imidacloprid on crab megalopae (the last planktonic stage before settlement to the sediments). Both documented that imidacloprid can cause death or tetany at concentrations that are likely to exist on-plot immediately following treatment, and that may occur off-plot,

particularly in those areas closest to the treatment plots that are most likely to experience high concentrations of imidacloprid. By extrapolation, impacts to other planktonic species appears likely. Given the abundance of zooplankton, there is uncertainty regarding effects bay wide; however they will extend off plot within areas that exceed the EPA marine acute and chronic criteria.

Limited information in marine environments is available regarding the possible sub-lethal effects of imidacloprid on non-target aquatic organisms. Ultimately, burrowing shrimp are controlled through sub-lethal effects.

- The SEIS reviews a number of studies that recorded sub-lethal effects, including tetany, reduced feeding, impaired movement, and behavioral changes. Laboratory studies document that these sub-lethal effects are reversed once imidacloprid has been removed. However, in the field we expect mortality based on predation and environmental stressors.
- A wide variety of sub-lethal impacts, such as immune suppression, growth, reproduction, molting success, etc., are likely to occur due to exposure to imidacloprid, but they are very difficult to document or measure outside of laboratory conditions. This may remain an area of uncertainty into the future without the development of specific monitoring requirements.

Limited information is available regarding imidacloprid impacts to marine vegetation.

- The results of field studies conducted during one season to evaluate uptake in eelgrass tissues showed limited uptake by eelgrass, and imidacloprid was undetectable after 14 days.
- Imidacloprid is an acetylcholinase inhibitor and plants do not have a biochemical pathway involving acetylcholinase. Therefore, it is unlikely that imidacloprid would adversely affect eelgrass or other marine vegetation (see FEIS Chapter 3, Section 3.2.4).

Limited field verification data are available at the time of this writing regarding the toxicity and persistence of imidacloprid degradation products.

- Some laboratory studies have been conducted using marine waters. The results of these studies showed that the imidacloprid degradation products have toxicity levels that are equal to or less than the toxicity of the parent compound (SERA 2005) (see FEIS Chapter 3, Section 3.2.3). The persistence of a variety of the degradation products in surface water and sediments is currently unknown.

A limited number of field studies have been conducted in the estuarine environment to confirm the off-plot movement of imidacloprid following applications of the flowable and granular forms on commercial shellfish beds.

- The SEIS evaluates field data from both 2012 and 2014 trials in Willapa Bay in which off-plot movement of imidacloprid was evaluated. These data showed a strong pattern of

> high on-plot and low off-plot concentrations during the first rising tide. Imidacloprid was detected at considerable distances off-plot, but at highly variable concentrations (e.g., 0.55 ppb to 1300 ppb). These varying results suggest that site-specific differences in how tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot. Consequently it is very difficult to determine off plot areal extent, and pesticide concentration, without extensive monitoring. Currently we do not have extensive off plot monitoring data, although modeling of existing off-plot data supports significant spread off-plot of imidacloprid at acute concentration levels.

It is not possible to quantify the total acreage of commercial shellfish beds to be treated with imidacloprid over the five-year term of the NPDES permit.

- The maximum possible acreage to be treated is known. If the growers apply imidacloprid to every acre allowed under the permit, and every such acre is sprayed only once, then the maximum acreage to be treated under the potential permit would be 2,425 acres in Willapa Bay (485 acres *per year* times five years), and 75 acres in Grays Harbor (15 acres *per year* times five years).
- It is uncertain what locations would be sprayed over a five year period, and whether repeated spray events would occur and/or how often. This would be determined annually with an Ecology approved annual operations plan if a permit is issued.
- In practice, WGHOGA growers may end up not spraying the maximum acreage each year, and/or some acres may be sprayed more than one time in the five-year period. Because this decision is up to WGHOGA growers, subject to Ecology's approval of their Annual Operations Plan, the exact acreage cannot be known for certain at this time.

2.0 Description of the Proposed Action and Alternatives

2.1 Project Proponent

Willapa Grays Harbor Oyster Growers Association (WGHOGA) has applied to the Washington State Department of Ecology (Ecology) for issuance of a new National Pollutant Discharge Elimination System (NPDES) Individual Permit and two Sediment Impact Zone (SIZ) authorizations in Willapa Bay and Grays Harbor for burrowing shrimp[1] control. The 2016 WGHOGA proposal for the use of imidacloprid with Integrated Pest Management (IPM) practices to control burrowing shrimp on commercial shellfish beds[2] would occur on a limited number of acres in each estuary: up to 485 acres *per year* within Willapa Bay (1.1% of total tideland acres exposed at low tide), and up to 15 acres *per year* within Grays Harbor (0.04% of total tideland area exposed at low tide). Over the 5-year term of a potential permit, the total acreage to be treated within Willapa Bay could be 2,485 acres, and 75 acres in Grays Harbor. Monitoring required by Ecology would establish where applications would be allowed. It would be a condition of the permit, if issued, that authorization for the use of imidacloprid would include using adaptive management principles, to be described in an Integrated Pest Management (IPM) Plan.[3] Applicators who may receive coverage under the Imidacloprid NPDES Individual Permit and SIZ permits would need to comply with the terms and conditions of those permits.

2.2 Purpose and Objectives of the Proposed Action

The objectives of the 2016 proposed action are the same as those proposed in a prior permit application in 2014:

- Preserve and maintain the viability of clams and oysters commercially grown in Willapa Bay and Grays Harbor by controlling populations of two species of burrowing shrimp on commercial shellfish beds.
- Preserve and restore selected commercial shellfish beds in Willapa Bay and Grays Harbor that are at risk of loss due to sediment destabilization caused by burrowing shrimp.

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1 The two species of burrowing shrimp to be controlled are the ghost shrimp (*Neotrypaea californiensis*) and mud shrimp (*Upogebia pugettensis*). These are the same species for which chemical control with integrated pest management (IPM) under the provisions of an NPDES Individual Permit was sought in 2015.

2 As used throughout this Supplemental Environmental Impact Statement (SEIS) in the context of alternatives to implement the proposed action, the term “commercial shellfish beds” refers to a specified amount of tideland acreage within Willapa Bay and Grays Harbor on which oysters and clams are commercially grown. The requested NPDES permit would not extend to other geographical areas, and would not authorize treatment on other species of commercially-grown shellfish (e.g., geoducks or mussels).

3 An IPM Plan acceptable to Ecology would be a condition of the NPDES permit, if issued.

2.3 Location

The proposed action would be implemented on commercial shellfish beds in Willapa Bay[4] and Grays Harbor,[5] Washington. These large estuaries are located in Pacific County and Grays Harbor County, respectively, on the Pacific Ocean coast in southwest Washington (see Figure 2.3-1).

Figure 2.3-1. Willapa Bay and Grays Harbor Location Map

4 Willapa Bay is located at Latitude 46.37 through 46.75, and Longitude -124.05 through -123.84.
5 Grays Harbor is located at Latitude 47.86 through 47.04, and Longitude -124.16 through -123.84.

In any given year, specific locations for imidacloprid treatment would be determined based on shellfish grower plans for their seed beds, grow-out sites, and fattening grounds; the efficacy of prior treatments; and the density of burrowing shrimp populations. WGHOGA would submit an Annual Operations Plan to Ecology each year for review, modification, and approval. It is anticipated that all applications would be made between the tidal elevations of -2 ft mean lower low water (MLLW) and +4 ft MLLW.

The 2016 WGHOGA proposal requests flexibility in how the 485 acres per year are selected for treatment within Willapa Bay. WGHOGA proposes to commit to maximum levels of treatment within a given year of 125 acres, 485 acres, and 50 acres of the North, Central, and South portions of Willapa Bay, respectively (see Figure 2.3-2). These areas represent the maximum acreage per year that would be treated in each of these areas of Willapa Bay. If 125 acres are treated in the North portion of the bay and 15 acres in the south, only the net difference of 345 acres could be treated in the same year in the Central portion of Willapa Bay.

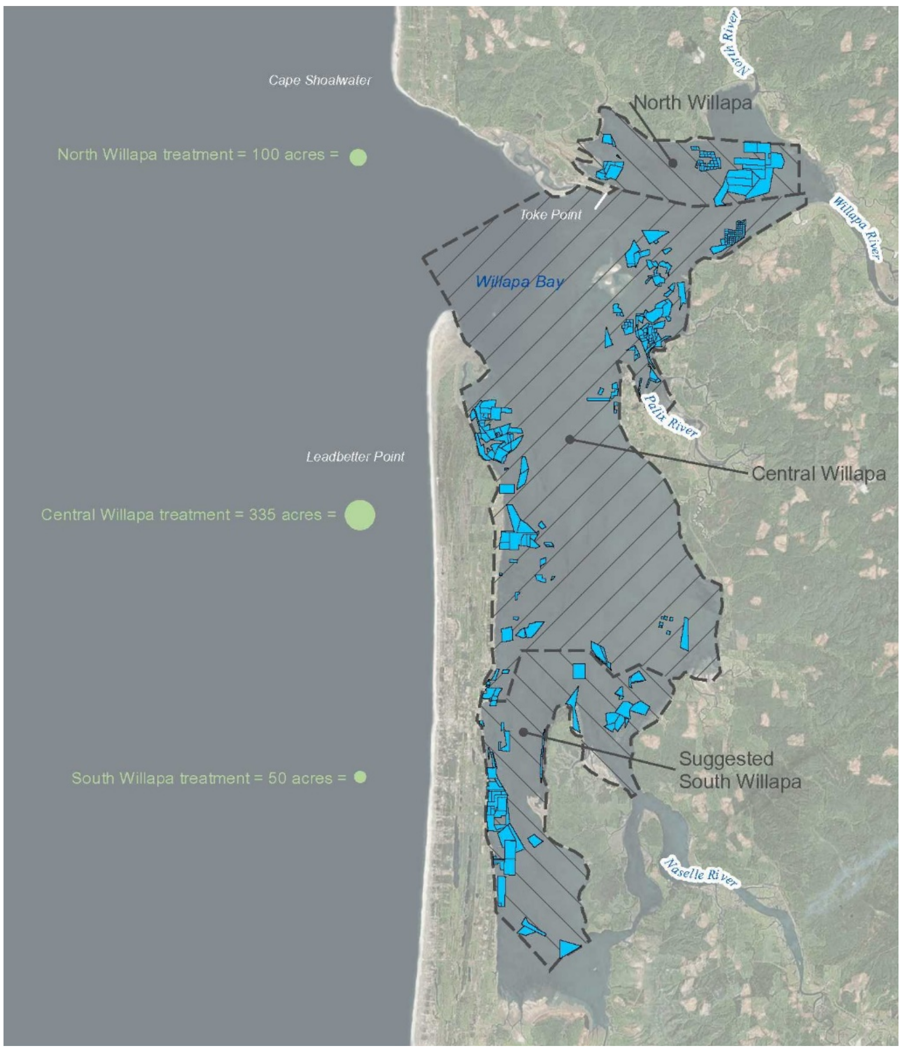

Figure 2.3-2. Willapa Bay Oyster Beds that may be treated with Imidacloprid under the NPDES Permit (if issued).

Within Grays Harbor, the treatment area (not to exceed 15 acres per year) would be within the South Bay area (see Figure 2.3-3).

Figure 2.3-3. Grays Harbor Oyster Beds that May be Treated with Imidacloprid under the NPDES Permit (if issued).

2.4 History and Background

The history and background of commercial clam and oyster aquaculture in Willapa Bay and Grays Harbor was previously described in the 2015 Final Environmental Impact Statement (FEIS) (Chapter 2, Section 2.4, pages 2-3 through 2-8). Also described in 2015 FEIS Chapter 2, Section 2.4 was the history of the impacts of the two burrowing shrimp species that are the subject of this SEIS, and treatment methods tested and used since the 1950s to attempt to control burrowing shrimp populations on commercial shellfish beds. The 2015 FEIS is adopted by reference for inclusion in the Supplemental Environmental Impact Statement (SEIS). The history of burrowing shrimp control in Willapa Bay and Grays Harbor is briefly summarized below.

The factors controlling burrowing shrimp populations are not well known, in part because long-term data on burrowing shrimp numbers in Willapa Bay and Grays Harbor are not available. Several authors (e.g., Stevens 1929, Feldman et al. 2000, Sanford 2012), have hypothesized that human-related impacts may have contributed to changes in Willapa Bay which led to increased burrowing shrimp populations. These potentially include excessive harvest of native Olympia oysters during the 1900s, land use changes in the watersheds (e.g. logging, farming), disturbance associated with current shellfish farming (including chemical and physical efforts to reduce burrowing shrimp), and other human activities. Changes in climate and oceanic conditions may also have altered conditions in ways that are favorable for burrowing shrimp.

The primary burrowing shrimp management practice used by Willapa Bay and Grays Harbor shellfish growers between 1963 and 2013 was chemical treatment with the n-methyl carbamate insecticide carbaryl. As Ecology gained increased understanding of pesticide impacts, it began to regulate carbaryl applications (under the trade name Sevin brand 4F)[6] in the 1990s, via both a Temporary Water Quality Modification Order, and a FIFRA Section 24 (c) Special Local Needs registration issued by the Washington State Department of Agriculture. Ecology issued a National Discharge Elimination System (NPDES) permit for the use of carbaryl in 2002. This permit was terminated in May of 2015. Under the permit provisions, carbaryl was applied annually on up to 600 acres (1.3 percent of total tideland acres) in Willapa Bay, and up to 200 acres (approximately 0.6 percent of total tideland acres) in Grays Harbor[7], predominantly in the form of liquid spray dispersed on exposed mudflats by helicopter over 5 to 10 days on extreme low tides during July and August of each year. Once a bed was treated with carbaryl, it typically did not need to be treated again for another 3 to 7 years, depending on the level of shrimp larvae recruitment and lateral movement of adults from neighboring tide flats to the treated bed area (2015 FEIS Chapter 2, Section 2.8.2, page 2-28).

WGHOGA and the Washington State University Long Beach Research and Extension Unit began testing imidacloprid in 1996 as an alternative to carbaryl for the control of burrowing shrimp on areas primarily grown for commercial oysters in Willapa Bay.[8] With the carbaryl registration due to expire, WGHOGA applied to Ecology in 2014 for a NPDES Individual Permit to authorize use of imidacloprid combined with Integrated Pest Management (IPM) practices to suppress burrowing shrimp populations on up to 1,500 acres per year of commercial shellfish beds in Willapa Bay and up to 500 acres per year of commercial shellfish beds in Grays Harbor (up to 2,000 acres per year, total). Clarification was requested in the 2014 application to allow imidacloprid applications on tidelands primarily grown with commercial clams as well as

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[6] The FIFRA Section 24(c) Special Local Need registration (SLN Reg. No. WA-120013) for the trade name Sevin brand 4F expired on December 31, 2013 (NovaSource 2012). Regulatory action would be required to continue the use of this insecticide (clarified in the description of FEIS Alternative 2).

[7] Shellfish growers reduced the carbaryl treatment area by 10 percent (down to 720 acres) in 2003, by another 10 percent (20 percent total) in 2004, and by an additional 10 percent (30 percent total) to 560 acres in 2005. The annual treatment area remained approximately 560 acres through 2013. These actions were taken to comply with a Settlement Agreement entered into by WGHOGA, the Washington Toxics Coalition, and the Ad Hoc Coalition for Willapa Bay. Ecology was not a party to this Agreement.

[8] See the description of Imidacloprid Efficacy Trials in FEIS Chapter 2, Section 2.8.3.4.

tidelands primarily grown with commercial oysters.[9] Ecology invited and received public and agency comments on both the Draft EIS and the 2015 draft permit between October 24 and December 8, 2014. Ecology responded to the comments in the Final EIS, and issued a 5-year NPDES Individual Permit (WA0039781) on April 16, 2015, with an effective date of May 16, 2015. On May 3, 2015, WGHOGA asked Ecology to withdraw the permit in response to strong public concerns. Ecology agreed and cancelled the permit on May 4, 2015, effectively terminating commercial use of imidacloprid on shellfish beds in Willapa Bay and Grays Harbor. The 2015 permit was cancelled prior to the close of the appeal period and before the permit was active.

The 2015 permit authorized the establishment of two Sediment Impact Zones (SIZs), one in Willapa Bay and one in Grays Harbor, as mapped in Appendix C of that permit. The SIZ in the Cedar River Area (northern Willapa Bay) and Grays Harbor were identified as "conditional," authorized under special conditions, and subject to modification or rescission of the permit and SIZ in these two areas, dependent on the results of field studies that were to have been completed in the calendar years 2015 and 2017. South Willapa Bay was excluded from the SIZ established by the 2015 permit, due to field study data that indicated imidacloprid binds more readily and appears to be more persistent in sediments that have a higher level of total organic carbon (TOC) than in sediments with lower concentrations of TOC. Field study results that caused Ecology to exclude South Willapa Bay are described in Section 2.8.3.5 of the 2015 FEIS (pages 2-40 through 2-47). This exclusion did not modify the 2014 WGHOGA proposal for Alternative 3 evaluated in the FEIS, which requested authorization for imidacloprid treatments on up to 1,500 acres throughout Willapa Bay (north, central and south). For this reason, the SEIS analysis of Alternative 4 (Imidacloprid Applications with IPM on up to 485 acres within Willapa Bay) and comparison to Alternative 3 does not distinguish South Willapa Bay as a new treatment area under Alternative 4, as this area was subject to prior environmental review in the 2015 FEIS.

On January 8, 2016, a group of about a dozen growers from WGHOGA applied to Ecology for a new pesticide permit for the use of imidacloprid to control burrowing shrimp on commercial clam and oyster beds in Willapa Bay and Grays Harbor. The 2016 proposal requests authorization to treat up to 500 acres per year in the two estuaries (compared to up to 2,000 acres per year in the 2014 application), and commits to making spray and granular applications from boats and/or ground equipment rather than aerial applications from helicopters. Ground application equipment will include all-terrain vehicles equipped with a spray boom, backpack reservoirs with hand-held sprayers, and/or "belly grinders". Similar to the 2014 application, the 2016 WGHOGA proposal requests approval to apply imidacloprid to commercial shellfish lands in north, middle and south Willapa Bay, and to a smaller group of commercial shellfish acreage in the western portion of Grays Harbor. The revised scope of the 2016 application for the use of imidacloprid is being evaluated in this SEIS in the context of additional research that has been performed, and additional literature that has been published on the environmental effects of imidacloprid since the 2015 FEIS was issued.

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[9] The request to authorize use of imidacloprid on tidelands primarily grown with commercial clams as well as tidelands primarily grown with commercial oysters is described in more detail in FEIS Chapter 2, Section 2.8.3 (page 2-34). This request is also an element of the 2016 WGHOGA application.

2.5 Description of Shellfish Aquaculture

Methods of clam and oyster culture are described in detail in FEIS Chapter 2, Section 2.5 (pages 2-8 through 2-16). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

2.6 Economics

FEIS Chapter 2, Section 2.6 (pages 2-16 through 2-18) described the economic, employment, and tax base significance of the clam and oyster aquaculture industry in Pacific County, Grays Harbor County, Washington State, and the nation. It also described the value of ecological services that are beneficial effects of shellfish aquaculture – things like carbon sequestration, nutrient filtration, and nitrogen removal. Reviewers interested in these subjects are encouraged to review the 2015 FEIS section on these subjects (adopted in the SEIS by reference).

With regard to direct economic impacts to growers in Willapa Bay and Grays Harbor in the absence of burrowing shrimp population control, the 2015 FEIS cited the growers' estimate at that time that they would anticipate a 60 to 80 percent reduction in oyster production. The bay-wide loss of clams and oysters in Willapa Bay without pesticide treatments for burrowing shrimp population control was estimated at a higher level by the Washington State University Pacific County Extension Director – on the order of 80 to 90 percent. Information regarding economic estimates has not been independently verified by the Department of Ecology (Ecology).

Information provided with the 2016 WGHOGA NPDES permit application responds to a question from Ecology and others about the estimated economic consequences of not being able to control burrowing shrimp on commercial clam and oyster beds in Willapa Bay and Grays Harbor. WGHOGA members were surveyed and asked to project their bed losses over the next 5 years (2017 through 2022).[10] WGHOGA growers estimated cumulative losses of approximately 500 acres of seed or nursery ground, 575 acres of fattening beds, and more than 530 acres of clam beds by 2022 (Miller Nash Graham & Dunn, February 13, 2017). Based on growers' estimates of the dollar value of productivity per acre of these commercial shellfish beds, cumulative production losses by 2022 are projected to be just under $50 million without chemical control of burrowing shrimp populations on selected tideland acreage. Not included in this estimate are indirect economic impacts to the communities that surround Willapa Bay and Grays Harbor; the indirect or induced economic consequences to others associated with employment, the consumption of shellfish, regional recreation and tourist resources. For additional information on these subjects, the *Economic Analysis to Support Marine Spatial Planning in Washington* prepared for the Washington Coastal Marine Advisory Council (Cascade Economics, June 30, 2015) includes estimates of income and expenditures for WGHOGA as a whole in Pacific and Grays Harbor counties.[11]

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[10] Losses projected over the next 5 years do not include losses already experienced by WGHOGA's growers due to not being able to control burrowing shrimp over the past three years (2015-2017), and do not take into account the possibility that these growers may have to close farms due to increased burrowing shrimp activity. As with economic impact information published in the 2015 FEIS, information provided by WGHOGA with the 2016 application has not been independently verified by Ecology.

[11] http://www.msp.wa.gov/wp-content/uploads/2014/02/WMSP_2015_small.pdf.

Approval of the proposed NPDES permit, and subsequent use of imidacloprid to control burrowing shrimp could have negative economic consequences. For example, some tourists and recreationalists might choose to avoid Willapa Bay and Grays Harbor due to the use of chemical controls. Prices for shellfish from these estuaries could also fall due to negative perceptions about the use of imidacloprid. Additionally, some consumers have stated that they would not purchase and/or consume shellfish from Willapa Bay even if the shellfish beds did not receive direct application of the pesticide.

Shellfish farmers from outside of Willapa Bay and Grays Harbor have stated that an imidacloprid permit would convey an unfair advantage to the potential permittees.

In the interim since the FEIS was published, a number of shellfish producers, including Taylor Shellfish and Coast (Pacific Seafoods), have announced that they will not use imidacloprid to treat their commercial shellfish grounds in Willapa Bay. Taylor Shellfish has separately indicated it will continue the process of moving much of its shellfish production in Willapa Bay to off-bottom culture. Ecology contacted representatives of Taylor Shellfish to obtain information on their current operations, and more generally to seek their input on the feasibility of shifting much or most of the oyster culture in Willapa Bay and Grays Harbor to off-bottom production. The following points were derived from that discussion:[12]

- Burrowing shrimp are constraining production of ground-based oysters on Taylor Shellfish lands in Willapa Bay. Two 20-acre shellfish beds, one at Cedar River and one on North River, and another 50-acre bed near Goose Point can no longer be bottom-planted with cultched seed for shucked oyster meat production due to heavy populations of burrowing shrimp. A 30-acre bed at Stoney Point traditionally treated and used for bottom culture of oysters is currently threatened for continued bottom-culture use.
- Taylor Shellfish is developing custom equipment and their own methods of off-bottom oyster culture in Willapa Bay for beds lost to burrowing shrimp. These methods include line cultures with larger and longer posts and different types of anchors to prevent sinking in soft sediments, as well as harrowing of some bottom-culture beds, and a faster rotation to decrease loss of oysters due to the effects of burrowing shrimp populations. While some of the methods Taylor Shellfish is experimenting with seem to be working for them, these methods are still in experimental stages.
- Bottom-cultured oysters grown for the shucked meat market have historically been and continue to be the predominant crop of the shellfish industry in Willapa Bay and Grays Harbor. Single-oyster production for the half-shell market is an entirely different, more specialized industry, requiring different farming, processing, and marketing approaches than shucked oyster meat production. It is an expensive process to convert from bottom culture to off-bottom systems of shellfish farming. Taylor Shellfish Farms' representative shared that in their opinion, it is not appropriate to compare single-oyster production for live sales to cluster production for shucked meat sales. "It is not apples to apples. They are entirely different products, culture systems, processing and markets."

[12] Bill Dewey, Director of Public Affairs, Taylor Shellfish, personal communication, July 28 and August 22, 2017.

- Taylor Shellfish does not believe it would be feasible for all of the growers in Willapa Bay and Grays Harbor to convert to off-bottom oyster culture to supply the half-shell market. It would be infeasible to cultivate enough single oyster seed stock in the appropriate nursery setting to provide stock for this many growers or this much tideland acreage. A significant shift to half-shell cultivation in Willapa Bay and Grays Harbor would also result in saturation of the half-shell market, thus dropping prices, making it economically infeasible and unsustainable for growers. In addition, Willapa Bay and Grays Harbor contribute significantly to the entire U.S. shucked-meat industry. If shucked oysters were to be lost or significantly reduced in Washington, this would create a large void (up to 25% by some accounts) in the national supply of shucked oyster meats, and there would be secondary impacts to on-shore processing facilities, and related support services for this industry.
- Although Taylor Shellfish has chosen not to treat its shellfish beds in Willapa Bay with imidacloprid, the company believes that burrowing shrimp control is necessary to maintain a healthy and viable bottom-culture, shucked-meat oyster industry in Willapa Bay and Grays Harbor.

2.7 Regulatory Status, Regulatory Control, and Policy Background

A comprehensive section describing the regulatory status, regulatory control, and policy background that applies to commercial shellfish aquaculture and to the use of pesticides in the aquatic environment is provided in FEIS Chapter 2, Section 2.7 (pages 2-18 through 2-24). The Federal Registrations for imidacloprid were provided in FEIS Appendix A. All of this information is still applicable in the SEIS, has not changed, and is adopted by reference.

Since the 2015 FEIS was published, the U.S. Environmental Protection Agency (EPA) issued two large literature reviews. The EPA (2015) review assessed the effects of imidacloprid on pollinators, with some emphasis on honeybees. The EPA (2017) review included a comprehensive literature review and assessment of imidacloprid toxicity in the environment, focusing on aquatic ecosystems and species. These more recent EPA risk assessments, along with study results reported in other literature sources published since the 2015 FEIS was issued, are described in SEIS Chapter 3, Section 3.2. EPA (2017) makes three broad conclusions: 1) aquatic insect species have a relatively high response to imidacloprid toxicity compared to other classes of arthropods or other phyla; 2) imidacloprid concentrations present in many freshwater bodies of the U.S. would result in toxicity to sensitive aquatic insects and crustaceans; and, 3) there is low risk of direct imidacloprid toxicity to fish or aquatic-phase amphibians, although indirect effects by reducing invertebrate prey are possible. There are limited available data on imidacloprid concentrations in estuaries and saltwater bodies; however, EPA concluded that chronic toxicity to crustaceans in saltwater environments is possible. EPA’s assessment is discussed in SEIS Chapter 3, Section 3.2, and in Appendix A.

Compliance with Chapter 173-204 Washington Administrative Code (Sediment Management Standards)

WAC 173-204-110 – Applicability

> WAC 173-204-110 (6): Nothing in this chapter shall constrain the department's authority to make appropriate sediment management decisions on a case-specific basis using best professional judgement and latest scientific knowledge for cases whether the standards of this chapter are reserved or standards are not available.

WAC 173-204-420 (3(c)(iii)) –

> For Willapa Bay and Grays Harbors, the sediment impact zone maximum biological effects level is established as benthic abundance in which test sediments have, "less than fifty percent of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta and the test sediment abundances are statistically different (t test, $p \leq 0.05$) from the reference sediment abundances."

WAC 173-204-420 (5) –

> **Puget Sound marine sediment impact zone maximum other toxic, radioactive, biological, or deleterious substances criteria.** Other toxic, radioactive, biological or deleterious substances in, or on, sediments shall be below levels which cause minor adverse effects in marine biological resources, or which correspond to a significant health risk to humans, as determined by the department. The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

2.8 The Proposed Action and Alternatives

Guidelines for the Analysis of Alternatives

Washington State Environmental Policy Act (SEPA). The SEPA Rules (Chapter 197-11 WAC) that implement the State Environmental Policy Act (Chapter 43.21C RCW) require an EIS to describe and evaluate the proposal (or preferred alternative, if one exists) and reasonable alternative courses of action. Reasonable alternatives are actions that could feasibly attain or approximate the objectives of the proposal, but at a lower environmental cost or decreased level of environmental degradation. The word "reasonable" is intended to limit the number and range of alternatives, as well as the amount of detailed analysis for each alternative. The level of detail is to be tailored to the significance of environmental impacts, and one alternative may be used as a benchmark against which to compare the other alternatives. The EIS may indicate reasons for eliminating some alternatives from detailed study (WAC 197-11-440[5]).

Washington State Surface Water Quality Standards and the Water Pollution Control Act. Washington State surface water quality regulations and standards (Chapter 173-201A WAC) provide authority to Ecology to establish criteria for waters of the State and to regulate various activities. These standards protect public health and maintain the beneficial uses of surface water, which are defined in the statute to include:

- Recreational activities such as swimming, SCUBA diving, water skiing, boating, fishing, and aesthetic enjoyment;
- Public water supply;
- Stock watering;
- Fish and shellfish rearing, spawning, and harvesting;
- Wildlife habitat; and
- Commerce and navigation.

Introduction to the Alternatives Analysis

The 2015 FEIS evaluated the No Action Alternative, and two action alternatives for the control of burrowing shrimp: one using carbaryl with Integrated Pest Management (IPM) practices, and one using imidacloprid with IPM. Development of an IPM Plan was required by the Memorandum of Agreement (Washington Department of Ecology et al., January 30, 2001) that accompanied the 2001 NPDES permit; however, an IPM Plan for the carbaryl permit was never finalized and accepted by Ecology. Similarly, no IPM plan was submitted by WGHOGA as part of the 2016 NPDES permit application for the use of imidacloprid. Because the FEIS is adopted by reference in the SEIS, the 2016 WGHOGA proposal is evaluated in the SEIS as a fourth action alternative, with cross-reference to the 2015 FEIS alternatives as appropriate. Carbaryl with IPM (Alternative 2) is not considered in this SEIS because of the expiration of authorizations required for its use (see SEIS Section 2.8.2, below).

The 2015 FEIS also described Alternatives Considered and Eliminated from Detailed Evaluation (Chapter 2, Section 2.8.4, pages 2-48 through 2-56). These included mechanical control methods, physical control methods, alternative culture methods, alternative chemical control methods, and biological controls. Although some methods were at least partially effective (e.g., graveling or oyster shell pavement), at this time none have been determined by WGHOGA to be economically feasible on the scale of commercial shellfish operations. The SEIS includes updated information on alternative control methods in Chapter 2, Section 2.8.5 (below).

Consistent with its responsibility to maintain beneficial uses of State waters and protect the environment, Ecology will consider the 2016 WGHOGA application (Alternative 4) in the context of:

- Probable adverse environmental or human health impacts;
- Economic viability of the shellfish industry;
- Effectivess in controlling burrowing shrimp (*Neotrypaea californiensis* and *Upogebia pugettensis*); and
- Other possible indirect or cumulative effects of the proposed application on beneficial uses of Willapa Bay and/or Grays Harbor.

The potential effects of the 2016 WGHOGA proposal on recreational activities, fish and shellfish, wildlife habitat, and navigation are discussed in SEIS Chapter 3. Other beneficial uses listed in Chapter 173-201A WAC (i.e., public water supply and stock watering) would not be affected by the proposed action since the affected environment encompasses the saltwater estuaries of Willapa Bay and Grays Harbor.

2.8.1 Alternative 1, No Action: No Permit for Pesticide Applications

The 2015 FEIS evaluated a No Action Alternative in which there would be no permit authorizing insecticide applications to treat a limited acreage of commercial oyster beds in Willapa Bay and Grays Harbor for the control of burrowing shrimp. Commercial shellfish growers would only be able to utilize mechanical methods and alternative shellfish culture practices. Studies performed since the 1950s, and particularly from about the year 2000, have failed to find a non-chemical approach to controlling burrowing shrimp that was both effective, and economically feasible on a commercial scale. Some mechanical treatments also had large impacts on non-target animal species (e.g., dredging, deep harrowing, etc.). Off-bottom culture techniques, such as long-line or bag culture, are feasible in some areas with burrowing shrimp, such as areas protected from strong waves or currents. But these culture techniques would not support the shucked meat market that is the focus of most oyster culture in Willapa Bay and Grays Harbor, and would require large changes in the culture, harvest, processing, and marketing of oysters from these estuaries. Therefore, under Alternative 1, it was expected that most productive commercial clam and oyster grounds would decline over the subsequent 4- to 6-year period if no permit was issued to authorize pesticide applications to treat burrowing shrimp populations. The economic impacts of a decline in shellfish productivity on the order of 60 to 80 percent or more were discussed in FEIS Section 2.6 (pages 2-16 through 2-18). Ecosystem changes that would result from a significant increase in burrowing shrimp populations and significant reductions in shellfish (bivalve) populations were evaluated in FEIS Chapter 3. Reviewers interested in the analysis of the No Action Alternative are referred to the 2015 FEIS.

2.8.2 Alternative 2, Continue Historical Management Practices: Carbaryl Applications with Integrated Pest Management (IPM)

The primary burrowing shrimp management practice used by Willapa Bay and Grays Harbor shellfish growers between 1963 and 2013 was chemical treatment with the n-methyl carbamate insecticide, carbaryl. Use of carbaryl for the control of burrowing shrimp populations on Willapa Bay and Grays Harbor commercial shellfish beds is no longer considered by Ecology and other agencies to be a viable alternative. The Washington Special Local Need Registration was cancelled by the Department of Agriculture in January 2014, and Ecology denied the application for administrative extension of the NPDES permit for carbaryl applications (No. WA0040975) in May 2015. For these reasons, the potential effects of the 2016 WGHOGA proposal (Alternative 4) are not compared to FEIS Alternative 2 in SEIS Chapter 3.

2.8.3 Alternative 3, Imidacloprid Applications with Integrated Pest Management (IPM) – 2015 Alternative

FEIS Alternative 3 described and evaluated the effects of a new NPDES Individual Permit that would authorize chemical applications of the neonicotinoid insecticide imidacloprid for burrowing shrimp control on up to 2,000 acres total per year (1,500 acres per year in Willapa Bay[13] and 500 acres per year in Grays Harbor[14]). It was possible over the 5-year term of the 2015 Imidacloprid NPDES Individual Permit that the total tideland acreage to be treated within Willapa Bay could range from 1,500 to 7,500 acres, and in Grays Harbor could range from 500 to 2,500 acres under Alternative 3.

WGHOGA would be required to follow an approved Integrated Pest Management Plan for the use of imidacloprid and to submit Annual Operations Plans for proposed treatments, subject to review and approval by Ecology. The IPM Plan has been submitted. The Annual Operations Plan for implementing Alternative 3 had not been finalized at the time the 2015 FEIS was prepared and the permit was requested to be withdrawn by WGHOGA. Both these documents would have to be approved by Ecology as part of Alternative 3. The 2013 conditional Federal registrations for the imidacloprid products Protector 2F (flowable) and Protector 0.5G (granular) limited the application rate to 0.5 pound a.i./acre, to be applied between April 15 and December 15 in any year for which all required permits and approvals were in-place. A preferred method of application under Alternative 3 was aerial spraying using a helicopter. Reviewers interested in a more detailed description of Alternative 3 are referred to FEIS Chapter 2, Section 2.8.3 (pages 2-32 through 2-48). Analysis of the impacts of Alternative 3 compared to the No Action Alternative and Alternative 2 is provided throughout Chapter 3 of the 2015 FEIS.

2.8.4 Alternative 4, Imidacloprid Applications with Integrated Pest Management (IPM) – 2016 WGHOGA Proposal

The 2016 WGHOGA proposal for the use of imidacloprid combined with IPM practices to control burrowing shrimp on commercial clam and oyster beds would limit chemical applications to up to 485 acres per year within Willapa Bay (1.1 percent of total tideland acres exposed at low tide), and up to 15 acres per year within Grays Harbor (0.04 percent of total tideland area exposed at low tide). This is a reduced-impact alternative compared to FEIS Alternative 3 in that the acreage that may be treated under the currently requested permit is approximately two-thirds less (64 percent) compared to the acreage of the 2014 WGHOGA proposal evaluated in the FEIS as Alternative 3 (Willapa Bay: 485 acres compared to 1,500 acres), and approximately 97 percent less in Grays Harbor (15 acres compared to 500 acres).

The 2016 WGHOGA application (Alternative 4) requests flexibility in how treatment acres are allocated, but proposes to commit to maximum levels of treatment within any given year of 125 acres in North Willapa Bay, 485 acres in Central Willapa Bay, and 50 acres in South Willapa Bay. These acreages are the maximum for each geographical area of Willapa Bay in any one

[13] Under Alternative 3, the imidacloprid treatment area would constitute approximately 3.3 percent of total tideland area exposed at low tide.

[14] Under Alternative 3, the imidacloprid treatment area would constitute approximately 1.5 percent of total tideland area exposed at low tide.

treatment season; in no case would the total acreage treated within Willapa Bay exceed 485 acres per year. Under Alternative 4, the flexibility requested by growers includes only partially treating some commercial shellfish parcels, to avoid areas where burrowing shrimp population control is not needed; e.g., shallow channels with flowing water, transportation corridors, eelgrass beds, and areas that may be more suitable to alternative methods like subsurface injection of imidacloprid (see SEIS Section 2.8.5.3, below). However, treatment is still expected to consist of contiguous blocks in most cases, rather than a more dispersed pattern such as a "checkerboard" or "shotgun" approach[15]. Figure 2.3-2 in SEIS Chapter 2 shows the tideland parcel locations where imidacloprid may be applied in Willapa Bay under Alternative 4. Within Grays Harbor, the 15 acres of commercial clam and oyster beds proposed for inclusion in the potential permit would be located in South Bay (see Figure 2.3-3).

Over the 5-year term of the permit (if issued), the total tideland acreage to be treated under Alternative 4 within Willapa Bay could be up to 2,485 acres, and up to 75 acres within Grays Harbor.

The pesticide to be applied under Alternative 4 is the same as that described in FEIS Alternative 3: Protector 2F (21.4 percent Nuprid, flowable), and Protector 0.5G (0.5 percent Mallet, granular), both known by the common name imidacloprid. Protector 2F would be applied using ground methods over exposed tide-flat clam and oyster beds during very low tides. Protector 0.5G would be applied to shallow standing water over commercial clam and oyster beds. Both formulations may be applied using suitable equipment, such as scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, backpack reservoirs with hand-held sprayers, belly grinders, and/or subsurface injectors. The WGHOGA application for the 2016 permit (if issued) specifically excludes aerial applications using helicopters. The application rate of 0.5 pound a.i./acre for any treatment scenario is the same as the rate of application evaluated in FEIS Alternative 3. The reduction in total tideland acreage to be treated (from 2,000 acres per year total in Willapa Bay and Grays Harbor to 500 acres total per year in the two estuaries), and the elimination of aerial spraying from helicopters may result in smaller plot sizes for individual treatments (WGHOGA 2017a).

If the NPDES permit and Sediment Impact Zones are authorized by Ecology, imidacloprid applications would occur between the tidal elevations of -2 feet mean lower low water (MLLW) and +4 feet MLLW. In any given year, the specific discharge locations would be determined based on shellfish grower plans for the seed beds, grow-out sites, and fattening grounds; the efficacy of prior treatments; and the density of burrowing shrimp populations on their commercial shellfish beds.

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15 The location of proposed treatment blocks could affect the likelihood of off-plot impacts to water, sediment, and animals. For example, a "checkerboard" arrangement of many adjacent treatment blocks would be more likely to produce off-plot impacts than a similar level of treatment of blocks that are physically distant from one another. Ecology will evaluate the proposed distribution of treatment blocks on a year to year basis through its review of the Annual Operations Plan (discussed below) that WGHOGA would be required to submit under the permit. Ecology may require changes in the proposed distribution of treatment blocks, the timing of treatment, or the water quality monitoring following treatment to address this concern.

The WGHOGA proposal for treatment sites would be presented to Ecology in an Annual Operations Plan (AOP), subject to Ecology's review and approval prior to commencing treatment with imidacloprid. Information provided in the AOP would identify potential shellfish beds to be treated that year, including legal descriptions of potential treatment beds, total acreage, type of application (liquid or granular formulation, method of application – by ground or boat), the legal owner and (if applicable) the lessee, and the bed identification name. The AOP would also specify the location and type of non-chemical controls to be used during the year as part of WGHOGA's IPM Plan. Research plans designed to improve the efficacy of imidacloprid treatments and of non-chemical controls would also be specified.

The proposed permit, if issued, would be subject to all applicable State and Federal regulations, and would require annual monitoring in and around application areas to record and document environmental effects. Applicable regulations administered by Ecology include Clean Water Act (CWA) water quality certification (WQC), regulation of aquatic pesticide applications under a NPDES waste discharge permit, and compliance with Washington State Sediment Management Standards (SMS). The NPDES Individual Permit, if issued, would list discharge limitations, monitoring requirements, reporting and recordkeeping requirements; and would require preparation of an AOP, compliance schedule, Spill Control Plan, and Best Management Practices (BMPs) to ensure that the regulated action complies with the CWA. The NPDES permit could have a duration of up to 5 years. Monitoring results would be reviewed during the 5-year term of the permit, with provisions for Ecology to alter permit conditions if necessary for the protection of the environment. Although a monitoring plan has been proposed as a condition of the applications by the WGHOGA, Ecology had not yet finalized or approved the monitoring plan at the time of this writing (see below).

2.8.4.1 Proposed Monitoring Plan

The proposed *Monitoring Plan for WGHOGA SIZ Application: Willapa Bay and Grays Harbor, Washington* (GeoEngineers, March 20, 2017) is in draft form at the time of this writing. Monitoring will be required if the NPDES Individual Permit is issued for Alternative 4, Imidacloprid Applications with IPM – the 2016 WGHOGA proposal. The purpose for monitoring will be to characterize potential impacts of imidacloprid to surface water, sediments, and benthic invertebrates within the Sediment Impact Zone (SIZ); i.e., on commercial clam and oyster plots and adjacent areas within Willapa Bay and Grays Harbor, up to the annual treatment acreage limits.

The draft Monitoring Plan describes a proposed schedule, location, and methods for collecting water column samples; whole sediment, sediment porewater, and sediment persistence monitoring; and benthic and epibenthic organism samples from within a series of treatment and control plots. Ecology will review the draft Monitoring Plan in relation to the conditions and intent of Washington State Sediment Management Standards (SMS), and will require modifications as appropriate.

Ecology has stated that monitoring and environmental sampling is very difficult to conduct in a very dynamic and constantly changing situation like Willapa Bay and Grays Harbor. There are a significant number of variables that are difficult to control which make data collection and interpretation subject to a high degree of uncertainty. This is supported by high variability noted in the 2014 field trial data report which was submitted to Ecology in early 2016. The current analytical approach led to a non-statistical evaluation of outcomes in 2014, suggesting that the approach is inadequate to evaluate the nature of the benthic community data (Terastat memo dated January 2, 2018, Appendix A). A new analytical approach to monitoring would need to be developed which is both more rigorous, in order to meet power, and more available to make a statistically defensible conclusion as required by SMS. A Sampling and Analysis Plan (SAP) would also be submitted to Ecology for review and approval each year, as part of the Annual Operations Plan (AOP) required by the NPDES permit (if issued). The SAP would describe detailed procedures to be followed; for example, methods for handling samples, sample storage requirements, chain of custody procedures, and statistical methods to be used to analyze invertebrates. Specific sampling dates, the location of treatment sites and any required corresponding control site locations would be identified in the AOP each year.

A Water Column and Sediment Monitoring Report would be submitted to Ecology each sampling year. A summary report on the taxonomic identification of benthic invertebrates within the SIZ, and the statistical analysis of abundance, may take 6 months or more to complete following sample collection. Ecology would review monitoring results in relation to the SMS, for which representative requirements include:

> *Existing beneficial uses shall be maintained and protected, and no further degradation which would interfere with or become injurious to existing sediment beneficial uses shall be allowed* (Antidegradation and Designated Use Policies, WAC 173-204-120[1][a]).

> *The sediment quality standards of this section shall correspond to a sediment quality that will result in no adverse effects, including no acute or chronic adverse effects on biological resources and no significant health risk to humans* (Puget Sound Marine Sediment Quality Standards, WAC 173-204-320[1][a]).

> *[Adverse effects are inferred if the] test sediment has less than fifty percent of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca, or Class Polychaeta and the test sediment abundance are statistically different (t test, p≤0.05) from the reference sediment abundances* (Puget Sound Marine Sediment Zone Benthic Abundance Criteria, WAC 173-204-420[3][c][iii]).[16]

2.8.4.2 Imidacloprid Efficacy and Environmental Impact Trials

The 2015 FEIS Chapter 2, Section 2.8.3.4 (pages 2-39 through 2-40) describes the results of imidacloprid efficacy trials conducted between 2010 and 2014. At the time the FEIS was written,

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[16] WAC 173-204-320 and -420 state that the Department (of Ecology) shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of the SMS for non-Puget Sound marine sediment impact zones (such as Willapa Bay and Grays Harbor). Ecology's *Sediment Cleanup Users' Manual II* (SCUM II) is used as a guidance document by Ecology sediment specialists, site managers, potentially liable persons, and technical consultants for how to implement Part V provisions of the SMS rule. Ecology applies the Puget Sound criteria to all marine environments in the State, as guidance not as a codified rule.

the complete results of the 2014 efficacy trials were not available; therefore, they are presented in this SEIS.

The 2014 field trials indicated a range of results using imidacloprid to control burrowing shrimp on shellfish beds, depending on site conditions. Efficacy was variable, ranging from 20 to 97 percent, with most sites showing efficacy levels in excess of 60 percent in assessments conducted by WGHOGA and the Washington State University (WSU) Long Beach Research and Extension Unit. Low levels of efficacy were noted in areas with flowing water, high eelgrass densities, or both. WGHOGA members also observed this variable efficacy on their grounds following spraying in 2014, but were able to plant oysters on many of the beds they sprayed in 2014, and subsequently were successful in raising crops on them (Douglas Steding, Miller Nash Graham and Dunn, personal communication via e-mail to Derek Rockett, July 31, 2017). For those habitat types where treatment efficacy is low, WGHOGA may not be successful in controlling burrowing shrimp populations with imidacloprid.

Trials in the laboratory have shown that burrowing shrimp are not typically killed at imidacloprid concentrations proposed for use by WGHOGA (Dr. Chris Grue, University of Washington, personal communication). Efficacy of imidacloprid on burrowing shrimp during field trials may be due to their tunneling behavior: on exposure to imidacloprid, any resulting tetany would prevent them from circulating water through their burrows, or burrow maintenance, resulting in burrow collapse and eventual suffocation.

Effects of Imidacloprid on Epibenthic and Benthic Invertebrates. Epibenthic and benthic invertebrate samples were collected both within and adjacent to the treatment plots, using a grid-based sampling approach. Epibenthic and benthic invertebrates were sampled prior to the application of imidacloprid and at 14 and 28 days post-treatment. Imidacloprid effects were assessed for three criteria (absolute abundance, taxonomic richness, and Shannon diversity index) for each of three primary taxonomic groups: (polychaetes, molluscs, and crustaceans) by comparing invertebrate numbers in the treated plots to those in the control plots at each post-treatment sampling date.

As in prior years, the invertebrate results showed high variability, both within individual plots over time, and when plots were compared to one another. Thus, the primary finding of the 2014 invertebrate trials that estuarine epibenthic and benthic invertebrates were similar on control plots as compared to treatment plots, may be due to weak statistical power to detect differences.

Differences in epibenthic or benthic invertebrates between control and treatment plots fell within the permissible range of Ecology's SIZ standards, a result noted in most trials from prior years as well. The SAP Field Report proposed that this lack of significant differences between treatment and control plots may be due to imidacloprid having a limited effect on non-target epibenthic or benthic species, rapid recolonization following treatment, or some combination of these factors.

A detailed explanation of the results of the 2014 field studies is provided in the next section.

2.8.4.3 2014 Field Studies

The 2014 field trials were designed to assess the magnitude, extent, and duration of impacts from commercial use of imidacloprid for the control of burrowing shrimp on tidelands used for clam and oyster aquaculture. Whereas the previous year's studies had focused on smaller plots (i.e., 10 acres or less), the 2014 field trials were designed to assess these potential effects when imidacloprid is applied to larger (>50 acres) plots. Commercial treatment of plots of this size is most likely only feasible using aerial spraying by helicopter, which is not proposed under the 2016 WGHOGA NPDES permit application. The 2014 field trials provide data on the potential effects of imidacloprid spraying over larger areas, including clusters of smaller plots that are located in proximity to one another. It also indirectly allowed a test of whether post-spraying recruitment of invertebrates from unsprayed areas to the sprayed plots would be impeded when larger blocks and clusters are sprayed (e.g., due to the greater distance to be traveled, and the smaller amount of unsprayed area available as potential sources of recruitment). The results of the 2014 field trials are described in detail in Hart Crowser (2015), which is available through Ecology.

The 2014 field trials involved two trial plots (the "Coast plot" and the "Taylor plot"), immediately adjacent to one another, collectively covering approximately 90 acres, located near Stony Point in Willapa Bay. Both sites had high levels of burrowing shrimp, and were owned by members of WGHOGA. The beds were selected both for their larger size, and because they were in close proximity to other beds scheduled for commercial treatment. A total of 90 acres were treated by helicopter with liquid imidacloprid, Protector 2F, at 0.5 lb a.i./acre on July 26, 2014. The control site was matched to the treatment plots, to the extent feasible, to have similar elevation, vegetation and substrate as the treatment plots. The control plot was located near Bay Center, approximately five miles from the treatment plots, to ensure no imidacloprid was carried there from the treatment plots by the rising tide. In addition, two sites (the "Nisbet plot" and the "Coast plot") were located in the Cedar River area. These plots were selected to allow collection of water samples over long distances from the treatment plots in order to better understand how imidacloprid in surface waters is diluted by tidal inflow.

The 2014 field trials were intended to assess:

- Pre- and post-application water column concentrations of imidacloprid;
- Whole sediment imidacloprid concentrations after treatment and over time;
- Whole sediment characteristics (texture, total organic carbon, dissolved organic carbon);
- Sediment porewater imidacloprid concentrations after treatment and over time;
- The efficacy of imidacloprid in controlling burrowing shrimp on larger treatment areas;
- The impact of large-scale imidacloprid application on megafauna (e.g., Dungeness crab); and
- The impact of large-scale imidacloprid application on benthic invertebrate communities.

Overall, the Sampling and Analysis Plan (SAP) Field Report found that the 2014 field trials produced results comparable to the 2012 monitoring: imidacloprid was widely detected in water and sediments shortly after treatment, concentrations diminished quickly with increasing distance from the treatment plots (water) or over 14 to 28 days following treatment (on-plot sediments), and impacts to epibenthic and benthic invertebrate communities were documented. Benthic invertebrates showed some evidence of recovery, but statistical power was weak due to high variability.

Screening values were used to determine when levels of imidacloprid in various sample types were high enough to potentially result in environmental consequences. These values were used to determine which samples were analyzed and reported on in the SAP field report.

- Surface water – 3.7 ppb (screening value);
- Sediment – 6.7 ppb (laboratory quantitation limit); and
- Sediment porewater – 0.6 ppb (screening value).

Water Column Sampling and Analysis. Water column samples were collected from the leading edge of the rising tide, typically about two hours after treatment. On-plot water sampling followed the same protocols as in prior year trials. For off-plot samples (taken at the Cedar River sites only), the primary goal of water quality sampling was to determine the maximum distance, off-plot, that imidacloprid could be detected in surface water. Accordingly, off-plot sampling design focused on long, linear transects, rather than the extensive network of off-plot samples used in the 2012 trials. Imidacloprid concentrations in surface water at the Taylor and Coast plots (on-plot samples) ranged from 180 to 1,600 ppb, with an average value of 796 ppb. At the first Cedar River location (- Coast plot), the on-plot concentration of imidacloprid was 230 ppb. At approximately 731 meters from the plot (about 2,400 feet) the concentration was 0.054 ppb. At the second Cedar River location (Nisbet plot), samples were taken on-plot, and at distances of 62 meters (203 feet), 125 meters (410 feet), 250 meters (820 feet), 500 meters (1,640 feet), and on the shoreline (approximately 706 meters or 2,316 feet). This set of samples documented a decrease in imidacloprid concentrations with distance as follows: on-plot = 290 ppb, 62 meters (203 feet) = 0.55 ppb, 125 meters (410 feet) = 0.14 ppb, 250 meters (820 feet) = not detectable, 500 meters (1,640 feet) = 0.066 ppb, and shoreline (2,316 feet) = not detectable. The 2014 Cedar River samples confirmed results in 2012 that detectable concentrations of imidacloprid are present on the leading edge of the incoming tide at considerable distances from the treated plots.

Overall, the surface water data collected during the 2014 trials indicate a strong pattern of high on-plot and lower off-plot concentrations during the first rising tide, a result also noted in prior trials. For the Cedar River sites, on plot locations had concentrations up to 1,600 ppb, with an average value of approximately half this amount. Imidacloprid was detected at considerable distances off-plot, but at low concentrations of 0.55 ppb to 0 ppb. However, unlike 2012 monitoring, in which a broad spatial area was sampled off-plot, only a single transect per spray location was collected in 2014. Off-plot surface water sampling could therefore miss the plume of imidacloprid dispersing off-plot. Thus, although the 2014 data confirm a greater distance off-plot for movement of imidacloprid (up to 500 meters), the concentrations were much lower than those observed in the off-plot data from 2012. This limits the interpretability of this data. These varying results suggest that site-specific differences in how tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot. To ensure consistent results, a potential permit would require more rigorous water quality monitoring and analysis.

Sediment and Sediment Porewater Sampling and Analysis. The 2014 field trials confirmed prior studies that demonstrate a rapid decline in imidacloprid concentrations in whole sediment and pore water after treatment. At 14 days, four of eight sites had whole sediment concentrations ranging from 6.8 ppb to 18 ppb, but imidacloprid was below detection limits (6.7 ppb) at the other four locations. All but one sampling site declined to below detection limits in whole sediment by 28 days after treatment, with the one sample (12 ppb) exceeding the 6.7 ppb screening level established for whole sediment. Sediment porewater demonstrated a similar decline of imidacloprid concentrations, with all sediment porewater samples except one below the screening level of 0.6 ppb by day 28. Compared to the EPA (2017) chronic marine endpoint, six of eight (75%) samples at 14 days, and five of eight (63%) samples at 28 days exceeded the EA chronic endpoint. The single sample that was above that screening level at day 28 exceeded that level, with a concentration of 1.2 ppb, more than five times the EPA chronic marine surface water endpoint.

Megafauna Sampling and Analysis. The 2014 trials differed from prior trials in that they focused on the edges of the plots in surveying effects on crabs, both because it was infeasible to survey the entire plot area sprayed due to its size, and because past trials had found that the edges often had higher numbers of Dungeness crab due to tidal depths (Dr. Kim Patten, WSU Long Beach Research and Extension Unit, personal communication). The monitored areas along the edge of the treated area were generally deeper and contained more eelgrass (*Zostera marina*) than the plots as a whole. Monitoring in 2014 found 137 out of 141 Dungeness crabs either dead or exhibiting tetany. Crabs in tetany would be unable to eat, move or avoid predators, and therefore would be at high risk of subsequent mortality. Based on their size, these were juvenile crabs. On a density basis, the 2014 field trials found that an average of two crabs/acre were affected, of which about two out of three were reported dead, and one out of three were in tetany. When the number of affected crab was divided using only the actual acreage examined, an average of more than 18 crab/acre is calculated. The first calculation (two crabs/acre) underestimates the density of affected crab because crab in unsurveyed portions of the sprayed plot were not counted. The second calculation (18 crabs/acre) may overestimate the density of affected crab because the surveyed area was selected because it had the highest density of affected crab. This compares to 0.87 to 3.8 crab/acre reported dead or in tetany during field trials in 2011 and 2012. Numbers up to 29 crab/acre were observed from the 2011 average calculations (Patten 2011); but, these were excluded for undocumented reasons. Another complication in interpreting these results is that most of the dead crab were either eaten by birds or were crushed by the field equipment used to conduct the experimental trials (Dr. Kim Patten, personal communication). It is not clear whether these crab were already dead due to imidacloprid exposure, or if they were in tetany, thereby making them vulnerable to predation and crushing. Regardless, the 2014 results confirm prior work that imidacloprid treatments result in impacts to juvenile Dungeness crab in the treated plots and immediately surrounding areas.

2.8.5 Alternatives Considered and Eliminated from Detailed Evaluation

The 2015 FEIS Chapter 2, Section 2.8.4 (pages 2-48 through 2-56) description of Alternatives Considered and Eliminated from Detailed Evaluation was derived from personal communications with Dr. Kim Patten (Director, WSU Long Beach Research and Extension Unit), and from documents he provided of studies performed over the years on mechanical control methods, physical control methods, alternative culture methods, alternative chemical control methods, and biological controls. The 2016 WGHOGA application to Ecology includes *A Review of the Past Decade of Research on Non-Chemical Methods to Control Burrowing Shrimp* (Miller Nash Graham & Dunn, February 13, 2017, Exhibit C, prepared by Dr. Patten) that summarizes many of the same experiments. Additional methods not previously described in the 2015 FEIS, and results obtained with these methods, are described below from that source.

2.8.5.1 Mechanical Control Methods

Suction Harvesting. Several suction head devices were designed and connected to water pumps. The premise was to create enough suction to selectively evacuate shrimp from their burrows, without removing sediment. Plastic barrels 33 gallons in size were cut longitudinally and attached to a sharp-edged plywood platform. It was possible to apply enough suction to collapse the barrels and selectively pull large volumes of water out of burrows; however, few shrimp were removed from their burrows. The conclusion was that suction is not a feasible method for shrimp control. Not only did it fail to remove a significant number of adult shrimp, it was destructive to the benthic environment.

Subsurface Air Bubble Harvester. The premise of an air bubble harvester was to introduce enough air below the shrimp to force them up out of their burrows into the water column where they could be trapped in a net or other harvest device. Two devices were constructed. One used compressed air at 10.7 cubic feet per minute (cfm) at 125 psi applied through the six-wheel spikewheel unit previously described in FEIS Chapter 2, Section 2.8.4.4 (page 2-55). The other used 185.5 cfm at 100 psi applied through a large shank system constructed by oysterman Leonard Bennett. The first system was tested using the WSU spikewheel barge. The second system was tested using a commercial shellfish barge. Based on data obtained from underwater cameras, there was no evidence that any shrimp were raised from the substrate. Burrow counts post-treatment were temporarily reduced by 39 percent with the high-volume air bubble method (to 60 vs. 98 burrows/m^2), but this level was still well above what would be considered successful control (i.e., less than 10 burrows/m^2).

Behavioral Weak Links. Assessments were made to find weak links in the biology of burrowing shrimp that could help focus mechanical control efforts. Individuals were pit-tagged, as well as filmed under the surface in their burrows to determine if there is a time when they come closer to the surface. Shrimp maintained a fairly constant depth within their burrows, at approximately 10 to 13 inches (25 to 30 cm), regardless of the conditions. Adult burrow depth, 24 to 40 inches (60 to 100 cm), is deep enough to preclude most types of mechanical control. The depths of new recruits were sampled as a function of time and size. New recruits were also often found at depths too deep to facilitate mechanical or physical control.

2.8.5.2 Physical Control Methods

Heat. Surface areas of shrimp-infested sediment were heated with a propane torch for two minutes/m^2. The sediment temperatures at 4- to 8-inch (10 cm and 20 cm) depths did not change sufficiently to affect burrowing shrimp. Therefore, there was no effect on adult shrimp below the heated area.

Water Injection. The traditional method to harvest shrimp is by pumping water into the sediment along a drainage channel bank, causing shrimp to float out. This method is destructive to the sediment, and is only effective on channel banks, not flat commercial shellfish beds. A method was devised to extract shrimp from small areas on flat ground by pumping water into an 8-inch diameter aluminum pipe sunk approximately 1 yard (1 meter) deep into the sediment. This proved to be effective for sampling, but not practical for controlling burrowing shrimp on large areas.

High Pressure, Low-Volume Water Injection. A shanking system was designed to inject water at 1,500 psi while being dragged through the sediment. Penetration of the water jet into the sediment was not deep enough to reach the burrowing shrimp, and therefore did not reduce shrimp densities.

Low Pressure, High-Volume Water Injection. Taylor Shellfish designed a tow sled (previously described in FEIS Chapter 2, Section 2.8.4.2 [page 2-52]) that was capable of injecting water into tideland sediment at approximately 10,000 gallons per minute. This large injection sled was very difficult to tow in a straight line; the barge was not able to maintain the plotted course of direction. An assessment of post-treatment efficacy indicated good shrimp control in affected areas, but the entire sediment profile, vegetation, and invertebrate population was also destroyed. Overall, this method was not practical to implement and extremely destructive to the habitat.

Trapping. Scents were tested for their attractiveness to burrowing shrimp. Several were found to be effective. Scent lures were then used in crawfish traps on the sediment surface to trap adult burrowing shrimp. Although a few large male shrimp were trapped, this method had no impact on the density of shrimp in the immediate vicinity.

Dr. Patten concluded his review of research on non-chemical methods to control burrowing shrimp by stating:

> *No suitable biological control method has yet been found to suppress the population of ghost shrimp. None of the mechanical methods assessed provided viable options for management of burrowing shrimp populations. They all failed to permanently reduce shrimp populations below the economic threshold (10 burrows/m^2). Most of the methods tested were also very destructive to the habitat, as well as to any shellfish that would be present at the time of treatment. At present, the only commercial production of oysters in shrimp-infested ground in Willapa Bay and Grays Harbor is in the small areas of the bays that are protected from exposure to major winter storms and have low enough shrimp densities to provide for secure anchoring for off-bottom culture. None of these production methods, however, are viable for large-scale production across the major*

growing regions of these estuaries (Miller Nash Graham & Dunn, February 13, 2017, Exhibit C, page 5).

2.8.5.3 A Combined Mechanical/Physical Control Method: Use of Subsurface Injectors

Dr. Patten also prepared *A Summary of Ten Years of Research (2006 to 2015) on the Efficacy of Imidacloprid for Management of Burrowing Shrimp Infestations on Shellfish Grounds* (Miller Nash Graham & Dunn, February 13, 2017, Exhibit B). In this document, Dr. Patten documents site-specific methods used to increase the efficacy of imidacloprid by ensuring chemical contact with the sediment-water interface, particularly in areas where flowing water or heavy eelgrass is present. A wide range of efficacy (from 40 percent to 80 percent) was achieved using a granular, pelletized version of imidacloprid under “normal” tidal conditions. Somewhat less efficacy was achieved (from 30 percent to 70 percent) under “moderate to thick densities of eelgrass” (see Table 2.8-1). Under these conditions, spikewheel injection of the flowable form of imidacloprid (Protector 2F) resulted in the most efficacy.

Table 2.8-1. Efficacy of broadcast-applied imidacloprid at ≤ 0.5 lbs ai/ac in locations that do not fully dewater (K. Patten, undated; Miller Nash Graham & Dunn, February 13, 2017, Exhibit B).

Condition	Imidcaloprid Formulation	Application conditions	Expected range of control found under experimental conditions
Sand	2F	Broadcast, tide out, no standing water	60 to 80% [1]
Sand	0.5G	Broadcast, tide out, no standing water	40 to 70% [2]
Sand	2F	Broadcast, tide out, shallow standing water with no outflow	60% [3]
Sand	2F	Broadcast, tide out or going out, shallow or deep swale with constant flow of water	0% [4]
Sand	0.5G	Broadcast, tide out, shallow standing water with no outflow	70%
Sand	0.5G	Broadcast, applied in shallow water 3 to 60 inches as tide was going out	30 to 80% [5]
Sand	2F	Injected via spikewheel 4 to 6 inches deep, shallow or deep swale with constant water flow	70 to 90%

1 Lower if applied to dry beds, higher if applied just as tidal water is going off the bed.
2 Much lower if applied to beds, higher if applied in shallow water just as tidal water is going off the bed.
3 WSU data from small pools, not large sites. Results have not been provided in any progress report.
4 WSU observations and data not contained in any progress report.
5 Lower efficacy in deeper water.

Given that a relatively high level of efficacy was achieved with spikewheel injection, the 2016 WGHOGA application requests small-scale, experimental use of subsurface injectors in order to continue to test the effectiveness of this adaptive management method of application. If small trials identify application methods that would increase efficacy, and/or that would reduce imidacloprid use for a given level of efficacy, WGHOGA may request a modification to the potential permit to allow commercial-scale use of subsurface injectors in the latter part of the 5-year duration of the NPDES Individual Permit (if issued).

2.9 Comparison of the Environmental Impacts of the Alternatives

The SEIS Alternative 4 impact analysis in Chapter 3 of this document was conducted for two areas of effect: 1) on-plot where imidacloprid applications would be allowed by the NPDES Individual Permit (if issued) for imidacloprid applications with Integrated Pest Management (IPM) –(2016 WGHOGA proposal); and 2) bay-wide within Willapa Bay and Grays Harbor, in the context of applying imidacloprid with IPM on up to 485 acres per year on commercial shellfish beds in Willapa Bay, and on up to 15 acres per year of commercial shellfish beds in

Grays Harbor. For comparison between Alternative 4 and the 2015 FEIS alternatives, an on-plot impact analysis is also provided in Chapter 3 for Alternative 3, Imidacloprid Applications with IPM on up to 1,500 acres per year of commercial shellfish beds in Willapa Bay, and up to 500 acres per year of commercial shellfish beds in Grays Harbor.[17]

The on-plot and bay-wide impact analyses are summarized in this SEIS text section, and in a summary table in SEIS Chapter 1, to compare the potential effects of the alternatives evaluated by Ecology for the use of pesticides to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor. The imidacloprid application rate would be the same under Alternative 3 or 4 (0.5 lb a.i/ac). The substantive difference between these two action alternatives would be the number of commercial shellfish bed acres per year that could be treated with the pesticide,[18] and the method of application. Under Alternative 4, there would be no aerial applications by helicopter.

2.9.1 Comparison of On-Plot Impacts

The 2015 FEIS Chapter 3 impact analysis evaluated potential effects throughout Willapa Bay and Grays Harbor, but did not consider the potential effects of imidacloprid application on specific commercial clam and oyster plots. SEIS Chapter 3 (this document) describes and compares on-plot impacts for Alternative 3 and Alternative 4 − the 2016 WGHOGA proposal. Those impact analyses are summarized here. The purpose for the on-plot impact analyses is to evaluate potential impacts of chemical applications within the Sediment Impact Zone (SIZ) that would be authorized by the NPDES Individual Permit (if issued).

Sediment and Sediment Porewater. On-plot sediment and sediment porewater would likely see environmental impacts of either Alternative 3 or Alternative 4 imidacloprid applications. Field trials conducted in 2012 and 2014 confirm that imidacloprid persists in sediment after application (Hart Crowser 2013 and 2016). Both the 2012 and 2014 results confirm that imidacloprid concentrations in the sediment decline, with concentrations often above screening values after 14 days but generally undetectable or below screening values at 28 days. The 2012 results documented detectable concentrations of imidacloprid at 56 days for two of five sampled locations, both of which were below screening levels. Imidacloprid is known to bind to organic materials in sediments, which delays the rate of decline in imidacloprid concentrations compared to sediments low in organic materials (Grue and Grassley 2013). Sediment porewater declined below 2014 screening levels by 28 days for seven or eight sites. Compared to the EPA (2017) chronic marine endpoint, five of eight (63%) samples at 28 days exceeded the EPA chronic endpoint. There are slower levels of decline at sites with higher organic levels in the sediments (e.g., the Cedar River test plots).

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[17] FEIS Alternative 2 is not included in the SEIS comparative analysis of impacts, as it is no longer considered a viable alternative at the time of this writing (see SEIS Section 2.8.2, above).

[18] Under Alternative 3, up to 2,000 tideland acres per year (up to 1,500 acres per year within Willapa Bay, and up to 500 acres per year within Grays Harbor) could be treated with imidacloprid. Under Alternative 4, up to 500 tideland acres per year (up to 485 acres per year within Willapa Bay, and up to 15 acres per year within Grays Harbor) could be treated with imidacloprid.

Air Quality. Potential impacts to air quality for treated plots under Alternative 3 or 4 would likely be minor and short-term. Sources of emissions to the air would be vehicles (e.g., ATVs or boats under either alternative, or from a helicopter under Alternative 3) operating immediately over a plot during treatment. Under Alternative 4, there would be no aerial applications, and thus no use of helicopters.

Surface Water. Under Alternative 3 or 4, surface water on plots that have been treated with imidacloprid would be likely to show impacts due to the application. Experimental trials conducted in 2012 and 2014 confirm that imidacloprid dissolves in surface water and may persist in the water column during the first tidal cycle. The highest concentrations of imidacloprid would occur during the first rising tide after application, and would dilute and flow off-plot during consecutive tidal cycles (Hart Crowser 2016).

Plants. Under Alternative 3 or 4, it is unlikely that imidacloprid would impact plants present on treated plots immediately after treatment since plants lack the nervous system pathway through which imidacloprid impacts some organisms.

Animals. Alternative 3 or 4 would be expected to cause on-plot impacts to zooplankton and benthic invertebrates, including commensal species, through either death or paralysis. These impacts would be expected within the boundaries of the treatment plots as imidacloprid is applied directly to the substrate or in shallow water. These on-plot impacts are generally expected to be in the range of 14 days or longer in some cases, as field trials have shown that benthic invertebrate populations recover (e.g., repopulate treated plots). For example, trials with imidacloprid have demonstrated invertebrate recovery within 14 days of chemical applications (Hart Crowser 2013 and 2016). However, one set of studies in an area of sediments containing higher organic carbon levels (Cedar River), found incomplete recovery for several invertebrate organisms, after 28 days. Imidacloprid binds to organic carbon, so these results for the Cedar River area may have been due to longer retention of imidacloprid in the sediments, with an accompanying increase in toxicity to invertebrates. In such areas, on-plot recovery may be delayed compared to other areas with lower sediment organic carbon levels.

Alternative 3 or 4 would be expected to cause on-plot impacts to epibenthic invertebrates, e.g. crabs through either death or paralysis. These impacts extend off-plot to at least areas directly adjacent to the spray plots. Crabs in tetany would be unable to eat, move or avoid predators, and therefore would be at high risk of subsequent mortality.

Under Alternative 3 or 4, forage fish and groundfish may be impacted by treatment with imidacloprid, but these would be short-term impacts. There would also be a potential for fish to be impacted by imidacloprid if they were to enter a treated area immediately after application and prior to dissipation of imidacloprid from the on-plot area. Indirect impacts may occur to fish due to potential impacts to their food base.

Under Alternative 3 or 4, birds, pollinators, and mammals may be affected by imidacloprid applications. It is possible for a minor effect to occur due to the potential short-term reduction in prey items present on treated areas. This would also be true for threatened, endangered, and protected species in the vicinity of treated plots. They are not likely to be present on-plot during the time of application, but may see a minor and temporary loss in prey items. Pollinators are highly susceptible to imidacloprid; however, there are no flowering plants present on the commercial shellfish beds where this pesticide would be applied; therefore, it is highly unlikely that pollinators would be present on treated plots.

Human Health. Under Alternative 3 or 4, the on-plot risk to human health due to application of imidacloprid would only apply to the small number of people that handle and apply the chemical. Applicators would need to be covered under a pesticide license. This risk is discussed further in Chapter 3 of this document.

Land Use, Recreation, and Navigation. None of these elements of the environment would be impacted by on-plot application of imidacloprid under Alternative 3 or Alternative 4.

2.9.2 Comparison of Bay-Wide Impacts

The 2015 FEIS Chapter 3 impact analysis evaluated potential effects throughout Willapa Bay and Grays Harbor of no permit for pesticide applications (Alternative 1), carbaryl applications with IPM (Alternative 2),[19] or imidacloprid applications with IPM (Alternative 3) for burrowing shrimp control on up to 1,500 acres per year of total tideland acreage exposed at low tide within Willapa Bay, and up to 500 acres per year of total tideland acreage exposed at low tide within Grays Harbor (Alternative 4). SEIS Chapter 3 (in this document) includes bay-wide environmental impact analyses for Alternative 4.

The 2015 FEIS concluded that the No Action Alternative (Alternative 1) would result in neither significantly beneficial nor significantly adverse ecological impacts to either estuary as a whole, due to the relatively small area of each bay that would be affected by the cessation of chemical treatments.[20] Reviewers are referred to FEIS Chapter 2, Section 2.9 for additional discussion (pages 2-57 and 2-58). However, it is the position of WGHOGA that the adverse effect of the No Action Alternative would be larger for them than the loss of the annual treatment acreage in Willapa Bay and Grays Harbor. WGHOGA growers believe that if progress is not made each year to stay ahead of, or keep pace, with burrowing shrimp recruitment on commercial shellfish beds that experience the most damage, it would take years to restore these beds if insecticide treatments became available in the future. WGHOGA's growers report that efforts to attempt to control burrowing shrimp populations using only mechanical means results in temporary increases in turbidity, damage to benthic communities, and damage to or displacement of marine and salt marsh vegetation, with no significant control of burrowing shrimp. Additional information on alternative methods that have been tried for burrowing shrimp control is provided above in SEIS Section 2.8.5, and in FEIS Chapter 2, Section 2.8.4 (pages 2-48 through 2-56).

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19 Alternative 2 is no longer considered a viable alternative (see SEIS Section 2.8.2, above).

20 The total area of tide flats exposed on low tide in Willapa Bay is approximately 45,000 acres. Of this acreage, up to 600 acres (1.3 percent) per year could be treated with carbaryl under Alternative 2, or up to 1,500 acres (3.3 percent) per year could be treated with imidacloprid under Alternative 3, if the 2015 permit had gone into effect. The total area of tide flats exposed on low tide in Grays Harbor is approximately 34,460 acres. Of this acreage, up to 200 acres (approximately 0.6 percent) per year could be treated with carbaryl under Alternative 2, or up to 500 acres (1.5 percent) per year could be treated with imidacloprid under Alternative 3, if the 2015 permit had gone into effect.

Analysis of the 2015 FEIS action alternatives took into account the dilution factor of two tidal exchanges per day in these estuaries, the life cycle and feeding habitats of potentially affected species, biochemical pathways of effect for the pesticides evaluated in various species, and the mitigating effects of complying with all applicable pesticide registrations, permits and regulations that govern pesticide applications. From the bay-wide perspective, no significant unavoidable adverse impacts were identified in the 2015 FEIS for the action alternatives. This conclusion has been revised to state there are adverse impacts for sediments, benthic invertebrates and surface water in both alternatives. There would less of an impact for Alternative 4, under which there would be no aerial applications of imidacloprid by helicopter, and the total acreage over which imidacloprid applications could occur would be significantly less under Alternative 4 compared to Alternative 3.[21]

2.10 Cumulative Impacts and Potential Interactions

The SEPA Rules specifically define only direct and indirect impacts, as follows: those effects resulting from growth caused by a proposal (direct impacts), and the likelihood that the present proposal will serve as a precedent for future actions (indirect impacts) (WAC 197-11-060[4][d]). Cumulative impacts are those that could result from the combined incremental impacts of multiple actions over time.

2.10.1 Summary of the 2015 FEIS Cumulative Impact Analysis

The 2015 FEIS is incorporated by reference in the SEIS. There is no change to the bay-wide cumulative impact analysis provided in that document, summarized below.

The FEIS cumulative impacts analysis considered the potential additive effects of the presence of imazamox and imazapyr in Willapa Bay for the control of non-native eelgrass (*Zostera japonica*) and *Spartina*, respectively, if imidacloprid were to be applied on up to 1,500 acres of commercial shellfish beds in Willapa Bay under Alternative 3 (FEIS Chapter 2, Section 2.10.1, pages 2-60 through 2-62). There currently are no known studies that address additive or synergistic effects between imidacloprid and imazamox or imazapyr. However, imidacloprid has a completely different toxic mode of action compared to these two chemicals. Imidacloprid is a neonicotinoid insecticide that affects neural transmission in animals. Imazamox and imazapyr are both acetolactate synthesis (ALS) inhibitors that act on a biochemical pathway that occurs in plants but not in animals. Therefore, there is no reason to expect that there would be additive or synergistic effects between these chemical applications. Further, Willapa Bay is a large estuary that experiences tidal flushing twice per day, and only limited quantities of any of these chemicals would be applied over a limited amount of acreage within the estuary in any year. As a cautionary approach, the FEIS suggested that Ecology could consider utilizing different treatment periods for imidacloprid targeting burrowing shrimp, and imazamox or imazapyr

[21] The 2016 WGHOGA proposal for Alternative 4 is a request to apply imidacloprid on up to 485 acres per year within Willapa Bay (1.1% percent of total tideland acreage exposed at low tide), and up to 15 acres per year within Grays Harbor (0.04 percent of total tideland acreage exposed at low tide). These areas constitute approximately two-thirds (64 percent) less treatment acreage within Willapa Bay, and approximately 97 percent less treatment acreage within Grays Harbor compared to FEIS (2015) Alternative 3.

targeting invasive species of marine plants. Additional information is provided in the FEIS chapter and section referenced above.

The 2015 FEIS cumulative impact analysis also identified (but did not analyze in detail) potential additive effects within Willapa Bay and Grays Harbor of other shellfish pests, like the oyster drill (*Ceratostoma inornatum*), crab, moon snails (*Euspira lewisii*), starfish, and some polychaetes.

Not considered in the 2015 FEIS cumulative impact analysis was the potential expansion of NPDES permit authority to other aquatic lands (e.g., Puget Sound) for the use of imidacloprid or other pesticides to control burrowing shrimp. No such proposals have been submitted to Ecology, and the Department does not know at this time whether expansion would be considered in other water bodies of the State. For this reason, this scenario is considered speculative and outside the scope of the FEIS or SEIS.

2.10.2 SEIS (2017) Cumulative Impact Analysis

With the addition of an on-plot impact analysis in SEIS Chapter 3, and the comparison of the potential on-plot effects of Alternative 4 with FEIS Alternative 3 (summarized above in SEIS Chapter 2, Section 2.9.1), the potential for on-plot cumulative impacts from pesticide applications to control burrowing shrimp is described in this section. Ecology has previously identified three types of cumulative effects that could occur based on the location and type of imidacloprid applications proposed by WGHOGA: cumulative effects to sediment quality, cumulative effects to water quality, and cumulative effects to marine invertebrates.

Sediment. Previous field trials with imidacloprid in Willapa Bay (reviewed in the 2015 FEIS, and in Chapter 3 of this document) have examined the persistence of imidacloprid in the porewater of sediments, and in whole sediments. These data indicate that imidacloprid concentrations decrease rapidly following treatment, with concentrations in sediments falling below screening levels in most samples within 28 days. However, these data also demonstrate that imidacloprid remained at detectable levels in some samples on the last sampling date of the trials (28 days or 56 days), particularly in sediments with higher organic carbon levels (e.g., the 2012 Cedar River trials). Thus, data demonstrating that imidacloprid will not persist for long periods in some sediment types (e.g., those with high silt or organic carbon levels) is not available. By extension, it is possible that imidacloprid residues may remain in some treatment areas at the time that imidacloprid could again be applied to the site. Such a circumstance would constitute a cumulative effect, over time, such that imidacloprid levels could occur at higher levels than those expected where no residual imidacloprid remains. To test for this possibility, Ecology would (if the permit is issued) require that WGHOGA, as part of its mandatory Monitoring Plan, conduct long-term persistence monitoring of imidacloprid in sediments. This sampling would continue through time to determine when no imidacloprid is detectable in sediment pore water or whole sediments, and to confirm whether a cumulative buildup of imidacloprid would occur over time.

Water Quality. Previous trials with imidacloprid applications in Willapa Bay (reviewed in the 2015 FEIS, and in Chapter 3 of this document) have examined the water concentration of imidacloprid with distance from the area of treatment. These data clearly demonstrate that imidacloprid concentrations, as measured on the leading edge of the incoming tide, are diluted by that tide compared to on-plot concentrations. However, field data indicate that the amount of dilution has been highly variable, likely due in large part to site-specific differences in how tidal waters rise and mix on the incoming tide. As the tide continues to rise, dilution would increase. Both Willapa Bay and Grays Harbor have large tidal prisms, that is, the amount of water that enters and exits these bays on each tidal cycle is large. Accordingly, both field data and a simple analysis of dilution indicate that water quality concentrations of imidacloprid may be reduced to non-detectable, and biologically inert concentrations, however, there is uncertainty regarding this information. Similarly, EPA (2017) and others have documented that imidacloprid is subject to relatively rapid photolysis (molecular deactivation by light), and so the diluted imidacloprid is expected to break down within days to weeks into inert compounds but only under ideal weather and water clarity conditions. Cumulative effects of imidacloprid applications on water quality could occur under certain conditions when plots within one quarter mile of each other are sprayed on different dates but before complete breakdown of imidacloprid occurs.

Marine Invertebrates. Both the scientific literature (e.g., Health Canada 2016, EPA 2017) and imidacloprid field trials in Willapa Bay (reviewed in the 2015 FEIS, and in Chapter 3 of this document) lead to the conclusion that imidacloprid exposure leads to death and paralysis ("tetany") in marine invertebrates. Field trials, in particular, have documented that some types of animals show a decline in abundance or diversity on the treatment plots compared to pre-treatment levels or to animal abundance on untreated control plots. The plots that WGHOGA proposes to treat would have biologically toxic concentrations in water of a few hours, and in sediment, toxic concentrations may persist for a period of days to weeks. In addition, field trials have demonstrated when invertebrate numbers and diversity fall after treatment, recolonization occurs for many types of invertebrates. At some sites, within 14 to 28 days, treatment plots have invertebrate communities similar to those of unsprayed control plots, although variability is high and statistical power is weak. At high total organic carbon (TOC) sites (Cedar River 2011) recovery did not occur during the monitoring period. Ecology would (if the permit is issued) require that WGHOGA, as part of its mandatory Monitoring Plan, conduct repeated trials in which invertebrate abundance and diversity are tracked from before treatment to 28 days after treatment on both sprayed and control plots. These trials would be required in areas that have not previously been tested (i.e., Grays Harbor, south Willapa Bay), and in north Willapa Bay where a previous trial suggested invertebrate recovery, post-application, was delayed or absent for a number of polychaete and crustacean invertebrate species. These trials would also likely occur again in other areas that were previously tested.

Cumulative effects to mud shrimp and ghost shrimp would occur for those areas sprayed with imidacloprid. By design, the proposed permit is meant to reduce numbers of these species over time. However, cumulative effects to the populations of these species within Willapa Bay and Grays Harbor are not expected because of the relatively small area of these estuaries proposed for treatment with imidacloprid. There is risk that lethal or sublethal impacts from spraying may act as an additive stressor to mud shrimp infested with an invasive parasite. The impact to animals that feed on burrowing shrimp have not been quantified from reduced availability of this prey type.

Impacts to Dungeness crab have been noted following treatment of plots with imidacloprid. Both mortality of crab from crushing by application equipment and bird predation have been noted, as well as tetany and death in remaining crab both on-plot and directly adjacent off-plot. It is likely that all plots sprayed under a potential permit would result in mortality of Dungeness crab. However, it is likely that no measurable cumulative effect is expected because: 1) the number of crab killed on the plots is a very small proportion of the entire population, 2) the majority of Willapa Bay and Grays Harbor tidelands would not be directly treated with imidacloprid, and would therefore remain as nursery and foraging habitat for the species, and 3) for planktonic forms, any impact would be offset by the very high fecundity of females of this species (approximately 2 million eggs/individual). There is also uncertainty regarding the overall impacts to crabs. For example, the outer extent of off-plot impacts has not been identified and sublethal impacts have not been quantified.

2.11 Benefits and Disadvantages of Reserving the Proposed Action for Some Future Time

The benefits and disadvantages of postponing burrowing shrimp control using imidacloprid applications on a limited number of acres of commercial shellfish beds in Willapa Bay and Grays Harbor are essentially the same as previously described in FEIS Chapter 2, Section 2.11 (page 2-62), restated here.

Opinions vary regarding the benefits and disadvantages of reserving, until some future time, applications of imidacloprid to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor. For those who are opposed to the use of insecticides in these estuaries, the benefit would be that no additional chemicals would be discharged into Willapa Bay or Grays Harbor. The disadvantage would be that the two species of burrowing shrimp would proliferate unmanaged, which WGHOGA argues would likely cause unrecoverable damage to commercial shellfish beds, and significant alterations to the bay-wide ecosystem.[22] Even during the 50+ years of the carbaryl control program, methods have often not been enough to protect commercial shellfish beds, causing the industry to shrink over time (testimony of WGHOGA members at the Imidacloprid EIS Scoping meeting, February 1, 2014, and at public hearing to receive comments on the Draft EIS, December 2, 2014). WGHOGA therefore expects that elimination or delay of approval of imidacloprid as a chemical control for burrowing shrimp would have serious negative effects on shellfish aquaculture in Grays Harbor and Willapa Bay.

Burrowing shrimp recruitment is monitored by Dr. Brett Dumbauld, Ecologist, U.S. Department of Agriculture, Agriculture Research Service, and by Dr. Kim Patten, Director, WSU Long Beach Research and Extension Unit. FEIS Chapter 2, Section 3.1 (page 3-1) cites a November 28, 2014 memo from Dr. Dumbauld in which he concludes that conditions were favorable for ghost shrimp larval recruitment to Willapa Bay and Grays Harbor during the period 2010 through 2013, with a combined density that may be significant, after what appeared to have been a period of very low or no recruitment and declining adult populations prior to that since the mid-1990s. Dr. Patten and Scott Norelius (2017 report to WDFW) monitored the density of ghost shrimp larvae recruiting into Willapa Bay at seven locations between mid-August and mid-September 2016. They found very high recruitment in the north end of the bay: 543 ghost shrimp per square meter (m^2) near the entrance to the estuary at Tokeland. The mean density of new

[22] See FEIS (2015) Chapter 3, Section 3.1, Biological Background Information (pages 3-1 through 3-6).

2016 recruits declined at sampling locations further away from the estuary mouth, to 14/m^2 at Middle Island Sands. The bay-wide average for 2015-2016 recruits was 152/m^2, indicating an overall robust population of new ghost shrimp recruits in 2015 and 2016 in Willapa Bay. Dr. Patten concludes from this study that:

> *When these population cohorts become large enough to cause significant bioturbation, their numbers, on top of the currently existing population of adults, represent a severe threat to the Willapa Bay shellfish industry*.

At the time this SEIS was prepared, WGHOGA growers were three years into a period of time with no pesticide control of burrowing shrimp, coinciding with the spike in recruitment between 2010 and 2016. Some commercial shellfish beds are crossing the threshold into non-productivity, causing them to be abandoned by the WGHOGA growers (personal communication with Douglas Steding, Miller Nash Graham and Dunn). Economic losses due to burrowing shrimp impacts to commercial shellfish beds in Willapa Bay and Grays Harbor are described above in Section 2.6.

3.0 Affected Environment, Potential Impacts, and Mitigation Measures

3.1 Biological Background Information

The biological background information on the history, characteristics, and interactions of burrowing shrimp with the intertidal community was previously described in the 2015 FEIS (Chapter 3, Section 3.1, pages 3-1 through 3-6). The 2015 FEIS is adopted by reference for inclusion in the SEIS.

3.2 Literature Review

The 2015 FEIS included a review of over 100 scientific reports and papers that evaluated the ecology of burrowing shrimp, physical and biological conditions in Grays Harbor and Willapa Bay, and effects of imidacloprid on invertebrate and vertebrate animals, including species listed under the Endangered Species Act (ESA). Information derived from that literature review is incorporated in the FEIS, and is the basis for the summary of imidacloprid's expected effects under the permit conditions analyzed in 2015. The FEIS concluded that application of imidacloprid would have minor to moderate effects on non-target invertebrates (e.g., polychaete worms, honey bees), minor effects on vertebrate species, including birds, and minor or insignificant effects on ESA-listed species.

Since the FEIS was published in 2015, a number of new studies on the effects of imidacloprid have been published. These new studies include three substantial literature surveys that synthesize toxicity data to estimate exposure risk to freshwater and marine species.

Health Canada (2016) conducted a comprehensive risk assessment of the toxicology literature on imidacloprid and published a report summarizing the expected effects of agricultural uses of imidacloprid on the environment based on that review, and on modeled and field data-based estimates of imidacloprid concentrations. The publication included evaluation of toxicity to birds, mammals, and terrestrial and aquatic insects, and assessed exposure pathways and possible effects to humans.

The U.S. Environmental Protection Agency (EPA) issued two large literature reviews and risk assessments. The EPA (2015) review assessed the effects of imidacloprid on pollinators, with some emphasis on honeybees. The EPA (2017) review and risk assessment was similar to the Health Canada study in that it included a comprehensive literature review and assessment of imidacloprid toxicity in the environment. The EPA (2017) literature review differed from the Health Canada study in that it only focused on aquatic ecosystems and species, and also used a different approach to estimating imidacloprid toxicity to various groups of animals. The EPA (2017) analysis of the effects of imidacloprid to marine invertebrates was based in part on unpublished scientific studies. Ecology used a Freedom of Information Act (FOIA) request to the EPA to obtain these studies for review.

Other published studies relevant to WGHOGA's proposed use of imidacloprid are available, some published since the 2015 FEIS was issued. Most of these studies are reviewed in the Health Canada and EPA documents described above. Multiple studies address potential impacts to freshwater ecosystems, particularly aquatic insects, while fewer have focused on marine systems.

The studies reviewed demonstrate a very wide range of toxicity of imidacloprid, depending on the environment and the animals involved. In general, this new scientific literature continues to document that imidacloprid is acutely toxic to many types of freshwater invertebrates. Measured concentrations of imidacloprid in the environment often exceed these toxicity thresholds. Consequently, imidacloprid is widely viewed as having actual or potential effects on freshwater invertebrates, and through food chain effects, potential impacts on vertebrate species that depend upon these freshwater invertebrate species as prey items. Conversely, the majority of this newly published literature provides further support for the conclusion that imidacloprid has relatively little effect on vertebrates, with birds, mammals, and fish having little to no risk from imidacloprid except in specialized circumstances (e.g., bird consumption of treated agricultural seeds).

The literature review of studies published since 2015, the studies obtained through the FOIA request, and some older studies relevant to the proposed permit is presented in Appendix A to this SEIS. Analysis of the current literature review are incorporated in the relevant sections of the "Elements of the Environment" below, specifically sediments, surface water, animals, and human health. There were no literature sources describing the effects of imidacloprid on air quality, land use, recreation, or navigation.

3.3 Elements of the Environment

This section is organized by elements of the environment assessed by the Washington State Department of Ecology (Ecology) when making the NPDES permit decision regarding the proposed action to control burrowing shrimp populations on commercial shellfish beds in Willapa Bay and Grays Harbor using chemical applications of imidacloprid combined with Integrated Pest Management (IPM) practices. Existing environmental conditions are described for each element, followed by a description of potential impacts that could result from Alternative 4.[1] The impact analysis presents two different contexts: bay-wide impacts within Willapa Bay and Grays Harbor, and potential impacts on treatment plots (i.e., on-plot impacts). The analysis of the potential impacts of Alternative 4 is followed by a description of required, recommended, and proposed (i.e., WGHOGA growers will voluntarily conduct those actions) mitigation measures that could be implemented to avoid or minimize potential adverse impacts of Alternative 4.

Ecology's review of the 2016 WGHOGA NPDES permit application must ensure that the proposed use of imidacloprid will comply with Washington State Water Quality Standards (Chapter 173-201A WAC; see also 33 U.S.C. § 1313; 40 C.F.R. Part 131, §§ 131.6, 131.10

[1] Alternative 4 is the 2016 WGHOGA proposal, described in SEIS Chapter 2, Section 2.8.4. Additional alternatives were described and evaluated in the 2015 FEIS, adopted by reference (see FEIS Chapter 2, Section 2.8, pages 2-24 through 2-56).

through .12), State Sediment Management Standards (WAC 173-204-120, -300 through -350, and -400 through -450), and other applicable laws and regulations. The permit, if issued, would be conditioned to protect State resources. Before requiring additional mitigation measures through the SEPA process, Ecology is required to consider whether local, State, or Federal requirements and enforcement could adequately mitigate any identified significant adverse impact. The SEPA Rules with regard to imposing mitigation measures are as follows (WAC 197.11.660(1)(a through e)):

> *(1) Any governmental action on public or private proposals that are not exempt may be conditioned or denied under SEPA to mitigate the environmental impact subject to the following limitations:*
>
> *(a) Mitigation measures or denials shall be based on policies, plans, rules, or regulations formally designated by the agency (or appropriate legislative body, in the case of local government) as a basis for the exercise of substantive authority in effect when the DNS or FSEIS is issued.*
>
> *(b) Mitigation measures shall be related to specific, adverse environmental impacts clearly identified in an environmental document on the proposal and shall be stated in writing by the decision maker. The decision maker shall cite the agency SEPA policy that is the basis of any condition or denial under this chapter (for proposals of applicants). After its decision, each agency shall make available to the public a document that states the decision. The document shall state the mitigation measures, if any, that will be implemented as part of the decision, including any monitoring of environmental impacts. Such a document may be the license itself, or may be combined with other agency documents, or may reference relevant portions of environmental documents.*
>
> *(c) Mitigation measures shall be reasonable and capable of being accomplished.*
>
> *(d) Responsibility for implementing mitigation measures may be imposed upon an applicant only to the extent attributable to the identified adverse impacts of its proposal. Voluntary additional mitigation may occur.*
>
> *(e) Before requiring mitigation measures, agencies shall consider whether local, state, or federal requirements and enforcement would mitigate an identified significant impact.*

3.3.1 Sediments

AFFECTED ENVIRONMENT

3.3.1.1 *Willapa Bay*

Information regarding the sediments of Willapa Bay is described in the 2015 FEIS (Chapter 3, Section 3.2.1, page 3-7). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. Information obtained since the 2015 FEIS was published is presented here.

Sediments containing higher percentages of clays, silts, organic matter, and total organic carbon (TOC) are found throughout Willapa Bay and are more prevalent in the northern and southern ends of the bay, with sand dominating in other areas (Brett Dumbauld, unpublished data). Incomplete tidal water exchange causes increased water residence times along a southern gradient into Willapa Bay. The 2016 WGHOGA application proposes to apply imidacloprid at locations throughout the bay.

3.3.1.2 *Grays Harbor*

Information regarding the sediments of Grays Harbor is described in the 2015 FEIS (Chapter 3, Section 3.2.1, pages 3-8 through 3-9). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

POTENTIAL IMPACTS

The potential impacts to sediments of Alternative 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.1, pages 3-9 through 3-11). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

The 2016 WGHOGA permit application requests authorization to apply imidacloprid in both north and south Willapa Bay, locations known to contain sediments with higher organic carbon levels. Field and laboratory studies have documented that imidacloprid levels in sediments decline more slowly over time as organic carbon levels increase (Grue and Grassley 2013). This is likely to lead to higher toxicity of benthic organisms than in sediments where imidacloprid dissipates more quickly. Only one field trial in Willapa Bay has been conducted in areas with high organic carbon to test this possibility, the 2011 test in Cedar River. Results in this area found greater persistence of imidacloprid in sediments, and greater impacts to benthic invertebrates than those noted in other trials (see Section 3.3.5 for discussion of invertebrate analysis).

Given the risk assessments and new published peer-reviewed journal articles highlighting acute and chronic impacts to aquatic invertebrates, a more precise analysis of the Cedar River failures (i.e., 2011 field trials) can be concluded based on a weight of evidence approach. The north Willapa Bay-Cedar River sampling from 2011 experimental trials document significant acute and persistent on-plot benthic community unavoidable adverse impacts in high total organic carbon (TOC) areas. 14 and 28 day mean crustacean and polychaete abundance showed a more than 50% reduction in mean abundance. Mean abundances at control plots increased during the same time. All 2012 and 2014 monitoring occurred in sites containing low TOC levels in sediment. There are likely other shellfish beds in the 2012 and 2014 areas with higher TOC levels than those included in the monitoring studies. The current NPDES and SIZ application specifically requests the ability to spray areas that are known to include high TOC sediments. Combined with the updated risk assessments and recent published peer-reviewed articles, Ecology is confident in the determination of the 2011 Cedar River failure results.

At the North Willapa Bay experimental trial site (Cedar River) there was inadequate recovery of the benthic invertebrate population 14 days after treatment. Specifically, mean crustacean abundance showed an 86% decline after 14 days, while there was little change in the control plot. After 28 days, while there was more than a 40% increase in crustaceans at the control plot, there was a 60% decrease in crustaceans on the treatment plot. Ostracods, noted as susceptible in the EPA (2017) risk assessment reflected this trend. After 28 days, 6 out of 9 subgroups showed a more than 60% decrease compared to before treatment numbers.

This location failed, or exceeded, the minor adverse effects criteria in the Sediment Management Standards of WAC173-204-415, as established by the department. If this test exceeded a minor effects threshold, it is above, or in exceedance, of the levels that can be allowed in a SIZ under the sediment management regulations. A SIZ must be authorized by Ecology such that compliance with the SIZ requirements can be met and compliance time periods are sufficient to meet the standards of this section WAC 173-204-420. This problem would repeat in areas of high TOC or areas with a low rate of tidal exchange (residence times) in the summer. Areas of high TOC have noted an extended duration of persistence in the sediment, increasing the period of sub-lethal (chronic) impacts which are likely to accumulative to toxic levels (see page 3-6 of the draft SEIS).

Based upon an updated review of best available science regarding neonicotinoid pesticides, Ecology has determined that under the proposed action, areas in Southern Willapa Bay would be likely to exceed SMS standards if sprayed and that these areas would experience significant unavoidable adverse impacts. There is no known reasonable mitigation in the record to reduce these environmental impacts. This is consistent with Ecology's 2015 determination to exclude Southern Willapa Bay due to high TOC and poor circulation during the summer given our current knowledge. Ecology has concluded that under the proposed action, high TOC locations including the Cedar River and other high TOC areas throughout the bay, would be impacted and could not be sprayed without having significant unavoidable impacts due to the persistence of imidacloprid in high TOC sediments.

Under Alternative 4, imidacloprid would be applied (if the permit is issued) on up to 485 acres of commercial shellfish beds per year within Willapa Bay, and up to 15 acres of commercial shellfish beds within Grays Harbor per year (see SEIS Chapter 2, Section 2.8.4). This is a reduced-impact alternative compared to FEIS Alternative 3 in that the acreage that may be treated under the requested permit is approximately two-thirds less (64 percent) compared to the acreage of the 2014 WGHOGA proposal evaluated in the FEIS (Willapa Bay: 485 acres compared to 1,500 acres), and approximately 97 percent less in Grays Harbor (15 acres compared to 500 acres).

IPM practices would be implemented to continue experimenting with alternative physical, biological, or chemical control methods that are as species-specific as possible, economical, reliable, and environmentally responsible. Preparation of an IPM Plan acceptable to Ecology would be a condition of the NPDES permit, if issued. Applications of imidacloprid to shellfish beds are proposed to occur on low tides from April through December each year. Minor (if any) sediment disturbance would occur at the time of treatment with methods of application suitable for the chemical formulation (i.e., "flowable" or granular): scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, back pack reservoirs with hand-held sprayers and/or belly grinders. Sediment disruption that occurs during shellfish harvest would continue to occur, as would disruptions concurrent with any mechanical controls implemented through IPM strategies.

The 2015 FEIS discusses the interactions of imidacloprid with water and sediments, including site-specific studies conducted to clarify the persistence of imidacloprid in estuarine environments (Chapter 3, Section 3.2.1, pages 3-9 through 3-11). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. Ecology has interpreted some of the information based on new scientific studies and public comment. Results of the 2014 field trials in Willapa Bay were not available at the time the 2015 FEIS was written. The results of the 2014 sediment studies are presented here.

The 2014 field trials were designed to assess the magnitude, extent, and duration of impacts from imidacloprid that could be associated with commercial use of imidacloprid for population control of burrowing shrimp on tidelands used for commercial clam and oyster aquaculture. Whereas the previous year's studies had focused on smaller plots (i.e., 10 acres or less), the 2014 field trials were designed to assess these potential effects when imidacloprid is applied to larger (>50 acre) plots. Commercial treatment of plots of this size is most likely only feasible using aerial spraying from helicopters, which is not proposed under the 2016 WGHOGA NPDES application. Nonetheless, the 2014 field trials provide data on the potential effects of imidacloprid spraying over larger areas, including clusters of smaller plots that are located in proximity to one another. It also indirectly allowed a test of whether post-spraying recruitment of invertebrates from unsprayed areas to the sprayed plots would be impeded when larger blocks and clusters are sprayed (e.g., due to the greater distance to be traveled, and the smaller amount of unsprayed area available as potential sources of recruitment). The results of the 2014 field trials are described in detail in Hart Crowser (2016), which is available through Ecology.

The 2014 field trials involved two trial plots (the "Coast plot," and the "Taylor plot"), immediately adjacent to one another, collectively covering approximately 90 acres, located near Stony Point in Willapa Bay. Both sites had high populations of burrowing shrimp, and were owned by members of WGHOGA. The beds were selected both for their larger size, and because they were in close proximity to other beds scheduled for commercial treatment. A total of 90 acres were sprayed by helicopter with liquid imidacloprid, Protector 2F, at 0.5 lb a.i./acre on July 26, 2014. The control site was matched to the treatment plots, to the extent feasible, to have similar elevation, vegetation and substrate as the treatment plots. The control plot was located near Bay Center, approximately five miles from the treatment plots, to ensure no imidacloprid was carried there from the treatment plots by the rising tide.

The 2014 field trials confirmed prior studies that demonstrate a rapid decline in imidacloprid concentrations in whole sediment and pore water after treatment. Imidacloprid screening values of 6.7 ppb for whole sediment and 0.6 ppb for sediment porewater were used during field trials, based mainly on quantitation limits. At 14 days, 4 of 8 sites had whole sediment concentrations ranging from 6.8 ppb to 18 ppb, but imidacloprid was below detection limits (6.7 ppb) at the other four locations. All but one sampling site declined to below detection limits in whole sediment by 28 days after treatment, with one sample (12 ppb) exceeding the 6.7 ppb screening level established for whole sediment.

Sediment porewater demonstrated a similar decline of imidacloprid concentrations, with all sediment porewater samples except one below the screening level of 0.6 ppb by day 28. The single sample that was above that screening level at day 28 exceeded that level, with a concentration of 1.2 ppb. For the SEIS, Ecology has also compared these results against the EPA (2017) acute and chronic marine endpoints for surface water. One day post treatment, concentrations in porewater ranged from 4.7 ppb to 100 ppb, three of eight samples exceeded the acute marine endpoint of 16.5 ppb. Although concentrations (range 0.09 to 3.1 ppb) declined over 14 days, 6 of 8 (75%) samples exceeded the EPA chronic marine endpoint of 0.16 ppb. At 28 days post treatment, concentrations (range 0.11 to 1.2 ppb) continued to exceed the EPA chronic marine endpoint in 5 of 8 (63%) samples. No data were collected after 28 days so it is uncertain as to when sediment porewater declined to below the EPA chronic marine endpoint. Benthic invertebrates living in and on sediment are regularly in contact with sediment porewater and thus chronic levels of imidacloprid in porewater pose a risk to benthic invertebrates. That risk is demonstrated by effects such as reduced reproductive success, delayed growth and other indirect, sub-lethal effects, which are difficult to measure.

Potential On-plot Impacts

Potential impacts to sediment and sediment porewater would be similar for Alternatives 3 and 4. Under the proposed action, imidacloprid in on-plot sediment porewater would likely result in exposure to benthic invertebrates above the new EPA and Health Canada risk assessment endpoints, resulting in impacts from imidacloprid application. This is supported by lower marine biologic endpoints identified the new Environmental Protection Agency (EPA) Risk Assessment, other governmental risk assessments (e.g. Health Canada and the European Food Safety Authority), and new research papers that have been incorporated into Ecology's understanding of this topic.

Although risk assessment biologic endpoints were calculated for marine surface waters, Ecology has determined there is some applicability to sediments because benthic dwelling organisms are in contact with sediment porewater. Field trials conducted in 2012 and 2014 confirm that imidacloprid does persist in the sediment after application (Hart Crowser 2013 and 2016) possibly serving as a source. Both the 2012 and 2014 results confirm that imidacloprid concentrations in the sediment decline, remain above screening values after 14 days, and are generally undetectable or below screening values at 28 days. The 2012 results documented detectable concentrations of imidacloprid at 56 days for two of five sampled locations, both of which were below screening levels. Imidacloprid is known to bind to organic materials in sediments, which delays the rate of decline in imidacloprid concentrations compared to sediments low in organic materials (Grue and Grassley 2013). Similar results are seen for sediment porewater, with measurable concentrations of imidacloprid generally undetectable or falling below 2014 screening levels by 28 days or less at a majority of the sites tested, but with slower levels of decline at sites with higher organic levels in the sediments (e.g., the Cedar River test plots).

MITIGATION MEASURES

Prior to issuing a NPDES permit for the discharge of a pesticide to waters of the State, Ecology must determine whether the proposed action will comply with Washington's Water Quality Standards (WQS), Sediment Management Standards (SMS), and other applicable laws and regulations. Washington's SMS establish sediment quality standards for marine surface sediments, sediment source control standards with which point source discharges must comply, and an antidegradation policy (WAC 173-204-120, -300 through -350, and -400 through -450). Sediment quality criteria for marine surface sediments include criteria establishing maximum concentrations of specified chemical pollutants, biological effects criteria, and criteria for benthic abundance (WAC 173-204-320).

Under Alternative 4, the NPDES Individual Permit for the use of imidacloprid would only be issued if appropriate conditions were imposed to achieve compliance with the Washington State WQS and SMS.

Applicators would be required to follow all pesticide label instructions to prevent spills on unprotected soil. If the NPDES permit is issued, a Spill Control Plan would be prepared to implement Alternative 4 that would address the prevention, containment, and control of spills or unplanned releases and would describe the preventative measures and facilities that would avoid, contain, or treat spills of imidacloprid. It would also list all oil and chemicals used, processed, or stored at the facility which may be spilled into State waters (if any). The plan would be reviewed at least annually and updated as needed. In the event of a spill, applicators would be required to follow spill response procedures outlined in the NPDES Individual Permit and Spill Control Plan.

As of the time of this publication, Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has not proposed any mitigation to address this impact to sediment and sediment porewater.

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS[2]Under the proposed action, impacts to sediment and sediment porewater would be similar for Alternatives 3 and 4, although the extent

[2] WAC 197-11-794 defines "significant" as used in SEPA as "a reasonable likelihood of more than a moderate adverse impact on environmental quality… The severity of an impact should be weighted along with the likelihood of its occurrence. An impact may be significant if its chance of occurrence is not great, but the resulting environmental impact would be severe if it occurred." The determination that a proposed action will (or may) have a significant adverse impact involves context and intensity, and does not lend itself to a formula or quantifiable test. Context may vary with the physical setting. Intensity depends on the magnitude and duration of an impact.

of impacts would be greater in Alternative 3 due to greater acreage sprayed. Imidacloprid in on-plot sediment and sediment porewater would likely result in exposure to benthic invertebrates above the new EPA and Health Canada risk assessment endpoints. Exceeding these thresholds could result in mortality (acute toxicity) or sub-lethal effects (chronic toxicity). These effects would represent significant adverse impacts from imidacloprid application. Discussion of the toxic effects of imidacloprid in respect to the sediment and porewater concentrations documented in the field trials are further discussed in section 3.3.5 Animals.

The Department of Ecology's analysis shows that new information demonstrates there are both acute and chronic significant unavoidable adverse impacts from imidacloprid application to on-plot sediments and on-plot sediment pore water in Willapa Bay (485 acres) and Grays Harbor (15 acres).

3.3.2 Air Quality

AFFECTED ENVIRONMENT

Information regarding regulations applicable to air emissions is described in the 2015 FEIS (Chapter 3, Section 3.2.2, pages 3-12 through 3-13). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

3.3.2.1 *Willapa Bay*

Information regarding the air quality of Willapa Bay is described in the 2015 FEIS (Chapter 3, Section 3.2.2, page 3-13). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. Willapa Bay meets all National Ambient Air Quality Standards (NAAQS), as well as the more stringent State standards set for total suspended solids and sulfur dioxide.

3.3.1.2 *Grays Harbor*

Information regarding the air quality of Grays Harbor is described in the 2015 FEIS (Chapter 3, Section 3.2.2, page 3-13). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. Grays Harbor meets all NAAQS, as well as the more stringent State standards set for total suspended solids and sulfur dioxide.

POTENTIAL IMPACTS

The potential impacts of Alternative 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.2, pages 3-13 through 3-14). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

Emissions to the air under Alternative 4 would be lower than those projected to occur with Alternative 3, which were discussed and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.2, page 3-14). Alternative 3 considered the use of helicopters for aerial applications of imidacloprid. Alternative 4 specifically excludes from the permit application aerial applications using helicopters. Imidacloprid may be applied using suitable vessels or land-based equipment, such as scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, backpack reservoirs with hand-held sprayers, and/or belly grinders. Vehicular and boat trips associated with imidacloprid applications would be added to existing trips for shellfish planting, rearing and harvest activities. Boat application of imidacloprid, if approved and used, would also contribute to emissions. Emissions associated with Alternative 4 would not be expected to impair attainment of air quality standards in Pacific or Grays Harbor counties.

Both the flowable (Protector 2F) and granular (Protector 0.5G) forms of imidacloprid have only a slight odor and most or all applications would be made away from the public and during periods of low wind. Therefore, it is unlikely that the odor would be detectable to off-site observers. This effect would be the same with Alternative 4 as that previously described for Alternative 3.

Protector 2F is considered to be non-volatile, but slightly toxic by inhalation. Protector 0.5G is also considered to be non-volatile and is relatively non-toxic by inhalation. There should be little to no inhalation exposure to the applicator during aquatic applications of either formulation under Alternative 4. The pesticide label requires the following personal protective gear: a long-sleeved shirt and long pants, shoes and socks, protective eyewear, dust mask (Protector 0.5G only), and chemical-resistant gloves when applying Protector 0.5G and Protector 2F. Imidacloprid would be applied on private tidelands normally located well away from public gathering locations; therefore, there should be little to no risk of air-based exposure to the public or other bystanders. These effects would be the same with Alternative 4 as those previously described for Alternative 3.

Potential On-plot Impacts

Potential impacts to air quality for treated plots under Alternative 3 or 4 would likely be minor and short-term. Sources of emissions to the air would be vehicles (e.g., ATVs or boats) operating immediately over a plot during treatment. Under Alternative 4, there would be no aerial applications, and thus no use of helicopters.

MITIGATION MEASURES

Under Alternative 4, it would be the responsibility of the applicator to select appropriate application equipment and treat commercial shellfish beds only during appropriate environmental conditions when wind speed, temperature, and tidal elevation would minimize the risk of spray drift, to avoid off-target dispersion. The FIFRA Registrations for Protector 0.5G and 2F (No. 88867-1 and 88867-2, the granular and flowable forms of imidacloprid, respectively) state that average wind speed at the time of application is not to exceed 10 mph

(EPA 2013a and EPA 2013b). In addition, the FIFRA Registration for Protector 0.5G requires the use of a dust mask by all handlers of imidacloprid. It would be a violation of the FIFRA label and the proposed NPDES individual permit for the applicator to not follow label directions.

To help prevent human exposure, the NPDES Individual Permit, if issued to implement Alternative 4, would require public notification measures that are the same as or similar to the measures listed in the FIFRA Registrations for Protector 2F and 0.5G (EPA 2013a and 2013b). All public access areas within a one-quarter mile radius of any bed scheduled for treatment would be posted with a sign, or signs would be located at 500-foot intervals at those access areas more than 500 feet wide. Signs would be posted at least 2 days prior to treatment and would remain for at least 30 days after treatment (EPA 2013a and 2013b). In addition, WGHOGA would use a website for public notification of specific dates of proposed imidacloprid applications in Willapa Bay and Grays Harbor. The website would include a link for interested persons to request direct notification regarding proposed treatment dates and locations. The WGHOGA Integrated Pest Management (IPM) Coordinator would send e-mail notification to registered interested parties, as needed.[3]

LOCALIZED, SHORT-TERM IMPACTS

Potential impacts to air quality for treated plots under Alternative 3 or 4 would likely be localized and short-term. Sources of emissions to the air would be vehicles (e.g., ATVs or boats) operating immediately over a plot during treatment. Under Alternative 4, there would be no aerial applications, and thus no use of helicopters.

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations (including disclosure of application dates and locations), no significant unavoidable adverse impacts to air quality would be expected as a result of implementing Alternative 4. Pesticide applications for burrowing shrimp population control would be implemented in compliance with FIFRA Registration restrictions and NPDES permit conditions that specify appropriate application equipment and spray drift management techniques to avoid or minimize off-target exposures. FIFRA Registration and NPDES permit conditions also include public notification requirements to inform landowners, adjacent landowners, lessees, interested individuals, recreational users and others of proposed application dates and locations so that potential direct exposure could be avoided.

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[3] If a SIZ is defined to implement Alternative 4, prior to authorization of the SIZ Ecology would make a reasonable effort to identify and notify all landowners, adjacent landowners, and lessees affected by the SIZ in accordance with WAC 173-204-415(2)(e). This notification would also include an opportunity for affected landowners, adjacent landowners, and lessees to comment on the proposed SIZ. This notification is separate from the public notice requirements for chemical applications for which WGHOGA would be responsible under a potential NPDES permit.

3.3.3 Surface Water

AFFECTED ENVIRONMENT

3.3.3.1 *Willapa Bay*

Information regarding the surface water characteristics of Willapa Bay is included in the 2015 FEIS (Chapter 3, Section 3.2.3, pages 3-16 through 3-18). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

3.3.3.2 *Grays Harbor*

Information regarding the surface water characteristics of Grays Harbor is described in the 2015 FEIS (Chapter 3, Section 3.2.3, pages 3-18 through 3-21). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

POTENTIAL IMPACTS

The potential impacts to surface water of Alternative 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.3 pages 3-21 through 3-24). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

Under Alternative 4 (imidacloprid applications with IPM – the 2016 WGHOGA proposal), imidacloprid and the degradation byproducts of imidacloprid would enter Willapa Bay and Grays Harbor following treatments of commercial shellfish beds on approximately 485 acres per year within Willapa Bay, and approximately 15 acres per year within Grays Harbor. These applications are proposed to occur between April 15 through December 15 (see SEIS Chapter 2, Section 2.8.4).

Hydrolysis, photolysis, and microbial degradation would be the primary means of imidacloprid breakdown in aquatic environments. Factors such as water chemistry, temperature, adsorption to the sediment, water currents, and dilution can all have significant effects on the persistence of imidacloprid (CSI 2013). Laboratory studies have shown that the half-life of imidacloprid at pH 5 and 7 can be greater than one year, while the half-life of imidacloprid at pH 9 is approximately one year (CSI 2013). Other laboratory studies of photodegradation of imidacloprid in freshwater suggest that imidacloprid has a half-life of approximately 4.2 hours in water and quickly degrades under natural sunlight (CSI 2013). Turbidity, plankton blooms and clouds can reduce photodegradation rates. Further laboratory experiments have had varied results, with one showing a half-life of 129 days (Spiteller 1993 as cited in CSI 2013) and the other 14 days (Henneböle 1998, cited in CSI 2013). Imidacloprid that is not degraded by environmental factors would be subject to dilution through tidal flows into and out of the estuaries.

Studies have shown that imidacloprid has eight degradation products as a result of hydrolysis, photolysis, and soil and microbial degradation. These degradation products include: imidacloprid-olefin, 5-hydroxy- imidacloprid, imidacloprid-nitrosimine, imidacloprid-guanidine, imidacloprid-urea, 6-chloronicotinic acid, imidacloprid-guanidine-olefin, and acyclic derivative. The toxicity levels of all the degradation products are equal to or lower than the toxicity of the parent compound (SERA 2005). There is no information to date in the literature documenting the persistence and environmental fate of imidacloprid breakdown products in marine waters.

Site-specific studies have been conducted to assess the transport and persistence of imidacloprid in surface water. Studies were conducted in Willapa Bay in 2012 and 2014 (Grue and Grassley 2013; Hart Crowser 2013 and 2016) to quantify the concentrations of imidacloprid in the water column, sediment, and sediment porewater. Surface water monitoring has not been conducted after the first tidal exchange during any experimental imidacloprid applications. The scope of these trials was to describe the SIZ that could be associated with the commercial use of imidacloprid for burrowing shrimp population control. A SIZ is the area where the applicable State sediment quality standards of WAC 173-204-320 through 173-204-340 are exceeded due to ongoing permitted or otherwise authorized wastewater, storm water, or nonpoint source discharges (WAC 173- 204-200). One of the studies was also designed to measure one of the degradation products of imidacloprid: imidacloprid-olefin. Other degradation products were not measured because analytical laboratories were not able to obtain laboratory standards for calibration of their analytical equipment.

Results of the 2012 commercial-scale experimental trials conducted in Willapa Bay were described in the 2015 FEIS (Chapter 3, Section 3.2.3, pages 3-23 through 3-24). These trials documented that detectable concentrations of imidacloprid were observed at up to 1,575 feet from the edge of the sprayed plots, on the leading edge of the rising tide. Imidacloprid was frequently detected off-site in drainage channels and areas covered by the rising tide, especially in those areas located closest to the treatment plots. Off-plot concentrations were highly variable, ranging from non-detection up to concentrations of 4,200 µg a.i./L. All remaining information on the 2012 trials is unchanged at the time of this writing, and the FEIS discussion is incorporated by reference in the SEIS.

The 2014 field trials were designed to assess the magnitude and spatial extent of impacts from imidacloprid that could be associated with commercial use of imidacloprid for burrowing shrimp population control on tidelands used for commercial clam and oyster aquaculture. Whereas the previous year’s studies had focused on smaller plots 10 acres or less), the 2014 field trials were designed to assess these potential effects when imidacloprid is applied to larger (>50 acre) plots. Commercial treatment of plots of this size is most likely only feasible using aerial spraying from helicopters, which is not proposed under the 2016 WGHOGA application. Nonetheless, the 2014 field trials provide data on the potential effects of imidacloprid spraying over larger areas, including clusters of smaller plots that are located in proximity to one another. It also indirectly allowed a test of whether post-spraying recruitment of invertebrates from unsprayed areas to the sprayed plots would be impeded when larger blocks and clusters are sprayed (e.g., due to the greater distance to be traveled, and the smaller amount of unsprayed area available as potential sources of recruitment). The results of the 2014 field trials are described in detail in Hart Crowser (2016), which is available through Ecology. A total of 90 acres were sprayed by helicopter with liquid imidacloprid, Protector 2F, at 0.5 lb active ingredient per acre (a.i./ac) on July 26, 2014 ("Taylor and Coast Sites"). A screening criterion of 3.7 ppb was used to determine when surface water samples indicated a potential for negative biological effects. Liquid formulation was also sprayed (0.5 lb a.i./ac) at two smaller sites (<10 acres) in the Cedar River area ("Coast and Nisbet Plots") to specifically test on-plot and off-plot concentrations of imidacloprid in water. All flowable imidacloprid was sprayed on treatment plots that were exposed by an outgoing tide.

Water column samples were collected from the leading edge of the rising tide, typically about 2 hours after treatment. Imidacloprid concentrations in surface water at the Taylor and Coast sites (on-plot samples) ranged from 180 to 1,600 ppb, with an average value of 796 ppb. The Cedar River sites were designed to test the linear extent to which imidacloprid concentrations are diminished with distance from the sprayed plots (e.g., due to dilution by the incoming tide) and to determine the maximum distance of detectability. At the Coast plot, the on-plot concentration of imidacloprid was 230 ppb. At approximately 731 meters from the plot (about 2,400 feet), the concentration was 0.054 ppb. For the Nisbet plot, samples were taken on-plot, and at distances of 62 meters (203 feet), 125 meters (410 feet), 250 meters (820 feet), 500 meters (1,640 feet), and on the shoreline (approximately 706 meters or 2,316 feet). This set of samples documented a decrease in imidacloprid concentrations with distance as follows: on-plot = 290 ppb, 62 meters = 0.55 ppb, 125 meters = 0.14 ppb, 250 meters = not detectable, 500 meters = 0.066 ppb, and shoreline = not detectable.

Overall, the surface water data collected during the 2014 trials indicate a strong pattern of high on-plot and low off-plot concentrations during the first rising tide, a result also noted in prior trials. For the Cedar River sites, on plot locations had concentrations up to 1,600 ppb, with an average value of approximately half this amount. Imidacloprid was detected at considerable distances off-plot, but at low concentrations of non-detected to 0.55 ppb. However, unlike 2012 monitoring, in which a broad spatial area was sampled off-plot, only a single transect per spray location was collected in 2014. Off-plot surface water sampling did not adequately characterize the variability of off-plot dispersal of imidacloprid. Although the 2014 data confirm a greater distance off-plot for movement of imidacloprid (up to 500 meters), the concentrations were much lower than those observed in the off-plot data from 2012. These results suggest that site-specific differences in how tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot; and, that a more robust spatial sampling for surface water should be conducted to control for and better evaluate the variable off-plot distribution of imidacloprid.

Imidacloprid dissolves readily in surface water and moves off treated areas with incoming tides and in drainage channels. The exact spatial extent of imidacloprid water concentrations is difficult to accurately measure in the field and then extrapolate to other spray locations because of highly variable site conditions such as complex incoming tide water movement that is dependent on the site topography, hydrology and local weather. Surface water was only sampled on the initial incoming tide and do not represent a comprehensive analysis of the extent of imidacloprid movement off the treatment plots. The off-plot data does show that imidacloprid is diluted and distributed with the tide. “Off-site Nuprid concentrations reached 900 ppb (maximum for all inundation samples) and included seven detections above 100 ppb, with concentrations as high as 200 ppb at a distance of 480 m from the plot. By contrast, off-site Mallet concentrations reached 130 ppb at a distance of 60 m and no concentrations above the screening value (3.7 ppb) at further distances” (Hart Crowser 2014). As the data above show, imidacloprid impacts non-treated areas through surface water conveyance, particularly as tide waters first pass over off-plot areas. However, as tide waters continue to flow into off-site areas, imidacloprid is expected to dilute significantly, a process that would continue through successive tidal cycles. Sufficient data do not exist to demonstrate the full spatial extent of imidacloprid concentrations in off plot areas.

Potential On plot and off plot Impacts

Under Alternative 3 or 4, surface water on plots that have been treated with imidacloprid would likely show significant impacts due to the application. Experimental trials conducted in 2012 and 2014 confirm that imidacloprid dissolves in surface water and may persist in the water column during the first tidal cycle. The highest concentrations of imidacloprid would occur during the first rising tide after application, and would dilute and flow off-plot during consecutive tidal cycles (Hart Crowser 2016). Much of the imidacloprid is dissolved and transported off the plot in the first incoming tide resulting in transport and exposure that extends significantly beyond the boundaries of the treated plot.

Using EPA’s (2017) acute toxicity endpoint of 16.5 ppb, Ecology modeled potential impacts of imidacloprid on marine invertebrates as it is carried off-plot by rising tidal waters. Specifically, Ecology calculated the off-plot area that could be exposed to acutely toxic levels of imidacloprid as it was carried by the rising tide. Ecology used Inverse Distance Weighting (IDW), a type of area-weighted averaging GIS tool that uses actual data calculated from monitoring, in this case surface water measurements from the 2012 monitoring report for imidacloprid application. IDW estimates concentrations between individual distinct data points to interpolate concentrations between these points. Area-weighted averaging is an established protocol for using individual data points to calculate proportional concentrations in areas between sampling points (SCUM II 2017). This modeling was limited to data collected in 2012 as it provided the most spatially diverse collections, and incorporated several assumptions:

- As throughout this document, Ecology retained EPA’s acute toxicity endpoint as the current best available science. was based on scientific literature showing toxicity at 33 µg a.i./L. EPA used a level of concern (i.e., a factor of safety) of 0.5 to lower this toxicity criterion to 16.5 µg a.i./L even though the underlying scientific study did not find toxicity at this lower level. Ecology retained EPA’s level of concern in its analysis.
- EPA’s acute toxicity endpoint of 16.5 ppb was based on a 96-hour exposure. Ecology’s modeling is based upon the areal extent of exceedance of the EPA endpoint and should not necessarily be equated as actual mortality. For Ecology’s modeling scenario, it was assumed that toxicity would occur at any location where the instantaneous concentration equaled or exceeded this level, regardless of the duration of exposure. This is offset by the exceedance of EPA by up to a factor of 100 on certain areas of the plot as shown by surface

water measurements. As this only a single snapshot of surface water quality as the tide is rising, a more thorough collection of surface water values over a longer period of time would address uncertainties as to how long the areal extent exceeded the EPA acute marine biologic endpoint.

- This method provides a conservative estimate of off-plot distribution as it equally weights low detection values during interpolation, therefore lowering concentrations in areas where higher concentrations may be expected. For instance, lower concentrations of imidacloprid were estimated on the spray plots than directly off-plot because of adjacent low water SW concentrations in areas of the incoming tide lowered estimated on-plot concentrations. 2014 monitoring of surface water on-plot found average concentrations of 796 ppb on-plot, considerably higher than modeled on-site in 2012 due to lower concentrations coming updrift, from incoming tidal waters.
- IDW is estimated only to the farthest point where data was collected. For example, at the Palix site, surface water concentrations of 200 (shoreline) and 46 ppb (farthest east) exceeded the EPA criteria, however the modeling was cut off because no further data points were available.

Ecology evaluated two plots sprayed with the Nuprid (liquid) form of imidacloprid, roughly rectangular spray plots of 10 acres in size.[4] Based upon IDW modeling of the 2012 surface water monitoring results, the area exposed to levels exceeding the EPA acute marine biologic endpoint criteria for imidacloprid off-plot is greater than five (5) times the spray plot location, i.e. greater than 50 acres. Depending on the spray location, Palix versus Leadbetter, the off-plot spatial area exceeding by 5x's the EPA acute marine criteria ranged from 5 to 20 acres. That is, it was assumed that invertebrates in off-plot areas approximately double the size of the modeled spray plot would experience imidacloprid levels at least five (5) times above the acute toxicity criterion of 16.5 µg a.i./L. It should be noted that site conditions may play a significant role in off-plot distribution of imidacloprid. Tidal channels, currents, wind and other factors make it difficult to extrapolate from one spray plot to another, confounding extrapolation of modeling results. If a permit were issued, monitoring of off-plot distribution of imidacloprid would be required at multiple locations at over an extended period of time to provide clarity.

Actual toxicity to off-plot invertebrates may be less given tidal dilution associated with field exposures. The impact of tidal dilution from multiple tides is unknown as no field measurements were collected to determine how long, for example, surface water values on-plot exceeded the EPA marine biologic endpoint. Further, the potential for delayed or cumulative toxicity (e.g. Rondeau et al 2014 and Tennekes and Sanchez-Bayo 2013) was not factored into modeling and impacts. As data was only collected at a single point as tidal inundation occurred and no surface water collections were collected after the day of spray, modeling of the extent of chronic impacts could not be performed. The extent and duration of chronic impacts on- and off-plot are unknown from the data collected.

MITIGATION MEASURES

[4] Plots of different sizes or geometry would produce different results.

The NPDES Individual Permit, if issued, would include conditions that limit the maximum annual tideland acreage for pesticide applications; specify treatment methods; require buffers from sloughs, channels, and shellfish to be harvested; and require discharge monitoring to evaluate the effects of pesticide applications. Adjustments to permit conditions, if issued, could be made throughout the 5-year term of the permit based on the results of this monitoring. Discharge monitoring and data reporting would be required under the NPDES Individual Permit for the use of imidacloprid, if issued (EPA 2013a and 2013b). The imidacloprid water quality monitoring plan would take into account the treatment plan proposed, and current information regarding this proposal would be used to condition the permit.

Applicators would be required to follow all pesticide label instructions for the use of imidacloprid to prevent spills where applications are not permitted. If the NPDES permit is issued, a Spill Control Plan would be prepared to address the prevention, containment, and control of spills or unplanned releases and would describe the preventative measures and facilities that would prevent, contain, or treat spills of imidacloprid. It would also list all oil and chemicals used, processed, or stored at the facility that may be spilled into State waters. The plan would be reviewed at least annually and updated as needed. In the event of a spill, applicators would be required to follow spill response procedures outlined in the NPDES Individual Permit and the Spill Control Plan. The FIFRA Registrations for the flowable and granular formulations of imidacloprid (Protector 2F and Protector 0.5G, respectively) recommend that a properly designed and maintained containment pad be used for mixing and loading imidacloprid into application equipment. If a containment pad is not used, a minimum distance of 25 feet should be maintained between mixing and loading areas and potential surface to groundwater conduits (EPA 2013a and 2013b).

If issued, the NPDES permit would include FIFRA Registration conditions requiring that a 25-foot buffer for treatment by hand spray if an adjacent shellfish bed is to be harvested within 30 days. This mitigation measure would be required to address the potential for transport off-plot of the imidacloprid and the potential significant travel as discussed above.

As of the time of this publication, Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has not proposed any mitigation to address this impact to the surface water.

SIGNIFICANT UNAVOIDABLE IMPACTS TO SURFACE WATER

Under Alternative 3 or 4, surface water on plots that have been treated with imidacloprid would likely show impacts due to the proposed action. Experimental trials conducted in 2012 and 2014 confirm that imidacloprid dissolves in surface water and is present in the water column during the first incoming tide at concentrations between 0.04 ppb and 4,200 ppb. Results of the 2012 commercial-scale experimental trials conducted in Willapa Bay were described in the 2015 FEIS (Chapter 3, Section 3.2.3, pages 3-23 through 3-24). Field studies were not robust enough to accurately characterize the full spatial extent of off-plot impact due to the highly variable site attributes. However, these trials documented that detectable concentrations of imidacloprid were observed, in some cases at up to 1,575 feet from the edge of the sprayed plots, on the leading edge of the rising tide.

Discussion of the toxic effects of imidacloprid in respect to the surface water concentrations documented in the field trials are further discussed in section 3.3.5 Animals.

3.3.4 Plants

AFFECTED ENVIRONMENT

3.3.4.1 *Willapa Bay*

Information regarding the plant communities of Willapa Bay is described in the 2015 FEIS (Chapter 3, Section 3.2.4, pages 3-25 through 3-27). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

3.3.4.2 Grays Harbor

Information regarding the plant communities of Grays Harbor is described in the 2015 FEIS (Chapter 3, Section 3.2.4, pages 3-27 through 3-28). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

POTENTIAL IMPACTS

The potential impacts to plants of Alternative 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.4, pages 3-28 through 3-31). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

Under Alternative 4 (imidacloprid applications with IPM – the 2016 WGHOGA proposal), the application of imidacloprid may have localized, temporary, and negligible impacts on plants within Willapa Bay and Grays Harbor if the NPDES permit is issued. Imidacloprid is a systemic insecticide that is taken up from the soil (or sediments) by plants and is present in the foliage of plants. There is limited information available regarding imidacloprid impacts to marine vegetation, as discussed below.

While imidacloprid would, if the permit is issued, be applied to areas with high populations of burrowing shrimp on commercial shellfish beds only, research also indicates that imidacloprid can move off-site rapidly in surface water and can be detected at least 480 meters (1,575 feet) away from the application site. Earlier research conducted by Felsot and Ruppert (2002) showed that imidacloprid dissipated rapidly in marine waters, but was detectable in sediments for longer periods of time. Sediment porewater concentrations of imidacloprid were also examined and researchers found that imidacloprid was almost undetectable 56 days after application (Grue and Grassley 2013). Rooted plants such as eelgrass and salt marsh plants could uptake the insecticide in these areas and small concentrations of imidacloprid have been found in eelgrass for limited periods of time (Grue & Grassley 2013; Hart Crowser 2013).. Also, if applicators failed to employ effective spray drift management techniques, imidacloprid might stray from the application zone to adjacent aquatic or shoreline plants that are occasionally inundated by tidal waters.

The 2015 FEIS discusses the potential impacts of imidacloprid on marine plants including marine algae (Chapter 3, Section 3.2.4, pages 3-28 through 3-31), and is incorporated by reference in the SEIS. The results of more recent studies on the effects of imidacloprid on plants are presented below.

EPA (2017) provides a comprehensive review of imidacloprid risks to the environment. A detailed review of this Risk Assessment is provided in SEIS Appendix A. For plants, EPA noted *"[a]quatic plants will not be assessed as available data for vascular and non-vascular aquatic plants indicate toxicity endpoints that are several orders of magnitude above the highest estimated environmental concentrations in surface waters."* Imidacloprid toxicity derives from its ability to bind to specific sites on nerves (nicotinic acetylcholine receptors – nAChRs), causing them to malfunction (e.g., excessive nervous stimulation, blockage of the receptor sites). Plants lack a nervous system, thus making it unlikely that imidacloprid would negatively affect marine plant species.

Potential On-plot Impacts

Under Alternative 3 or 4, it is unlikely that imidacloprid would impact plants present on treated plots immediately after treatment since plants lack the nervous system pathway through which imidacloprid impacts some organisms.

MITIGATION MEASURES

Under Alternative 4, if the NPDES permit is issued, imidacloprid application would be administered off-shore during periods of low wind, and during outgoing tides or over water, thus exposure to flowering plants would also be minimized.

Under Alternative 4, applicators would be required to follow all pesticide label instructions for the use of imidacloprid to prevent spills on unprotected soil and vegetation. FIFRA Registration restrictions (EPA 2013a and 2013b) would restrict the aerial application of imidacloprid to conditions when the wind speed is 10 mph or less, but may allow application to beds covered by an outgoing tide (i.e., with a granular form of imidacloprid). Further, imidacloprid could only be used pursuant to a NPDES permit, which would contain terms and conditions to ensure compliance with all applicable regulatory standards.

If the NPDES permit is issued, a Spill Control Plan would be prepared to address the prevention, containment, and control of spills or unplanned releases, and would describe the preventative measures and facilities that would prevent, contain, or treat spills of imidacloprid.

The FIFRA Registrations (EPA 2013a and 2013b) establish a series of application methods and spray drift management techniques that would minimize the risk of exposure of imidacloprid to non-target species and plants. For the granular form of imidacloprid (Protector 0.5G), average wind speed at the time of application would not exceed 10 mph to minimize drift to adjacent shellfish beds and water areas when applied by spray. This would minimize the potential for exposure to terrestrial habitats and plants, as would the avoidance of aerial applications. Applications would also not occur during temperature inversions. Applications would be made at the lowest possible height (scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, back pack reservoirs with hand-held sprayers and/or belly grinders) that is safe to operate, and that would reduce exposure of the granules to wind. When applications of the granular form of imidacloprid (Protector 0.5G) are made crosswind, the applicator would compensate for displacement by adjusting the path of the application equipment upwind. Swath adjustment distance should increase with increasing drift potential. For the flowable form of imidacloprid (Protector 2F), applicators would avoid and minimize spray drift by following detailed instructions on the FIFRA Registration label, including measures to control droplet size, making applications at the lowest possible height (scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, back pack reservoirs with hand-held sprayers and/or belly grinders) that is safe and practical and reduces exposure of droplets to evaporation and wind, applying during appropriate wind speeds and avoiding temperature inversions, and using authorized application methods and equipment.

LOCALIZED, SHORT-TERM IMPACTS

It is unlikely there would be any localized, short-term impacts to plants under Alternative 3 or 4, since plants lack the nervous system pathway through which imidacloprid impacts some organisms.

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, permits and regulations, no significant unavoidable adverse impacts to estuarine or terrestrial plants would be expected as a result of implementing Alternative 4. FIFRA Registration specify spray drift management techniques and the requested Ecology NPDES permit, if issued, would include conditions that specify treatment methods; require buffers from sloughs and channels; and require discharge monitoring. Adjustments to permit conditions could be made during the 5-year term of the permit.

3.3.5 Animals

AFFECTED ENVIRONMENT

3.3.5.1 Willapa Bay

Information regarding the animal communities of Willapa Bay is described in the 2015 FEIS (Chapter 3, Section 3.2.5, pages 3-32 through 3-38). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

3.3.5.2 Grays Harbor

Information regarding the animal communities of Grays Harbor is described in the 2015 FEIS (Chapter 3, Section 3.2.5, pages 3-38 through 3-47). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

POTENTIAL IMPACTS

The potential impacts to animals of Alternative 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.5, pages 3-47 through 3-54). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. However, Ecology's interpretation of the data is revised based on new scientific studies and public comment. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

Under Alternative 4, imidacloprid applications occurring on up to 485 acres each year within Willapa Bay and the on-plot effect could affect approximately 1.1 percent of total exposed tideland acreage within the bay annually through direct spray application, and based upon modeling results, would extend a considerable distance off-plot at levels above the EPA acute marine biologic endpoint. Imidacloprid applications occurring on up to 15 acres within Grays Harbor each year could affect approximately 0.04 percent of total exposed tideland acreage within the harbor annually (see SEIS Chapter 2, Section 2.8.4), although it would also extend a considerable, yet currently unknown, distance off-plot.

Information on zooplankton and invertebrates not available at the time the 2015 FEIS was written or obtained since the FEIS is presented below.

Several studies have been published since the 2015 FEIS was issued, including risk assessments prepared by both Health Canada (2016) and EPA (2017). EPA (2017) examined the effects of imidacloprid on 15 species of freshwater crustaceans and seven species of estuarine or marine invertebrates. The freshwater crustaceans included water fleas (Branchiopoda), amphipods and isopods (Malacostraca), and seed shrimp (Ostracoda). Seed shrimp appeared to be the most sensitive group of freshwater crustaceans (EPA found some freshwater insects to be the most sensitive invertebrates), while water fleas were found to be more resistant to imidacloprid toxicity. Ostracods are *"widely distributed in freshwater and saltwater ecosystems"* and are *"considered important components of the aquatic food web."* A detailed discussion of the toxicity values associated with these invertebrates is presented in SEIS Appendix A. EPA concludes that the concentrations of imidacloprid measured in many freshwater habitats exceed the toxicity thresholds for sensitive freshwater invertebrates, and therefore that imidacloprid is likely impacting these animals.

For saltwater invertebrates, EPA (2017) found only a limited number of studies covering seven estuarine or marine species, five of which were crustaceans. Acute toxicity values ranged widely, from a low LC_{50}[5] of 10 micrograms of active ingredient per liter (µg a.i./L is equal to ppb) for blue crab megalopae (a planktonic stage), to an LC_{50} of 361,000 µg a.i./L for brine shrimp. The blue crab study (Osterberg et al. 2012) is of particular interest given its possible relevance to imidacloprid effects on Dungeness crab in Grays Harbor and Willapa Bay, and so is reviewed separately below. EPA (2017), deemed the study *"qualitative,"*, so EPA chose to use *"the lowest acceptable (quantitative) acute toxicity value of 33 µg a.i./L …for estimating risks to saltwater aquatic invertebrates."* The value of 33 µg a.i./L is the 96-hour LC_{50} for a species of mysid shrimp (*Americamysis bahia*). EPA notes that this value is *"42X less sensitive than that for freshwater invertebrates."* EPA then applied a Level of Concern of 0.5 (i.e., a factor of safety) to this value, resulting in an acute toxicity standard for marine invertebrates of 16.5 µg a.i./L. (i.e., 33 µg a.i./L x 0.5 LOC = 16.5 µg a.i./L). Given selection of this toxicity standard by EPA (2017), Ecology has chosen to utilize 16.5 µg a.i./L as the imidacloprid acute toxicity criterion for marine invertebrates. However, given the limited number of marine studies, and known sensitivity of freshwater invertebrates such as ostracods for which marine species are also found, it is likely that as additional species are studied more sensitive species will be documented. This would be likely to further lower the EPA acute marine benthic criteria. Surface water monitoring in 2014 reported an average concentration of imidacloprid of 796 ppb, nearly 50 times the EPA acute marine endpoint; although reports of up to 4200 ppb (250 times the EPA endpoint) have been reported (Hart-Crowser 2013).

For chronic toxicity of saltwater invertebrates, EPA (2017) again used data on *A. bahia* to develop a 28-day No Observable Adverse Effects Concentration (NOAEC) value of 0.163 µg a.i./L and a Lowest Observable Adverse Effects Concentration (LOAEC) of 0.326 µg a.i./L based on *"significant reductions in length and weight."* EPA (2017) includes only two chronic studies of imidacloprid effects on saltwater invertebrates. If a larger database had been available, it seems likely that lower values for chronic toxicity would have been noted for one or more invertebrate types, especially given the consistent pattern of wide variation in imidacloprid toxicity among species. See the literature review in SEIS Appendix A for further details.

These selected values for saltwater invertebrate toxicity were used by EPA to evaluate potential environmental effects from runoff of imidacloprid from upland areas. For its modeled imidacloprid exposures (based on different uses of imidacloprid in agriculture), EPA found only one acute risk to saltwater invertebrates in any of its modeled scenarios. For chronic exposures, it found that foliar spraying of imidacloprid (e.g., on fruit trees) could lead to runoff that would produce toxicity, and obtained a similar result in three of its eight modeled scenarios of agricultural use of imidacloprid-treated seed. EPA's comparison of field data on imidacloprid concentrations in estuarine and marine environments to its chosen toxicity values was limited, probably because it

5 LC_{50} is the concentration of imidacloprid that killed 50 percent of the test organisms in the allotted test time (e.g., 48-hours, 96-hours, etc.).

notes that field data were limited. However, it concluded that, "Chronic risks were also identified for saltwater invertebrates from *all* foliar spray and combination application method scenarios modeled." Based on this review, EPA concluded that chronic toxicity to crustaceans in saltwater environments is possible from existing levels of imidacloprid in marine waters based upon terrestrial application (i.e. indirect) sources. The proposed action will apply imidacloprid directly to the marine environment.

Zooplankton and Benthic Invertebrates (Burrowing Shrimp, Clams and Oysters, Dungeness Crab). Information on the potential impacts of imidacloprid on zooplankton and benthic invertebrates is presented in the 2015 FEIS (Chapter 3, Section 3.2.5, pages 3-48 through 3-49). Alternative 4 would provide burrowing shrimp control on commercial shellfish beds with potentially reduced environmental side effects, compared to Alternative 3 (2015 FEIS), but with impacts great than Alternative 1. Imidacloprid spraying would exceed the EPA acute marine endpoint on-plot and in adjacent areas off-plot; and, these effects would also exceed SMS SIZ criteria. Imidacloprid applications at the proposed rate to control the burrowing shrimp species is high enough that non-target marine invertebrates such as other shrimp, crab, and polychaete species will be killed inadvertently from acute toxicity. Additionally, sub-lethal effects, such as growth and fecundity, are uncertain but likely to occur.

Most field trials of imidacloprid in Willapa Bay have been conducted in or near the middle of the bay where predominantly sandy sediments exist and organic carbon levels are generally low. In these areas, as discussed in the FEIS, impacts to invertebrates from spraying imidacloprid have generally been limited in either extent or duration. For example, on-plot invertebrate measurements have generally not been more than 50 percent different than those on control plots after 14 or 28 days, although reaching appropriate statistical power has been difficult to achieve. In part, this may be due to high recolonization rates of invertebrates following treatment.

In response to comments received during the public comment period which question benthic abundance monitoring results, and as part of Ecology's review of benthic monitoring data based upon new available literature, an examination of the previous benthic abundance monitoring has been conducted by Ecology and TerraStat, Inc. Benthic abundance monitoring was conducted during 2011, 2012, and 2014 as part of experimental applications of imidacloprid. During all three years, statistical power was low, requiring Ecology to make determinations based on best professional judgement. A statistical review of monitoring results have identified a number of concerns with the proposed approach. Abundance values are highly variable. In order to obtain required statistical power to adequately measure variability, larger sample sizes (analysis of previous monitoring show up to 200 samples per plot are required to reach power) and more replication of control and treatment plots were advised (TerraStat, January 2, 2018). The current analytical approach led to a non-statistical evaluation of outcomes in 2014, suggesting that the approach is inadequate to evaluate the nature of the benthic community data (TerraStat 2018). Based upon this review, if the NPDES permit were to move forward, it is likely a new analytical approach to monitoring would need to be developed that is more robust to meet the power necessary to be able to make a statistical conclusion of "no negative effects."

The 2016 WGHOGA permit application requests authorization to spray in both north and south Willapa Bay, locations known to contain sediments with higher organic carbon levels. Field and laboratory studies have documented that imidacloprid levels in sediments decline more slowly over time as organic carbon levels increase (Grue and Grassley 2013). The risk of exposure of benthic organisms to toxic levels of imidacloprid in these sediments and sediment porewater is potentially higher than in sediments where imidacloprid dissipates more quickly. Only one field trial in Willapa Bay has been conducted in areas with high organic carbon to test this possibility, the 2011 test in Cedar River. Results in this area found impacts to benthic that exceeded Sediment Management Standard (SMS) criteria. As discussed in the FEIS:

> *Before imidacloprid application, invertebrates on the control and treatment plots at the Cedar River site were statistically different for five of the nine endpoints that were examined. Polychaetes and crustaceans, in particular, were far more abundant on the treatment plot than at the control plot. In part, this was likely due to differences in vegetation levels and tidal elevations between the control and treatment plots. The differences between the plots were great enough to make any interpretation of invertebrate numbers after imidacloprid application difficult. Results of the analyses showed a decrease in abundance for most crustacean and polychaete species on the treatment plot, while a general increase was seen in the control plot. These differences were seen at both 14 and 28 days after treatment. While not conclusive, these results are consistent with an interpretation that imidacloprid reduced the number of polychaetes and crustaceans on the treatment plot, and that the decline lasted for at least 28 days following treatment, at least for some species. However, the data also show that the abundances of some species increased 28 days after treatment. Subtle differences in temperature, tidal elevation, and vegetation accounted for some differences between the treated and control site as well. A treatment effect was not evident for the three endpoints for molluscs (abundance, taxonomic richness, and Shannon diversity), or for richness and diversity in polychaetes or crustaceans.*

Specifically, mean crustacean abundance showed an 86% decline after 14 days, while there was little change in the control plot. After 28 days, while there was more than a 40% increase in crustaceans at the control plot, there was a 60% decrease in crustaceans on the treatment plot. Ostracods, noted as susceptible in the EPA (2017) risk assessment reflected this trend. After 28 days, 6 out of 9 subgroups showed a more than 60% decrease compared to before treatment numbers. Similar to the crustaceans, a 44% increase in polychaetes at the control plot after 14 days, was matched by a 72% decrease at the spray site. At 28 days, a 75% increase in polychaetes at the control site compares to a 55% decrease at the spray site. In conclusion, mortality was greater than 50% and did not recover to less than 50% in 14 days.

If this test exceeded a minor effects threshold, it is above, or in exceedance, of the levels that should be allowed in a SIZ under SMS. This problem will repeat in areas or treatment sites with high TOC or areas with a low rate of tidal exchange (i.e. high residence times) in the summer. Areas of high TOC have noted an extended duration of persistence in the sediment, increasing the period of sub-lethal (chronic) impacts which are likely to accumulative to toxic levels (see Sediments section above).

During evaluation of the original 2015 WGHOGA permit application, Ecology determined that these results exceeded the “minor adverse effects” standard of the SIZ regulations (TCP memo dated April 7, 2015). This location failed, or exceeded, the minor adverse effects criteria in the Sediment Management Standards of WAC173-204-415, as established by the department. Ultimately, Ecology in 2015 granted provisional approval to apply imidacloprid in north Willapa Bay, but removed south Willapa Bay from the permit. The provisional approval in north Willapa Bay was linked to a requirement to conduct additional field trials in this area as part of the permit’s monitoring and reporting plan. Based upon additional information reviewed for this SEIS, and comments received, Ecology has determined that imidacloprid application in Cedar River and Southern Willapa Bay, and other areas with high TOC, would exceed the SMS maximum biological effects criteria.

In reviewing the extent of imidacloprid off-plot distribution against the EPA acute marine biologic endpoint for the 2012 monitoring report, Ecology noticed that imidacloprid was found in surface water samples at the Leadbetter control site on the day of spray. Under Ecology’s understanding of the circumstances on this day, imidacloprid should not have been found at this site at this time since it was serving as a control, or no-spray, area for this study. The presence of imidacloprid in a control sample could be from cross contamination during data collection and analysis or from drift from another treatment area. Regardless, a contaminated control sample significantly weakens the validity of the results from this experimental trial. While this confounds Ecology’s interpretation of benthic abundance monitoring, it does not alter other aspects of the 2012 monitoring report, such as surface water monitoring or sediment persistence.

Two studies particularly relevant to the potential impacts of imidacloprid on Dungeness crab were reviewed. The first, Patten and Norelius (2017) summarizes nine sets of experiments on the effects of imidacloprid on Dungeness crab. Seven of the studies looked at the onset of and recovery from tetany in crab under laboratory conditions exposed to varying levels and durations of imidacloprid. Two studies assessed the number of crab affected following field applications of imidacloprid to commercial shellfish grounds in Willapa Bay. Based on the results of water quality monitoring during field applications of imidacloprid, the authors report an average imidacloprid concentration of 170 µg/L in the “leading edge” of the rising tide that carries imidacloprid off treated plots, and 2.2 µg/L on-plot during high tide on the day of application. In the lab, they found that Dungeness crab megalopae (the last planktonic form before crabs settle to the bottom) did not develop tetany at imidacloprid concentrations up to 100 µg/L for 2 hours exposure; however, significant tetany was observed at 500 µg/L within 20 minutes. Dungeness crab juveniles also did not develop tetany at imidacloprid concentrations up to 100 µg/L (6 hours exposure).

In studies designed to mimic the rate of dilution of imidacloprid from rising tidal waters following field applications (i.e., dilution by approximately 50% every 4 minutes) they did not observe tetany of juvenile Dungeness crab at starting concentrations of either 250 µg/L or 500 µg/L (highest concentration tested). Monitoring surveys following field applications (2011, 2012, and 2014) consistently found affected Dungeness crab in the spray plots. Across surveys, the authors found an average of 3.2 affected crab/acre sprayed, but numbers up to 29 crab/acre were observed.

The authors noted both crabs crushed by the ATVs used to spread imidacloprid on the plots, and widespread predation by gulls on Dungeness crab following field spraying. Considering all their results, the authors concluded that some level of Dungeness crab megalopae and juvenile crab mortality from treatment of shellfish beds is "likely." The study's conclusions that paralyzed crab would require multiple tidal cycles to recover supports the EPA's (2017) determination that tetany in the field would be equivalent to mortality." Similar lab studies of burrowing shrimp subjected to high concentrations of imidacloprid showed similar low lab mortality and eventual recovery from tetany (Grue, pers. comm.). Ecology's conclusion from this study, and supported by other commentators, when taken in context with monitoring in the field, is that crab are likely to be directly impacted from imidacloprid applications both on-plot and adjacent off-plot areas.

The second study relevant to Dungeness crab is Osterberg et al. (2012), who studied blue crab, a species common on the U.S. Gulf and East coasts. The authors exposed blue crab megalopae and juveniles to acute, 24-hour, static concentrations of various pesticides, including both laboratory-grade (i.e., pure) and commercial grade (formulated and sold as Trimax^{TM}) imidacloprid. They recorded mortality, effects on metamorphosis and subsequent juvenile survival. The authors found a significant difference in the toxicity of laboratory and commercial-grade imidacloprid on megalopae toxicity, with estimated LC_{50} values of 10.04 µg/L and 312.7 µg/L, respectively. This difference was reversed for juveniles, with LC_{50} values for the laboratory and commercial grades of 1,112 µg/L and 816.7 µg/L, respectively. No explanation was offered for these observed differences in toxicity. Imidacloprid exposure did not delay the onset of metamorphosis in megalopae, but did result in lower molting rates and higher mortality in newly metamorphosed juveniles compared to controls. The authors included a short literature review on imidacloprid toxicity in crustaceans, and also conducted a simplified dilution study which led them to conclude that *"direct overspray of Trimax or imidacloprid has a good chance to be acutely toxic to any blue crabs there [in shallow estuarine waters]."*

Based on these two studies, and particularly the results reported in Patten and Norelius (2017), application of imidacloprid to control burrowing shrimp populations will result in tetany and death of planktonic and juvenile Dungeness crab on-plot. Whether through crushing by application equipment, predation on individual animals in tetany, or direct mortality, the result will be a reduction in Dungeness crab in the imidacloprid application areas. Dungeness crab in off-plot areas may also experience tetany and mortality, particularly in those areas adjacent to the sprayed plots where water concentrations of imidacloprid being moved off-plot are highest. Based monitoring studies, including the 2014 monitoring submitted January 2016, a high percentage of surveyed crab are documented to be impacted by imidacloprid application. While on-plot and off-plot adjacent impacts to juvenile Dungeness crab have been documented, the extent of off-plot impacts not directly adjacent have not been quantified and may be significant. Acute and sub-lethal impacts more than seven meters from the edge of the spray plot have not been quantified. For instance, delayed mortality during molting, as evidenced by Osterberg et al. (2012) has not been monitored.

Ecology cannot quantify the effect on total crab populations in either Willapa Bay or Grays Harbor in relation to the overall size of these populations[6] and the total area that would be impacted from spray and off-plot dispersal of imidacloprid each year under the permit (if issued). Impacts to planktonic life stages of Dungeness crab will also occur, but there is little current scientific information or monitoring reports to accurately quantify Dungeness crab impacts. Conservatively, if all planktonic forms of Dungeness crab on plot, and those in off-plot areas exposed to 500 µg/L or more imidacloprid in the water column for even short periods are assumed to be lost, the effects on-plot would be substantial, and off-plot losses would add to this impact. Planktonic forms of Dungeness crab are extremely abundant compared to juvenile forms. For example, a single Dungeness crab female can produce up to 2 million eggs per year (https://www.nwrc.usgs.gov/wdb/pub/species_profiles/82_11-063.pdf). However, on- and off-plot mortality from imidacloprid applications in the field have not been measured. There is significant uncertainty as to the extent of off-plot drift and acute mortality during the first rising tide. Similarly, there is uncertainty surrounding the impacts of chronic exposure to imidacloprid and potential sub-lethal impacts to planktonic and juvenile crabs (as shown in Osterberg et al. 2012). Uncertainty remains regarding bay-wide impacts to Dungeness crab from imidacloprid effects on planktonic forms of this species.

While the number of crab per acre is a valuable metric for explaining impacts to Dungeness crab, it is not the only metric. Percent adversely impacted crab is equally important. Washington Sediment Management Standards (WAC 173-204), require evaluations of impacts on-plot. Ecology is required to determine whether "*minor adverse effects in marine biological resources*" occurred on plot (WAC 173-204-420(5)). Based upon analysis of crab impacts from imidacloprid spraying, Ecology has determined that more than a minor adverse impact has occurred on and adjacent to plots sprayed with imidacloprid. Based upon these criteria, i.e. on-plot impacts and percentage of crabs impacted, Ecology has determined that if Alternative 3 or 4 were to move forward, there would be a significant unavoidable adverse impact to crabs for which WGHOGA has proposed no mitigation. The 2014 monitoring data confirms EPA's (2013) conclusions that "direct effects on the individual organisms, including crab species, can also be expected" from spraying imidacloprid in the environment.

New information submitted by WGHOGA in 2016 showed an exceedance of the Sediment Management Standards (SMS) regulatory biological effects level as demonstrated by the documented rate of juvenile Dungeness crab mortality seen during the 2014 Field Trials of Imidacloprid in Willapa Bay. Data collected at the 90 acre plot treated with imidacloprid in 2014 showed that 137 dead or affected (tetany) out of a total of 141 crab observed in and around the treatment area. That is a mortality rate for observed Dungeness crab that exceeds levels which cause more than a minor adverse effect in marine biological resources of the Sediment Management regulations (WAC 173-204-420).

[6] For example, the commercial harvest in Pacific County, in which Willapa Bay is located, averages 2 to 6 million pounds of adult crabs/year (http://msp.wa.gov/wp-content/uploads/2014/03/FishingSectorAnalysis.pdf). At an average weight of 1 pound, this is equal to 2 to 6 million adult crabs. When this catch is combined with adult crabs not captured in the fishery (e.g., all females) and with the numbers of juvenile crabs not sampled by the fishery, the total population of Dungeness crabs in Pacific County likely exceeds 10 to 20 million animals or more.

While on-plot and directly off-plot impacts were defined by 2014 surveys, there is considerable uncertainty regarding the extent of off-plot impacts due to limited survey data taken 24 hours after application. Therefore, with the limited spatial information, Ecology can only determine impacts near and adjacent to the areas of spray. In these zones, impacts to crab would be unavoidable since imidacloprid drift cannot be controlled.

In addition to Dungeness crab, other specific biologic resources include commensal species that co-exist with burrowing shrimp, often in their burrows. A variety of commensal species are directly associated with, and dependent upon, mud shrimp and the ghost shrimp. Horning et al. (1989) noted that, "by aerating the subsurface sediment and digging burrows protected from most predators, ghost shrimp and blue shrimp provide an environment attractive to commensals." Species collocated with burrowing shrimp include: the arrow goby, several species of pea crabs, two species of clams including *Cryptomya californica*, copepods, other shrimp (such as the mud visored shrimp, *Betaeus ensenadensis*), polynoid worms, and isopods (Kozloff 1983, Hornig et al. 1989, Jensen 2014). Negative impacts to burrowing shrimp would also then directly cause negative impacts to these commensal species. If target efficacies are achieved to control burrowing shrimp, non-target commensal species will be also be killed at similar rates. Chapman et al. (2012) stated, "Functional and absolute losses of Upogebia species reduce their ecosystem services and dependent symbionts," clarifying that control of burrowing shrimp will also lead to negative impacts to species living with the shrimp.

Forage Fish and Groundfish. It is unlikely that there would be direct adverse effects to forage fish or groundfish from imidacloprid in water (Alternative 4), according to EPA's Risk Assessment (2017). Although EPA identified a data gap for chronic effects of imidacloprid on saltwater fish, they used the ratio of acute to chronic toxicity values to estimate a chronic No Observed Adverse Effects Concentration (NOAEC), which served as a basis for its conclusion of no direct chronic effects on saltwater fish. The estimated chronic NOAEC for saltwater fish was 6,420 µg a.i/L; by comparison, the highest concentration of imidacloprid in the water column was measured at 4,200 µg a.i/L during the 2012 field studies, and was associated with a rising tide that likely resulted in rapid dilution to much lower levels.[7] The Health Canada (2016) literature review did not analyze in detail the toxicity of imidacloprid to freshwater and marine fish; however, it did list tabular data documenting LC_{50} values that were consistently greater than 1,000 µg/L, indicating low potential for imidacloprid toxicity. Similarly, based on a review of 150 published studies, Gibbons et al. (2015) report LC_{50} values for fish of 1,200 to 241,000 µg/L (various exposure durations). They note that reported concentrations of imidacloprid in surface waters are *"except in the most extreme cases…2 to 7 orders of magnitude lower than the LC_{50} measurements for fish,"* and therefore direct mortality in these groups is unlikely.

The authors also reviewed literature to show that imidacloprid can cause sub-lethal effects (e.g., reduced growth or reproductive success) in fish at 30 to 320,000 µg/L (duration of exposure unknown). The authors conclude that *"the possibility of sub-lethal effects [in fish]…cannot be ruled out."* Other authors have raised concerns about potential sub-lethal effects (e.g. Hayasaka

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7 Field protocols require that water samples be taken on the leading edge of the rising tide. Samples taken at the sprayed plots on the first high tide after treatment averaged 2.2 µg/l imidacloprid (Patten and Norelius 2016).

et al. 2012, Sanchez-Bayo et al. 2016). Sanchez-Bayo et al. (2016) stated a main area of concern is "starvation of insectivores and other vertebrate fauna that depend on invertebrates as a major or only food source." Impacts to the prey base for herring and other forage fish in the system from early season spraying have not been quantified but may be increased during early season (spring) spray activities relative to summer spraying. Impacts to populations from food web impacts are difficult to quantify and remain an unknown, but may potentially occur. Although the area that would receive imidacloprid applications each year is small relative to the total area available for such foraging in Willapa Bay and Grays Harbor, the extent of off-plot drift considerably increases the potential are which may be impacted. In addition, Hornig et al. (1989), and citations within, identified multiple species prey on burrowing shrimp, including the ground fish staghorn sculpin. Staghorn sculpin were reported positively associate with dense shrimp beds.

Birds. Marbled murrelet, Western snowy plover, and streaked horned lark are individually discussed below in the Threatened, Endangered, and Protected Species section. The 2015 FEIS provides a discussion of the potential impacts to birds from imidacloprid exposure (Chapter 3, Section 3.2.5, page 3-20 through 3-51). Information not available or reviewed before the 2015 FEIS was issued is presented here.

As with other vertebrates, high concentrations of imidacloprid are required to produce toxicity in birds. The Health Canada (2016) risk assessment includes an extensive review of imidacloprid toxicity to different bird species, as well as modeling to compare likely environmental exposure levels (e.g., from eating imidacloprid-containing seed or invertebrates). Health Canada noted a wide range of reported acute and chronic toxicity levels for different bird species, and modes of exposure. It concluded that imidacloprid is *"not expected to pose a risk to birds"* due to low toxicity relative to exposure, and the reality that *"birds are unlikely to feed solely on imidacloprid-contaminated foodstuffs."* The modeled toxicity to small and insectivorous birds concluded that imidacloprid is *"not expected to pose a risk to birds,"* again based on an inherent high toxicity threshold, and because imidacloprid is expected to decline in their prey organisms following treatment with imidacloprid. Similarly, Health Canada concluded that the *"risk to small and medium sized birds is considered to be relatively low."* Health Canada did find that consumption of agricultural seeds treated with imidacloprid could lead to toxicity if ingested by seed-eating birds. Health Canada also evaluated anecdotal reports of birds that had fallen ill, or were dead or dying, following turf treatments of imidacloprid. Health Canada concluded that these reports demonstrate a potential for impacts from pellet applications of imidacloprid, but indicated that this risk could be mitigated by prompt exposure of the pellets to water following application. The use of imidacloprid pellets in Willapa Bay or Grays Harbor is unlikely to impact birds because pellets will dissolve on contact with water from the incoming tide.

Although Health Canada (2016) did not conclude that imidacloprid toxicity in birds is likely, it noted that imidacloprid toxicity to invertebrates could have food chain effects that could indirectly affect birds. Birds that eat invertebrates would be particularly susceptible. Reduction in invertebrates could reduce the levels of food for these species, at least locally, particularly for shorebirds that feed exclusively on invertebrates. Impacts to populations are difficult to quantify and remain an unknown. Although relative to the whole bay, the area that would receive imidacloprid applications each year is small relative to the total area available for such foraging in Willapa Bay and Grays Harbor, the extent of off-plot drift considerably increases the potential area which may be impacted.

Granular-form applications of imidacloprid on commercial shellfish beds (sand or mudflats) could result in an opportunity for birds to be exposed to this chemical through ingestion of the solid form, but direct exposure would be limited since application techniques flush birds from the site, and imidacloprid dissolves readily in water. It is unclear how quickly birds would return to feed. Comments from Audubon cited studies that waterfowl disturbed from feeding areas frequently return after the disturbance has passed. The granular form of imidacloprid uses clay pellets, which presumably are not sought as a prey item by foraging birds; however, tetanied or dead target and non-target species may be consumed. Even if the pellets were readily eaten, the period for birds to ingest the granular form of imidacloprid would be a few hours or less due to rising tides that would inundate treated plots.

Another study containing an extensive review of imidacloprid effect on birds is Gibbons et al. (2015). They reviewed 150 previously published studies on the effects of pesticides on vertebrate wildlife, including fish, birds, and mammals. Common to many studies, they found widely varying toxicity of imidacloprid to different species. For birds, they report LC_{50} values ranging from 13,900 to 283,000 µg/L. The authors also reviewed literature to show that imidacloprid can cause sub-lethal effects (e.g., reduced reproductive success) in birds at doses (in food) of 1,000 to 53,400 µg/kg animal weight per day. The authors noted that one of the greatest potential impacts of imidacloprid is from imidacloprid-treated agricultural seeds, where *"ingestion of even a few treated seeds could cause mortality and reproductive impairment to sensitive bird species."* The authors also concluded that sub-lethal effects can occur in birds, particularly those exposed to imidacloprid-treated seeds. Finally, the authors noted the rarity of studies looking at potential indirect effects, in particular how reductions in invertebrates caused by pesticide treatments may reduce the prey available to vertebrate consumers of these animals.

Pollinators. Pesticide exposure to honey bees is the primary concern for pollinators in Willapa Bay and Grays Harbor. Additional information not presented in the 2015 FEIS is presented below.

In 2016, EPA conducted an assessment of the potential risks of imidacloprid to terrestrial pollinators, focusing on honey bees (*Apis mellifera*). Overall, EPA (2016) concludes that most modeled agricultural uses of imidacloprid are at low or uncertain risk of impacting bee hives, that many uses pose risks to individual bees (i.e., can kill or impair individual animals), and a few modeled scenarios indicate risks to both individual bees and bee hives. Although imidacloprid was deemed by EPA to be "*highly toxic*" to honey bees, their modeled concentrations were also deemed "*conservative*" because they exceeded the levels measured in field studies. In general, scenarios that do not involve direct, on-field exposure by honey bees to imidacloprid did not exceed EPA's toxicity thresholds for the majority of agricultural uses modeled. But EPA (2016) concluded that some agricultural uses pose significant environmental risks to bees and bee colonies. Many other published studies have also concluded that imidacloprid can cause both mortality and sub-lethal effects in bees and other pollinators. This body of literature, and documentation of increasing levels of bee colony collapse, has combined to raise many concerns about the effects of imidacloprid on pollinators. This remains an active area of scientific research.

In Willapa Bay and Grays Harbor, imidacloprid would be applied on tidelands that are located approximately 0.5 mile or more from the nearest bee hive colonies. Imidacloprid would not be applied on any shoreline or upland vegetation. Therefore, it is unlikely that this use of imidacloprid would impact pollinators in the area. In addition, the 2016 WGHOGA NPDES permit application specifically excludes aerial spraying of imidacloprid from helicopters, which further decreases the likelihood of impacts to pollinators due to spray drift.

Mammals. Imidacloprid (Alternative 4) exposure to mammals would be related to direct ingestion. The Health Canada risk assessment (2016) concludes that mammals would likely have little to no risk from imidacloprid toxicity at the concentrations expected in the field. There could, however, be secondary effects to mammals from a potential reduction in their invertebrate prey. For Willapa Bay and Grays Harbor, terrestrial mammals, such as raccoons and coyotes, would be expected to forage along the shoreline and intertidal areas at times. Reduction in invertebrates could reduce the levels of food for these species, at least locally. However, any such reductions are not expected to be significant because of the small area that would be treated relative to the total area available in these estuaries for such foraging.

Although marine mammals such as harbor seals and gray whales are present in Willapa Bay and Grays Harbor, few use the high intertidal mudflats where clam and oyster farming generally occurs. It is unlikely that any impacts to invertebrate prey species would be large enough to consequently impact these marine mammals.

Threatened, Endangered, and Protected Species.

Salmonids including Bull Trout. Imidacloprid (Alternative 4) would be unlikely to adversely affect adult salmonids, bull trout, or their critical habitat (CSI 2013). Imidacloprid does not bioaccumulate in invertebrates, and uptake through contaminated prey would be no greater than environmental exposure. In addition, EPA (2017) and Health Canada (2016) both indicate that there is low potential for imidacloprid toxicity to fish species.

As discussed in the 2015 FEIS, juvenile salmonids travel through the nearshore habitat during out-migration, feeding on copepods and zooplankton. There may be short-term effects on crustacean zooplankton populations during imidacloprid application.[8] Indirect impacts may occur but there is currently uncertainty as to the extent of this impact. Imidacloprid application rate to control the burrowing shrimp species is high enough that non-target marine invertebrates such as other shrimp, crab, and polycheate species will be killed inadvertently from acute toxicity. Additionally, sub-lethal effects, such as growth and fecundity, are potentially likely to occur for prey species. EPA (2017) noted that vertebrate groups could be indirectly affected by reduction in invertebrate prey that are susceptible to imidacloprid. The EPA assessment states,

[8] See SEIS Chapter 2, Section 2.8.4.

"the potential exists for indirect risks to fish and aquatic-phase amphibians indirectly through reduction in aquatic invertebrates that comprise their prey base" (EPA 2017).

Green Sturgeon. Imidacloprid (Alternative 4) has a limited effect on large vertebrates, and only when high concentrations are ingested directly. Imidacloprid applications would occur in shallow water or on exposed sand or mudflats, when sturgeon are unlikely to be present over commercial shellfish beds. Studies have been conducted in an attempt to determine the effects of imidacloprid on green sturgeon. Frew (2013) used white sturgeon as a surrogate for green sturgeon and found the 96-hour LC_{50} was 124,000 µg/L, indicating that sturgeon do not possess high sensitivity to imidacloprid. An exposure model was used to estimate the ingestion of imidacloprid by green sturgeon following treatment to reduce burrowing shrimp in Willapa Bay (Frew et al. 2015). The exposure model included four components: ingestion of imidacloprid-exposed shrimp, uptake from water containing imidacloprid within shrimp burrows by swallowing, uptake from water passing across the gills, and uptake from ingestion of sediment containing imidacloprid. Conservative assumptions were used throughout the exposure model, the three most important of which were that green sturgeon ate a large volume of exposed shrimp, that uptake of imidacloprid from such shrimp had a 10 percent efficiency (i.e., 10 percent of the imidacloprid in the shrimp was assimilated by the sturgeon), and that sturgeon were exposed to porewater concentrations of imidacloprid for the entire feeding session modeled (4 hours). The authors acknowledge that their conservative assumptions likely result in an overestimation of actual imidacloprid uptake by green sturgeon. Their results indicate that uptake from porewater was 9.5 and 7.5 times greater (at 6 and 30 hours post-exposure, respectively) than estimated uptake from ingestion of exposed shrimp. The authors estimated total imidacloprid uptake, from all four sources, of 196.7 µg/L at 6 hours and 113.2 µg/L at 30 hours post-exposure. The authors cite the Frew (2013) LC_{50} of imidacloprid for white sturgeon of 124,000 µg/L, which is 630 times higher than their maximum modeled uptake, to conclude "*Imidacloprid concentrations and durations of exposure following chemical application in Willapa Bay would be lower than the levels expected to elicit direct acute toxic effects in green sturgeon. Furthermore, no chronic toxic effects would be expected following unforeseen extended periods of exposure.*"

Marbled Murrelet. Marbled murrelet critical habitat and foraging habitat do not overlap with areas where imidacloprid applications (Alternative 4) would occur on commercial shellfish beds in Willapa Bay or Grays Harbor; therefore, it would be unlikely to adversely affect marbled murrelet (CSI 2013). Were murrelets to forage in areas where imidacloprid is applied, such use would be at higher tide levels because murrelets are diving birds, ensuring any imidacloprid from treatment would have been diluted to below toxic levels. Potential uptake from consumption of contaminated fish is possible, but such uptake would be minimal given the limited exposure pathways for prey fish species to ingest imidacloprid and the fact that imidacloprid does not bioaccumulate (i.e., it would not persist in fish that were exposed). In addition, fish are highly mobile, so murrelet foraging would be on the larger population of fish in Willapa Bay and Grays Harbor, the vast majority of which would not have been exposed to imidacloprid.

Western Snowy Plover. Granular-form applications of imidacloprid (Alternative 4) on commercial shellfish beds (sand and mudflats) could result in an opportunity for birds to be exposed to this chemical through ingestion of the solid form, but direct exposure would be limited since application techniques flush birds from the site, imidacloprid dissolves readily in water, and only small percentages of total tidelands within Willapa Bay and Grays Harbor would receive imidacloprid applications in any given year. This limited period of potential exposure would be interrupted when the sand or mudflats became inundated by the incoming tide. CSI (2013) found imidacloprid toxicity exposure for snowy plover to have a low likelihood of indirect effects (e.g., through effect on food chains), and concluded that it would be unlikely to have adverse effects. “Flowable”-form applications of imidacloprid would result in minimal exposure times for birds (Giddings et al. 2012). Plovers are also generally found only on the ocean beaches on the west side of Willapa Bay and Grays Harbor, not in the bays themselves; therefore, it is unlikely they would be found in the vicinity of the commercial oyster and clam beds. See the 2015 FEIS (Chapter 3, Section 3.2.5.3, pages 3-45 through 3-46) for further discussion on western snowy plover habitat.

Streaked Horned Lark. Streaked horned lark critical habitat is centered on nesting beaches along the coast. Nests are established on bare ground, well above MHHW, and the birds do not forage on or near shellfish beds (Pearson and Hopey 2004 and 2005). Application of imidacloprid (Alternative 4) would be unlikely to adversely affect streaked horned lark or their nest sites because they do not occur on commercial shellfish beds within Willapa Bay or Grays Harbor.

Potential On-plot Impacts

Alternative 3 or 4 would be expected to cause on-plot impacts to zooplankton and benthic invertebrates through either death or paralysis. These impacts would be expected within the boundaries of the treatment plots as imidacloprid is applied directly to the substrate or in shallow water and will extend outward a considerable distance off-plot. Modeling of 2012 surface water data has shown that more than 5 times the area sprayed exceeds EPA’s acute marine endpoint. In areas with sediments containing higher organic carbon levels (Cedar River), Ecology has determined that impacts to Imidacloprid spraying resulted in exceedance of the “minor adverse effects” standard of the SIZ regulations (WAC 173-204-420), at both 14 and 28 days. No recovery was documented at this site as samples after 28 days were not collected. Imidacloprid binds to organic carbon, so these results for the Cedar River area may have been due to longer retention of imidacloprid in these sediments, posing a higher risk of toxicity to invertebrates found there. In such areas, on-plot recovery may be delayed compared to other areas with lower sediment organic carbon levels.

The Canadian environmental risk assessment showed that imidacloprid from terrestrial application, i.e. indirect entry into the aquatic environment, is “being measured at levels that are harmful to aquatic insects,” and that the continued use of imidacloprid is “not sustainable.” Health Canada has determined that “for the protection of the environment, PMRA is proposing to phase-out all the agricultural and a majority of other outdoor uses of imidacloprid over three to five years” (PMRA 2016). The EPA (2017) risk assessment similarly concluded chronic risks to marine invertebrates “from all foliar spray and combination application method scenarios” and that the “vast majority” of soil application methods, within indirect entry to marine waters, modeled resulted in “chronic risk concerns” for marine invertebrates. Using this, and other lines of evidence described above (e.g. Cedar River benthic abundance failures), Ecology has concluded that for both alternatives 3 and 4 there would be impacts in the short-term on plot for all site sprayed, and for long-term sites throughout Willapa Bay and Grays Harbor containing high TOC for benthic invertebrates.

The two reviewed crab studies (Patten and Norelius 2017, Osterberg et al. 2012), and in particular the field observations of affected crab after field-spraying in Patten and Norelius, confirm that Dungeness crab juveniles and planktonic forms are likely to be killed by the proposed application of imidacloprid on shellfish beds. Given the concentrations of imidacloprid required to produce tetany in crabs, as evidenced both in the lab and in field surveys, even with dilution by rising tide waters, impacts to juvenile crab will be observed on-plot, and immediately adjacent areas directly sprayed with imidacloprid during low tide conditions. The extent of off-plot effects is limited by the lack of field monitoring during previous spray events both at acute and chronic levels. This is a significant unknown, but Ecology acknowledges that impacts off-plot to juvenile crabs is likely to extend beyond areas previously surveyed during monitoring. Planktonic forms of Dungeness crab off-plot may be impacted by rising tidewaters carrying imidacloprid. Although the area that would receive imidacloprid applications each year (if the permit is issued) may be small, compared to the total size of Willapa Bay and Grays Harbor, the extent of off-plot migration of imidacloprid is likely to considerably expand the footprint of impacts. The total number animals that would be affected compared to the total number of animals present in these estuaries and surrounding areas is currently unknown.

Under Alternative 3 or 4, impacts to commensal species, e.g. *Cryptomya* clams, would occur directly due to the loss of burrowing shrimp. High efficacy in reducing burrowing shrimp will lead to a commensurate loss of commensal species on-plot and off-plot. During 2012 monitoring, off-plot impacts were delineated in-part by the density of dead commensal clam shells encountered.

Under Alternative 3 or 4, forage fish and groundfish may be impacted by shellfish bed treatment with imidacloprid, but these would be short-term impacts. The lower toxicity of imidacloprid to fish indicates that there is only a small potential for fish to be directly impacted by imidacloprid on-plot. Fish that enter a treated area immediately after application or those that feed extensively on imidacloprid-treated invertebrates may be exposed to high enough concentrations of imidacloprid to experience effects. In addition, reductions in invertebrate numbers on-plot would reduce the availability of prey items for fish that feed on these animals, and this effect would persist populations recovered from acute and chronic impacts from imidacloprid application. The long-term indirect impacts from reduced prey available are currently unknown but cannot be discounted.

It is highly unlikely that there would be on-plot effects to pollinators because bees and other pollinators are rare or absent from the intertidal, salt-water areas that would be treated. This absence is likely because there are no flowering plants present on the commercial shellfish beds to attract such pollinators. If pollinator use of such areas is assumed to occur, then under Alternative 3 or 4 on-plot impacts would be likely to occur when such use occurs in the interval between chemical spraying and the first rising tide to inundate the sprayed plots. Imidacloprid is acutely toxic to bees that are directly exposed to these chemicals. So it is reasonable to assume that any pollinators that were so exposed would die.

Direct toxicity to birds and mammals as a result of Alternative 3 or 4 is not expected on-plot given the low toxicity of imidacloprid to vertebrates. There could be minor effects to birds and mammals due to the potential short-term reduction in prey items present on treated areas. This would also be true for threatened, endangered, and protected species that occur or forage in the vicinity of treated plots. They are not likely to be present on-plot during the time of application, but may see a minor and temporary loss in prey items.

MITIGATION MEASURES

Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has currently not proposed any mitigation to reduce impacts described above to benthic invertebrates and Dungeness crabs. Under the proposed action, mitigation may be difficult to address all of the identified impacts. The best reasonable mitigation to reduce the identified impacts would be to reduce the amount of the pesticide applied or reduce the geographic area of pesticide application. Both of these mitigation measures would reduce the effectiveness of the proposed action and WGHOGA's goal to control burrowing shrimp. In practice, the only way to minimize impacts to commensal species would be minimize impacts to burrowing shrimp in which these species cohabitate. Ecology is not aware of any mitigation measures that would reduce impacts in high TOC areas given high persistence and mortality observed.

Under Alternative 4, conditions would be required in the NPDES permit to address the proposed action's impact on the benthic community. New information detailed in the section describe the chemical effects of the proposed action on and off plot, the biological effects on the benthic community of the proposed action, and biological effects on Dungeness crabs and other commensal invertebrate species of the proposed action. Given the high solubility of imidacloprid and the dynamic nature of the estuary, it is not possible for the proposed action to prevent imidacloprid from entering the water column nor to prevent it from being transported throughout the estuary resulting in currently unknown exposure and toxicity to non-target organisms thus furthering the impact of the proposed action on the benthic community.

If the permit was issued, specific mitigation measures would likely require imidacloprid to be administered on commercial shellfish beds in a manner consistent with the spray drift management techniques and treatment site requirements specified in the FIFRA Registrations for the flowable and granular formulations of imidacloprid. These state that applications must occur on beds exposed at low tide, and granular applications may be applied to beds under water using a calibrated granular applicator, operating from a floating platform or boat. Liquid applications from boats or ATVs would be limited by spray drift management measures to minimize or prevent exposure of imidacloprid to non-target terrestrial species or flowering terrestrial plants, and therefore would be unlikely to adversely affect local honey bee, bumble bee, butterfly, fish, mammal, or bird populations.

To avoid and minimize potential exposure to bees, the spray drift management requirements indicated in the FIFRA Registrations for the granular and flowable formulations of imidacloprid (Protector 0.5G and Protector 2F, respectively) would be employed (EPA 2013a and 2013b). Imidacloprid would be applied either to exposed mudflats at low tide or to shallow water covering shellfish beds during an out-going tide. Drift management techniques include, among other things, a controlled nozzle applicator used during low wind speeds, and drift to blooming crops or weeds is a violation of the label. Additional spray drift management requirements are described below.

With regard to Alternative 4, the WSDA Special Pesticide Registration Program Coordinator stated during preparation of the 2015 FEIS that, in his professional opinion, there is no risk to bees from the application of imidacloprid (either granular or flowable formulation) to tidal flats despite proposed aerial applications using a helicopter. Implementing appropriate spray drift management techniques for the flowable formulation of imidacloprid, or maintaining an adequate buffer between the imidacloprid treatment areas and blooming plants, would mitigate potential risk to bees (personal communication with Erik Johansen, Policy Assistant, Washington State Department of Agriculture, March 19, 2014). The current permit application does not include aerial applications from helicopters, further reducing potential spray drift and effects to bees or other pollinators.

The FIFRA Registrations limit the application of imidacloprid to the period between April 15 and December 15. This application window would limit exposure to herring and sand lance during their peak spawning periods, and would avoid the late winter migration of birds. However, early fall migration would overlap with the current application. Application of imidacloprid between April 15 and July 15 would overlap with the window of juvenile salmon out-migration, and with spring and fall bird migrations. In addition, within Willapa Bay and Grays Harbor, WDFW's construction work windows (WAC 220-660-330) identify periods when WDFW has identified as primary periods for salmonid outmigration. Avoidance of spraying during this period would limit direct exposure to salmonids and to their prey species. However, this does not address potential chronic impacts which may be incurred during other spray windows. Fall migration is generally considered to begin in early October. Impacts to the food base of migrating waterfowl would be similar to those identified for fishes, loss of a portion of their prey base. Impacts from late season spraying would be greater than summer spraying. Appropriate mitigation would include restricting spray dates to outside periods of juvenile salmonid and waterfowl migration.

Imidacloprid would not be applied to any areas with shellfish to be harvested within 30 days of treatment (FIFRA Registrations 88867-1 and 88867-2; EPA 2013a and 2013b). In addition, a 25-foot buffer zone would be maintained when treatment is by hand spray. All shellfish beds to be treated would be properly staked and flagged to protect adjacent shellfish and water areas.

The FIFRA Registrations for the flowable and granular formulations of imidacloprid (EPA 2013a and 2013b) establish a series of application methods for spray drift management that would minimize the risk of exposure to non-target species. Granular applications would be made at the lowest possible height (scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, back pack reservoirs with hand-held sprayers and/or belly grinders) that is safe to operate and reduce exposure of the granules to wind. When applications are made crosswind, FIFRA Registration conditions would require the applicator to compensate for displacement by adjusting the path of the application equipment upwind. Swath adjustment distance should increase with increasing drift potential. For the flowable form of imidacloprid (Protector 2F), applicators would avoid and minimize spray drift by following detailed instructions in the FIFRA Registration, including measures to control droplet size, making applications at the lowest possible height (scows or shallow-draft boats, all-terrain vehicles equipped with a spray boom, back pack reservoirs with hand-held sprayers and/or belly grinders) that is safe and practical and reduces exposure of droplets to evaporation and wind, applying during appropriate wind speeds, avoiding temperature inversions, and using authorized application methods and equipment.

LOCALIZED, SHORT-TERM IMPACTS

Alternative 3 or 4 would be expected to cause on-plot impacts to zooplankton and benthic invertebrates through either death or paralysis. These impacts would be expected within the boundaries of the treatment plots as imidacloprid is applied directly to the substrate or in shallow water, and could extend to adjacent off-plot areas, particularly those closest to the treated plot that would be exposed to the highest concentrations of imidacloprid as it is carried off-plot by the incoming tide. These impacts are generally expected to be localized and short-term, as field trials have shown that benthic invertebrate populations recover (e.g., re-populate treated plots), although high variability confounds this. However, one set of studies in an area of sediments containing higher organic carbon levels (Cedar River), found incomplete recovery for several invertebrate organisms after 28 days.

The two reviewed crab studies (Osterberg et al. 2012, Patten and Norelius 2017), and in particular the field observations during experimental imidacloprid application monitoring, confirm that Dungeness crab juveniles, and likely planktonic forms, will be killed by the proposed application of imidacloprid on shellfish beds. Impacts to juvenile crab were documented where they were surveyed, an area limited to the edge of spray plot areas (as shown in 2014 field trials). These exceeded SMS standards of more than minor impact to biologic resources (WAC 173-204-420). The extent of off-plot impacts may be significant but are currently unknown. It is likely impacts off-plot occur at both the acute and chronic level. Planktonic forms of Dungeness crab off-plot are also likely to be impacted by rising tidewaters carrying imidacloprid.

Sub-lethal toxicity may be compounded by repeated exposures because imidacloprid has irreversible binding to neurological receptors so that each subsequent exposure reduces the organism’s neurological capacity. Rondeau et al. (2014) showed that terrestrial insects exposed to imidacloprid have delayed mortality which may not be detected in studies with less than 10 days duration. These comments suggest that there is significant uncertainty in the toxicity thresholds and that with more information they are likely to be lower. In addition, multiple application events on different plots over consecutive days may create multiple exposures throughout local surface waters. It is not known what duration of exposure is needed to create an acute effect and whether a short "pulse" of high concentrations is less likely to create an effect than a sustained exposure of hours.

All of the on-plot water samples immediately after treatment significantly exceed the EPA acute toxicity endpoint of 16.5 ppb, with averages of 796 ppb (Taylor and Coast plots 2014) and 290 ppb (Nisbet plot 2014), and 800 ppb (Cedar River 2014). Maximum concentrations on-plot were measured up to 1,600 ppb, which is approximately 100 times the acute toxicity endpoint published by EPA.

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Given Ecology's current understanding of best available science and monitoring reports, in areas where the sediment is high in TOC, significant unavoidable impacts to benthic invertebrates will occur and extend for more than the short-term, i.e. longer than 14 days. No recovery in high TOC areas has been observed during the monitoring period. Taking into account the potential of tidal waters to distribute imidacloprid off-plot for significant distances while eventually diluting due tidal interactions with cleaner waters, and the significant exceedances of EPA criteria combined with known long-term binding and delayed mortality (e.g. Rondeau et al. 2014), this has lead Ecology to the reasonable conclusion that the proposed action will result in significant unavoidable on- and off-plot impacts to benthic invertebrates which will occur directly after spraying in high TOC areas.

The direct impact to commensal species associated with burrowing shrimp are unavoidable. If target efficacies are achieved by WGHOGA to control burrowing shrimp, non-target commensal species will be also be killed at similar rates. If greater than 50% of burrowing shrimp on-plot are killed due to imidacloprid, then more than 50% of the dependent commensals on plot would also be killed. Chapman et al. (2012) stated, "Functional and absolute losses of *Upogebia* species reduce their ecosystem services and dependent symbionts," clarifying that control of burrowing shrimp will also lead to negative impacts to species living with the shrimp.

No known significant unavoidable adverse direct impacts to threatened, endangered or protected species would be expected as a result of implementing Alternative 4. There is a low probability of direct adverse effects to birds, fish, or other vertebrates. However, similar to the EPA, Ecology acknowledges that indirect impacts to the food web may occur which may be unavoidable as off-plot drift of imidacloprid is unavoidable. No monitoring or published research has occurred which documents chronic impacts and impacts to food webs. However, recent peer-reviewed publications have identified food-web level impacts for terrestrial species (Hallman et al 2014, Woodcock et al 2016, Hallman et al. 2017). This remains a significant unknown for marine estuaries. Invertebrates, including Dungeness crab would likely be killed or displaced from treatment areas.

As of the time of this publication, Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) has not proposed any mitigation to address this impact to the benthic invertebrate population or marine zooplankton off-plot.

3.3.6 Human Health

AFFECTED ENVIRONMENT

3.3.6.1 *Willapa Bay*

Information regarding human health in the Willapa Bay area is described in the 2015 FEIS (Chapter 3, Section 3.2.6, pages 3-55 through 3-56). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

3.3.6.2 *Grays Harbor*

Information regarding human health in the Grays Harbor area is described in the 2015 FEIS (Chapter 3, Section 3.2.6, page 3-56). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

POTENTIAL IMPACTS

The potential impacts to human health of Alternatives 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.6, pages 3-58 through 3-60). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

Alternative 4 would likely have no effect on human health or potentially affect only a very small number of people (primarily pesticide handlers and applicators) in Willapa Bay and Grays Harbor.

There would be a risk of exposure to a small number of people who would handle and apply imidacloprid. Up to 500 acres would be treated per year: up to 485 acres within Willapa Bay and up to 15 acres per year within Grays Harbor on commercial clam and oyster beds (see SEIS Chapter 2, Section 2.8.4). Imidacloprid is a systemic insecticide of the chemical class of chloronicotinyls-neonicotinoids; specifically, it is a chloronicotinyl nitroguanidine. The compound acts on the nicotinergic acetylcholine receptors (nAChR) in the nervous system of insects, blocking the transmission of nervous signals in the post-synaptic region, resulting in paralysis and death. Mammals, birds, fish, and amphibians, are much less sensitive to imidacloprid than certain aquatic invertebrates because of differences in the nAChR receptors in vertebrates. Imidacloprid is not considered acutely toxic to humans via dermal or inhalation exposure routes even though it is designated an acute oral toxicant. The 2015 FEIS discusses in detail potential impacts to humans (Chapter 3, Section 3.2.6, pages 3-58 through 3-60).

The Health Canada (2016) risk assessment evaluated the effects of imidacloprid on humans, using an analysis largely based on studies of other mammals, as well as an extensive review of potential exposure pathways (e.g., ingestion or adsorption in agricultural workers using imidacloprid). There is no direct analysis of the likelihood of imidacloprid toxicity in humans, but the general discussion indicates a low risk, as for other vertebrates. Health Canada (2016) reviewed case reports of attempted suicides through ingestion of imidacloprid. Based on this work they identified that imidacloprid toxicity *"symptoms in humans consist of nausea, vomiting, headache, dizziness, abdominal pain, and diarrhea."* Of 56 attempted suicides, *"recovery was seen in all 56 patients reported."*

Potential On-plot Impacts

The on-plot risk to human health due to the application of imidacloprid under either of the action alternatives would only apply to the small number of people that handle and apply the chemicals. Required safety measures for applicators, including personal protective equipment (e.g., gloves, long sleeved shirts) are expected to prevent adverse effects during application (discussed further below).

MITIGATION MEASURES

While no mitigation for potential impacts to human health with implementation of Alternative 4 are indicated by the results of testing imidacloprid, Federal and State laws require various measures to be implemented to protect human health. These measures would mitigate potential significant adverse impacts. The following conditions imposed by the imidacloprid FIFRA Registrations (USEPA 2013a and 2013b) would be protective of human health:

- The public would be notified prior to imidacloprid applications through signs, website postings, and e-mail to interested parties.
- All public access areas within one-quarter mile and all public boat launches within one-quarter mile radius of any bed scheduled for treatment with imidacloprid would be posted. Public access areas would be posted at 500-foot intervals at those access areas more than 500 feet wide.
- Signs would be posted at least 2 days prior to aerial treatment and will remain for at least 30 days after treatment. Signs shall say "Imidacloprid will be applied for burrowing shrimp control on [date] on commercial shellfish beds. Do not Fish, Crab or Clam within one-quarter mile of the treated area." The location of the treatment area would be included on the sign. The WGHOGA IPM Coordinator would be responsible for posting, maintaining, and removing these signs.
- No bed would be treated with imidacloprid if it contains shellfish within 30 days of harvest.
- A 25-foot buffer zone would be maintained between the imidacloprid treatment area and the nearest shellfish to be harvested within 30 days when treatment is by hand.
- Imidacloprid would not be applied during Federal holiday weekends.

Under Alternative 4, WGHOGA proposes to also use a website in lieu of newspaper announcements for public notification of specific dates of proposed imidacloprid applications in Willapa Bay and Grays Harbor. The website would include a link for interested persons to request direct notification regarding proposed treatment dates and locations. The WGHOGA IPM Coordinator would send e-mail notifications to registered interested parties, as needed.

Washington State law requires that imidacloprid be used and applied only by certified applicators or persons under the direct supervision of a certified applicator.

To mitigate potential exposure for persons applying imidacloprid, applicators would be required to wear approved Personal Protective Equipment (PPE), and would be trained in pesticide applications. The following PPE would be required of all imidacloprid applicators and handlers, as required by the FIFRA labels (i.e., required pursuant to Federal law) and would mitigate potential significant impacts:

- Long-sleeved shirt and long pants;
- Chemical-resistant gloves made of any waterproof material such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene, polyvinylchloride (PVC) or Viton;
- Shoes and socks;
- Protective eyewear; and
- Dust mask when using Protector 0.5G, the granular formulation of imidacloprid.

Manufacturer’s instructions must be followed for cleaning/maintaining PPE. If instructions for washables do not exist, detergent and hot water would be used. PPE should be kept and washed separately from other laundry.

Boats would also need to use a hopper, hopper loaders, and possibly a barge to hold additional chemicals, equipment, and personnel.

Alternative 4 specifically excludes aerial (helicopter) applications of imidacloprid from the permit application, which would decrease the potential for drift compared to Alternative 3.

LOCALIZED, SHORT-TERM IMPACTS

Localized and short-term impacts to human health due to the application of imidacloprid under either of the action alternatives would only apply to the small number of people that handle and apply the chemicals. Required safety measures for applicators, including personal protective equipment (e.g., gloves, long sleeved shirts) are expected to prevent adverse effects during application (discussed further below).

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with pesticide registrations and regulations (including Washington State Department of Agriculture General Pesticide Rules), no significant unavoidable adverse impacts to human health would be expected as a result of implementing Alternative 4. Applicators and handlers would be required to use appropriate application equipment and wear specified Personal Protective Equipment. Public notification requirements would inform landowners, adjacent landowners, lessees, interested individuals, recreational users and others of proposed application dates and locations so that potential direct exposure could be avoided. As a dietary precaution, avoidance and waiting periods are specified between dates of pesticide application and shellfish harvest for consumption.

3.3.7 Land Use

AFFECTED ENVIRONMENT

3.3.7.1 *Willapa Bay*

Information regarding land use around Willapa Bay is described in the 2015 FEIS (Chapter 3, Section 3.2.7, pages 3-64 through 3-65). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

3.3.7.2 *Grays Harbor*

Information regarding land use around Grays Harbor is described in the 2015 FEIS (Chapter 3, Section 3.2.7, pages 3-66 through 3-67). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

POTENTIAL IMPACTS

The potential impacts of Alternatives 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.7, page 3-68). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

There would be no direct or indirect impact to upland land uses from Alternative 4.

Due to the distance between existing cranberry farms and the nearest commercial shellfish beds adjacent to Willapa Bay and Grays Harbor, and the proposal under Alternative 4 to apply spray applications only at ground level (i.e., no use of helicopters), it is expected that spray drift management requirements for the use of imidacloprid under Alternative 4 would avoid risk of exposure to pollinators present at these farms during the approximate period of April 15 through December 15 each year.

Potential On-plot Impacts

There would be no on-plot risk to land use due to the application of imidacloprid under either of the action alternatives.

MITIGATION MEASURES

The NPDES permit for Alternative 4, if issued, would include public notification requirements at public and private shoreline access sites that would be the same as those described above under mitigation measures for Human Health (SEIS Section 3.2.6), or below under mitigation measures for Recreation (SEIS Section 3.2.8).

Federal and State regulations contain measures to mitigate potential significant impacts to land and shoreline use. The FIFRA Registrations for the use of imidacloprid with IPM techniques (Alternative 4) include precautions and spray drift management practices for the use of either the granular or flowable forms of imidacloprid on commercial clam or oyster tidelands. Primarily, no direct treatment on terrestrial blooming crops or weeds, or drift to blooming crops or weeds, would be allowed. This would avoid the potential for impacts to pollinators.

The WSDA Special Pesticide Registration Program Coordinator stated during preparation of the 2015 FEIS that, in his professional opinion, there is no risk to bees from the application of imidacloprid (either the granular or flowable formulation) to tidal flats. Implementing appropriate spray drift management techniques for the flowable formulation of imidacloprid, or maintaining an adequate buffer between the imidacloprid treatment area and blooming plants would mitigate potential risk to bees (personal communication with Erik Johansen, Policy Assistant, Washington State Department of Agriculture March 19, 2014). Alternative 4 specifically excludes aerial applications of imidacloprid by helicopter from the permit application.

LOCALIZED, SHORT-TERM IMPACTS

There would be no localized, short-term impacts to land use due to the application of imidacloprid under either of the action alternatives.

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations and regulations, no significant unavoidable adverse impacts to land or shoreline use would be expected as a result of implementing Alternative 4.

3.3.8 Recreation

AFFECTED ENVIRONMENT

Ecology will review the 2016 WGHOGA application for NPDES permit coverage for the use of imidacloprid for burrowing shrimp population control on commercial clam and oyster beds in Willapa Bay and Grays Harbor for potential effects on beneficial uses of surface waters, which include recreational activities such as swimming, SCUBA diving, water skiing, boating, fishing and aesthetic enjoyment. Washington State surface water quality regulations and standards

(RCW 90.48; Chapter 173-201A WAC) authorize Ecology to establish criteria for waters of the State and to regulate impacts to water quality.

3.3.8.1 *Willapa Bay*

Information regarding recreation in Willapa Bay is described in the 2015 FEIS (Chapter 3, Section 3.2.8, pages 3-69 through 3-72). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

3.3.8.2 *Grays Harbor*

Information regarding recreation in Grays Harbor is described in the 2015 FEIS (Chapter 3, Section 3.2.8, pages 3-72 through 3-75). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

POTENTIAL IMPACTS

The potential impacts to Recreation of Alternative 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.8, page 3-76). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

Under Alternative 4, imidacloprid applications on up to 485 acres per year in Willapa Bay could affect approximately 1.1 percent of total exposed tideland acreage within the bay per year (see SEIS Chapter 2, Section 2.8.3). Imidacloprid applications on up to 15 acres in Grays Harbor per year could affect approximately 0.04 percent of total exposed tideland acreage within the harbor per year (see SEIS Chapter 2, Section 2.8.4). These small areas of application each year would minimize the potential for exposure of persons using exposed tide flats for recreation in Willapa Bay or Grays Harbor. Further, as described above in the Human Health section, based on the relatively low acute toxicity and short half-life of imidacloprid in sediment and surface water, there is a very low likelihood of possible human health impacts from imidacloprid exposure to the general population engaging in recreational activities (e.g., shellfish gathering, fishing, swimming). Imidacloprid is classified as a "Group E" carcinogen indicating *"no evidence of carcinogenicity in humans"* (USEPA 1999a, 1999b, 2003).

As discussed in SEIS Section 3.3.5, impacts to birds, fish, and mammals from imidacloprid applications are not expected, and therefore no impacts to recreation involving these animal groups are expected. Short-term impacts to invertebrates are expected on the sprayed plots, including to Dungeness crab that are subject to an active fishery by the public. But the small areas being sprayed compared to the overall size of the Willapa Bay and Grays Harbor estuaries are expected to result in no population-level effects to this species, and therefore no significant impacts to recreational or commercial harvest (see Section 3.3.5 for additional analysis of impacts to Dungeness crab).

Potential On-plot Impacts

Chemical applications would be small-scale activities that occur on privately-owned or leased tidelands designated for commercial shellfish aquaculture. These areas are normally located well away from public gathering areas. People do not tend to walk on the commercial shellfish beds as most are remote and are private farm lands. Therefore, recreational swimmers, fishers, and shellfish gathers are unlikely to be present at the treatment sites, and potential exposure to the public would be from more distant locations. For these reasons, there would be no expectation of on-plot risk to recreation due to the application of imidacloprid under either of the action alternatives.

MITIGATION MEASURES

Federal and State regulations would mitigate potential impacts to recreational users of Willapa Bay and Grays Harbor. The FIFRA Registrations would require public access points within a one-quarter-mile (1,320-foot) radius of any commercial shellfish bed scheduled for applications of either Protector 0.5G or Protector 2F to be posted with a “WARNING” OR “CAUTION” sign that states *“Imidacloprid will be applied for burrowing shrimp control on [date] on commercial shellfish beds. Do not fish, crab or clam within one-quarter mile of the treated area.”* The location of the treatment area would be included on the sign. If the public access area at any of these locations is more than 500 feet wide, additional signs would be posted at 500-foot intervals. The WGHOGA IPM Coordinator would be responsible for posting, maintaining and removing these signs.

Under Alternative 4, WGHOGA proposes to also use a website in lieu of newspaper announcements for public notification of specific dates of proposed imidacloprid applications in Willapa Bay and Grays Harbor. The website would include a link for interested persons to request direct notification regarding proposed treatment dates and locations. The WGHOGA IPM Coordinator would send e-mail notifications to registered interested parties, as needed.

Further, the 2016 WGHOGA proposal for the use of imidacloprid (Alternative 4) specifically excludes aerial (helicopter) applications from the permit.

LOCALIZED, SHORT-TERM IMPACTS

There would be no localized, short-term impacts to recreation due to the application of imidacloprid under either of the action alternatives.

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Based on currently available information and studies, and with full and successful implementation of all applicable requirements to comply with the conditions of pesticide registrations, regulations, and public notification requirements, no significant unavoidable adverse impacts to recreation would be expected as a result of implementing Alternative 4.

3.3.9 Navigation

AFFECTED ENVIRONMENT

3.3.9.1 *Willapa Bay*

Information regarding navigation in Willapa Bay is described in the 2015 FEIS (Chapter 3, Section 3.2.9, pages 3-77 through 3-78). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

3.3.8.2 *Grays Harbor*

Information regarding recreation in Grays Harbor is described in the 2015 FEIS (Chapter 3, Section 3.2.9, pages 3-78 through 3-79). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS.

POTENTIAL IMPACTS

The potential impacts to navigation of Alternatives 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.9, page 3-79). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

As with each of the previously-evaluated alternatives, there would be no significant adverse impacts to navigation as a result of Alternative 4. The tidelands where commercial shellfish beds are located are staked for various purposes at various times of the year. For this reason, stakes placed to identify beds for applications of imidacloprid under Alternative 4 would not constitute a new or different obstruction to watercraft that navigate the shallow areas of Willapa Bay or Grays Harbor where these shellfish beds are located. There would be no stakes or obstructions placed in the main navigation channels of either bay.

Potential On-plot Impacts

There would be no on-plot risk to navigation due to the application of imidacloprid under either of the action alternatives.

Mitigation Measures

No mitigation measures for impacts to navigation would be required with the No Action Alternative.

If Alternative 3 or Alternative 4 were selected for implementation, public notification requirements at marinas and boat launch sites would be the same as those described above under mitigation measures for Recreation (FEIS Section 3.2.8). These measures would mitigate potential significant adverse impacts.

Localized, Short-term Impacts

There would be no localized, short-term impacts to navigation due to the application of imidacloprid under either of the action alternatives.

Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts to navigation would be expected as a result of implementing Alternative 4.

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Appendix A

Literature Review

The Final Environmental Impact Statement (FEIS; Ecology 2015) included a review of more than 100 scientific reports and papers that evaluated the ecology of burrowing shrimp, physical and biological conditions in Grays Harbor and Willapa Bay, and effects of imidacloprid on invertebrate and vertebrate animals, including species listed under the Endangered Species Act (ESA). That literature review is incorporated in a number of sections of the FEIS, and is the basis for much of the summary of imidacloprid's expected effects under the permit conditions analyzed in the 2015 FEIS that is presented in Chapter 1, Section 1.6 of that document. In general, the FEIS concluded that the application of imidacloprid would have minor to moderate effects on non-target invertebrates (e.g., polychaete worms, honey bees), minor effects on vertebrate species, including birds, and minor or insignificant effects on ESA-listed species.

Since the FEIS was published, a number of new studies on the effects of imidacloprid have been published. These new studies include three very large and comprehensive literature surveys and numerous peer reviewed journal articles. Health Canada (2016), also known as PMRA, conducted a comprehensive review of the toxicology literature on imidacloprid and published a report summarizing the expected effects of agricultural uses of imidacloprid on the environment based on that review, and on modeled and field data-based estimates of imidacloprid concentrations. The document included evaluation of toxicity to humans; fish, birds and mammals; terrestrial and aquatic invertebrates, both freshwater and marine; and, assessed exposure pathways and possible effects to humans. The U.S. Environmental Protection Agency (EPA) issued two large literature reviews. The EPA (2015) review assessed the effects of imidacloprid on pollinators, with some emphasis on honeybees. The EPA (2017) review was similar to the Health Canada study in that it included a comprehensive literature review and assessment of imidacloprid toxicity in the environment, and both addressed aquatic ecosystems and species. Although both reviews used similar data sets, each used a different approach to estimating imidacloprid toxicity to various groups of animals. Ultimately, EPA (2017) concluded that it's "risk findings…were comparable" to those from the Health Canada study. Each of these studies is described in some detail below.

Other published studies relevant to WGHOGA's proposed use of imidacloprid are available, some published since the 2015 FEIS was published. Most of these studies are covered in the Health Canada and EPA reviews noted above. Numerous studies address potential impacts to freshwater ecosystems, particularly aquatic insects. Marine studies are limited, perhaps because most imidacloprid applications are for terrestrial croplands that drain to freshwater habitats. The absence of direct spraying to marine environments, other than the field trials in Willapa Bay, also limits the availability of studies on marine environments. Extrapolating the results of freshwater studies to marine environments is challenging. Some freshwater studies have reported results for crustacean and mollusk species, which tend to dominate marine in marine systems (i.e., as opposed to insects). These results are emphasized in the literature review.

Finally, the EPA (2017) analysis of the effects of imidacloprid to marine invertebrates was based, in-part, on unpublished scientific studies. Ecology used a Freedom of Information Act (FOIA) request to the EPA to obtain these studies, which are also reviewed below.

EPA. 2017. Preliminary aquatic risk assessment to support the registration review of imidacloprid. PC Code 129099. DP Barcode 429937. USEPA, Office of Chemical Safety and Pollution Prevention, Washington DC. Prepared by USEPA Office of Pesticide Programs, Environmental Fate and Effects Division, Washington DC.

Many regulators and scientists were awaiting publication of the EPA Risk Assessment, both because it promised to be a comprehensive review of imidacloprid risks to the environment, and because its source, EPA, has broad jurisdiction to regulate pesticides under a variety of statues, including the Clean Water Act. Additionally, EPA has registered imidacloprid for the control of burrowing shrimp in Willapa Bay and Grays Harbor. The EPA Risk Assessment contains an extensive review of the scientific literature on the toxicity of imidacloprid to aquatic life forms, including fish and amphibians. The approach involves: review of the toxicity literature to determine appropriate toxicity thresholds, modeling of agricultural uses of imidacloprid to estimate concentrations of imidacloprid that could be released to the environment, and a comparison of the two metrics to determine the potential environmental risks. EPA (2017) also includes an extensive review of field data on imidacloprid concentrations in surface waters of the U.S., and then compares those levels to its selected toxicity thresholds to establish whether toxic concentrations of imidacloprid are present in the environment.

EPA's analysis uses several metrics: the Risk Quotient (RQ) is the ratio of modeled or measured imidacloprid concentrations divided by the concentration known to cause toxicity. RQs, in turn, are compared to EPA's selected Levels of Concern (LOC), which is the multiple of the RQ at which the agency assumes imidacloprid is having a negative effect. RQs are calculated for groups of animals (e.g., freshwater insects, marine invertebrates), and for two different exposure types: acute, which is typically applied to exposure periods of 96-hours or less, and chronic, which applies to longer-term exposures (e.g., 21-days, 28-days, etc.).[1] Criteria chosen to represent acute and chronic toxicity were selected by EPA using results for the most sensitive animal types from among those studies that met its criteria for data quality. Calculating RQs using the most sensitive animals is a standard approach in risk assessment of toxicants in order to protect all species present in that system and to cover other sensitive species which may not have been tested yet. This turns out to be particularly true for imidacloprid, which shows widely varying levels of toxicity among different groups of animals, and among species

[1] Most such studies are "static", meaning a known concentration of imidacloprid is established at the start of the test and no more imidacloprid is added during the length of the trial. In a static test it is possible that the actual concentration of imidacloprid will fall below the initial value over time due to degradation, particularly over long trials (e.g., 14 or 28 day chronic tests).

within each group. In most cases, the toxicity data EPA used were either LC_{50} (Median Lethal Dose) or EC_{50} (Maximal Effective Concentration) values. LC_{50} is the concentration of imidacloprid that killed 50 percent of the test organisms in the allotted test time (e.g., 24-hours, 48-hours, 96-hours, etc.). The EC_{50} is the concentration of imidacloprid that produces 50 percent of the maximum response (i.e., halfway between the baseline and the maximum response). EC_{50} values are used where less than 100 percent of the test organisms are killed, or where the metric of interest is something other than mortality (e.g., paralysis, reduced growth). Both LC_{50} and EC_{50} values were typically expressed as µg a.i./L (micrograms active ingredient per liter). A value of 1 µg a.i./L is the same as saying one part per billion of imidacloprid per liter of water.

EPA (2017) makes three broad conclusions. First, there is little or no direct risk of imidacloprid toxicity for groups other than invertebrates. *"No direct risk to fish or aquatic phase amphibians is indicated…since all acute and chronic RQs were well below their respective LOCs.[2]"* EPA estimated an acute LC_{50} for freshwater fish of 229,000 µg a.i./L, an acute LC_{50} of 163,000 µg a.i./L for saltwater fish, and a chronic No Observed Adverse Effects Concentration (NOAEC) of 6,420 µg a.i/L for saltwater fish. For plants, EPA noted *"[a]quatic plants will not be assessed as available data for vascular and non-vascular aquatic plants indicate toxicity endpoints that are several orders of magnitude above the highest estimated environmental concentrations in surface waters."* Imidacloprid toxicity derives from its ability to bind to specific sites on nerves (nicotinic acetylcholine receptors − nAChRs), causing them to malfunction (e.g., excessive nervous stimulation, blockage of the receptor sites). Nerves in vertebrates are different from those in invertebrates (i.e., differences in receptor sites and associated neurochemicals), and these differences make vertebrates broadly resistant to imidacloprid toxicity. Plants lack a nervous system. EPA (2017) did not analyze toxicity to birds or mammals, but states it plans to do so in a future version of its risk assessment.

Despite concluding that direct effects of imidacloprid on vertebrates are unlikely, EPA (2017) noted that animal groups could be indirectly affected by reductions in invertebrate prey that are susceptible to imidacloprid; The RA states, "**the potential exists for indirect risks to fish and aquatic-phase amphibians indirectly** through reduction in aquatic invertebrates that comprise their prey base" (EPA bolded). Impacts to vertebrate consumers would be expected to increase in severity where reductions in their prey are extensive or chronic. Several authors, some reviewed here or by EPA (2017), have also raised concerns over indirect impacts to food webs from imidacloprid or other neonicotinoid pesticides (e.g., Gouslon 2013, Gibbons et al. 2014, Hallman et al. 2014, van der Sluijs et al. 2014, Chagnon et al. 2015, Sanchez-Bayo et al. 2016).

The second broad conclusion is the *"relatively high sensitivity of aquatic insect species compared to other classes of arthropods or other phyla"* to imidacloprid toxicity. For the

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2 EPA noted "one aquatic effects data gap was identified for chronic effects of imidacloprid on saltwater fish". Given this, EPA used the ratio of acute to chronic toxicity values to estimate a chronic NOAEC (No Observed Adverse Effects Concentration), which served as its basis for concluding no chronic effects are expected for saltwater fish.

most sensitive mayflies, EPA found acute EC_{50} values as low as 0.77 µg a.i./L, and chronic NOAEC values as low as 0.01 µg a.i./L. In more than 50 percent of its modeled imidacloprid scenarios (i.e., for various types of agricultural uses of imidacloprid), EPA found potential for acute toxicity to the most sensitive aquatic insects (e.g., mayflies). Extensive evidence of chronic toxicity was also found (e.g., toxicity in the "vast majority" of modeled scenarios for soil applications).

The final broad conclusion is that imidacloprid is present in many freshwater bodies of the U.S. in concentrations that would result in toxicity to sensitive aquatic insects and crustaceans (e.g., seed shrimp). Its analysis of estuaries and saltwater bodies was limited by the available data on imidacloprid concentrations in these habitats, but EPA concluded that chronic toxicity to crustaceans in saltwater environments is possible (e.g., toxicity in 39 percent of their modeled soil applications).

EPA (2017) noted that, "imidacloprid is classified as very highly toxic to both freshwater and saltwater invertebrates on an acute exposure basis." In its review of the literature EPA (2017) confirmed that status for many groups of animals, but also documented a very wide range of toxicities to imidacloprid." Within groups (e.g., among aquatic insects), the range of toxicity could vary over four orders of magnitude or more (i.e., the difference between a value of 1 and a value of 10,000), while between groups (e.g., vertebrates compared to aquatic insects) the range of toxicity could vary over five orders of magnitude (i.e., the difference between 1 and 100,000).

Because the majority of the invertebrates in Willapa Bay and Grays Harbor are crustaceans, two sections of EPA (2017) are particularly relevant to the proposed NPDES permit for WGHOGA: its analysis of freshwater crustaceans, and its analysis of saltwater crustaceans. For freshwater crustaceans, EPA examined 15 species including water fleas (Branchiopoda), amphipods and isopods (Malacostraca), and seed shrimp (Ostracoda). They found that seed shrimp were the most sensitive group, with acute EC_{50} values of 1–3 µg a.i./L. EPA noted that this group is *"widely distributed in freshwater and saltwater ecosystems"* and are *"considered important components of the aquatic food web."* Thus, impacts to ostracods could have broader effects on aquatic food chains. One reviewed study found that *Ceriodaphnia dubia* (a species of water flea) had a 48-hour LC_{50} of 2.1 µg a.i./L, making it the second most sensitive freshwater crustacean examined by EPA. EPA found that other water fleas were resistant to imidacloprid toxicity, with acute LC_{50} values of 5,000 µg a.i./L or more. Finally, EPA's literature review found freshwater amphipods and isopods had acute LC_{50} and EC_{50} values of 17–74 µg a.i./L. Data on chronic effects to freshwater crustaceans were limited. EPA reported 28-day NOAEC values of 1–3.4 µg a.i./L for two amphipods and one isopod, and an 8-day Lowest Observable Adverse Effect Concentration (LOAEC) of 0.3 µg a.i./L for a species of water flea. EPA also noted a report of runoff from treated grass that resulted in "(e)xtensive mortality of crawfish."

For saltwater invertebrates, EPA (2017) found only a limited number of studies covering seven estuarine or marine species, five of which were crustaceans. Acute toxicity values ranged widely, from a low LC_{50} of 10 µg a.i./L for blue crab megalopae (a planktonic stage), to an LC_{50} of 361,000 µg a.i./L for brine shrimp. The blue crab study (Osterberg et al. 2012) is of particular interest given its possible relevance to imidacloprid effects on Dungeness crab in Grays Harbor and Willapa Bay, and so is reviewed separately below. The study was deemed *"qualitative,"* so EPA chose to use *"the lowest acceptable (quantitative) acute toxicity value of 33 µg a.i./L …for estimating risks to saltwater aquatic invertebrates."* The value of 33 µg a.i./L is the 96-hour LC_{50} for a species of mysid shrimp (*Americamysis bahia*)[3]. EPA notes that this value is *"42X less sensitive than that for freshwater invertebrates."* For chronic toxicity of saltwater invertebrates, EPA (2017) again used data on *A. bahia* to develop a 28-day NOAEC value of 0.163 µg a.i./L and a LOAEC of 0.326 µg a.i./L based on *"significant reductions in length and weight."* EPA (2017) includes only two chronic studies of imidacloprid effects on saltwater invertebrates. If a larger database had been available, it seems likely lower values for chronic toxicity would have been noted for one or more invertebrate types, especially given the consistent pattern of wide variation in imidacloprid toxicity among species.

None-the-less, EPA provides useful information on both acute and chronic endpoints. The EPA's preliminary risk assessment proposes acute (peak exposure concentrations) and chronic (21-day exposure for invertebrates) marine surface water criteria (Table X.x) which are then compared to other recent risk assessments conducted by other regulating entities. The chronic endpoint of 0.16 ug a.i./L is designed to protect sensitive invertebrates at a level low enough to not affect reproduction, therefore taking into account non-lethal impacts to imidacloprid that would not be measured solely through benthic abundance surveys. The EPA saltwater toxicity endpoint is higher than the Health Canada endpoint based upon differing analysis methods (lowest endpoint used by EPA vs. HC_5 used by Health Canada); although EPA also notes that this may in combination to "limited data available for saltwater invertebrates."

[3] Given EPA's use of a LOC of 0.5, this translates into a toxicity screening criterion for saltwater invertebrates of 33/0.5= 16.5 µg/l. Later, this literature review covers results for the 2014 Field Trials of imidacloprid in Willapa Bay. Both in that analysis, and in the field trials reviewed in the FEIS, a toxicity screening threshold of 3.7 µg/l was used, based on $1/10^{th}$ the acute LC_{50} value obtained in a separate study of imidacloprid's effects on mysid shrimp.

Table x.x – Comparison of Recent Regulatory and Non-Regulatory Aquatic Risk Assessments for Imidacloprid (copied from EPA 2017).

Endpoint Description	USEPA 2016	PMRA 2016	EFSA 2014	BCS 2016
Freshwater Invertebrates (µg ai/L)				
Acute Endpoint (Basis)	**0.39** (Lowest EC_{50} of 0.77/2)	0.36 (Acute HC5)	0.098 (Acute HC5 of 0.49/5)	1.73 (Acute HC5)
Chronic Endpoint (Basis)	**0.01** (Lowest NOAEC)	0.021 (Chronic HC5/2)	0.009 (Chronic HC5 of 0.027/3)	0.039 (Chronic HC5)
Saltwater Invertebrates (µg ai/L)				
Acute Endpoint (Basis)	**16.5** (Lowest EC_{50}/2)	1.37 (Acute HC5)	n.d.	n.d.
Chronic Endpoint (Basis)	0.16 (Lowest NOAEC)	0.33 (Lowest NOAEC)	n.d.	n.d.
Risk Findings				
RQ range	**<0.01-2,130**	54-1,790 (select scenario)	High acute and chronic risk (select representative scenarios)	Screening: 0.3-296 (Tier 1) 0.5-11.4 (Tier 2) Refined: = low risk

Note – PMRA refers to Health Canada (2016), EFSA refers to Smit et al. 2014, both reviewed below, and BCS refers to Bayer Crop Sciences, not reviewed below as Ecology was unable to obtain a copy for this review and marine biologic endpoints were not estimated.

These selected values for saltwater invertebrate toxicity were used by EPA to evaluate potential environmental effects. EPA modeled imidacloprid exposures based on different terrestrial uses of imidacloprid in agriculture and the projected runoff from those uses into marine systems (i.e., did not model direct spraying to marine systems)., EPA found only one acute risk to saltwater invertebrates in any of its modeled scenarios.[4] For chronic exposures, it found that foliar spraying of imidacloprid (e.g., on fruit trees) could lead to runoff that would produce toxicity, and obtained a similar result in three of its eight modeled scenarios of agricultural use of imidacloprid-treated seed. EPA's comparison of field data on imidacloprid concentrations in estuarine and marine environments to its chosen toxicity values was limited, probably because it notes that field data were limited. Based on this review, EPA concluded that chronic toxicity to crustaceans in saltwater environments is possible from existing levels of imidacloprid in marine waters. Because it did not evaluate direct application of imidacloprid to marine sediments, as proposed by WGHOGA, EPA's conclusions regarding marine toxicity of imidacloprid provide indirect information on the likely effects of spraying in Willapa Bay and Grays Harbor.

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4 Note: the LOC used in these analyses was 0.5, that is ½ of the calculated RQ that was assumed to produce toxicity. One acute test exceeded this level. However, EPA used a separate LOC of 0.05 for any invertebrate species listed under the ESA, a decrease by a factor of 10 selected to provide a higher level of protection for listed species. Under a LOC of 0.05, additional acute tests exceeded levels predicted to produce toxicity. There are no ESA listed marine or estuarine invertebrates in Willapa Bay or Grays Harbor, making this result irrelevant with respect to WGHOGA's proposed permit.

J.S. Osterberg, K.M. Darnell, T.M. Blickley, J.A. Romano, and D. Rittschof. 2012. Acute toxicity and sub-lethal effects of common pesticides in post-larval and juvenile blue crabs, *Callinectes sapidus.* J. Exper. Marine Bio. and Ecol. 424-425: 5-14.

These authors exposed blue crab megalopae (the last planktonic stage before crabs settle to the substrate) and juveniles to acute, 24-hour, static concentrations of various pesticides, including both laboratory grade (i.e., pure) and commercial grade (formulated and sold as Trimax^{TM}) imidacloprid. They recorded mortality, and for megalopae, effects on metamorphosis and subsequent juvenile survival. Sample sizes for toxicity tests ranged from 2–4 assays, which limited the precision of the subsequent toxicity curves. The authors found a significant difference in the toxicity of laboratory and commercial grade imidacloprid on megalopae toxicity, with estimated LC_{50} values of 10.04 µg/L and 312.7 µg/L, respectively. This difference was reversed for juveniles, with LC_{50} values for the laboratory and commercial grades of 1,112 µg/L and 816.7 µg/L, respectively. No explanation was offered for these observed differences in toxicity. Imidacloprid exposure did not delay the onset of metamorphosis in megalopae, but did result in lower molting rates and higher mortality in newly metamorphosed juveniles compared to controls. The authors include a short literature review on imidacloprid toxicity in crustaceans, and also conduct a simplified dilution study which leads them to conclude that *"direct overspray of Trimax or imidacloprid has a good chance to be acutely toxic to any blue crabs there [in shallow estuarine waters]" and that "lethal and sub-lethal effects here could have serious implications for the broader estuarine ecosystem."*

Health Canada. 2016. Proposed re-evaluation decision, Imidacloprid. Document PRVD2016-20. Health Canada Pest Management Regulatory Agency, Ottawa, Canada.

Broadly, the Health Canada assessment is very similar to EPA (2017). It is a risk assessment, it includes a review of the scientific literature to establish toxicity thresholds, it models aquatic concentrations of imidacloprid from various types of agricultural uses of that chemical, and it compares thresholds to exposure to determine if environmental impacts are likely. And, as with EPA (2017), Health Canada includes a review of imidacloprid concentrations in surface bodies of freshwater to determine whether these field data indicate imidacloprid toxicity is occurring. Unlike EPA (2017), Health Canada includes an analysis of imidacloprid toxicity to birds and mammals, and an analysis of potential human exposure from a variety of imidacloprid uses.

The Health Canada literature review discussed many of the same studies as EPA (2017); however, the Health Canada review did not use data for the most sensitive species or study to set toxicity thresholds. It instead used a mathematical process to develop "species sensitivity distributions" (SSDs). SSDs are plots of species-specific toxicity versus imidacloprid toxicity. These curves are arranged so that the species are listed from the most sensitive to the least sensitive. A statistical approach is used on all data to estimate the hazardous concentration assumed to be protective of 95 percent of all species in the distribution, the so called "HC_5" value. Although this sounds similar to EPA (2017) use of the most sensitive taxon, in practice the HC_5 can be, and in the Health Canada study often is, a lower value than the lowest toxicity actually noted in experiments (i.e., because the HC_5 is statistically derived). Thus, in practice, Health Canada used a more conservative approach to assessing potential environmental effects of imidacloprid than EPA (2017).

One example that is relevant to WGHOGA's proposed application involved the use of the blue crab data from Osterberg et al. (2012). Unlike EPA (2017), Health Canada used data from this study in developing its toxicity thresholds for saltwater invertebrates, specifically the 10.04 µg/L LC_{50} observed in blue crab megalopae using laboratory grade imidacloprid. This was the most sensitive result in the studies reviewed by Health Canada. Once Health Canada constructed its SSD for saltwater invertebrates, it derived an estimate of the HC_5 of 1.37 µg/L, a result 8.7 µg/L lower than the lowest research-based value. Health Canada used the 1.37 µg/L as its toxicity threshold for all its subsequent analyses. By contrast, EPA (2017) used 33 µg/L times a LOC of 0.5 to produce an acute toxicity threshold of 16.5 µg/L for saltwater invertebrates in its analysis.

Major findings of the Health Canada study overlap some of those in EPA (2017). Health Canada concluded that aquatic insects are the most sensitive to imidacloprid, and both their modeled scenarios and their review of field data on imidacloprid support a conclusion that widespread impacts to sensitive freshwater species are likely occurring. Their analysis also documented the wide range of toxicities to imidacloprid present among groups (e.g., birds versus invertebrates) and among species within groups (e.g., within aquatic insects). They also found that vertebrate species, including the birds and mammals analyzed, were not predicted to experience toxicity from imidacloprid for the majority of their modeled field concentrations. A notable exception to this was the conclusion that direct ingestion of imidacloprid-treated seeds could lead to toxicity in birds and small mammals. Like EPA (2017), Health Canada identified potential secondary effects to insectivorous birds and mammals from a potential reduction in their invertebrate prey.

With respect to imidacloprid effects on humans, Health Canada used an analysis largely based on studies of other mammals, as well as an extensive review of potential exposure pathways (e.g., ingestion or adsorption in agricultural workers using imidacloprid). There is no direct analysis of the likelihood of imidacloprid toxicity in humans, but the general discussion indicates a low risk, as for other vertebrates. Health Canada reviewed case reports of attempted suicides through ingestion of imidacloprid. Based on this work they identified that imidacloprid toxicity *"symptoms in humans consist of nausea, vomiting, headache, dizziness, abdominal pain, and diarrhea."* Of 56 attempted suicides, *"recovery was seen in all 56 patients reported."*

Specific findings of the Health Canada study include:

- For marine invertebrates, the acute HC_5 value used to assess potential toxicity was 1.37 µg/L. The reviewed studies showed acute LC_{50} values ranging from 10 µg/L to 313 µg/L (both values are for blue crab megalopae). Too few data were available to develop an HC_5 value for chronic exposure. A NOEC value of 0.33 µg/L was used based on a single study of mysid shrimp. Health Canada concluded that *"[i]midacloprid may pose an acute and chronic risk to marine/estuarine invertebrates based on water modelling results. The monitoring data for imidacloprid in marine/estuarine environments are not robust enough to exclude risks to marine/estuarine invertebrates."*
- For freshwater invertebrates, the acute and chronic HC_5 values used to assess potential toxicity were 0.36 and 0.041 µg/L, respectively. Based on its analysis of monitoring data, Health Canada concluded that imidacloprid levels found in surface waters that receive agricultural runoff frequently exceed these concentrations, and thus would be expected to affect the most sensitive species of freshwater invertebrates.
- Freshwater crustaceans were analyzed and the results include acute LC_{50} estimates for the amphipod *Hyalellea azteca* of 17.4–526 µg/L (96-hour test), for seed shrimp (Ostracods) a 6-day LC_{50} of 1.5 µg/L, and growth inhibition at 1–1.5 µg/L, and for the amphipod *Gammarus* sp. a 96-hour LC_{50} of 111–263 µg/L, with immobility noted at 18.3 µg/L. Results for chronic toxicity tests include 28-day LC_{50} values of 7.08 µg/L, 1.26 µg/L, and 2.03 µg/L, for the amphipods *H. azteca* and *Gammarus* sp., and the isopod *Asellus aquaticus*, respectively. For *H. Azteca* a No Observed Effects Concentration (NOEC) of 3.44 µg/L was reported (96-hour test).
- Table 29 specifically compares marine aquatic organisms exposed to imidacloprid from indirect applications (i.e. not spraying sediments directly) for curcurbit vegetables at a rate of 587 g a.i. / hectare (which converts to 0.5 lbs. a.i. / acre) and determined that both acute and chronic levels of concern (LOCs) were exceeded.
- Toxicity to freshwater and marine fish was not analyzed in detail, but the tabular data listed by Health Canada for its review documented LC_{50} values that were consistently greater than 1,000 µg/L, indicating low potential for imidacloprid toxicity to this animal group.
- Low toxicity or no toxicity to birds. Their model of potential toxicity to large birds concludes that imidacloprid is *"not expected to pose a risk to birds"* due to low toxicity relative to exposure, and the reality that *"birds are unlikely to feed solely on imidacloprid-contaminated foodstuffs."* The modeled toxicity to small and insectivorous birds concluded that imidacloprid is *"not expected to pose a risk to birds,"* again based on an inherent high toxicity threshold, and because imidacloprid is expected to decline in their prey organisms following treatment with imidacloprid. Similarly, Health Canada concluded that the *"risk to small and medium sized birds is considered to be relatively low."* The selected HC_5 for imidacloprid toxicity to birds was 8,070 µg/L.

- Low toxicity to mammals for many of the same reasons as those noted above for birds.
- Toxicity to birds and mammals is possible under special circumstances. Modeled ingestion of imidacloprid-treated seeds (animals assumed to be able to eat as much treated seed as they wanted) resulted in predictions of toxicity for all bird sizes (20,100 and 1,000-gram bird categories) and all seed types that were modeled. Also, Health Canada analyzed reports of birds that had fallen ill, or were dead and dying, following turf treatments (e.g., on golf courses) with imidacloprid or a mixture of pesticides that included imidacloprid. The data were considered anecdotal, but indicative of a potential for impacts from turf applications of imidacloprid. The report concluded that pellet applications of imidacloprid to turf could be mitigated by prompt exposure to water following application (i.e., because pellets quickly dissolve on contact with water).
- Health Canada had as one of its goals the development of recommendations for the continued use of imidacloprid for agricultural uses. Based on their results for freshwater invertebrates the review *"propos[ed] continued registration of certain uses of imidacloprid and removal of others based on environmental risks of concern*." Elsewhere in the document the recommendations were more strongly negative: "The environmental assessment showed that, in aquatic environments in Canada, imidacloprid is being measured at levels that are harmful to aquatic insects," and that the continued "use of imidacloprid in agricultural areas is not sustainable." Health Canada's key finding was, "For the protection of the environment, PMRA is proposing to phase-out all the agricultural and a majority of other outdoor uses of imidacloprid over three to five years."

EPA. 2016. Preliminary pollinator review to support the registration review of imidacloprid. PC Code 129099. DP Barcode 435477. USEPA, Office of Chemical Safety and Pollution Prevention, Washington DC. Prepared by USEPA Office of Pesticide Programs, Environmental Fate and Effects Division, Washington DC.

EPA (2016) is an assessment of whether imidacloprid poses a risk to terrestrial pollinators, with a focus on honey bees (*Apis mellifera*). As with the other risk assessments reviewed above (EPA 2017, Health Canada 2016), the EPA 2016 assessment involves modeling of different agricultural uses of imidacloprid to develop potential exposure concentrations, as well as review of published literature, which for this document is centered on environmental measurements of imidacloprid in field crops, and studies of honey bee toxicity from such exposures. The EPA 2016 document has no analysis of potential effects to either freshwater or saltwater invertebrates. Overall, although "highly toxic" to honey bees, EPA 2016 concludes that most modeled agricultural uses of imidacloprid are at low or uncertain risk of impacting bee hives, many uses pose risks to individual bees, and a few modeled scenarios indicate risks to both individual bees and bee hives. Specific findings include:

- Honey bees are most likely to be exposed to agricultural uses of imidacloprid from direct contact with foliar sprays and oral ingestion (e.g., through consumption of contaminated pollen and nectar).
- Imidacloprid does not appear to "*carryover*" from one year to the next in plants (e.g., is not persistent).
- Adult mortality thresholds were selected for both acute (96-hour) contact exposure (0.043 µg a.i./L) and acute (48-hour) oral toxicity (0.0039 µg a.i./L). The adult chronic (10-day) oral toxicity value selected was 0.00016 µg a.i./L. Based on these values, EPA deemed imidacloprid as "*highly toxic*" to honey bees.
- EPA's modeled imidacloprid concentrations were deemed "*conservative*" because they exceeded the levels measured in field studies.
- Some on-field exposure scenarios (e.g., direct exposure to foliar spray applications in citrus crops) exceed EPA's selected toxicity thresholds (i.e., honey bees are predicted to experience toxicity).
- Scenarios that do not involve direct, on-field exposure (e.g., ingestion of contaminated pollen and nectar) did not exceed EPA's toxicity thresholds for the majority of agricultural uses modeled.
- For direct, on-field exposure, EPA (2016) contains a "red grouping" of agricultural uses of imidacloprid that are predicted to impact both individual honey bees and bee hives. These uses are foliar applications in citrus crops, and foliar, soil, soil + foliar, and seed treatment + foliar applications in cotton. Remaining modeled agricultural uses were either deemed "*green grouping*" (i.e., low risk of toxicity) or "*yellow grouping*" (i.e., toxic effects may occur in individual bees but there is scientific uncertainty whether any effect on hives would occur).

Patten, K. 2016. A summary of ten years of research (2006-2015) on the efficacy of imidacloprid for management of burrowing shrimp infestations on shrimp grounds. Memorandum included in WGHOGA's 2017 SIZ application to Ecology. 23 p.

Dr. Patten led most of the studies of the effectiveness of imidacloprid in reducing burrowing shrimp densities in Willapa Bay, Washington. The experimental work included efficacy measurements as part of the formal imidacloprid field trials in 2011, 2012, and 2014, as well as a large number of smaller studies designed to test approaches to increasing efficacy, reducing imidacloprid concentrations necessary for shrimp control, or both. Given the wide variation in study types, he reports efficacy levels that range from 0 to 100 percent. Most of his reported efficacy levels exceed 40 percent, and average 80 percent or more. But Dr. Patten reports that where flowing water or heavy eelgrass are present at the time of treatment, imidacloprid efficacy can decline below 40 percent unless site-specific approaches to ensure chemical contact with the sediment-water interface can be enhanced (e.g., hand spraying, sediment injectors). For difficult treatment areas he suggests that use of pelletized forms of imidacloprid, reduction in eelgrass densities before treatment, or spot treatments may be effective strategies to boost efficacy. Dr. Patten also recommends continued investigation of approaches to improve the efficacy of imidacloprid in reducing burrowing shrimp densities, as part of an integrated pest management plan by WGHOGA.

Patten, K., and S Norelius. 2017. Response of Dungeness crab megalopae and juveniles to short-term exposure to imidacloprid. 2017 Report to Washington Department of Fish and Wildlife. Washington State University, Long Beach Research and Extension Unit, Long Beach, WA. 21 p.

This is a report summarizing nine different sets of experiments on the effects of imidacloprid on Dungeness crab. Five of the studies were conducted in 2017, and the remaining four, which are included in appendices, were conducted in prior years. The specific methods, imidacloprid concentrations, and exposure pathways (e.g., lab studies versus field trials) tested vary considerably and sample numbers in some cases were limited. Seven of the studies brought crab from Willapa Bay into the laboratory where a variety of experiments were conducted to look at the onset of tetany in crab exposed to varying levels and durations of imidacloprid. Most of these laboratory studies also tracked recovery from tetany over time using clean salt water. The two field studies were both assessments of the number of crab affected following applications of imidacloprid to commercial shellfish grounds in Willapa Bay. Potentially relevant highlights from these studies include:

- Water quality data from field trials in Willapa Bay indicate an average imidacloprid concentration of 170 µg/L in the "leading edge" of the rising tide that carries imidacloprid off treated plots, and 2.2 µg/L on-plot during high tide on the day of application. Methods for how this was calculated were not provided. On- and adjacent off-plot monitoring (ex. see 2012 monitoring report) have shown exceedances of this average by more than 5 times.
- Dungeness crab showed "no short-term tetany response of megalopae to imidacloprid up to 100 µg/L for 2 hours [exposure]; however significant tetany was observed at 500 µg/L within 20 minutes."
- Dungeness crab juveniles exposed to imidacloprid at concentrations up to 100 µg/L for 6 hours did not experience tetany.
- Studies designed to mimic the rate of dilution of imidacloprid from rising tidal waters following field applications (i.e., dilution by approximately 50% every 4 minutes) did not result in tetany of juvenile Dungeness crab at starting concentrations of either 250 µg/L or 500 µg/L.
- Surveys following field applications consistently found affected Dungeness crab in the spray plots. Across surveys the authors found an average of 3.2 affected crab/acre sprayed, but numbers up to 29 crab/acre were observed. The authors noted widespread predation by gulls on Dungeness crab in the plots following field spraying.
- Tetany reversal, i.e. resumption of motion, was observed in both megalopae and juveniles under lab conditions, generally within 10-24 hours. This would correspond to one to two tidal cycles in the field.

- The authors conclude: "there will likely be some mortality of Dungeness megalopae and juvenile crab resulting from commercial treatment of tide flats with imidacloprid. This mortality will result from mechanical damage from being run over by ATVs during application (Patten 2012) and the result of tetany and subsequent predation following exposure to high doses of imidacloprid in the wetting front [i.e., leading edge].

This study has not undergone rigorous scientific peer review. Some areas of concern are;

- Lack of detailed study methodologies
- Tidal dilution studies are incomplete models of actual tidal cycles
- 2014 studies show Dungeness crab tetany and mortality
- The study underestimates mortality in the field as it does not include tetany as leading to mortality

Patten, K., and S Norelius. 2016. 2016 Progress report to Washington Department of Fish and Wildlife – burrowing shrimp recruitment survey for Willapa Bay late summer 2016. Washington State University, Long Beach Research and Extension Unit, Long Beach, WA. 8 p.

This is an annual report on the results of WSU research that was funded by WDFW. Sediment samples were taken from seven locations across Willapa Bay and then screened to obtain samples of juvenile ghost shrimp (*Neotrypaea californiensis*) that recruited into the bay in 2015 (as determined by a carapace length greater than 3.5 mm or about 0.14 inches), or 2016 (carapace length less than 3.5 mm). Recruitment was "*very high*" at the north end of Willapa Bay (543 recruits per square meter or 50.4 per square foot), and "*progressively declined towards the south end of the bay*" (down to 14 recruits/meter squared or 1.3 per square foot). Across all sites the average number of juvenile shrimp estimated to have recruited in 2015 and 2016 was 152 animals/meter squared (14.1 per square foot). The number of individuals in each size class (greater than 3.5 mm, and less than 3.5 mm) indicates that recruitment was higher in 2015 than in 2016. The authors note that recruitment in Willapa Bay since 2000 "*has been relatively minor*," but that recruitment over the past two years has been "*robust*." The authors raise concerns that as these juveniles reach adulthood they will "*represent a severe threat to the Willapa Bay shellfish industry*."

Gibbons, D., C. Morrissey, and P. Mineau. 2015. A review of direct and indirect effects of neonicotinoids and fibronil on vertebrate wildlife. Environmental Science and Pollution Research 22: 103-118

The authors conducted a literature review on 150 previously published studies on the effects of pesticides on vertebrate wildlife, including fish, birds, and mammals. Based on the relative abundance of published studies, the authors focused on three pesticides, imidacloprid, clothianidin, and fibronil. Most (91%) of the studies they reviewed were laboratory-based toxicity studies, but a few were based on field work. Common to many studies, they found widely varying toxicity of imidacloprid to different species. For mammals they report LC_{50} values ranging from 131,000 – 475,000 µg/L, for birds 13,900 – 283,000 µg/L, for fish 1,200-241,000 µg/L, and for amphibians 82,000 – 366,000 µg/L. Even the lowest of these LC_{50} values is orders of magnitude higher than reported LC_{50} values for sensitive marine and freshwater invertebrates, confirming the much lower toxicity of imidacloprid to vertebrates than to invertebrate groups. The authors note that one of the greatest potential impacts of imidacloprid is from imidacloprid treated agricultural seeds, where "ingestion of even a few treated seeds could cause mortality and reproductive impairment to sensitive bird species." They note that reported concentrations of imidacloprid in surface waters are "except in the most extreme cases…2 to 7 orders of magnitude lower than the LC_{50} measurements for fish and amphibians," and therefore direct mortality in these groups is unlikely. Their tables include a study for rainbow trout fry that reported an LC_{50} of 1.2 ppm (1,200 ug/L). Gibbons et al. concluded that although concentrations were too low to exert a direct effect on the fish, they were deemed sufficiently high to reduce prey abundance. The authors also review literature to show that imidacloprid can cause sub-lethal effects (e.g., reduced reproductive success) in birds at doses (in food) of 1,000 to 53,400 µg per kilogram animal weight per day, and in fish at 30 – 320,000 µg/L (duration of exposure unknown). For example, the author's cite a study by Sanchez-Bayo and Goka (2005) which noted fish became physiologically stressed following exposure to imidacloprid and subsequerntly became susceptible to parasites. The authors conclude that sub-lethal effects can occur in birds, particularly those exposed to imidacloprid treated seeds, and that for fish and amphibians "the possibility of sub-lethal effects…cannot be ruled out." Finally, the authors note the rarity of studies looking at potential indirect effects, in particular how reductions in invertebrates by pesticides may reduce the prey available to vertebrate consumers of these animals. They raise concerns about this impact pathway, and call for more study in this area.

Lintott, D. R. 1992. NTN 33893 (240 FS Formulation): Acute Toxicity to the Mysid, *Mysidopsis bahia* under Flow-through Conditions: Lab Project Number: J9202001: 103845. Unpublished study prepared by Toxikon Environmental Sciences. 43 p.

Lintott (1992) exposed mysid shrimp to imidacloprid over 96 hours (i.e., an acute test) and found an LC_{50} of 36 µg a.i./L, with 95 percent confidence limits (CL) of 31 and 42 µg a.i./L. The NOEC was 21 µg a.i./L based on the lack of mortality observed at this concentration.

Wheat, J. and S. Ward. 1991. NTN 33893 Technical: Acute Effect on New Shell Growth of the Eastern Oyster, *Crassostrea virginica*: Lab Project Number: J9008023D: J9107005. Unpublished data by Toxikon Environmental Sciences. 54 p.

Wheat and Ward (1991) conducted two acute exposure tests evaluating the effects of imidacloprid on new shell growth in the Eastern oyster (*Crassostrea virginica*). Specifically, they compared new shell growth in oysters exposed to imidacloprid to control oysters. In the first study, the effective concentration to produce a 50 percent reduction in new shell growth of Eastern oysters was very high, greater than 23,300 µg a.i./L. At 2,930 µg a.i./L, new shell growth was reduced by only 5 percent relative to the controls. The second test found that new shell growth of exposed oysters was reduced by 22 percent relative to the controls at the highest concentrations tested. Survival of oysters was 100 percent in all treatments. The authors state that evaluation of new shell growth data from the second exposure study found the 96-hour EC_{50} was greater than 145,000 µg a.i./L.

Gagliano, G. G. 1991. Growth and Survival of the Midge (*Chironomus tentans*[5]) Exposed to NTN 33893 Technical Under Static Renewal Conditions: Lab Project Number: N3881401: 101985. Unpublished study prepared by Mobay Corp. 43 p.

Gagliano (1991) studied the growth and survival of a freshwater midge exposed to imidacloprid under static conditions. The study found a 10-day (i.e., chronic) LC_{50} of 3.17 µg/L. Evaluation of survival over 10 days found no observed effects at 1.24 µg/L. The study examined effects over a shorter duration of 96 hours, and found an LC_{50} of 10.5 µg/L, and a NOAEL based on survival of 1.24 µg/L, similar to that observed over the 10-day study. There was zero percent mortality observed in midges exposed for 10 days to concentrations of 0.67 µg/L and 1.24 µg/L, and 100 percent mortality at 102 µg/L and 329 µg/L concentrations.

England, D. & J. D. Bucksath. 1991. Acute Toxicity of NTN 33893 to *Hyalella azteca*: Lab Project Number: 39442: 101960. Unpublished study prepared by ABC Labs., Inc. 29 p.

England and Bucksath (1991) studied the effects of imidacloprid on the survival and mobility of the freshwater amphipod, *Hyalella azteca.* They reported a 96-hour LC_{50} of 526 µg/L (95 percent confidence interval [CI] of 194 µg/L to 1,263 µg/L) and a 96-hour EC_{50} based on immobilization of 55 µg/L (95 percent CI of 34 µg/L to 93 µg/L). At 0.35 µg/L, there were no observed effects to mortality or mobility over the 96-hour exposure.

Ward, G. S. 1990. NTN-33893 Technical: Acute Toxicity to the Mysid, *Mysidopsis bahia*, under Flow-Through Test Conditions: Lab Project Number: J9008023B/F: 100355. Unpublished study prepared by Toxikon Environmental Sciences. 46 p.

Ward (1990) conducted two acute exposure tests under flow-through test conditions to the mysid, *Mysidopsis bahia.* The first test found a 96-hour LC_{50} of 37.7 µg a.i./L with a 95 percent confidence limit (CL of 25.7 µg/L and 46.4 µg a.i./L). A second flow-through test was conducted because the NOEC was not determined within the test concentration range. The second test found a 96-hour LC_{50} of 34.1 µg a.i./L with a 95 percent CL of 22.9 µg a.i./L and 37.2 µg a.i/L. The NOEC was 13.3 µg a.i./L, based on lack of mortality and sublethal effects after 96 hours of exposure. The authors noted that after 96

[5] Now *C. dilutus*

hours of exposure, no surviving imidacloprid-exposed mysid displayed any sublethal effects.

Frew, J. A. 2013. Environmental and Systemic Exposure Assessment for Green Sturgeon Following Application of Imidacloprid for the Control of Burrowing Shrimp in Willapa Bay, Washington. Dissertation, University of Washington, School of Aquatic and Fishery Sciences.

Frew (2013) conducted a comprehensive study looking at the potential environmental and systemic (i.e., physiological) effects of imidacloprid on green sturgeon associated with its use to control burrowing shrimp in Willapa Bay. Using white sturgeon as a surrogate, an exposure study found the 96-hour LC_{50} was 124,000 µg/L, indicating that sturgeon do not possess high sensitivity to imidacloprid. The author calculated a hazard quotient (HQ) using the ratio of the maximum pore water concentration measured during field trials of imidacloprid in Willapa Bay divided by his calculated LC_{50} value. Frew reports that this HQ was two orders of magnitude (100X) below the threshold for potential effects. Given the observed sediment and pore water concentrations of imidacloprid following treatment to control burrowing shrimp, he concludes that green sturgeon would be at minimal risk for toxic exposure resulting from imidacloprid treatments in Willapa Bay. Frew also modeled a worst-case scenario of exposure to green sturgeon over a 4-hour foraging time window during a high tide following application of imidacloprid. This scenario incorporated sturgeon exposure from both sediment/porewater exposure, and ingestion of burrowing shrimp exposed to imidacloprid. He found that even in these conservative exposure scenarios, uptake of imidacloprid by green sturgeon would be modest and two to three orders of magnitude lower than levels known to cause acute or chronic effects.

Frew, J.A., M. Sadilek, and C. E. Grue. 2015. Assessing the risk to green sturgeon from application of imidacloprid to control burrowing shrimp in Willapa Bay, Washington – Part I: Exposure Characterization. Environmental Toxicology and Chemistry. Vol 34, 11: 2533-2541

This document summarizes a major piece of John Frew's 2013 Ph.D. dissertation on imidacloprid toxicology. The paper describes an exposure model used to estimate the ingestion of imidacloprid by green sturgeon, an ESA-listed species, following treatment to reduce burrowing shrimp in Willapa Bay. The exposure model included four components: ingestion of imidacloprid-exposed shrimp, uptake from water containing imidacloprid within shrimp burrows by swallowing, uptake from water passing across the gills, and uptake from ingestion of sediment containing imidacloprid. The paper also includes field counts of sturgeon feeding pits on sprayed and control plots that confirm extensive feeding on treated areas. Conservative assumptions were used throughout the exposure model, the three most important of which were that green sturgeon ate a large volume of exposed shrimp, that uptake of imidacloprid from such shrimp had a 10 percent efficiency (i.e., 10 percent of the imidacloprid in the shrimp was assimilated into the sturgeon), and that sturgeon were exposed to porewater concentrations of imidacloprid for the entire feeding session modeled (4 hours). The authors acknowledge that their conservative assumptions likely result in an overestimation of actual imidacloprid uptake by green sturgeon. Their results indicate that uptake from porewater was 9.5 and 7.5 times greater (at 6 and 30 hours post-exposure, respectively) than estimated uptake from ingestion of exposed shrimp. The authors estimated total imidacloprid uptake, from all four sources, of 196.7 µg/L at 6 hours and 113.2 µg/L at 30 hours post-exposure. The authors cite an LC_{50} of imidacloprid for white sturgeon of 124,000 µg/L, which is 630 times higher than their maximum modeled uptake, to conclude "*Imidacloprid concentrations and durations of exposure following chemical application in Willapa Bay would be lower than the levels expected to elicit direct acute toxic effects in green sturgeon. Furthermore, no chronic toxic effects would be expected following unforeseen extended periods of exposure.*"

Frew, J.A., and C.E. Grue. 2015. Assessing the risk to green sturgeon from application of imidacloprid to control burrowing shrimp in Willapa Bay, Washington--Part II: controlled exposure studies. Environmental Toxicology And Chemistry Vol. 34. 11: 25420-2548.

This publication is based on the remaining parts of the John Frew's 2013 Ph.D. dissertation. Controlled experiments were conducted using surrogate white sturgeon to determine acute and chronic effect concentrations of imidacloprid, and to examine effects at more environmentally realistic concentrations and durations of exposure. They report the 96-hour median lethal concentration was 124,000 µg/L with a predicted 35-day NOAEC of 700 µg/L. Imidacloprid half-life in plasma was greater than 32 hours. The authors report that no "*overt effects*" were observed in white sturgeon following environmental exposures that could be expected following imidacloprid treatment for burrowing shrimp. Measured concentrations of imidacloprid in porewater were significantly lower than the derived acute and chronic effect concentrations for white sturgeon. Exposure risk quotients were calculated using the effect concentrations and estimated environmental exposure. The resulting values were considerably below the level of concern for direct effects from either acute or chronic exposure to sturgeon.

Key, P., K. Chung, T. Siewicki, and M. Fulton. 2007. Toxicity of three pesticides individually and in mixture to larval grass shrimp (*Palaemonetes pugio*). Ecotoxicology and Environmental Safety. 68:272-277.

Key et al. (2007) examined the toxicity of three different pesticides, both in combination and individually. A mixture of fipronil and imidacloprid resulted in significantly lower toxicity to grass shrimp compared to each insecticide alone. By contrast, addition of atrazine increased the toxicity of the mixture. With respect to imidacloprid, the authors found it was significantly more toxic to grass shrimp larvae than adults. For larval grass shrimp the observed 96-hour LC_{50} was 308.8 µg/L (95 percent CI 273.6 µg/L -348.6 µg/L). For adult grass shrimp the 96-hour LC_{50} was 563.5 µg/L (95 percent CI = 478.1 µg/L -664.2 µg/L).

Somers, N and R. Chung. 2014. Case study: Neonicotinoids. Ontario Agency for Health Protection and Promotion, Toronto, ON. 8 pps.

Somers and Chung (2014) provide a short review of scientific literature and regulatory treatment of neonicotinoids, of which imidacloprid is only occasionally called out specifically. The paper is focused on, and largely limits itself to, environmental effects associated with neonicotinoid use on crops, particularly corn and soy beans. The study identifies three pathways for exposure related to agriculture: exposure to airborne dust when planting treated seed, exposure to residues in pollen or nectar, and exposure to guttation fluids (sap droplets on leaves). The authors make few definitive findings, instead concluding that "*sub-lethal concentrations may be of ecological significance*" and "*adverse effects may occur in non-target species*" based on a general view of their literature search rather than on data analysis or specific findings. The authors conclude by calling for more study.

Morrissey, C. A., P. Mineau, J. H. Devries, F. Sanchez-Bayo, M. Liess, M.C. Cavallaro, and K. Liber. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: a review. Environment International 74:291-303.

In common with EPA (2017) and Health Canada (2016), Morrissey et al. (2015) conducted an extensive review of the toxicology data on neonicotinoids[6] for aquatic organisms. They subsequently use their review to develop recommended limits on water concentrations of this class of chemicals. The paper also includes a good review of the mechanisms of toxicity of neonicotinoids, and a review of evidence that surface water sampling has documented contamination with these substances. They conclude that, "strong evidence exists that water-borne neonicotinoid exposures are frequent, long-term and at levels which commonly exceed several existing water quality guidelines." Specific papers and findings from the toxicology literature are generally not reviewed. Instead, the authors conclude that differences in relatively toxicity among neonicotinoids within taxonomic groups (e.g., freshwater insects, bees, etc.) are minor compared to differences amongst taxonomic groups. Accordingly, their methodology assumes that toxicology data on different neonicotinoid compounds can be combined, and they then use these pooled datasets to determine the average and range of toxicities observed with different groups of organisms. They conclude that "neonicotinoid insecticides can exert significant lethal and sub-lethal effects on many aquatic invertebrate populations." The authors also propose receptor binding by neonicotinoid insecticides in invertebrates may be near irreversible and may result in delayed toxicity, leading to an "underestimation of the true toxic potential of these insecticides" during risk assessments.

The authors indicate that aquatic insects are the most sensitive group, particularly mayflies and caddisflies. LC_{50} values for these most sensitive insect species were generally in the range of 3-9 µg/L, whereas crustacean toxicity was generally 1 to 2

[6] Although the paper deals with data for a number of neonicotinoids, the authors note that most of their reviewed studies were on imidacloprid.

orders of magnitude higher. The authors use their collected data to produce two SSDs, one based on chronic toxicity exposure data and one on acute data, and then use them to estimate the HC_5 (i.e., the concentration of neonicotinoids expected to be non-toxic to 95 percent of species). The authors then took the lower distribution or confidence limit of the HC_5[7] as recommended values (one chronic, one acute) for *"thresholds, above which, ecologically relevant population-level effects on sensitive aquatic invertebrate species are likely to occur."* Their recommended thresholds are 0.20 µg/L for acute exposure, and 0.035 µg/L for chronic exposure.

Smit, C.E.. 2014. Water quality standards for imidacloprid. Proposal for an update according to the Water Framework Directive. RIVM Letter Report, 270006001. National Institute for Public Health and the Environment, Ministry of Health, Welfare and Sport. Netherlands.

Smit (2014), again like EPA (2017) and Health Canada (2016), contains a substantial review of scientific literature on the freshwater toxicity of imidacloprid, with a much more modest review of saltwater studies. The author's goal is to identify organisms that are particularly sensitive to imidacloprid, and to then propose a water quality standard for imidacloprid in surface waters that is substantially below any observed toxic levels to provide a high probability such a standard would be protective to all species. The study evaluated imidacloprid toxicity in three ways: based on standard, laboratory toxicity studies; through development of acute and chronic SSD curves; and using published mesocosm data (multi-species tests meant to mimic natural environments). The calculation methods are complex, and appear to be based specifically on the Water Framework Directive (WFD), a Netherlands-specific regulatory framework. The Maximum Acceptable Concentration in Ecosystems (MAC-EQS) is somewhat similar to an acute toxicity threshold, representing the "standard for short-term concentration peaks." The document calculates the MAC-EQS using results from a pond mesocosm experiment in which imidacloprid was added at two intervals over 21 days. The 21 day NOEC for this study (on mayflies and true flies) was 0.6 µg/L. Through mathematical manipulation, the author coverts this chronic NOEC into a 48 hour NOEC estimate of 0.51 µg/L [8], and then divides it by a safety factor of three to produce a MAC-EQS of 0.17 µg/L, which is close enough to the existing MAC-EQS of 0.2 µg/L that the author proposed no change in the WFD water quality criterion. The study also includes something similar to a chronic toxicity threshold, the Annual Average Environmental Quality Standard (AA-EQS), "*which should protect the ecosystem against adverse effects resulting from long-term exposure.*" For the AA-EQS, an SSD was constructed and used to calculate an HC_5 of 0.025 µg/L. This was divided by a safety factor of three to produce a value of 0.0083 µg/L. This is the lowest toxicity threshold in any of the studies covered

[7] The review of Health Canada (2016) contains additional explanation of SSDs and HC5 values. Health Canada (2016) did not use a similar technique of selecting the lower distribution or confidence limit to set toxicity thresholds.

[8] The conversion results in a lower NOEC for 48 hours than was observed in the original study for 28 days. This is counterintuitive, but the provided description of methods is not sufficiently detailed to understand the mechanics of this transformation.

in the SEIS's literature review, explained in part by the use of NOEC values, rather than the LC_{50} and EC_{50} values used in most of the other reviewed studies to set toxicity thresholds.

A number of the other studies included in this literature review were on subjects already covered in detail in the large literature reviews (e.g., EPA 2017) and/or were less clearly related to the proposed permit. These additional studies are grouped below into general topic areas, and the specific reviews have been shortened into bullet form.

Scientific Studies of Neonicotinoid Effects on Honey Bees

With declines in honeybee populations observed since the early 1990s, scientists have conducted many studies of the potential role of neonicotinoids generally, and imidacloprid in particular, on honey bees and honey bee colonies. Although the proposed permit is not expected to affect honey bees because they do not visit areas that are proposed for treatment (i.e., saltwater sediments and eelgrass), these studies nonetheless provide insight into the potential impacts of imidacloprid on invertebrates.

- Sanchez-Bayo (2014) reviews and summarizes the effects of neonicotinoid toxicity and chemical behavior in the environment. The author notes that neonicotinoids are systemic and have been found to produce delayed mortality in arthropods at chronic, sublethal levels, but are not toxic to vertebrates. The author reviews experiments in freshwater aquatic ecosystems treated with single or repeated doses of imidacloprid and concludes that midges, ostracods, and mayflies are significantly reduced and do not recover when residues are above 1 ppb; while multi-year field monitoring showed imidacloprid concentrations as low as 0.01 µg/L "led to significant reductions in macroinvertebrates in surface waters." In addition, the author describes concerns with the effects to pollinators from daily sublethal exposure to imidacloprid. Described effects to these pollinators include olfactory learning, memory, locomotion impairment and inhibited feeding.
- Wu-Smart and Spivak (2016) focused on the sublethal effects of imidacloprid on queen bees. The authors found adverse effects on queen bee egg-laying and locomotor activity, foraging, and hygienic effects on worker bees. They also noted colony development impacts related to brood production and pollen stores. The authors found evidence that a larger colony size may act as a buffer to pesticide exposure, and that exposure in early spring when the colony is smallest will have greater effects.
- Hesketh et al. (2016) studied long term exposure of insecticides, trace metals, fungicides and herbicides to honeybees. The authors argue that short-term studies may not necessarily account for chronic or cumulative toxicity. The results found that honeybees were most sensitive to insecticides (including neonicotinoids), then metals (cadmium, arsenic), followed by the fungicide propiconazole and herbicide 2,4-D. The authors conclude that sensitivity to chronic exposure levels has the potential to affect over-wintering colonies.

- Rondeau et al (2014) evaluated published imidacloprid toxicity data to develop time-to-lethal-effect scaling, which they argue serves as an important tool for estimating the effect of chronic pesticide exposure to bees. They found that by extrapolating toxicity scaling for honeybees to the lifespan of winter bees that imidacloprid at 0.25 µg/kg in honey would be lethal to a large proportion of bees nearing the end of their life. They conclude that neonicotinoids "are of particular concern because they bind virtually irreversibly" to nervous system receptors. They postulate this could similarly be found in other invertebrates.
- Woodcock et al (2016), evaluated 18 years of data from the United Kingdom national wild bee distribution surveys for 62 species. They compared this census data to the estimated amount of neonicotinoid use in the agricultural crop oilseed rape in the areas around each census location. Through the use of modeling (i.e., a multi-species, dynamic Bayesian occupancy analysis) the authors found evidence of increased population extinction rates in response to neonicotinoid seed treatment use on oilseed rape. They suggest that sub-lethal effects could accumulate, producing impacts at the population level.

Terrestrial insects

A few studies have noted indirect impacts of neonicotinoids, including imidacloprid, to terrestrial insects.

- Parkinson et al (2017) investigated the sublethal effects of imidacloprid on a locust (*Locusta migratoria*), specifically the impairment of neural responses to visual stimuli. They examined dissected eyes and particular enzyme pathways that lead to neural stimulation. At 10 ng/g (10 µg/kg imidacloprid per g of locust body weight), they found that imidacloprid reduced firing of the visual motor sensitive neuron. The authors suggest that reduced firing from exposure to sub-lethal doses of imidacloprid would lead to deficits in collision avoidance in locust.
- Wang et al (2015) exposed red imported fire ants, *Solenopsis invicta*, to sublethal doses of imidacloprid and found that the ants consumed more sugar water containing imidacloprid than untreated sugar water, and ants fed imidacloprid (0.01 µg/mL) showed an increase in digging activity. At greater concentrations (≥ 0.25 µg/mL), exposed ants had suppressed sugar water consumption, digging and foraging behavior.

Vertebrates

Concerns over the use of pesticides has led to studies on the potential impacts on vertebrate embryo development.

- Hallman et al. 2014 – The authors conduct a review of many years of field survey data on the abundance and diversity of insect eating birds. They then compared population trends over time in areas where imidacloprid is used on agricultural crops and others where it is not. They conclude that in areas with imidacloprid use insectivorous bird numbers show an annual decline of 3.5% per year even after taking into account land-use changes. Impacts to prey species, specifically reductions in the total food base available for foraging birds, was suggested at the between imidacloprid and bird abundance.

- Wang et al (2016) exposed developing chick (leghorn) embryos to imidacloprid (500uM), and examined the embryos for skeletal and neural effects. They found disruption in the cranial neural crest cells, which led to defective cranial bone development.

Aquatic

Numerous scientists have been studying the toxicity of neonicotinoids in the aquatic environment and have found a diverse response among invertebrate species. As noted above, Health Canada (2016) and EPA (2017) include extensive reviews of these studies. Some additional studies on the effects of neonicotinoids on aquatic environments include:

- Sanchez-Bayo et al (201), a broad review of the toxicity of neonicotinoids to aquatic species, from an individual level to a population and ecosystem level. The study discusses the sensitivity of ostracods, amphipods, and midges to imidacloprid, and differs from some others on its more in-depth analysis of the potential for "delayed mortality" resulting from longer exposure duration under field conditions than those studied in the laboratory. The authors also cite numerous studies identifying sublethal effects on aquatic organisms including: feeding inhibition, impaired movement, reduced fecundity, reduced growth, and immune suppression; and, noted "their consistency in reporting population and community effects at levels well below the LC50s of the aquatic species tested." Finally, Sanchez-Bayo postulated that the scientific understanding of pesticide relationships to aquatic organisms has lagged behind our understanding of terrestrial (e.g. pollinator) impacts due to a focus on terrestrial systems.
- Chagnon et al. 2015 **–** This is a largely theoretical paper on the potential effects of systemic insecticides (i.e., those that are transported into plant tissues) on ecosystems. The authors raise concerns that systemic insecticides, including imidacloprid, because of their effects on sensitive animal taxa, could impact carbon and nutrient cycling, and food chains. A focus of the study is on potential effects of systemic insecticides on microbes, invertebrates, and fish and their ecosystem roles as decomposers, pollinators, consumers, and predators. The authors review example studies and scenarios as evidence of the "negative impacts of systemic insecticides on decomposition, nutrient cycling, soil respiration, and invertebrate populations valued by humans."
- Bottger et al (2012) tested the amphipod *Gammarus* to imidacloprid in the laboratory, with a study design intended to match stream conditions. The authors found seasonal/temperature effects, with animals collected at 12^{o}C being more sensitive than those tested at 17^{o}C, although differences in testing methodology may explain some of these differences. The authors report that the effects of length (as a proxy for age) and season had strongest effects with juveniles. Their most sensitive test group had an EC50 (96-hr) of 14.2 µg/L.

- Camp and Buchwalter (2016) studied a lotic mayfly and found an increase in imidacloprid uptake rates with increasing water temperature. The authors concluded that rates of sublethal impairment and immobility increased significantly with increasing temperature. The 96-hr EC50 (immobility) was 5.81 µg/L for the mayfly *Isonychia bicolor*. In testing other species, they also found increased uptake of imidacloprid as water temperatures increased. They noted sublethal effects at imidacloprid concentrations much lower than those that produce mortality, and concluded that sublethal effects presented a serious risk to exposed invertebrates due to an increased vulnerability to predation.
- Van Den Brink et al. (2016) studied the acute and chronic toxicity of neonicotinoids to the mayfly *Cloen dipterum* and discuss the seasonality of the toxicity of imidacloprid to several invertebrate species, including *C. dipterum*. The authors found increased sensitivity in the summer and overwintering generations in four invertebrate species. Specifically, for *C. dipterum*, the acute and chronic toxicity of imidacloprid was much higher for the summer generation than for the winter one.
- Hayasaka et al. (2012) studied the combined effects of two pesticides, imidacloprid and fibronil, on zooplankton in rice paddies in Japan. The study is relatively unique in that: 1) it was conducted in field mesocosms (e.g., mini-ecosystems) rather than the laboratory, 2) they evaluated the cumulative effect of two applications of insecticide, and 3) they specifically looked for and evaluated potential ecosystem level effects. They found direct negative effects on the species present and abundance of zooplankton following exposure to the pesticides. In turn, the found an indirect effect on fish in the ponds, suppression of growth of fishes feeding on the zooplankton. Because zooplankton were exposed to both imidacloprid and fipronil, the relative effect of each cannot be determined with certainty. The authors note that fipronil was more persistent in the soil than imidacloprid, and that ecological impacts on benthic species and associated fish were likely more strongly affected by residual fipronil, not imidacloprid.

2014 Experimental Trials of Imidacloprid Spraying in Willapa Bay

WGHOGA, in association with researchers from the University of Washington, Washington State University, and the Pacific Shellfish Institute (PSI), have conducted a number of field experiments and trials with imidacloprid in Willapa Bay over the past decade. Several of these trials were formal experiments to determine the effects of spraying imidacloprid to control burrowing shrimp. These formal trials were conducted under the supervision of the Washington Department of Ecology (Ecology), which reviewed and approved the Sampling and Analysis Plans (SAPs) for the work, and subsequently reviewed and approved the SAP Field Reports containing the results and analyses of these trials. At the time the 2015 FEIS was published, the SAP Field Report was not yet finalized for trials conducted in 2014 (results from trials conducted in previous years were reviewed in the FEIS). The review below is of that 2014 trial. It is based on the final SAP Field Report for that work, but follows the format used in the 2015 FEIS in its review of trials from prior years.

The 2014 field trials were designed to assess the magnitude, extent, and duration of impacts from imidacloprid that could be associated with commercial use of imidacloprid for the control of burrowing shrimp on tidelands used for commercial clam and oyster aquaculture. Whereas the previous year's studies had focused on smaller plots (i.e., 10 acres or less), the 2014 field trials were designed to assess these potential effects when imidacloprid is applied to larger (>50 acre) plots. Commercial treatment of plots of this size is most likely only feasible using aerial spraying, which is not proposed under the WGHOGA 2016 NPDES application. Nonetheless, the 2014 field trials provide data on the potential effects of imidacloprid spraying over larger areas, including clusters of smaller plots that are located in proximity to one another. It also indirectly allowed a test of whether post-spraying recruitment of invertebrates from unsprayed areas to the sprayed plots would be impeded when larger blocks and clusters are sprayed (e.g., due to the greater distance to be traveled, and the smaller amount of unsprayed area available as potential sources of recruitment). The results of the 2014 field trials are described in detail in Hart Crowser 2015, which is available through Ecology.

The 2014 field trials involved two trial plots ("Coast plot," "Taylor plot"), immediately adjacent to one another, collectively covering approximately 90 acres, located near Stony Point in Willapa Bay. Both sites had high levels of burrowing shrimp, and were owned by members of WGHOGA. The beds were selected both for their larger size, and because they were in close proximity to other beds scheduled for commercial treatment. A total of 90 acres were treated by helicopter with liquid imidacloprid, Protector 2F, at 0.5 lb a.i./acre on July 26, 2014. The control site was matched to the treatment plots, to the extent feasible, to have similar elevation, vegetation and substrate as the treatment plots. The control plot was located near Bay Center, approximately five miles from the treatment plots, to ensure no imidacloprid was carried there from the treatment plots by the rising tide. In addition, two sites ("Nisbet plot," "Coast plot") were located in the Cedar River area. These plots were selected to allow collection of water samples over long distances from the treatment plots in order to better understand how imidacloprid in surface waters is diluted by tidal inflow.

The 2014 field trials were intended to assess:

- Pre- and post-application water column concentrations of imidacloprid;
- Whole sediment imidacloprid concentrations after treatment and over time;
- Whole sediment characteristics (texture, total organic carbon, dissolved organic carbon);
- Sediment porewater imidacloprid concentrations after treatment and over time;
- The efficacy of imidacloprid in controlling burrowing shrimp on larger treatment areas;
- The impact of large-scale imidacloprid application on megafauna (e.g., Dungeness crab); and
- The impact of large-scale imidacloprid application on benthic invertebrate communities.

Overall the SAP Field Report found that the 2014 field trials produced results comparable to those of the prior trials: imidacloprid was widely detected in water and sediments shortly after treatment, concentrations diminished quickly with increasing distance from the treatment plots (water) or over 14 to 28 days following treatment (on-plot sediments), and impacts to epibenthic and benthic invertebrate communities were determined to not be significantly different from reference stations. However, as in previous years, variability in benthic abundance collections was high and statistical power was weak.

Screening values were used to determine when levels of imidacloprid in various sample types were high enough to potentially result in environmental consequences. These values were used to determine which samples were analyzed and reported on in the SAP field report.

- Surface water – 3.7 ppb[9] (screening value);
- Sediment – 6.7 ppb (laboratory quantitation limit[10]); and
- Sediment porewater – 0.6 ppb (screening value).

Water Column Sampling and Analysis. Water column samples were collected from the leading edge of the rising tide, typically about 2 hours after treatment. Imidacloprid concentrations in surface water at the Taylor and Coast sites (on-plot samples) ranged from 180 to 1,600 ppb, with an average value of 796 ppb. The Cedar River sites were designed to test the extent to which imidacloprid concentrations are diminished with distance from the sprayed plots (e.g., due to dilution by the incoming tide). At the Coast plot, the on-plot concentration of imidacloprid was 230 ppb. At approximately 731 meters from the plot (about 2,400 feet) the concentration was 0.054 ppb. For the Nisbet plot, samples were taken on-plot, and at distances of 62 meters (203 feet), 125 meters (410 feet), 250 meters (820 feet), 500 meters (1,640 feet), and on the shoreline (approximately 706 meters or 2,316 feet). This set of samples documented a decrease in imidacloprid concentrations with distance as follows: on-plot= 290 ppb, 62 meters= 0.55 ppb, 125 meters= 0.14 ppb, 250 meters= not detectable, 500 meters= 0.066 ppb, and shoreline= not detectable.

Overall, the surface water data collected during the 2014 trials indicate a strong pattern of high on-plot and low off-plot concentrations during the first rising tide, a result also noted in prior trials. For the Cedar River sites, on plot locations had concentrations up to 1,600 ppb, with an average value of approximately half this amount. Imidacloprid was detected at considerable distances off-plot, but at low concentrations of 0.55 ppb to 0 ppb. Thus, although the 2014 data confirm a greater distance off-plot for movement of imidacloprid (up to 500 meters), the concentrations were much lower than those observed in the off-plot data from 2012. These varying results suggest that site-specific differences in how

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[9] As noted above, 1 ppb is equal to 1 ug/L. The SAP field reports state concentrations in ppb, whereas many risk assessment and toxicology studies report concentrations in ug/L.

[10] The lowest level the laboratory could analyze and still retain statistical certainty in the results

tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot.

Sediment and Sediment Porewater Sampling and Analysis. The 2014 field trials confirmed prior studies that demonstrate a rapid, negative-exponential decline in imidacloprid concentrations in whole sediment and pore water after treatment. At 14 days, 4 of 8 sites had concentrations ranging from 6.8 µg a.i./L to 18 µg a.i./L, but imidacloprid was below detection limits at the other four locations. All but one sampling site declined to below detection limits in whole sediment by 28 days after treatment, with one sample (12 ppb) exceeding the 6.7 ppb screening level established for whole sediment. Sediment porewater demonstrated a similar rapid decline of imidacloprid concentrations, with all sediment porewater samples except one below the screening level of 0.6 ppb by day 28. The single sample that was above that screening level at day 28 exceeded that level, with a concentration of 1.2 ppb.

Megafauna Sampling and Analysis. The 2014 trials differed from prior trials in that they focused on the edges of the plots in surveying effects on crabs, both because it was impossible to survey the entire plot area sprayed due to its size, and because past trials had found that the edges often had higher numbers of Dungeness crab due to tidal depths (Dr. Kim Patten, WSU, personal communication). The monitored areas along the edge of the treated area were generally deeper and contained more eelgrass (*Zostera marina)* than the plots as a whole. Monitoring in 2014 found 137 Dungeness crabs exhibiting tetany (i.e., a reversible paralysis) or that were dead (see Table A-1). Based on their size, these were juvenile crabs. When the number of observed affected crab were divided by the total area sprayed, the 2014 field trials found an average of 2 crabs/acre were affected, of which about two out of three were reported dead, and one out of three were in tetany. This compares to 0.87–3.8 crab/acre reported dead or in tetany during field trials in 2011 and 2012. When the number of affected crab was divided using only the actual acreage examined, an average of more than 18 crab/acre is calculated. [11] One complication in interpreting these results is that most of the dead crab were either eaten by birds or were crushed by the field equipment used to conduct the experimental trials (Dr. Kim Patten, personal communication). It is not clear if these crab were already dead due to imidacloprid exposure, or if they were in tetany, thereby making them vulnerable to predation and crushing. Crabs in tetany that were not eaten or crushed on the day of sampling would remain highly vulnerable to future predation. The 2014 results confirm prior work that imidacloprid treatments result in impacts to juvenile Dungeness crab.

[11] During trials in 2011 and 2012 the plot sizes that were sprayed were small enough to allow sampling for crab over the entire area sprayed. As noted, in 2014 most of the plot was not sampled. For clarity two values are presented for the 2014 results, affected crab divided by the entire plot area to allow comparisons to 2011 and 2012 values, and affected crab divided only by the area surveyed. The first calculation underestimates the density of affected crab because crab in unsurveyed portions of the sprayed plot were not counted. And the second calculation overestimates the density of affected crab because the surveyed area was selected because it had the highest density of affected crab.

Table A-1 – Summary of Total Affected Crab Observed in 2014

Crab Size Class (carapace length, in inches)	Outside edge of spray zone			Inside edge of spray zone		
	Alive	Tetany	Dead	Alive	Tetany	Dead
< 2	1	4	7	0	1	10
2–3	1	8	20	0	3	18
3–4	0	9	22	2	7	12
4–5	0	5	2	0	7	2
> 5	0	0	0	0	0	0
Total	2	26	51	2	18	42

Note: Observations were recorded one day after treatment.

Efficacy Summary. The 2014 field trials indicated good results using imidacloprid to control burrowing shrimp on shellfish beds, particularly in areas with low densities of eelgrass. Efficacy was variable, ranging from 20 to 97 percent, with most sites showing efficacy levels in excess of 60 percent in assessments conducted by WGHOGA and WSU. Reduced efficacy was noted in areas with flowing water, high eelgrass densities, or both.

Effects of Imidacloprid on Epibenthic and Benthic Invertebrates. Epibenthic and benthic invertebrate samples were collected both within and adjacent to the treatment plots, using a grid-based sampling approach. Epibenthic and benthic invertebrates were sampled prior to the application of imidacloprid and at 14 and 28 days post-treatment. Imidacloprid effects were assessed for nine endpoints (absolute abundance, taxonomic richness, and Shannon diversity index) for each of three primary taxonomic groups: (polychaetes, mollusks, and crustaceans) by comparing invertebrate numbers in the treated plots to those in the control plots at each post-treatment sampling date.

As in prior years, the invertebrate results showed high variability, both within individual plots over time, and when plots were compared to one another. Thus, the primary finding of the 2014 invertebrate trials, that estuarine epibenthic and benthic invertebrates were similar on control plots as compared to treatment plots, is likely due to weak statistical power to detect differences.

Differences in epibenthic or benthic invertebrates between control and treatment plots fell within the permissible range of Ecology's SIZ standards, a result noted in most trials from prior years as well.

Ecology determined that the, "effects of imidacloprid cannot be discerned from seasonality and site variation or that relative recovery or recolonization is occurring within the 14-day period between the treatment date and first round of samples" (TCP

April 17, 2015 memo). The 2014 benthinc monitoring continued trends to date; all but one of the study monitoring locations have occurred in areas of low total organic carbon (less than 1% TOC) or high oceanic flushing.

Natural Resources Assessment Section - Toxicology Review

June 17, 2014

To: Erik W. Johansen,

Special Pesticide Registration Program Coordinator, Registration Services

From: George R. Tuttle, M.S.

Agency Toxicologist, Natural Resources Assessment Section

RE: Request for aquatic toxicology review of application for registration of 2 pesticides containing imidacloprid

Until recently oyster growers in Willapa Bay and Grays Harbor have used the N-methyl carbamate insecticide carbaryl to control burrowing shrimp populations under a National Pollutant Discharge Elimination System (NPDES) Permit (No. WA0040975) issued by the

Washington State Department of Ecology (Ecology) and a Section 24c Special Local Needs (SLN) registration issued by the Washington State Department of Agriculture (WSDA). They are now seeking the use of the terrestrial neonicotinoid insecticide imidacloprid as a replacement for carbaryl under the same permit. Considerable differences exist between these two chemistries in how they interact with biota and the environment. These include the mode-of-action, species sensitivity for both acute and chronic endpoints, as well as environmental persistence in surface water and sediments. The U.S. Environmental Protection Agency (EPA) has issued a conditional registration for the use of Protector 0.5G and Protector 2F (containing 0.5% and 21.4% imidacloprid respectively) in Willapa Bay and Grays Harbor, Washington, to control native populations of burrowing shrimp (ghost shrimp, *Neotrypaea californiensis* and mud shrimp, *Upogebia pugettensis*) in commercial oyster beds. In order for these two products to be used in

Washington State they need to be registered with the Washington State Department of

Agriculture (WSDA) under the state requirements of the Washington Pesticide Control Act (RCW 15.58). As the agency Toxicologist for WSDA I am submitting my formal toxicological review of the available data and recommendations on behalf of Natural Resources Assessment Section (NRAS) to the Pesticide Management Division (PMD) for consideration in their registration decision.

I have reviewed all of the studies that were submitted to WSDA by the Willapa Bay/Grays Harbor oyster Growers Association (WGHOGA) at the request of PMD (WSDA, 2014a). These studies were referenced in the ecological risk assessment prepared by Compliance Services International (CSI): *Ecological Risk Assessment of Imidacloprid Applications to Control Burrowing Shrimp in Oyster Beds of Willapa Bay and Grays Harbor, WA* (McGaughey et al., 2013) and the U.S. EPA ecological risk assessment: *IR4 Petition for the Use of Imidacloprid on Shellfish Beds in Willapa Bay and Grays Harbor, State of Washington (PC 129099); D399685, 399877,399882* (DeCant & Barrett, 2013). The studies were requested from WGHOGA by WSDA for the purpose of evaluating the environmental fate and effects data of formulated products containing imidacloprid on commercial shellfish beds. Review of these studies were necessary as WSDA requires information regarding the data collection methods used to generate the environmental data sets which formed the basis for the *in situ* exposure estimates used in both the EPA ecological risk assessment and CSI ecological risk assessments (WSDA, 2014a). After initially reviewing the studies submitted to WSDA, seven of the fifteen study reports appeared to be in draft form. WSDA contacted WGHOGA to confirm that the studies were final drafts and requested that WGHOGA submit final drafts where appropriate. WGHOGA verified that two of the seven studies in question were final drafts and resubmitted five others studies (WSDA, 2014b). After reviewing the final reports it is my opinion that the studies submitted to WSDA do not provide data at the level of scientific rigor and reliability that is required to ensure that the effects on non-target organisms will not result in unreasonable adverse effects for the following reasons:

1. The majority of the fifteen studies that were submitted to the WSDA did not clearly follow or reference methods or guidance for designing studies and collecting environmental effects data established by the EPA or supported by open scientific literature. Studies submitted to WSDA should include relevant citations that substantiate the methods used or developed and provide a justification for that choice.

2. Many of the studies submitted to WSDA showed little or no evidence of internal review, external review, or peer review. Studies submitted to WSDA should include the appropriate level of internal and external review to assure that the data is error free, data analysis is of high quality, and that the methods and study design are appropriate and sufficient to address the research questions.

3. The majority of the studies do not provide relevant citations or sufficient evidence that a literature review was conducted with which to form the basis for the study designs, methods used, or a framework with which to place these studies within a broader ecological relevance.

4. Of the studies that were received, (not including the CSI risk assessment) only one provides clear evidence of peer review and literature review and the scope of that study had limited relevance with regards to estimating environmental fate and effects of imidacloprid on nontarget organisms.

As a result of the aforementioned reasons (1-4), the studies submitted to WSDA are considered by NRAS to be preliminary in nature, an opinion also expressed by the authors of the EPA ecological risk assessment (DeCant & Barrett, 2013). Due to the preliminary nature of the environmental fate and effects data presented in these reports, the data do not provide the degree of certainty that is needed to predict ecological risk with a high degree of confidence.

Furthermore, in a letter to the Department of Ecology in response to a request for comments on the CSI ecological risk assessment and the environmental impact statement (EIS) scoping, U.S. Department of Fish and Wildlife Service expressed concerns that "The experimental field trials that have been performed to date do not adequately address a number of outstanding questions and sources of uncertainty, regarding the effectiveness of imidacloprid applications, effects to non-target species, and environmental persistence" (U.S. Fish and Wildlife Service, Washington Field Office, 2014). After reviewing the studies (including the CSI ecological risk assessment) provided by WGHOGA, NRAS's shares similar concerns. Some of the significant areas of uncertainty not addressed in these reports include:

1. No long-term studies conducted over a multi-year period available to assess persistent sediment toxicity effects on species assemblages.

2. Because initial studies were conducted on small (≤ 10 acres), isolated plots, it is unclear how scaling up from small plots to large commercial scale application of several hundred to thousands of acres annually may affect populations of benthic and epi-benthic invertebrates and the ability of the estuary ecosystems to maintain homeostasis as a whole. It is impractical to assume that increasing the spatial extent of the treatment area by a factor of ten or more will have negligible effect on the risk conclusions.

3. The risk assessments focus primarily on direct effects to non-target organisms including acute lethality and reduced mobility. However, indirect effects to fish and other organisms that occupy positions at higher trophic levels may be affected by temporary or long-lasting decreases in prey item availability. These indirect effects on prey availability could affect federally listed threatened or endangered species under the Endangered Species Act (ESA) including the southern district population segment of North American green sturgeon (*Acipenser medirostris*) and salmonid populations that use Willapa Bay and Grays Harbor to forage (National Marine Fisheries Service, 2014). The CSI ecological risk assessment states that "Imidacloprid use will have no direct effects on any of the 14 listed (threatened or endangered) species in Willapa Bay and Grays Harbor… and is not likely to cause adverse

habitat modification" (McGaughey et al., 2013). In contrast, the EPA ecological risk assessment states that, "Aquatic invertebrate taxa represent the base of the food chain, and impacts on these taxa will likely cascade up the food chain, resulting in a reduction in prey and modification of PCE's related to endangered species due to fewer prey,… the submitted biotic monitoring data indicate potential decreases in abundance for crustaceans and polychaetes at least 28 days post application without evident recovery, although these results are uncertain as well because the data are partial or incomplete and have not been formally submitted for review" (DeCant & Barrett, 2013). There is reason to believe that due to its physicochemical properties and mode-of-action, imidacloprid will persist in sediments for extended periods of time and may exert chronic effects on invertebrate populations. It is uncertain at this time how invertebrate populations (including the target species themselves), which serve as the prey base for other species (including ESA listed species) will be affected.

4. In recent publications in the primary literature, Tennekes & Sánchez-Bayo (2013) explain that, "Neonicotinoid insecticides show reinforcement of lethal effects over time of exposure", and Tennekes (2010) suggests that "Time-to-effect approaches that provide information on the doses and exposure times needed to produce toxic effects on the tested organisms are required for prediction of toxic effects." Because acute toxicity data utilized in the standard risk assessments methodology does not typically account for time-to-effect approaches, the risk estimates in the current two risk assessments may not adequately predict the latent toxicity of imidacloprid at sub-acute exposures and may underestimate the risk to invertebrate species. I recommend that time-to-effect approaches be investigated and addressed in future risk assessments and considered in any future EIS scoping.

There are several types of additional data that should be acquired in order to reduce the amount of uncertainty associated with this proposed use pattern and to ensure that impacts to the environment are minimized and short-lived. Needed data include:

1. "No laboratory studies were found on the toxicity of imidacloprid in sediment to marine organisms according to the analysis by McGaughey et al. (2013). In the absence of sediment toxicity data, the risk assessment is based on sediment pore water concentrations compared with water-only toxicity data". The fact that no sediment toxicity data exists for marine organisms represents a significant data gap and source of uncertainty in estimating risk to the most vulnerable species. It may be appropriate to request that the registrant conduct further Ecological Effects Studies that following EPA guidelines and could potentially include:
    a. Tier I - Whole Sediment Acute Toxicity (Saltwater) Testing
    b. Tier II - Fish Life-Cycle, Aquatic Invertebrate Life Cycle, or Whole Sediment Chronic Toxicity Testing

   c. Tier III - Simulated or Actual Field Testing

2. A more clearly defined temporal use pattern. The label currently states that all applications must occur between April 15th and December 15th. Limited date restrictions create uncertainty in trying to estimate which species are likely to be exposed and at which life stages. There should to be more specificity on the timing of seasonal application in order to more accurately characterize risk and avoid applications occurring during times when invertebrate species such as Dungeness crabs are present at sensitive life stages or during periods of seasonal recruitment. WSDA should coordinate with The Department of Ecology to determine if more restrictive treatment windows would help prevent off-target impacts.

3. More conclusive efficacy data of the product on the target organisms at individual beds from season to season is needed. The benefit gained by using the product needs to clearly outweigh the potential risks with regards to benthic and epi-benthic communities and ESA listed species.

4. Uncertainty associated with the risk conclusions that could be addressed directly through the NPDES permitting process include:
   a. Multi-year studies (≥ 2 years) to detect the possible accumulation of imidacloprid and primary metabolites in the sediments at several sites used to determine the "worst case scenario". These same studies are needed to determine the potential long-term impact of imidacloprid on benthic and free-swimming invertebrate communities and the species that utilize them as a food source (including ESA listed species). This data requirement could potentially be satisfied through the monitoring portion required by the NPDES permit process contingent upon pre-approval of sampling and analysis plans, annual operations plans, and quality assurance plans by Ecology and WSDA. Data should be submitted to both agencies.
   b. Additional data is needed to more clearly define the spatial extent of this use pattern. The EPA ecological risk assessment states that, "The data also highlight the concern that increasing acreage subject to application from potential increases in ghost and mud shrimp recruitment rates can lead to increases in the spatial extent of long-term impacts on invertebrate abundances, including polychaete and crustacean taxa"(DeCant & Barrett, 2013). According to the CSI ecological risk assessment, "Over 3000 acres of privately owned oyster-growing tidelands have burrowing shrimp (WDOE 2006), and the Section 3 registration does not require a limit to the acreage that could be treated with imidacloprid" (McGaughey et al., 2013). Although there is no restriction on the label that limits the total number of acres that may be treated per year, the NPDES permit for carbaryl (which is the same permit that imidacloprid will be issued under) has limited the area to be sprayed to 600 acres in Willapa Bay and 200 acres in Grays Harbor (Washington

State Department of Ecology, 2008). It is not certain if Ecology intends to extend this requirement of the permit to imidacloprid at this time, but limiting the total number of acres that may be treated with imidacloprid per year could serve as the most effective means to reduce uncertainty underlying the risk estimate, limit loading in the estuaries, and mitigate off-target effects. These values would need to be carefully considered and a system put in place to periodically reevaluate and adjust these values according the available monitoring data.

c. There is uncertainty regarding the persistence imidacloprid's primary metabolites (including the guanidine/desnitro metabolites) in sediment. This could be incorporated into the sediment impact zone (SIZ) assessment in accordance with WAC 173-204-415 and the NPDES permit.
d. Greater specificity is needed on the timing of seasonal application with respect to the life cycles of the two target species, or a well-defined method for determining the treatment threshold under the NPDES permit process must be identified to ensure efficacy of the product.
e. Imidacloprid should be used as part of an integrated pest management strategy to prevent overdependence on the use of chemical control and resistance by target species.

My recommendation to the Pesticide Management Division is that WSDA accept the application for registration of the Protector 0.5G and Protector 2F products at this time and notify the registrant that WSDA will require that specific conditions be met in order to re-register these two products in the future. Primarily these conditions should be submissions of study data and data generated under the NPDES permit process that will help the Departments of Agriculture and Ecology reduce the level of uncertainty and better the estimate the risk associated with this unique use. NRAS will assist the Pesticide Management Division in developing these data requirements. NRAS has already offered assistance to Ecology in developing the monitoring requirements for the NPDES permit.

Please feel free to call me at (360) 902-2066 or email to George.Tuttle@agr.wa.gov if you have any additional questions regarding this review. I would be happy to talk with you and provide further clarification.

Appreciatively,

George R. Tuttle, Agency Toxicologist

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MEMORANDUM

To: Leonard Machut, Washington Department of Ecology

From: Lorraine Read

Subject: Review of the SMS biological effects criteria for a SIZ, with applications to the WGHOGA benthic monitoring results from 2012 & 2014

Date: January 2, 2018

1.0 Introduction

Washington Department of Ecology has received two years of benthic monitoring data from WGHOGA's Imidacloprid test plots and corresponding control plots. Results from 2012 and 2014 were reviewed to evaluate the feasibility of using this type of data to assess impact within the context of a Sediment Impact Zone (SIZ) as defined by the Sediment Management Standards (SMS) (WAC 73-204-420). Benthic monitoring results from 2011 are also available; the sampling design used in 2011 differed from more recent years,[12] however, the data are useful for illustrating natural variability of benthic community metrics in untreated control plots over time.

In this memo, the SMS criterion used to define a SIZ is reviewed, with focus on statistical power and the specified analytical approach. Some recommendations are made for ways to improve both the analytical approach and the study design to create a more robust evaluation of the SMS SIZ benthic criterion. The benthic monitoring data collected by WGHOGA between 2011 and 2014 are summarized in light of the testing required by the SMS SIZ criterion.

2.0 Biological Effects Criteria specified in the SMS

SMS (WAC 173-204-420), part **3)** Puget Sound marine sediment impact zone maximum biological effects criteria states:

(c) *The sediment impact zone maximum biological effects level is established as that level below which any two of the biological tests in any combination exceed the criteria of WAC 173-204-320(3), <u>or</u> one of the following biological test determinations is made:*

> ***(iii) Benthic abundance:*** *The test sediment has less than fifty percent of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta and the test sediment abundances are statistically different (t test, $p \leq 0.05$) from the reference sediment abundances;*

The analytical approach implied by this criterion is two-fold:

1) the mathematical requirement that Treatment mean abundance < 0.5 x Reference mean abundance, AND
2) the statistical requirement established by a two-sample *t*-test ($\alpha = 0.05$). The standard specifies only "statistically different" not "statistically less than." A statistically significant <u>increase</u> over reference taxon abundance may indicate a negative effect if it applies to the abundance of opportunistic species and loss of other functional groups; but overall, a <u>decrease</u> in taxon abundance relative to reference is the assumed direction of concern indicated by this standard. Consequently, statistical difference is assumed to refer to a one-tail *t*-test ($\alpha = 0.05$) with the following null (Ho) and alternative (Ha) hypotheses:

[12] In 2011, a nested design was used with four cores taken at each of four stations within each plot. In 2012 and 2014, a minimum of 20 independent cores per plot were distributed across the sampled plot. The same sized coring device (with 10.2 cm diameter) was used in all three years.

Ho: Treatment ≥ Reference

Ha: Treatment < Reference

This expression of the statistical hypotheses uses a "proof of hazard" approach[13], where the assumed state of nature (i.e., the null hypothesis) is that the Treatment plot mean abundance is greater than or equal to Reference, and the burden of proof is to show that a hazard occurred (i.e., Treatment response is significantly less than Reference). A statistically significant decrease in two of the three major taxa leads to the conclusion that a negative benthic effect has occurred. Conversely, a failure to reject the statistical test leads to the conclusion that no significant negative effects have occurred. However, statistical significance is not necessarily equivalent to ecological significance, and failure to detect a statistically significant difference does not necessarily mean the ecological impact was not important, it just means that the difference observed was not statistically detectable in light of the sample size and the variability of the data. For this testing approach to be effective at accurately establishing a SIZ, then statistical power should be high and the minimum detectable difference (MDD) for the test should be tied to ecological significance. In this regard, the SMS criterion is incomplete in that neither the statistical power nor the ecologically meaningful difference[14] for the statistical test is specified.

3.0 Statistical Power

The power (1-β) of a statistical test is a function of α, sample size, MDD, and variance.

For the "proof of hazard" *t*-test hypotheses identified above, the type II error (β) is the consumer's risk: the risk of failing to reject the null hypothesis when a negative environmental impact has actually occurred (a false negative); and the type I error (α) is the producer's risk: the risk of rejecting the null hypothesis when no negative environmental impact has actually occurred (a false positive)[15]. In Ecology's memo regarding the WGHOGA Sampling and Analysis Plan for 2012 [from D. Podger, July 2012], power (1-β) was required to be 80% or greater. This allows the risk to the environment (β) to be four times higher than the risk to the permit

[13] In contrast, a "proof of safety" or precautionary approach assumes that a hazard may be present, and it is incumbent upon the permit proponent to prove that no harm has occurred. See Section 4.0 for a possible precautionary approach using equivalence testing.

[14] This may be assumed to be 50% of the Reference mean. Consistent with the "proof of hazard" approach this difference appears to be one that clearly indicates "an effect". In reality, ecologically meaningful effects may result from differences of smaller magnitude.

[15] If a precautionary approach is used, then the hypotheses are reversed, and α becomes the consumer's risk and β is the producer's risk.

proponent (α). In order to safeguard public health and the environment[16], it would be more appropriate to set the type II error rate to be comparable to the type I error rate, i.e., require 95% confidence and 95% statistical power for the statistical test.

All other things being equal, power and MDD are positively correlated: a test has more statistical power to detect a large difference between means than a small difference. When the desired MDD is expressed as 50% of the Reference mean abundance, a random value, the same design (sample size and station layout) can have very different statistical power depending on the random response at the Reference area. The existing data indicated a large amount of natural variability existed in the benthic abundances found at control plots from different areas and different years. Figure 1 shows the mean abundance at the control plots for four different locations over three different years. Among these control plots capturing both spatial and temporal differences, the abundance values varied by over an order of magnitude. The values for all test and control plots at one day before treatment (Figures 2 through 4) also illustrate the variability of responses observed in the absence of pesticide treatment.

Table 1 shows minimum sample size estimates using the coefficient of variation (CV) observed in the 2012 and 2014 datasets to achieve 80% and 95% power for a random MDD[17] equivalent to 50% of the reference (control) mean abundance. For polychaete abundance the minimum sample size estimates were quite low (n ≤ 12 for 95% power) using 2014 values – because the control plot mean abundance, and therefore the MDD, was large and variability (CV) was relatively low (≤ 41%); for the same endpoint at the LB site in 2012 the minimum sample size estimates were very high (n ≥ 84 for 95% power) because of a small MDD and larger CVs. Overall, of the 39 individual comparisons in 2012, 25 had inadequate sample sizes to achieve 80% power, and 27 were inadequate to achieve 95% power. In 2014, the outcome was similar: six of the nine individual comparisons had inadequate sample sizes for both 80% and 95% power.

Given the high natural temporal and spatial variability of the benthic data, it may be impractical to establish a sampling design in advance that would consistently meet either the 80% or the 95% power requirement for a random MDD (which ranged over an order of magnitude in the 2012/2014 WGHOGA dataset, resulting in sample size requirements from less than 10 to over 200).

[16] DOE's mission is to "…safeguard public health and the environment, and support high quality of life for current and future citizens."
[17] The MDD is random because it is a function of the Reference (control) mean abundance, a stochastic process and subject to random fluctuations.

4.0 Analytical Approach

The high natural spatial variability in benthic abundance values leads to the high potential for differences between treatment and reference (control) plots even before a pesticide treatment is applied. This initial difference could affect the ability to detect an important treatment effect. This potential for initial differences between treatment and control plots was addressed with the flowchart in Figure 7 of WGHOGA 2014 report. Which analytical path one takes is dependent on the pre-treatment bioequivalence test. In the 2014 monitoring report, none of the taxon abundances were statistically equivalent during the pre-treatment phase; mollusks and crustaceans had treatment plot abundance greater than the control plot leading to analytical Path C (Figure 7 in WGHOGA 2014 report), a non-statistical comparison of ratios (Table 19 in WGHOGA 2014 report). This suggests the need for a study design and analytical approach that is more robust to the natural behavior of these data, if possible. One example for a modified analytical approach is a Before-After-Control-Impact (BACI) analysis, coupled with a bioequivalence hypothesis (i.e., the null hypothesis defines the presence of an effect large enough to be ecologically meaningful, and the burden of proof is on the proponent to reject the null hypothesis with evidence that the observed difference is statistically within the specified bounds). A modification to the study design is discussed in Section 5.0.

A BACI design could address the potential for pre-treatment differences using a single, simplified model for all datasets. One way in which the BACI hypotheses could be framed using bioequivalence in a precautionary approach is:

Ho: $|\Delta_{Treatment} - \Delta_{Reference}|$[18] $\geq \delta$

Ha: $|\Delta_{Treatment} - \Delta_{Reference}| < \delta$

A conclusion of "no negative effects" is reached through rejection of the null hypothesis. This requires that the temporal change at the Treatment plot(s) be within δ units of the temporal change of the Reference (control) plot(s). The difference in temporal changes for Treatment and Reference must be significantly small, i.e., within δ, based upon the natural temporal change for Reference. This means that:

[18] $\Delta_{Treatment}$ is the temporal change from pre-treatment to post-treatment in means at the Treatment plot(s), and similarly, $\Delta_{Reference}$ is the temporal change in means at the Reference (control) plot(s).

- → If abundance at the Reference plot(s) increases over time, then the Treatment plot(s) must have a similar increase to reject the null hypothesis that a negative impact occurred, and conclude “no negative effects”.
- → If abundance at the Reference plot(s) decreases over time, then the Treatment plot(s) must have a similar decrease to reject the null hypothesis that a negative impact occurred, and conclude “no negative effects”.

If used, these hypotheses would require more specificity within the context of understanding how benthic communities respond and recover from environmental stressors. For example, if the Treatment response is an increase over time and the Reference response is a decrease, then $|\Delta_{Treatment} – \Delta_{Reference}|$ could exceed δ. This is a net difference that exceeds the ecologically meaningful range, but this may not necessarily be a negative effect. Also, the application of the “50% test” described in WAC 173-204-420 would need to be reviewed for how it could be implemented in the BACI framework expressing temporal change. Finally, the specification of an appropriate ecologically meaningful difference (δ) is key to the success of this approach.

Advantages to the BACI approach include: 1) more degrees of freedom leading to higher statistical power, in general, 2) better representation of the conditions because it uses variance of all the data; 3) cleaner analytical approach so every treatment plot at each point in time follows a single analytical path (i.e., Figure 7 of WGHOGA 2014 is greatly simplified). This should produce ‘testable’ results in every situation, and the only situations that end up in the ‘site-specific evaluation’ category are those with insufficient power to detect the desired level of change. This approach highlights the need to do some additional thinking and specification of the type and magnitude of differences that are deemed ecologically important. This is a complication, but not really a disadvantage. Not specifying what constitutes ecologically important differences relegates the SIZ decision to an overly simplified testable hypothesis which may fail to accomplish the intent of the SMS.

Complications to the BACI approach include: 1) the need to define the ecologically meaningful delta; and 2) if data are distinctly non-normal, the need to modify the data or the model (i.e., use an appropriate transformation to reach approximate normality, or specify a generalized linear model with error term appropriate for the count data, or use bootstrapping as a non-parametric alternative). These are “complications” only in the sense that they require more complex data analysis than a simple *t*-test or a non-parametric alternative, as well as a clearly articulated understanding of the underlying system.

5.0 Study Design

The fact that the MDD is a random variable means that not being labeled a SIZ (by failing to reject the statistical test) is strongly determined by the status of the random control plot that was selected.

Replication of control and treatment plots would be a valuable improvement to the study design. The use of a single plot for each treatment and control places substantial importance on those individual plots. However, it may be logistically problematic to have replicate plots as this requires locating enough suitable sites that are independent; and it would also greatly increase the cost for implementation of the monitoring. In light of the difficulty and cost associated with implementing the ideal study design, it may be problematic to adequately and cost-effectively ensure compliance with the SMS benthic monitoring requirement.

6.0 Conclusions

As stated, the SMS SIZ criterion lacks some necessary details to test the criterion, specifically power and the target MDD. The MDD may be interpreted to be 50% of the Reference plot mean; and the statistical power may be reasonably set at 95%, limiting both the consumer's and the producer's risk to 5%.

A review of existing intertidal benthic community data from Grays Harbor and Willapa Bay indicated that abundance values were highly variable, even within untreated plots. The estimated minimum sample sizes to achieve either 80% or 95% power, based on existing variance estimates, ranged from 5 per plot to over 200 per plot. In a majority of the comparisons of major taxon abundance values, the number of samples obtained in the monitoring events was inadequate to achieve even a lower standard of 80% power (Table 1). As a result of this level of variability, it may be impractical and costly to establish a sampling design in advance that would consistently provide sufficient statistical power for the test specified by the SIZ criterion.

In the 2014 monitoring report, none of the final conclusions were statistically based, and many conclusions required best-professional judgement from a site specific evaluation (SSE). This suggests an inadequate study design and/or analytical approach for the data types under review. This memo has identified modifications to the study design and analytical approach that would improve the ability to make inferences about negative environmental impacts, or lack thereof, under the SIZ criterion. Replication of both control and treatment plots would increase the confidence necessary to make inference from the experimental setting to the more broadly dispersed intertidal areas where the pesticide application would be allowed if such a permit was issued. Further, a modified analytical approach (e.g., a BACI framework with a 'proof-of-safety' null hypotheses and an ecologically significant difference specified) would provide powerful statistical evidence to support the conclusion of "no negative effects" prior to issuance of a permit.

Table 1. Summary of abundance results, including sample sizes for 80% and 95% power to detect 50% of the CHK mean at each time point.

			Polychaete abundance				Sample Size for Power		Mollusca abundance				Sample Size for Power		Crustacean abundance				Sample Size for Power	
Site	DAT	Treatment	Sample Size	Mean	SD	CV	95% Power	80% Power	Sample Size	Mean	SD	CV	95% Power	80% Power	Sample Size	Mean	SD	CV	95% Power	80% Power
2014 Monitoring																				
1	-1	CHK	24	193	64	33%			24	9	4.5	49%			24	311	207	67%		
1	-1	IMID-L	21	141	47	33%	9	6	21	20	8.9	45%	51	32	21	434	250	58%	49	31
1	14	CHK	24	182	66	36%			24	9	4.2	47%			24	410	226	55%		
1	14	IMID-L	22	167	45	27%	10	6	22	22	9.5	43%	60	31	22	481	387	80%	53	37
1	28	CHK	24	192	55	29%			24	11	4.7	44%			24	377	212	56%		
1	28	IMID-L	22	196	80	41%	12	8	22	24	13.0	54%	73	43	22	839	562	67%	111	58
2012 Monitoring																				
BC	-1	CHK	29	54	34	63%			29	7	5.0	76%			29	39	39	100%		
BC	-1	IMID-G	36	53	33	61%	34	20	36	7	6.7	92%	72	42	36	19	18	96%	54	32
BC	-1	IMID-L	26	42	21	51%	25	15	26	12	7.8	68%	88	51	26	24	21	86%	57	33
BC	14	CHK	27	122	46	37%			27	10	5.9	61%			27	84	51	61%		
BC	14	IMID-G	20	98	56	58%	17	10	20	10	9.3	91%	57	33	20	13	13	98%	18	11
BC	14	IMID-L	20	84	43	52%	13	8	20	17	7.1	42%	40	23	20	26	16	64%	19	11

			Polychaete abundance				Sample Size for Power		Mollusca abundance				Sample Size for Power		Crustacean abundance				Sample Size for Power	
Site	DAT	Treatment	Sample Size	Mean	SD	CV	95% Power	80% Power	Sample Size	Mean	SD	CV	95% Power	80% Power	Sample Size	Mean	SD	CV	95% Power	80% Power
BC	28	CHK	20	178	50	28%			20	12	5.3	45%			20	102	48	47%		
BC	28	IMID-G	21	100	57	57%	9	6	21	8	4.9	61%	18	11	21	26	27	101%	14	8
BC	28	IMID-L	20	134	53	39%	8	5	20	22	12.5	57%	60	35	20	64	46	72%	19	12
BC	58	CHK	No data						20	11	7.1	65%			20	245	157	64%		
BC	58	IMID-L					n/a	n/a	20	18	9.1	50%	49	29	20	110	53	48%	21	13
LB	-1	CHK	26	25	39	154%			26	5	10.4	226%			26	13	14	104%		
LB	-1	IMID-G	27	19	18	95%	126	73	27	1	1.5	111%	227	130	27	24	21	86%	157	90
LB	-1	IMID-L	26	16	13	85%	116	67	26	1	1.5	147%	227	130	26	12	14	118%	98	57
LB	14	CHK	21	15	21	143%			21	4	7.2	183%			21	17	19	107%		
LB	14	IMID-G	21	12	11	88%	113	65	21	2	1.8	113%	156	89	21	20	15	73%	83	48
LB	14	IMID-L	20	11	7	65%	100	58	20	2	4.8	219%	211	121	20	15	19	129%	103	59
LB	28	CHK	20	26	33	128%			20	10	22	212%			20	34	49	143%		
LB	28	IMID-G	20	17	14	83%	84	49	20	1	1.2	106%	197	113	20	16	14	88%	97	56
LB	28	IMID-L	20	21	14	69%	85	49	20	2	3.2	143%	201	115	20	15	23	157%	109	63

DAT = Days after treatment

CHK = Control plot (no insecticide)

			Polychaete abundance				Sample Size for Power		Mollusca abundance				Sample Size for Power		Crustacean abundance				Sample Size for Power	
Site	DAT	Treatment	Sample Size	Mean	SD	CV	95% Power	80% Power	Sample Size	Mean	SD	CV	95% Power	80% Power	Sample Size	Mean	SD	CV	95% Power	80% Power

IMID-G is a granular formulation of the imidacloprid insecticide

IMID-L is a liquid formulation of the imidacloprid insecticide

SD = Standard deviation

CV = Coefficient of variation (SD/mean)

Highlighted values are where sample sizes were insufficient to have an MDD equal to 50% of the CHK mean.

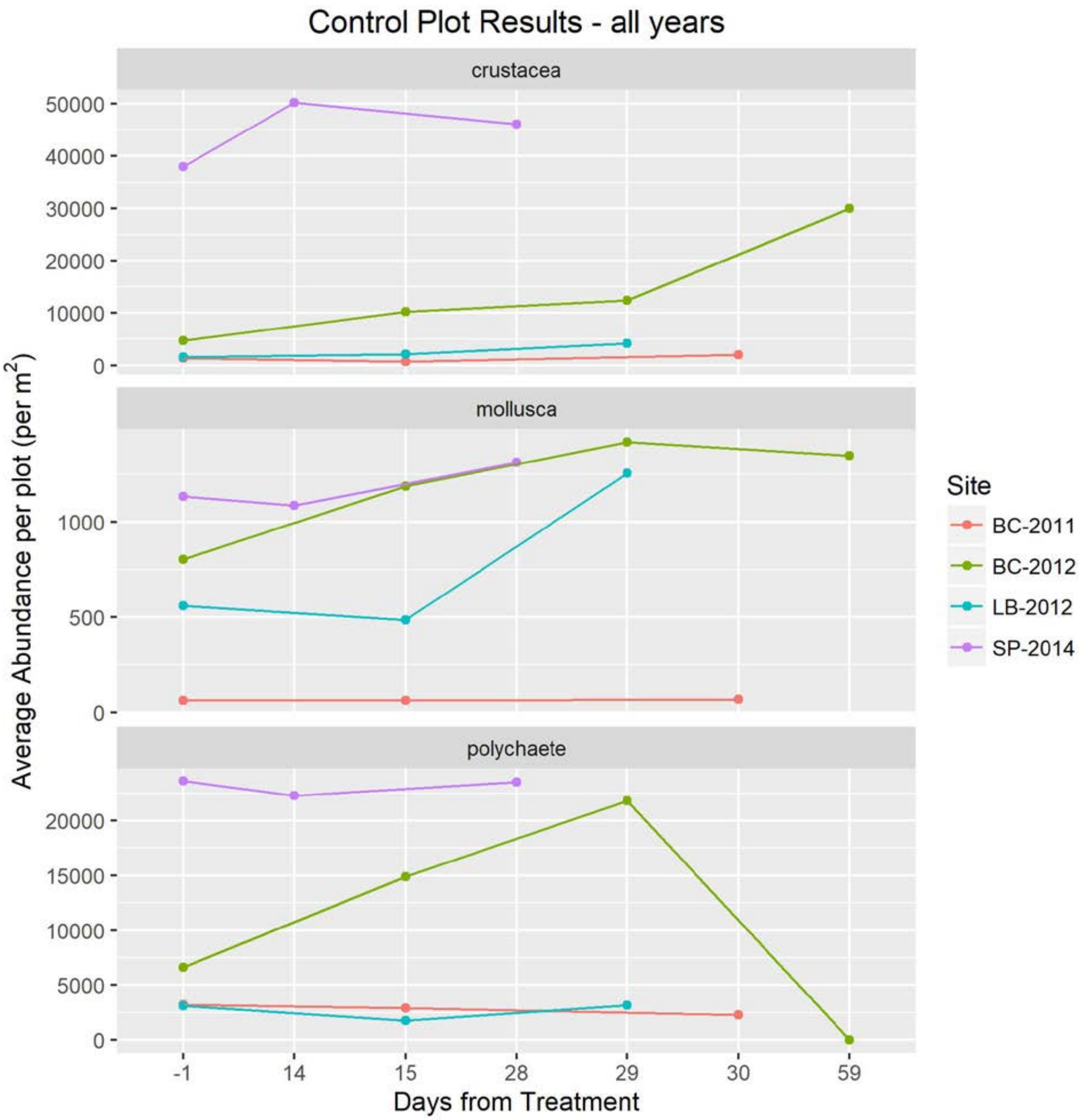


Figure 1. Abundance responses at the control plots over time for four different plots from three different years. Note the y-axis scales differ among the taxanomic groups. Site codes: BC = Bay Center, LB = Leadbetter, SP = Stony Point.

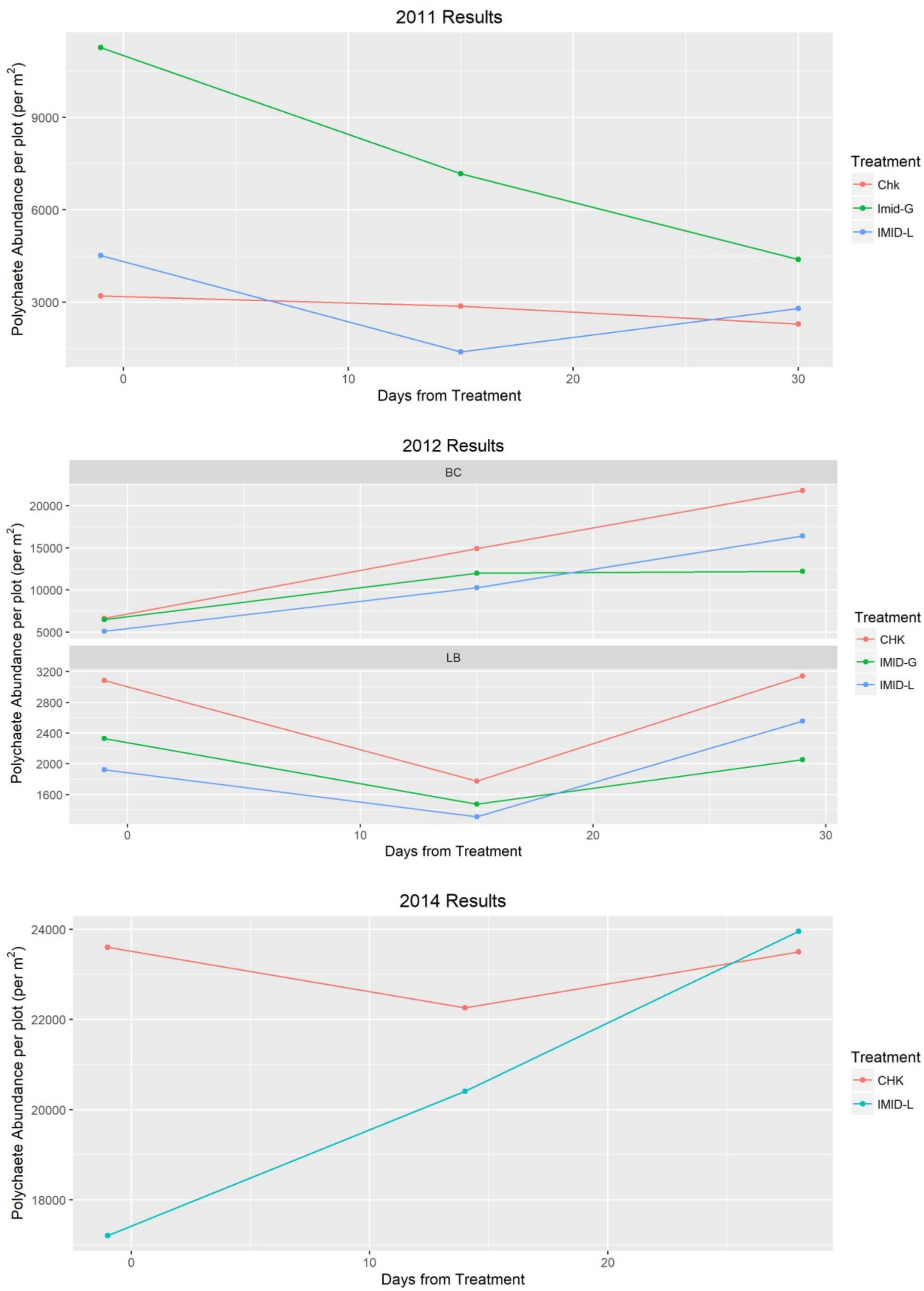
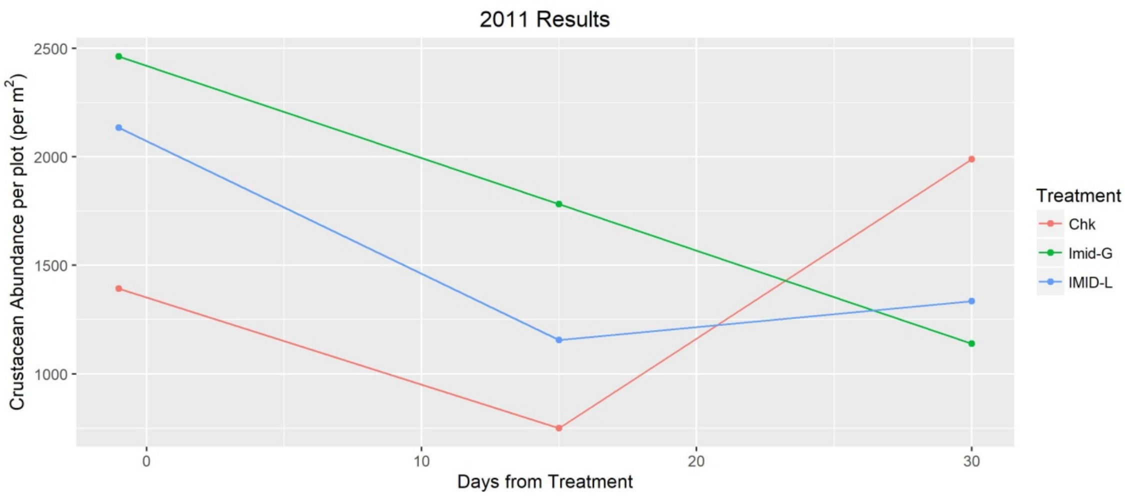
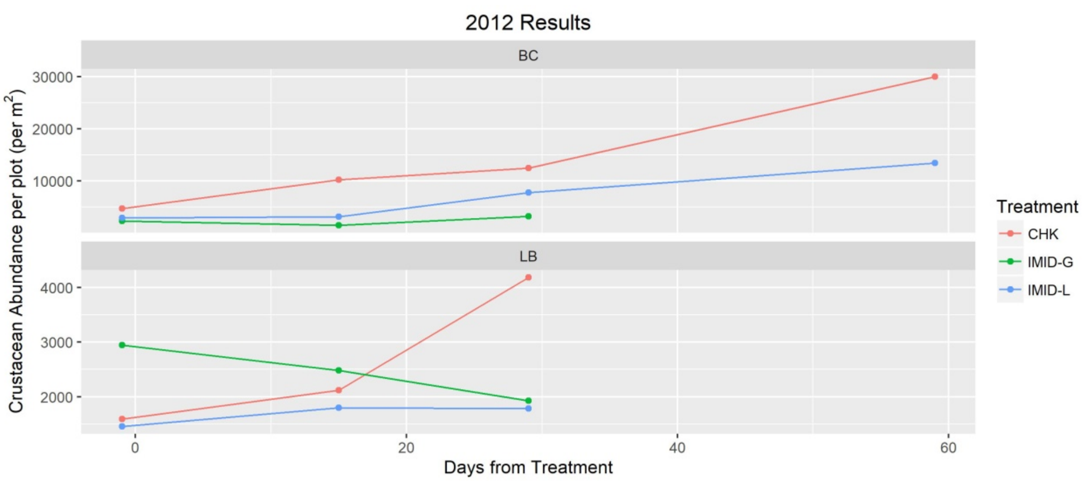


Figure 2. Polychaete abundance over time (days from treatment) for 2011 (top), 2012 (middle), and 2014 (bottom). Note the y-axis scales differ among years. Treatments: CHK = Control plot (no

insecticide); IMID-G and IMID-L are a granular and liquid formulation of the imidacloprid insecticide, respectively.





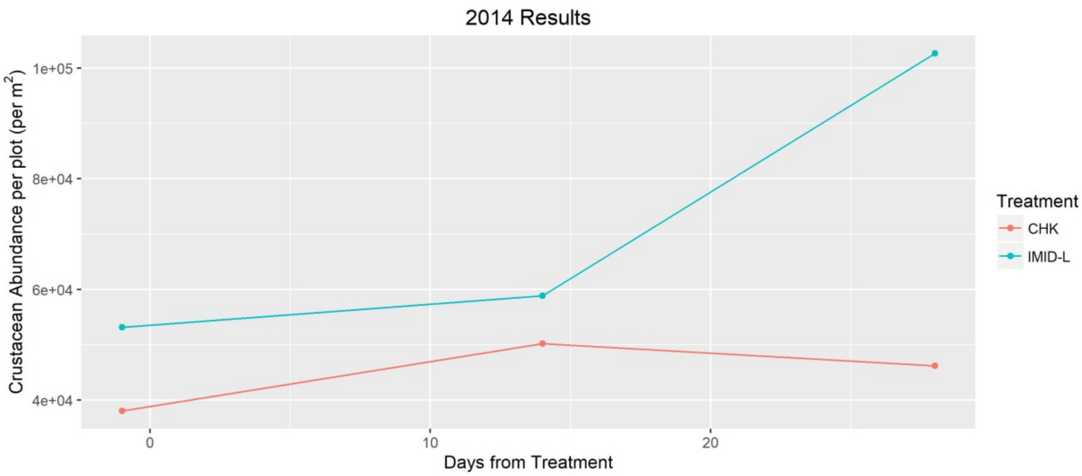
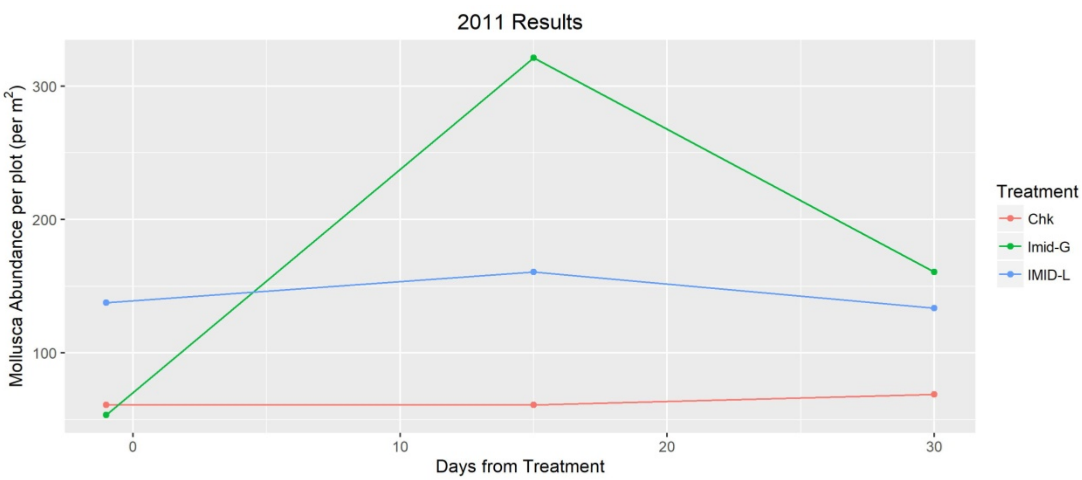


Figure 3. Crustacean abundance over time (days from treatment) for 2011 (top), 2012 (middle), and 2014 (bottom). Note the y-axis scales differ among years. Treatments: CHK = Control plot (no insecticide); IMID-G and IMID-L are a granular and liquid formulation of the imidacloprid insecticide, respectively.



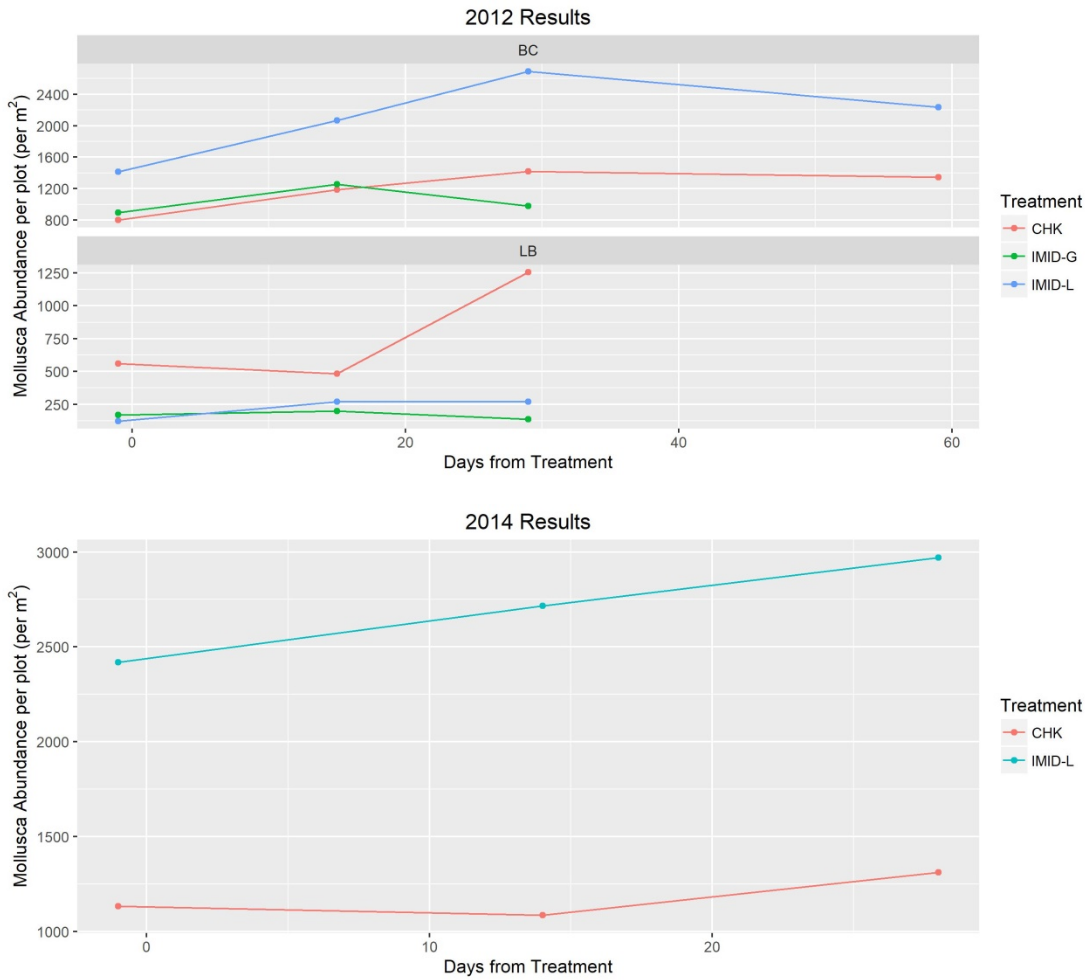


Figure 4. Mollusk abundance over time (days from treatment) for 2011 (top), 2012 (middle), and 2014 (bottom). Note the y-axis scales differ among years. Treatments: CHK = Control plot (no insecticide); IMID-G and IMID-L are a granular and liquid formulation of the imidacloprid insecticide, respectively.

Appendix B

Affiliation	Commenter Name	Topics where comments were assigned	Associated Comment numbers
Individual			
	Anonymous	Other	I-27-1
	Anonymous	Environment general	I-40-1
	Anonymous	Water Quality	I-63-1
	Anonymous	Other	I-72-1
	Anonymous	Other	I-85-1
	Anonymous	Environment general	I-115-2
		Human Health	I-115-1
	Anonymous	Other	I-131-1
	Eric	Pollinators	I-218-2
		Food Web/Prey	I-218-1
		Toxicity	I-218-3
	Jules	Food Web/Prey	I-237-1
		Sediment	I-237-2
		Benthic Organisms/Invertebrates	I-237-3
	Shari	ESA	I-73-1
	Aaron, Melissa	Pollinators	I-6-3
		Food Web/Prey	I-6-1
		Toxicity	I-6-2
	Abelson, Bill	Environment general	I-134-1
	Adams, Evelyn	Pollinators	I-312-1
	Aegerter, Bob	Environment general	I-314-1
	Alcyone, Daniel	Environment general	I-93-1
		Uncertainty	I-93-2
	Allen, Dana	Environment general	I-355-1
	ANDERSON, INDIA	Food Web/Prey	I-79-1
	anderson, valerie	Food Web/Prey	I-52-1
	Andrews, Rich	Avian	I-246-3
		Food Web/Prey	I-246-1
		Human Health	I-246-5
		Benthic Organisms/Invertebrates	I-246-4
		ESA	I-246-2
		Economics	I-246-7
		Toxicity	I-246-6
	Anthony, Hal	Human Health	I-373-1
	Armon, Caroline	Environment general	I-172-1
		ESA	I-172-2
	Asprey, W	Environment general	I-248-1
	Asprey, W	Environment general	I-249-1
	Asprey, W	Food Web/Prey	I-264-1

	Atwood, April	Pollinators	I-46-1
		Human Health	I-46-2
	Aufderheide, Jon/Anna	Pollinators	I-157-1
	Baldauski, Karen	Pollinators	I-336-2
		Environment general	I-336-1
	Bannerman, Lynne	Environment general	I-163-1
	Barkhurst, Ross	Pollinators	I-202-3
		Food Web/Prey	I-202-1
		Benthic Organisms/Invertebrates	I-202-4
		Patten	I-202-2
	Barkhurst, Ross	Avian	I-210-3
		Food Web/Prey	I-210-1 , I-210-4
		ESA	I-210-2
		Cumulative Impacts	I-210-5
	Barkhurst, Ross	Avian	I-247-5
		Sediment	I-247-3
		Benthic Organisms/Invertebrates	I-247-4
		Uncertainty	I-247-1
		Cumulative Impacts	I-247-2
	Barkhurst, Ross	Pollinators	I-220-5
		Avian	I-220-4
		Food Web/Prey	I-220-3
		Benthic Organisms/Invertebrates	I-220-2
		Uncertainty	I-220-1
		Cumulative Impacts	I-220-6
	Barrett, Michaela	Pollinators	I-5-1
		Avian	I-5-2
		Benthic Organisms/Invertebrates	I-5-3
		Toxicity	I-5-4
	Beattie, Jane	Food Web/Prey	I-268-1
		Benthic Organisms/Invertebrates	I-268-3
		Water Quality	I-268-2
	Beattie, Julian	Environment general	I-159-1
	Behmen, Glynn	Environment general	I-317-1
	Belleveau, Lisa	Avian	I-119-3
		Food Web/Prey	I-119-2
		Benthic Organisms/Invertebrates	I-119-1
	Bennett, Julie	Other	I-65-1
	Bensch, Eric	Environment general	I-166-1

	Bensch, Eric	Environment general	I-167-2
		Human Health	I-167-1
	Berg, Rachel	Environment general	I-369-1
	berman, birch	Uncertainty	I-26-1
	Beugli, David	Avian	I-221-3
		Food Web/Prey	I-221-2
		Human Health	I-221-4
		Economics	I-221-1
	Beugli, David	Avian	I-240-3
		Environment general	I-240-2
		Human Health	I-240-4
		Economics	I-240-5
		Full Comment	I-240-1
	Bhakti, Sara	Other	I-303-1
	Boelter , Jennifer	Uncertainty	I-70-1
	Book, Seth	Food Web/Prey	I-216-1
		Uncertainty	I-216-2
		Cumulative Impacts	I-216-3
	Book, Seth	Uncertainty	I-185-1
	Boteler, Diane	Food Web/Prey	I-34-1
		Human Health	I-34-3
		Toxicity	I-34-2
	Boteler, Diane	Environment general	I-143-1
	Bowers, Martin	Environment general	I-105-1
	Boyden, Jeff	Human Health	I-94-2
		Uncertainty	I-94-1
	Browne, Marie	Environment general	I-194-1
	Bubelis, Wally	Pollinators	I-300-1
	Buck, Erika	Environment general	I-179-1
		Human Health	I-179-3
		Sediment	I-179-2
	Bunnell, Katie	Pollinators	I-193-1
		Benthic Organisms/Invertebrates	I-193-2
	Burch, Ilse	Other	I-305-1
	Burdick , Sharon	Toxicity	I-87-1
	Caler, Josehp	Environment general	I-56-1
	Canarsky, Maurine	Environment general	I-328-1
	Candelaria, Joseph	Environment general	I-387-1
	Carroll, Linda	Other	I-280-1
	Carroll, Linda	Food Web/Prey	I-265-1
	Cassell, Patricia	Other	I-22-1
	Champagne, Cherry	Pollinators	I-192-1
		Benthic Organisms/Invertebrates	I-192-2

	Cheney, Daniel	Environment general	I-174-1
		Water Quality	I-174-2
		Uncertainty	I-174-3
	Christensen, Candace	Uncertainty	I-329-1
	Clark, David	Environment general	I-162-2
		Human Health	I-162-1
	Clifford, Margaret	Human Health	I-67-1
	Clyde, George	Environment general	I-108-1
		Human Health	I-108-2
	Cockrell, Ann	Other	I-364-1
	Cohen, Fritzi	Other	I-335-1
	Cohen, Fritzi	Patten	I-250-1 , I-250-2
	Cohen, Janine	Environment general	I-155-1
	Coleman, Timothy	Water Quality	I-301-1
	Conley , Allison	Environment general	I-37-1
	Conley, John	Environment general	I-173-1
		Human Health	I-173-3
		Benthic Organisms/Invertebrates	I-173-2
	Coombs, Eva	Environment general	I-311-1
	Coontz, Sharron	Environment general	I-116-1
	Costantino, Lisa	Pollinators	I-14-1
	Cruz, Deborah	Other	I-273-1
	D'Annunzio , Holly	Environment general	I-43-1
	Dale, Rebecca	Toxicity	I-54-1
	Daniel, Sherry	Human Health	I-279-1
	Daniels , Chad	Human Health	I-44-1
	Daschbach, Patricia	Food Web/Prey	I-98-1
	Davis, Erika	Pollinators	I-308-1
	De Danaan, LLyn	Environment general	I-145-1
	Deny Imidacloprid Use , Form Letter (Multiple)	Avian	I-242-2
		Food Web/Prey	I-242-3
		Benthic Organisms/Invertebrates	I-242-1
	Devlin, Felicity	Food Web/Prey	I-288-1
	Dick, Pat	Environment general	I-234-1
	Dietrich, Chris	Environment general	I-319-1
	Dietrich, Daniel	Environment general	I-110-1
	dixon, bill	Other	I-142-1
	Do Not Allow Imidacloprid, Form Letter (Multiple)	Food Web/Prey	I-270-1
		Sediment	I-270-6
		Benthic Organisms/Invertebrates	I-270-2
		Uncertainty	I-270-3
		ESA	I-270-7

		Monitoring	I-270-4
		Toxicity	I-270-5
	Donaldson, Margaret	Food Web/Prey	I-8-1
		Benthic Organisms/Invertebrates	I-8-2
		Uncertainty	I-8-4
		Cumulative Impacts	I-8-5
		Toxicity	I-8-3
	Donley, Nathan	Pollinators	I-204-5
		Avian	I-204-3
		Food Web/Prey	I-204-2
		Sediment	I-204-4
		Benthic Organisms/Invertebrates	I-204-6
		Uncertainty	I-204-1
	Douglas, Tom	Environment general	I-267-2
		Toxicity	I-267-1
	Drescher, Melanie	Pollinators	I-49-1
		Human Health	I-49-2
		Toxicity	I-49-3
	Driscoll, Ava	Food Web/Prey	I-244-2
		Uncertainty	I-244-1
	E, A	Environment general	I-19-1
	Eager, Dwight	Food Web/Prey	I-227-1
	Eck, Susan	Sediment	I-383-1
	Ellison, Richard	Other	I-295-1
	Emrich, Mark	Pollinators	I-211-1
		Benthic Organisms/Invertebrates	I-211-2
		Cumulative Impacts	I-211-3
	entress, susan	Pollinators	I-42-2
		Water Quality	I-42-1
		Toxicity	I-42-3
	Erlenborn, Daniel	Food Web/Prey	I-86-1
	Fairfax MD, George	Environment general	I-106-1
		Toxicity	I-106-2
	Fargo, Rich	Pollinators	I-41-1
		Toxicity	I-41-2
	Ferm, Mary	Food Web/Prey	I-337-1
	Ferrari, Teresa	Environment general	I-125-1
	Ferrari, Teresa	Environment general	I-126-1
	Figlar-Barnes, Kim	Avian	I-165-3
		Food Web/Prey	I-165-4
		Benthic Organisms/Invertebrates	I-165-1

		Toxicity	I-165-2
	Figlar-Barnes, Ron	Pollinators	I-117-1
		Avian	I-117-5
		Benthic Organisms/Invertebrates	I-117-2
		Uncertainty	I-117-4
		Toxicity	I-117-3
	Fillmore, Margaret	Avian	I-140-2
		Food Web/Prey	I-140-1
		Human Health	I-140-3
	Fink, Diane	Food Web/Prey	I-76-2
		Human Health	I-76-1
	Finley, Jennifer	Food Web/Prey	I-184-1
	Fletcher, Sarah	Human Health	I-45-1
		Uncertainty	I-45-2
	Foster, Beverly	Environment general	I-356-1
	Frank , Joanne	Food Web/Prey	I-35-1
		Human Health	I-35-2
	Fraser, Mary	Human Health	I-320-2
		ESA	I-320-1
	Frazer, Liz	Environment general	I-277-1
	Futrell, Sherril	Food Web/Prey	I-260-1
		ESA	I-260-2
	Futrell, Sherrill	Human Health	I-367-1
	Gale, Maradel	Environment general	I-326-1
	Galvan, Edgar	Environment general	I-177-1
		Economics	I-177-2
	Gardner, Kirk	Pollinators	I-293-1
	Gatton, Gail	Avian	I-233-1
		Food Web/Prey	I-233-2
		Benthic Organisms/Invertebrates	I-233-4
		Economics	I-233-3
	Gaut, Katie	Benthic Organisms/Invertebrates	I-120-1
		Uncertainty	I-120-2
		Toxicity	I-120-3
	Genaze, Matthew	Environment general	I-323-1
	Gillies, Don	Environment general	I-231-1
		Uncertainty	I-231-2
	Glikshtern, Anastasia	Environment general	I-345-1
	Goodman, Alice	Other	I-97-1
	Granlund, Scott	Other	I-316-1
	Gray, Martha	Other	I-156-1
	Gray, Pamela	Food Web/Prey	I-99-1

	Green, Stanley	Environment general	I-103-1
	Gresham, James	Pollinators	I-81-1
		Food Web/Prey	I-81-2
	Gruver, Paul	Environment general	I-152-1
	Gullekson, Ed	Cumulative Impacts	I-302-1
	Hagstrom, Erik	Other	I-276-1
	Haley, Stacia	Environment general	I-306-1
	Hall, Martha	Avian	I-151-3
		Environment general	I-151-1
		Human Health	I-151-4
		Benthic Organisms/Invertebrates	I-151-2
	Halliday, Jan	Other	I-266-1
	Hamilton , Jewell	Pollinators	I-1-1
	Hamilton, Tim	Economics	I-209-1
	Hanlon, Linda	Environment general	I-307-1
	Hanneman, Mary	Human Health	I-271-1
	Harrie, Susan	Other	I-322-1
	Harris, Bernice	Food Web/Prey	I-18-1
	Hart, Karma	Other	I-291-1
	Hart, Matthew	Food Web/Prey	I-3-1
		Benthic Organisms/Invertebrates	I-3-2
	Hartman, Peri	Food Web/Prey	I-24-1
	Hawk, Maggie	Pollinators	I-313-1
	Healy, Debra	Food Web/Prey	I-28-1
	Helsley, Jessica	Food Web/Prey	I-169-4
		Environment general	I-169-2
		Human Health	I-169-1
		ESA	I-169-3
	Hencken, Joel	Other	I-51-1
	Henderson, Parrie	Environment general	I-346-1
	Hendricks, Laura	Avian	I-207-4
		Food Web/Prey	I-207-1
		Benthic Organisms/Invertebrates	I-207-7
		Uncertainty	I-207-6
		ESA	I-207-5
		Monitoring	I-207-3
		Toxicity	I-207-2
	Henwood, Bonnie	Environment general	I-150-1
		Benthic Organisms/Invertebrates	I-150-2
	Herrold, Annie	Food Web/Prey	I-176-1
	Herrold, John	Environment general	I-199-1

	Hodie, Jake	Environment general	I-386-1
	Hoepfner, Christine	Uncertainty	I-261-1
	Hogan, Dan	Other	I-129-1
	Hollen, Mary	Environment general	I-32-2
		Human Health	I-32-1
	Horman, Blythe	Avian	I-133-3
		Environment general	I-133-4
		Benthic Organisms/Invertebrates	I-133-1
	Horner, Richard	Other	I-284-1
	Hughey, Lacey	Environment general	I-109-1
	Hutchinson, Randi	Environment general	I-333-1
	Huth, Graciela	Other	I-334-1
	Huth, Graciela	Environment general	I-374-1
	Jackson, Sego	Other	I-283-1
	Jacobson, Guy	Human Health	I-104-1
	james, richard	Environment general	I-170-3
		Human Health	I-170-1
		Toxicity	I-170-2
	Janzen, Gayle	Food Web/Prey	I-259-1
		Sediment	I-259-2
		Water Quality	I-259-4
		Cumulative Impacts	I-259-3
	Jaqua, Debra	Pollinators	I-186-1
	Jasper, Jessica	Food Web/Prey	I-75-1
	Jennings, Sam	Human Health	I-158-1
	Jensen, Tom	Pollinators	I-148-1
		Environment general	I-148-2
	Johnson, Brigetta	Environment general	I-95-1
		Toxicity	I-95-2
	Johnson, Lyn	Environment general	I-321-1
	Jones, Erica	Pollinators	I-304-3
		Avian	I-304-2
		Food Web/Prey	I-304-1
	Jones, Kevin	Pollinators	I-191-1
		Benthic Organisms/Invertebrates	I-191-2
	Jones, Una	Pollinators	I-197-2
		Human Health	I-197-1
	Jorgensen, Walter	Pollinators	I-190-1
		Environment general	I-190-3
		Uncertainty	I-190-2
	Jusela , Valerie	Food Web/Prey	I-20-2
		Human Health	I-20-1
	Jusela , Valerie	Environment general	I-21-1

	Keller, Heidi	Environment general	I-101-2
		Sediment	I-101-1
	Kelley, Jeremy	Environment general	I-58-1
	Kemnitz, Kristine	Other	I-385-1
	Kennedy, Linda	Environment general	I-338-1
	Kepner, Dennis and Susan	Environment general	I-372-1
	Kernes, Susan	Environment general	I-7-1
	Kershaw, Alexander	Pollinators	I-332-1
	Keyse, Robert	Uncertainty	I-50-1
	Kilgore, Janaki	Food Web/Prey	I-88-1
		Uncertainty	I-88-2
	Kingzett, Brian	Avian	I-236-3
		Food Web/Prey	I-236-1
		Monitoring	I-236-4
		Economics	I-236-2
	Kirby, Evelyn	Other	I-325-1
	Kisor, Dave	Human Health	I-365-1
	Knudson, Andy	Environment general	I-100-1
	Kolodziej, Edward	Uncertainty	I-122-1
		Toxicity	I-122-2
	Laakaniemi, Karen	Environment general	I-366-1
	Lackey, Shannon	Human Health	I-61-1
	Laughbon, Christopher	Environment general	I-29-1
	Lawrence, Thomas	Environment general	I-38-1
		Human Health	I-38-2
		Uncertainty	I-38-3
	Le Vee, Ilene	Other	I-181-1
	Leland, Lora	Pollinators	I-354-1
	Lewis, Sammarye	Food Web/Prey	I-82-1
	Lindberg, Jennie	Environment general	I-123-1
	Lloyd, Lynn	Food Web/Prey	I-160-1
	Lockridge, Ross	Pollinators	I-263-1
	Loudermilk, Betina	Environment general	I-77-2
		Human Health	I-77-1
	Lowman, Betty	Environment general	I-352-1
	Lyle, K	Environment general	I-357-1
	Mach, Stephen	Other	I-92-1
	Mackrow, Paula	Food Web/Prey	I-287-1
	Mahony, Kathleen	Food Web/Prey	I-84-1
	Mandelbaum, Ilene	Other	I-377-1
	Manning , Jacob	Environment general	I-80-1
	Marett, Susan	Other	I-296-1
	Marriott, Stan	Food Web/Prey	I-146-1
	Martinez, Priscilla	Environment general	I-370-1

	Massoni, Gina	Environment general	I-149-1
		Benthic Organisms/Invertebrates	I-149-4
		Uncertainty	I-149-3
		ESA	I-149-5
		Toxicity	I-149-2
	Matthews, Janet	Environment general	I-327-1
	Mattice, Eleanor	Environment general	I-107-1
	McCabe, Eileen	Economics	I-278-1
	McClintock, Gloria	Benthic Organisms/Invertebrates	I-363-1
	McCutcheon, Cristina	Environment general	I-153-1
	McElroy, Janis	Pollinators	I-196-1
		Benthic Organisms/Invertebrates	I-196-2
	McFarlane, Heather	Environment general	I-147-1
	McGrath, Laura	Environment general	I-132-1
		Human Health	I-132-2
		Toxicity	I-132-3
	McGraw, Sarah	Environment general	I-16-1
	McKee, Sara	Other	I-349-1
	McKinley, Ellen	Other	I-274-1
	Michel, Jules	Other	I-188-1
		Sediment	I-188-2
		Benthic Organisms/Invertebrates	I-188-4
		Uncertainty	I-188-3
	Mikell, Bowen	Uncertainty	I-30-1
	Miller, Karen	Environment general	I-139-1
	Moncy, Kathleen	Avian	I-228-3
		Food Web/Prey	I-228-2
		Economics	I-228-1
	Moncy, Kathleen	Food Web/Prey	I-214-2
		Economics	I-214-1
	Morgan, Caryn	Food Web/Prey	I-89-1
	Morrison, Caitlin	Uncertainty	I-11-1
	Morten, Ann and Douglas	Uncertainty	I-362-1
	Morten, Douglas	Uncertainty	I-255-1
	Moser, Rich	Food Web/Prey	I-269-1
		Benthic Organisms/Invertebrates	I-269-2
		Water Quality	I-269-3
	Mueller, Melinda	Pollinators	I-136-6
		Avian	I-136-2

		Environment general	I-136-1
		Benthic Organisms/Invertebrates	I-136-3
		Toxicity	I-136-4
	Mueller, Melinda	Pollinators	I-292-2
		Food Web/Prey	I-292-3
		Benthic Organisms/Invertebrates	I-292-1
	Muldoon, Chris	Food Web/Prey	I-371-1
	Musche&Richards, Ann&Alan	Pollinators	I-154-1
	nelson, herb	Environment general	I-13-1
	Nerenberg, Robert	Human Health	I-12-1
		Uncertainty	I-12-2
	Nesbitt, Jeff	Environment general	I-206-1
	Newland, Catherine	Pollinators	I-15-2
		Food Web/Prey	I-15-1
		Human Health	I-15-3
	Newmark, Leone	Food Web/Prey	I-286-1
	Nisbet, Dave	Environment general	I-198-1
	No Imidacloprid Use for Shrimp, Form Letter (Multiple)	Avian	I-252-3
		Food Web/Prey	I-252-2
		Benthic Organisms/Invertebrates	I-252-1
	Nordin, Mike	Other	I-229-3
		Environment general	I-229-1
		Economics	I-229-2
	Northrup, Lori	Pollinators	I-297-1
	Nowak, Mariette	Environment general	I-341-1
	Nunn, James	Environment general	I-10-1
	O'Brien, Mary	Pollinators	I-368-2
		Avian	I-368-1
		Food Web/Prey	I-368-3
	Olive , Peter	Human Health	I-59-1
	Olsen, Lisa	Other	I-232-3
		Environment general	I-232-1
		Economics	I-232-2
	Olsen, Lisa	Other	I-212-1
	Olsen, Lisa	Environment general	I-171-1
		Economics	I-171-2
	Olsen, Norm	Food Web/Prey	I-222-2
		Economics	I-222-1
	Olsen, Norman	Avian	I-215-3
		Food Web/Prey	I-215-2
		Economics	I-215-1

	Orr, Noel	Other	I-324-1
	Oswood, Judith	Other	I-298-1
	Paisley, Lorna	Other	I-339-1
	Palenshus, DouGlas	Human Health	I-78-1
	Palmer , Julia	Human Health	I-55-1
	Paradise, Robert	Environment general	I-168-1
	Patten, Kim	Pollinators	I-238-2
		Benthic Organisms/Invertebrates	I-238-3
		Economics	I-238-5
		Toxicity	I-238-4
		Full Comment	I-238-1
	Pelo, Ann	Pollinators	I-111-1
		Avian	I-111-3
		Benthic Organisms/Invertebrates	I-111-2
	Perry, Robin	Food Web/Prey	I-318-1
	Peterson, Kari	Other	I-180-1
	Petit, Eric	Environment general	I-224-1
	Pierce, Tanya	Pollinators	I-388-1
	Pine, Laurie	Pollinators	I-205-1
		Avian	I-205-6
		Food Web/Prey	I-205-5
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		Benthic Organisms/Invertebrates	I-205-4
		Water Quality	I-205-3
		Toxicity	I-205-7
	Plaggemeier, Gloria	Environment general	I-130-1
	Plesko, Jessica	Environment general	I-71-1
	Pollock, Ira	Human Health	I-36-2
		Water Quality	I-36-1
	Potts, Randall	Cumulative Impacts	I-290-1
	Powers, Karen	Pollinators	I-285-1
	Pressentin, Patrick	Food Web/Prey	I-189-2
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		Cumulative Impacts	I-189-4
	Protect Willapa & Grays Harbor, Form Letter (Multiple)	Benthic Organisms/Invertebrates	I-253-1
		Cumulative Impacts	I-253-3
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	Protect Willapa from Neonics, Form Letter (Multiple)	Cumulative Impacts	I-254-2
	R, Jennifer	Benthic Organisms/Invertebrates	I-251-1
	Rand, Penny	Environment general	I-4-1
		Human Health	I-4-3
		Toxicity	I-4-2
	Rao, Robert	Food Web/Prey	I-141-1
	Rapalee, Leah	Other	I-57-1
	Rasch, Ingrid	Environment general	I-175-1
	Rauch, Kelly	Other	I-343-1
	Richie , Cavin	Uncertainty	I-256-1
	Richman, David	Environment general	I-350-1
	Richman, David	Environment general	I-384-1
	Riker, Jennifer	Other	I-60-1
	Ropke, Melissa	Pollinators	I-315-1
	Rotondi, Paula	Food Web/Prey	I-275-1
	Rudner, Jane	Other	I-358-1
	Rudnick, Deborah	Environment general	I-281-1
	Rudnicki, Susan	Food Web/Prey	I-342-1
	Rupp, William Kelly	Environment general	I-112-1
	Ryan, David	Environment general	I-121-1
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	Ryan, David	Food Web/Prey	I-235-1
		Economics	I-235-2
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	Ryan, EM	Uncertainty	I-258-1
	Santerre, Gay and David	Human Health	I-310-1
	Sayce, Jim	Economics	I-226-1
	Sayce, Jim	Monitoring	I-203-2
		Economics	I-203-1
	Sayce, Kathleen	Environment general	I-118-1
	sayler, gloria	Pollinators	I-53-1
	Scarborough, James	Other	I-309-1
	Schary, Joy	Human Health	I-378-1
	Schulz, Chris	Other	I-17-1
	Schupsky, James	Environment general	I-331-1
		Water Quality	I-331-3
		Uncertainty	I-331-2
	Shafchuk, Patsy	Human Health	I-382-1
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	Shaughnessy, Mike	Environment general	I-272-1
	Sheldon, Brian	Other	I-230-2
		Food Web/Prey	I-230-1

	Sheldon, Brian and Marilyn	Food Web/Prey	I-239-2
		Full Comment	I-239-1
	Sheldon, Dick	Food Web/Prey	I-223-1
	Sheldon, Dick	Avian	I-201-2
		Environment general	I-201-1
		Benthic Organisms/Invertebrates	I-201-3
		Economics	I-201-4
	Sheldon, Dick	Food Web/Prey	I-208-1
	Sheldon, Dick	Environment general	I-164-1
	Sheldon, Marilyn	Food Web/Prey	I-213-1
		Economics	I-213-2
	Shirey, Linda	Environment general	I-360-1
	Shull Vogel, Holly	Uncertainty	I-96-1
		Toxicity	I-96-2
	Siebrands, Alda	Environment general	I-144-1
	Singer, Tenney	Environment general	I-62-1
	Smith, Clayton	Human Health	I-137-1
	Smith, Clayton	Other	I-127-1
	Smith, Courtenay	Environment general	I-379-1
	Smith, Lorna	Pollinators	I-257-2
		Avian	I-257-3
		Food Web/Prey	I-257-4
		Benthic Organisms/Invertebrates	I-257-1
	Smith, Marina	Environment general	I-69-1
		Human Health	I-69-2
	Speidel, Sunny	Pollinators	I-195-1
		Benthic Organisms/Invertebrates	I-195-2
	Spence, Katherine	Pollinators	I-282-3
		Avian	I-282-2
		Food Web/Prey	I-282-4
		Benthic Organisms/Invertebrates	I-282-1
	Spurling, Leslie	Other	I-376-1
	Stansfield, Jack	Environment general	I-353-1
	sTARK, Mel	Other	I-344-1
	STECK, AARON	Food Web/Prey	I-91-1
	Steiner, A.L.	Food Web/Prey	I-361-1
	Steitz, Jim	Food Web/Prey	I-262-1
	Stipanovich, Nadiya	Environment general	I-183-1
		Human Health	I-183-2
	Stram, Veda	Other	I-299-1
	Sullivan, Michael	Environment general	I-161-2

		Human Health	I-161-1
	Sullivan, Michael	Human Health	I-114-1
	Swarr, Amanda	Food Web/Prey	I-48-1
	Symington, Paul	Environment general	I-23-1
		Uncertainty	I-23-2
	Tanner, Todd	Human Health	I-64-1
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	Taylor, Loren	Other	I-33-1
	Thompson, Linda	Human Health	I-348-1
	Thompson, Tammy	Other	I-74-1
	Thompson, TJ	Other	I-381-1
	Townsend, Patrick	Pollinators	I-128-1
	Triggs, Bob	Avian	I-2-2
		Food Web/Prey	I-2-1
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	Trinidad, Susan	Environment general	I-102-1
	Turner, Tiffany	Food Web/Prey	I-245-1
		Economics	I-245-2
	Vahdat, Koni	Other	I-83-1
	Vaughn, Edward	Pollinators	I-135-1
	Vidal, Jennifer	Pollinators	I-66-1
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		Human Health	I-66-2
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	Volkman, Carol	Human Health	I-68-1
	Walsh, Jim	Uncertainty	I-217-1
	Warnberg, Larry	Environment general	I-124-1
		Patten	I-124-2
	Wayne, Julia	Other	I-9-1
	WENMAN, ROBERT	Pollinators	I-138-2
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		Environment general	I-138-1
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	Whatley, Judy	Other	I-243-1
	Wheatley, Helen	Pollinators	I-187-1
	Wheeler, David	Environment general	I-347-1
	Wiegardt, Gustave	Pollinators	I-225-1
	Wiegardt, Kenichi	Food Web/Prey	I-241-2
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	Wiegardt, Kenichi	Food Web/Prey	I-178-2
		Economics	I-178-1
	Wilcox, Kara	Food Web/Prey	I-90-1
	Wildwind, Landry	Toxicity	I-330-1

	Wiley, Jana	Environment general	I-182-1
	Wilkerson, James	Environment general	I-39-1
	Willoughby, Emily	Other	I-340-1
	Wolfe, Frank	Food Web/Prey	I-200-1
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	Wolfe, Frank	Food Web/Prey	I-219-1
		ESA	I-219-2
	Wolff, Kristen	Uncertainty	I-25-1
	Wood, Sandy	Other	I-294-1
	Woodcock, Charlene	Environment general	I-375-1
	Wrinn, Chris	Environment general	I-351-1
	Yake, Bill	Environment general	I-113-1
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NOAA	McDonald Carlson, Jennifer	Sediment	A-5-2
		Benthic Organisms/Invertebrates	A-5-4
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U.S. Fish and Wildlife Service	Davis, Jay	Pollinators	A-1-9
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		Food Web/Prey	A-1-11 , A-1-4
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		Toxicity	A-1-7
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U.S. Fish and Wildlife Service	Davis, Jay	Pollinators	A-2-4
		Avian	A-2-5
		Food Web/Prey	A-2-3
		Sediment	A-2-2
		ESA	A-2-7
		Toxicity	A-2-6
		Full Comment	A-4-1
US Fish and Wildlife Service	Quackenbush, Neil	Pollinators	A-4-6
		Avian	A-4-7
		Food Web/Prey	A-4-2 , A-4-8
		Sediment	A-4-3
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		Uncertainty	A-4-5
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		Monitoring	O-22-2
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Association of Washington Business	McAleer, Mary	Food Web/Prey	O-18-5
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		ESA	O-18-3
		Economics	O-18-4
		Full Comment	O-18-1
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		Benthic Organisms/Invertebrates	O-5-7
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		Full Comment	O-5-1
Center for Food Safety	, Center for Food Safety	Food Web/Prey	O-8-2
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		Benthic Organisms/Invertebrates	O-8-5
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Center for Food Safety	van Saun, Amy	Food Web/Prey	O-12-3
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		Economics	O-23-5
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Coastal Watershed Institute	Shaffer, Anne	Avian	O-3-5
		Food Web/Prey	O-3-3
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		SEPA	O-19-3
		Monitoring	O-19-4
		Full Comment	O-19-1
Northwest Center for Alternatives to Pesticides	Chesser, Ashley	Environment general	O-10-2
		Human Health	O-10-1
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Northwest Center for Alternatives to Pesticides	Dunn, Megan	Food Web/Prey	O-6-4
		Human Health	O-6-6
		Sediment	O-6-3
		Benthic Organisms/Invertebrates	O-6-2
		Toxicity	O-6-5
		Full Comment	O-6-1
Olympia Beekeepers Association	Pyne, Laurie	Pollinators	O-24-1
olympic environmental council	Breskin, Joe	Food Web/Prey	O-13-1
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Olympic Forest Coalition	Jones, Patricia	Pollinators	O-16-3
		Avian	O-16-4
		Food Web/Prey	O-16-2
		Benthic Organisms/Invertebrates	O-16-5
		Full Comment	O-16-1
Orca Conservancy	Tarantino, Shari	Food Web/Prey	O-4-5
		Sediment	O-4-3
		Water Quality	O-4-2

		ESA	O-4-4
		Full Comment	O-4-1
Pacific Coast Shellfish Growers Association	Barrette, Margaret	Avian	O-17-4
		Food Web/Prey	O-17-3
		Economics	O-17-2
		Full Comment	O-17-1
Pacific Coast Shellfishg Growers Association	Barrette, Margaret	Environment general	O-9-1
Twin Harbors Fish & Wildlife Advocacy	Hamilton, Tim	Uncertainty	O-21-2
		Economics	O-21-4
		Patten	O-21-3
		Full Comment	O-21-1
Washington Farm Bureau	Davis, Tom	Environment general	O-2-1
Willapa/Grays Harbor Oyster Growers Association	Steding, Douglas	Avian	O-20-7
		Food Web/Prey	O-20-6
		Sediment	O-20-5
		Benthic Organisms/Invertebrates	O-20-4
		Monitoring	O-20-3
		Economics	O-20-2
		Toxicity	O-20-8
		Full Comment	O-20-1
Willapa/Grays Harbor Oyster Growers Association	Steding, Douglas	Avian	O-14-5
		Food Web/Prey	O-14-4
		Sediment	O-14-3
		Benthic Organisms/Invertebrates	O-14-2
		Full Comment	O-14-1
Tribal Government/Agency			
Other			
Brady's Oysters Inc.	Ballo, Mark	Other	OTH-1-1

Comments and Responses:

Comments and Responses are grouped together and organized by topic. Each topic heading lists comments Ecology received for that topic. Several voluminous comments submitted are grouped in their entirety under the “Full Comment” topic.

Washington State Department of Ecology used the following topics to group comments together:

- Other

- Pollinators
- Avian
- Food Web/Prey
- Environment general
- Human Health
- Sediment
- Benthic Organisms/Invertebrates
- Water Quality
- Uncertainty
- SEPA
- ESA
- Monitoring
- Economics
- Cumulative Impacts
- Toxicity
- Patten
- Full Comment

Comments on Other

Commenter: - Comment I-27-1

NO! Just, no, now, never! Come up with another way to handle the problem...thank you.

Commenter: - Comment I-72-1

Are you crazy?! NO!

Commenter: - Comment I-85-1

NO!

Commenter: - Comment I-131-1

A

Commenter: Julie Bennett - Comment I-65-1

Please no pesticides!

Commenter: Sara Bhakti - Comment I-303-1

Here we go again. Will this chemical assault on our environment never end? You have the authority to do something about it. That is why I am writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor

Commenter: Ilse Burch - Comment I-305-1

I bet consumers like myself won't buy a single oyster that is soaked in imidacloprid. Chefs won't want them! So, in the end, this will not improve the bottom line of oyster farming!

Commenter: Linda Carroll - Comment I-280-1

As a Washington voter and the daughter of a chemist and science teacher who values our state's environment, I'm writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

Commenter: Patricia Cassell - Comment I-22-1

Please deny this request to spray oyster beds with Imidacloprid, OR any other neurotoxins.
Business cannot be allowed to dump poisons on our waterways for their personal profit.
Thank you.
Patti Cassell

Commenter: Ann Cockrell - Comment I-364-1

AS a retired biology major and teacher of 34 1/2 years. PLEASE no more IMIDACIPOPRID ! !
It is a disaster ! !

THANKS

Commenter: Fritzi Cohen - Comment I-335-1

I have been opposing pesticide spraying in Willapa Bay for over 20 years. I am also an active member of Beyond Pesticides and will sign any letter that opposes spraying in willapa Bay. I am in total agreement with the statement of Beyond Pesticides, and as you know the Moby Dick Hotel and Oyster farm not only has a direct interest in this particular permit, but has been drifted on by past permitted pesticides. It should come as no surprise that I I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Deborah Cruz - Comment I-273-1

You would think that with all the problems we're having with our shellfish, we would be more careful with them.

Commenter: bill dixon - Comment I-142-1

no!

Commenter: Richard Ellison - Comment I-295-1

As a biologist I'm writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

Commenter: Alice Goodman - Comment I-97-1

I vehemently oppose this proposal. Good public policy demands denial of this request for control and use of public land without a guarantee of massive payment to the public and posting a bond based on the present & future value of the tidelands. It so obviously interferes with Native American rights & intent. Additionally it's foolish for some growers to be willing to risk a boycott of their product, perhaps All WA State shellfish & marine products. The growers who support this request should be investigated!!

Commenter: Scott Granlund - Comment I-316-1

No, no, no. This spraying is a very bad idea. The information is widely available telling what a bad idea this is. Halt this now, please.

Commenter: Martha Gray - Comment I-156-1

It would be very dangerous as well as totally irresponsible for the Department of Ecology to approve using pesticides in Willipa Bay And Grays Harbor as well as any waters in Puget Sound. This should not be allowed anywhere in our state.

Commenter: Erik Hagstrom - Comment I-276-1

Yet another attempt by the current administration supporters to turn back the clock to a time when the health of its citizenry took a back seat to the profits of the businesses with a short term view of their resource.

Commenter: Jan Halliday - Comment I-266-1

(Email Submission)

If the oyster industry fails because of burrowing shrimp, so be it. Find another way to grow them.

Spraying neurotoxin or insecticide on mudflats is irresponsible and has been a travesty for decades.

I used to write for NationalFfisherman and was appalled when I researched the Dept. of Agriculture's so-called "solution" in the 1980s.

Guess it's time to interest a documentary filmmaker in a new project. I presume there's a money trail here.

Commenter: Susan Harrie - Comment I-322-1

This is sick and dangerous thinking! We need to stop pouring poison on our planet!

Commenter: Karma Hart - Comment I-291-1

Please think intelligently about the long term effects this spraying will have. Don't do it !

Commenter: Joel Hencken - Comment I-51-1

NONONONONONONONONONONONONONONONONO!!!!!!!!

NO SPRAYING !!!!!

The criterion of no current evidence of immediate irreversible impact is the WRONG criterion!

Commenter: Dan Hogan - Comment I-129-1

Willapa Bay produces some of the finest oysters in the country. Spraying Imidaclorid would destroy other species and hurt the rest of the oyster farmers because customers would not want to buy contaminated oysters. Plus there are other ways to farm where it is not needed.

Commenter: Richard Horner - Comment I-284-1

I'm writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor. If you do not do so, I will stop buying Washington shellfish.

Commenter: Graciela Huth - Comment I-334-1

Stop trying to teach Mother Nature how to heal itself. It has been doing it for eons while we are like children playing with matches. Help it in what you can. BUT NO POISONOUS SUBSTANCES THAT THE CORPORATIONS NEED TO SELL TO PROFIT! When will we learn that we know nothing and that profit is not a helping advisor?

Commenter: Sego Jackson - Comment I-283-1

I am an avid oyster eater, was formerly engaged in aquaculture in Penn Cove, and formerly owned Willapa Hills Hatchery. Even so, I am absolutely against use of these pesticides!

Commenter: Kristine Kemnitz - Comment I-385-1

Don't let the fishing and aquatic farmers poison the water for their profit!

Commenter: Evelyn Kirby - Comment I-325-1

The most important point here is to keep imidacloprid out of this habitat and to use more eco-friendly and responsible methods.

Commenter: Ilene Le Vee - Comment I-181-1

I recommend applying the Imidacloprid to 1000 acres of the burrowing-shrimp-affected area as 500 acres is not sufficient and doing nothing is not advisable. I also recommend that Taylor Shellfish partner with a local Tribe and harvest 1000 acres of shrimp infested beds. Attempt to develop a market for this shrimp by doing a study/cookout to determine customer satisfaction with the taste of these creatures.

After application/harvest, if DOE determines there are no negative environmental impacts from Imidacloprid on the 1000 acres, continued use may be advisable depending on cost/outcomes. If the results of the shrimp study/cookout is favorable, we may have discovered a new, plentiful and popular food source.

Good luck and thanks for the opportunity to comment.

Commenter: Stephen Mach - Comment I-92-1

I vehemently oppose this proposal, both as a Washington taxpayer & consumer. First because it so obviously interferes with Native American rights & intent. This also reminds me of "managing" the buffalo so livestock ranchers could enjoy use of the land. Good public policy demands denial of this request for control and use of public land without a guarantee of massive payment to the public and posting a bond based on the present & future value of the tidelands. Let's see where that goes! Additionally it's foolish for some growers to be willing to risk a boycott of their product, perhaps All WA St. shellfish & marine products. The growers who support this request should be investigated.

Commenter: Ilene Mandelbaum - Comment I-377-1

It is unconscionable that toxic and dangerous pesticides are still being considered for use in our bays and waterways

Commenter: Susan Marett - Comment I-296-1

No, No, No.

Commenter: Sara McKee - Comment I-349-1

Imidacloprid is something I have no interest in ingesting. Yet it would inevitably be on any food creatures grown there.

Commenter: Ellen McKinley - Comment I-274-1

I am alarmed by the blindness government has shown to the numerous poisons allowed to pollute our planet. Can't y'all see the effects?

Commenter: Jules Michel - Comment I-188-1

Thank you for considering the wealth of information provided on the importance of native burrowing shrimp, the important ecosystems which Willapa Bay and Grays Harbor make up, and the desire for shellfish growers to maximize their profits.

This issue is no different than Seattle Shellfish and Taylor Shellfish believing the "only way" to grow-out geoduck seed was to use hundreds of "kiddie wading pools" in the tidelands. When that method's impact was shown to detrimental to the benthic and marine ecosystem, they easily came up with alternative growing methods. Taylor Shellfish modified mussel farm rafts and Seattle Shellfish built a floating dock to which grow-out rafts were attached. It was more expensive, but they adapted and accepted it as a cost of doing business. This current situation is no different. Accepting Alternative 1 (do nothing) will show that to be the case here, as it was there.

Willapa Bay and Grays Harbor shellfish growers claim alternative growing methods are more expensive or not feasible, pointing to long lines "sinking" in the sediments and it being hard to walk in those sediments. While above sediment methods are more expensive, and in a few areas the sediments are soft, the current system pointed to is simply a poorly engineered system to grow oysters, and a poorly engineered system will always fail. But it does not mean alternatives are not available.

Look at Drakes Bay Oyster Company's use of racks in Drakes Estero where above sediment structures were used for years, accessed by boat, as they have been in Japan for decades (and where the nonnative Pacific oyster originated from). Pilings are driven into firm sediments which, in the case of Willapa Bay (and likely Grays Harbor) are 3 feet below what the current growers are complaining about. In turn, those pilings had stringers attached to them, over which "hangars" were draped, holding oyster spat. When mature, workers traveled to the structures by boat/barge, lifted the hangers off of the stringers and onto the barge, and returned them to the processing plant. It is only one of the alternatives available to growers. While Drakes Bay Oyster Company is not longer operating in Drakes Estero, it was not because the method used was more expensive.

In addition to providing the alternative growers testified at hearings they so dearly want, this also provides a permanent structure onto which marine organisms grow, and remain. The pilings and stringers become ecosystems in and of themselves. (While oysters suspended also provide "structure", they are removed at each harvest so cannot be truly called adding to the ecosystem.) Of course there is a risk of a boater running into them. But navigational hazards are easily marked and, if significant enough, lit. And unlike other areas, these have no eelgrass to shade.

Growers state the wave energy is too strong for a robust structure such as what is described. If that is true, then there is no way on- bottom oyster growing will be able to take place, burrowing shrimp or not. As Taylor Shellfish noted in a deposition submitted when an encroachment onto state tidelands was being investigated, waves on that parcel caused oysters to be pushed to the upper tidelands, having to be retrieved by hand, and then placed back in the lower tidelands. If on bottom oyster growing may be done on these parcels after killing burrowing shrimp, then most certainly a well engineered structure may be used, avoiding the use of this pesticide, providing "ecosystem services" as well.

Other growers claim above ground structures create such an impediment to tidal and sediment flow that they result in sediment deposition, putting other beds at risk. However, they site no studies to substantiate such a claim and merely provide conjecture on whether it is significant, let alone even happens. Further, Taylor Shellfish has been using above ground methods (flip bags in this case) for years and nobody complained to DOE about sediment transport issues.

Dick Sheldon's comment expresses concerns that above ground methods result in micro-plastics in oysters. Yet testimony by "expert witnesses" for Taylor Shellfish in numerous hearings claim grow-bags are not the source of micro plastics. More importantly, the method described easily avoids the use of any plastics at all, instead, using hangers. While Mr. Sheldon should be concerned about plastic, he should be more concerned about the public's perception of his oysters, those of Willapa Bay, and those in Washington, being grown on beds and in waters where pesticide and herbicides are being applied.

Another supporter of pesticide use is from Daniel Cheney who states the use of Carbayl (Sevin) by the shellfish industry (used since 1963, unknown to most consumers of Willapa Bay oysters) to kill burrowing shrimp resulted in an increase of eelgrass due to firmer sediments. Not noted is the species most common to grow in these areas where shrimp are killed in order to grow oysters is Japanese eelgrass, an eelgrass considered a "noxious weed" by shellfish growers who have been spraying the herbicide Imazamox on to eliminate. While there were areas where the native eelgrass increased, those were predominantly in tidal pools, where water never drained and lower in tidal elevation. In short, while applying a pesticide did result in an increase in eelgrass, it was predominantly Japanese eelgrass which shellfish growers would simply spray with Imazamox, adding more chemicals to Willapa Bay.

As noted by many, Willapa Bay and Grays Harbor provide ecosystems which support a large number of native species. That support starts at the bottom of the food chain where burrowing shrimp exist. Imidacloprid is not "shrimp specific" - it will kill any marine invertebrate it comes in contact with. Derreck Rockett noted many "uncertainties" in this proposal at public hearings. There are, and those uncertainties - coupled with the very real certainty that this is a pesticide which kills marine invertebrates - should prevent this proposal from considering anything other than Alternative 1, the "do nothing" alternative.

Like the timber industry who adapted to environmental constraints, like Taylor Shellfish and Seattle shellfish adapted to alternative growing methods for geoduck, so too can Willapa Bay and Grays Harbor shellfish growers adapt profitable alternative growing methods, avoiding the taint all shellfish grown in Washington would take on if pesticides are applied to shellfish beds.

Commenter: Mike Nordin - Comment I-229-3

I also am disappointed that – I understand why you have to have a hearing in Olympia – but I'd be really sad if this thing gets swayed by a bunch of people up there who are not intimate with the issue and have nothing to – no pain from making that decision – going in and overriding this issue. That scares me. Down here, it's a minority. It's only a couple people. If it was a vote in this area, this would already be done. In fact, I am in pain right now and I can't believe I even have to be here right now. I want you to look at the documents by Dr. Kim Patton and Dr. Brett Dumbold and by Kathleen Sayce. They talk a lot about the ecology of the bay and what's going to happen here if you don't control this. It's not just about the shellfish. Like I said, they've been controlling it for a long time. If you take their tool away, they go away – and I hate to use the slippery slope argument but I'm pretty sure that that's what's going to happen. I've seen it happen before. Anyway, thank you.

Commenter: Lisa Olsen - Comment I-212-1

Lisa Olsen (Oral Testimony): Good evening. My name is Lisa Olsen. I am a resident of South Bend, Washington and also a Pacific County Commissioner. And I'm going to submit a written submission but I just wanted to remind everyone for now that the oyster industry is the number one industry in Pacific County. It was the timber industry for years and everybody has tracked how that's been rather decimated with different issues but for right now it's the oyster industry. And everything in Pacific County relegates around natural resources. We are a natural resource county. We are not on the I5 corridor. We do not have Starbucks or Lowes we do not have anything else. And we like it that way, quite frankly. We like how we live. We like our community and how we operate. I'm sorry I'm not doing very well tonight, but it's just too much at stake to halt without science. You know, study study study. Continue to study. Continue to work with the oyster growers. But please don't cut them off at the knees without a really good reason to do so. Let them work and let them be a part , they're happy to be a part of making the Bay a fantastic place to grow oysters but also making it healthy. So, thank you so much.

Commenter: Lisa Olsen - Comment I-232-3

I would ask you to please consider using a common sense approach rather than succumbing to political pressures of those who really have no stake in what we're doing here in Pacific County and Willapa Bay. The negative impacts of this being questionable at best, but the farmers are not opposed to continuing observation while they continue to farm. They are happy to work and make it better. They're ecologists at heart -- and environmentalists by the very operation of their farms. They need to stay healthy and thriving. The fact that after the years of spraying this bay continues to be productive and thriving and beautiful should be a huge testament to the fact that we can do this. We can use this only tool that we have to keep this industry going. So I would very much be in favor of this permit being approved. Thank you very much.

Commenter: Noel Orr - Comment I-324-1

Far too many pesticides are being used and it has to stop! The chemical companies are already rich enough and the rest of us out here in the real world have had enough with the toxicity!

Commenter: Judith Oswood - Comment I-298-1

How many times does it take before you realize the people of Washington don't want this?

Commenter: Lorna Paisley - Comment I-339-1

When do we stop all of the destruction? When no one is here to do it any more?

Commenter: Kari Peterson - Comment I-180-1

I oppose the proposal to use pestcides. Please consider completing and publishing impact studies prior to taking steps to implement

Commenter: Leah Rapalee - Comment I-57-1

Do NOT allow these chemicals to be used.

Commenter: Kelly Rauch - Comment I-343-1

Who the heck are the idiots that are allowing this to happen? We know too much about the consequences of spraying chemicals around and yet they are still being used! Stupid, stupid, and stupid!

Commenter: Jennifer Riker - Comment I-60-1

No pesticides in our sound! No, no, no!

Commenter: Jane Rudner - Comment I-358-1

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid.

Commenter: James Scarborough - Comment I-309-1

I frequently enjoy oysters and excitedly anticipate the arrival of the "r" months after summer, which have traditionally been the season to consume them. However, I can just as easily stop eating oysters altogether; and the knowledge that imidacloprid is being sprayed by oyster farms is enough to make me lose my appetite, permanently.

Commenter: Chris Schulz - Comment I-17-1

Absolutely not. As I will never eat a farmed fish...I will never eat another oyster again if this chemical is used.

Commenter: Brian Sheldon - Comment I-230-2

It's an emotional issue. It's difficult to remove that from the discussion. And I understand why people get up in arms about it but the science says it's safe and we have no other tool available to us at this time. It doesn't mean we won't continue to look for one but we just don't have a tool right now. Any tool that we could find that has met the IPM, this basic IPM success of efficacy, would be great and I'm sure embraced by the shellfish growers. There's discussion in the SEIS about – it sort of leaves it unclear about different culture methods. Mainly off bottom culture somehow being a tool you can use to farm in shrimp ground. In all my years of experience and all my discussions with every shellfish grower that's tried off bottom that is not factual at all. There are off bottom culture does not developed to farm around shrimp. It was developed to farm marginal ground, where it was exposed to high energy wind wave or tidal flows. Or just wouldn't sustain a bottom culture crop. So you could use an off bottom culture method to try to farm some of that ground. It had nothing to do with farming and shrimp. And it doesn't now. I've asked some of the – we've had a vast expansion of off bottom culture and I've asked the folks that are doing that and every one of them has told me it is not successful. Not successful farming to farm around shrimp. I'm a little concerned in the SEIS that it doesn't talk about the no – I guess I'm done. I will submit more comments. I'll just leave you with I think that the SEIS fully supports issuing this permit. Thank you.

Commenter: Clayton Smith - Comment I-127-1

Do not allow spraying or other application of neurotoxins in Willapa Bay!

Commenter: Leslie Spurling - Comment I-376-1

We lived in the Willapa area for many many years and thoroughly enjoyed the bounty of those waters, not the least of which were the incredible oysters. We are sympathetic to the oyster growers' dilemma. However, short sighted solutions to long term problems are the wrong answer. There are outside influences creating the situation that will only be exacerbated by using these toxic chemicals.

Commenter: Mel sTARK - Comment I-344-1

https://www.thesun.co.uk/video/news/vladimir-putin-warns-of-future-sci-fi-super-human-soldiers-more-destructive-than-nuclear-bombs-who-feel-no-fear-or-pain/

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Veda Stram - Comment I-299-1

DO NOT POISON OUR COASTLINE!

Stop protecting corporate profiteers!!

Commenter: Loren Taylor - Comment I-33-1

I am absolutely opposed to this action. Poison of any kind in the bays is not acceptable.

Commenter: Tammy Thompson - Comment I-74-1

Please deny the use of these pestices

Commenter: TJ Thompson - Comment I-381-1

Life on our planet is already faced with many threats that can't be easily controlled at this point......but this is one thing that you can do to make a positive difference.
PLEASE, do the right thing here!

Commenter: Koni Vahdat - Comment I-83-1

No to this insecticide!!!!

Commenter: Julia Wayne - Comment I-9-1

Do not let this happen.

Commenter: Judy Whatley - Comment I-243-1

(Email Submission)

Dear Mr. Rocket,

I'm writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

There is a warning label on this product that says "Do Not Use Near Water"...so why would you consider spraying it on oysters????

I'm the daughter of an oysterman and both grandfathers ran oyster houses on the Chesapeake Bay, so I know the concerns of oyster growers but this is not the answer.

Please deny this request!

Judy Whatley

Judy Whatley

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3602401169

Commenter: Emily Willoughby - Comment I-340-1

I strongly oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology. That will take care of the current problems and prevent future problems as well.

Commenter: Sandy Wood - Comment I-294-1

This is a dangerous idea, ill conceived, and stupid.

Commenter: Adele Zimmerman - Comment I-380-1

THIS IS INSANE! WHY IN HELL WOULD ANYONE WANT TO POISON A WHOLE BAY?

Commenter: Mark Ballo - Comment OTH-1-1

Thank you for the opportunity to comment on this important issue. I am and have been the Oyster grower/farmer for Brady's Oysters Inc.for 24 years. Brady's Oyster's has been in business for 47 years and have never had the luxury of knowing there was going to be a tool for dealing with this problem at our disposal. This has been a constant question mark almost every year, even with a permit. I have witnessed the explosion of the burrowing shrimp populations on our oyster beds the past 2/3 years without any ability to do anything about it. We have spent huge amounts of money trying to work our way through the permitting process. The oyster growers are running out of time on this issue as crops and usable land are being lost to the shrimp. I have heard some say that you just need to use alternate culturing methods like long lines or suspended culture, but these are not solutions as these methods also will sink in a soupy substrate or can't be planted at all because is too hard to work in sinking mud. We need some tools in our tool box to deal with this problem. The Oyster growers have been done a dis-service by DOE by a constant moving of the bar. In the original Carbaryl agreement to stop using that product to treat the shrimp our counterparts agreed to help (not hinder)to find a new solution for the problem. I have never known this to be true, the more we have tried the more difficult it has become and you at DOE are a party to that behavior. I find it difficult to believe that DOE has less problem with the Army Corps of Engineers digging a giant channel through the middle of Grays Harbor that affects many more acres and disrupts bottom fish, kills Eel Grass and who knows what other detrimental impacts the dumping of dredge spoils has outside the bay. DOE owes the oyster growers of Washington a clearly defined path to a permit, please set the parameters of expectations and stick to them. The Oyster growers have approached this burrowing shrimp problem with the integrity of science and cooperation, help us get control of this problem by putting forth an achievable plan. Thank you, Mark Ballo, Farm Manager, Brady;s Oysters Inc.

Comments on Pollinators

Commenter: Eric - Comment I-218-2

My 2nd thing is I've worked in the oyster beds for almost 40 years now. I've never seen a bee. Every place we're spraying – most of our ground – all of my ground is almost 3 miles off the beach. I've never seen any bees anywhere close to any of the beds we're spraying.

Commenter: Melissa Aaron - Comment I-6-3

It's also toxic to bees.

Commenter: Evelyn Adams - Comment I-312-1

Pesticides are a grave threat to the living systems of our planet, leading to calamitous declines of insect pollinators. Neonicotinoids like imidacloprid are known for contributing to the decline of bees and other pollinators.

Further, the global pesticide industry has ensured that its products are not properly regulated or even, in real-world conditions, properly assessed (Science Magazine, 22 Sep 2017)

Commenter: April Atwood - Comment I-46-1

I vigorously oppose the use of imidacloprid to kill burrowing shrimp in oyster beds. This is a dangerous neurotoxin, deadly to bees and humans alike. It has no place in an aquatic environment, and would be very damaging to any ecosystem in which it is used. No one I know would even consider eating an oyster grown under such conditions! If oysters can't survive without pesticide use, then they should no longer be grown in that location.

Commenter: Jon/Anna Aufderheide - Comment I-157-1

Do not permit the use of imidacloprid to control the burrowing shrimp. We are straining gnats only to swallow the camel here. Our pollinators are dying en masse from neonicotinoid use! Do not grant permission, please!

Commenter: Karen Baldauski - Comment I-336-2

Restoring a balanced environment naturally is the ONLY way to go. Get rid of the stressors in the feeder streams first. Avoid more contamination of our estuaries and bays. Imidacloprid means death to ecosystems...AND OUR HONEY BEES. I mean really, doesn't anyone have a broader view of things to not stand for any more usage of chemicals others have already outlawed?!

Commenter: Ross Barkhurst - Comment I-202-3

In the flowering bushes on our banks we find hummingbirds, bumblebees, and pollinator flies by the thousands. Many different native plants feed these native pollinators. Our plum tree, apple trees, blueberry bushes, and huckleberries are pollinated by 99.5% native pollinators, not honeybees.

Commenter: Ross Barkhurst - Comment I-220-5

You've had a look at cumulative effects as they are well established in legal precedent such as DTM. You've just looked at synergistic effects between 2 chemicals acting on 1 plant. You have to look at how much eelgrass are you removing with Imazamox and how much zooplankton are you removing from the eelgrass that wasn't removed by Imazamox and add it all up. And you haven't done that. The average 10-mile per hour wind [unintelligible] you haven't precluded air boats. The average 10-mile per hour wind in my oyster beds and shellfish beds next to me will have this chemical on the bank in three months flowering plants and pollinators in 30 seconds

Commenter: Michaela Barrett - Comment I-5-1

Imidacloprid is a poison known to have toxic effects on not only insect pests, but also beneficial insects (bees!), birds, and marine invertebrates. It is unconscionable to deliberately apply this poison to an uncontained aquatic environment solely for economic gain.

Commenter: Wally Bubelis - Comment I-300-1

Oysters and other shellfish are a large and profitable industry, but the decline of bees and other pollinators, due in part to neonicotinoid pesticides, demands that we find other solutions.

Commenter: Katie Bunnell - Comment I-193-1

Dear Mr. Rockett-
Please deny Imidacloprid use for shrimp control in Grays Harbor. This neonicotinoid pesticide kills bees and other pollinators and can also devastate aquatic invertebrates and the animals that rely on them for food.
Thank you.
K. Bunnell

Commenter: Cherry Champagne - Comment I-192-1

Dear Mr. Rockett,
Imidacloprid use for shrimp control in Grays Harbor is harmful to bees and other pollinators and can also devastate aquatic invertebrates. Do not allow its use in this sensitive area.
Thank you.
Cherry Champagne

Commenter: Lisa Costantino - Comment I-14-1

From the EPA: "When bees encounter imidacloprid at levels above 25 parts per billion—a common level for neonics in farm fields—they suffer harm. "These effects include decreases in pollinators."

Harming necessary species to help another species is foolish and irresponsible. This is a proven harmful pesticide. In no way should its use be allowed in our waters - or anywhere.

It's unfortunate that oyster growers are suffering economic losses, but environmental endangerment is not a valid tradeoff.

Commenter: Erika Davis - Comment I-308-1

With alarmingly declining insect populations in the news, it is clearer than ever that use of pesticides needs to be drastically reduced, not expanded. The ecosystem we rely on for our very survival--a very complex and extensive web of life that we have barely begun to understand--is crumbling before our eyes, and still propose further decimating it? Those pesticides don't stop at the intended target--they go on to effect multitudes of other insects and micro organisms, all along the food chain to our own microbiomes that keep us alive.

Please, please, reject the permit allowing more pesticides in our environment! No More Pesticides!!

Commenter: Nathan Donley - Comment I-204-5

Will there be indirect effects to birds and fish that use these prey species that will be reduced? How may Dungeness crabs is it okay to kill before it affects the population or before it affects harvest numbers? Will Imidacloprid residues carry over to the following year and accumulate in the sediment in these areas? And these are just questions that we don't have answers to yet. But we do know that Canada's Pest Management Agency has proposed to ban Imidacloprid not due to impacts to pollinators or birds, but due to impacts to aquatics and vertebrates, specifically.

Commenter: Melanie Drescher - Comment I-49-1

NO WAY! Do NOT do this! "Imidacloprid is considered the main culprit in the collapse of our bee colonies and, in higher levels, is toxic to mammals — that means us! This is why the European Union has banned this pesticide in their waters, and we should too."

Commenter: Mark Emrich - Comment I-211-1

Mark Emrich (Oral Testimony): My name is Mark Emrich. I am past President of the Olympia Beekeepers Association and the Washington State Beekeepers Association. I've actually met with a good part of the panel here on beekeeping issues through the years. I'm a resident of Rochester, in Thurston County. 4 years ago I met with you folks in South Bend and basically talked about this issue then. We didn't have as much science as we have in the study of Imidacloprid as we do now -- relative to bees. But it's still a central nervous system. It's still small insects. And I take a look at what we've changed in the way the bay actually works. [unintelligible] salmon and all the rest of these , what I believe would be natural predators for some of the shrimp population is being removed, whether it's mismanagement or things that have been used in the past. But now we're thinking that we're intelligent enough that now we've screwed it up this bad that, geez, maybe we should just throw some chemicals in there and we can right the ship. And I'm concerned with the really small creatures in this particular act as far as zooplankton. And a lot of the microbiomes that are the feed for these oysters and mussels and a lot of other species that are out there that rely on them as well. And I know that you've done test plots in the past. I know that we've had loss of crab. We've lost some other things. But I don't know about the actual creatures that live in the silt population and certainly as Laurie Pyne pointed out earlier it's a systemic pesticide.

So if you do have wheat beds, any kind of low vegetation that is also around the beds that are being treated, that's going to be absorbed and that's going to have a long-lasting effect on the area , because it's going to continue to leach this stuff out. It becomes part of the plant. Until the plant dies, it's going to be there. So I just have a lot more questions than I have answers to and will actually forward 6 or 7 studies I was going to quote tonight but it's hard to follow some of these people and their passions so I won't dog you with this. But I will make sure that Derrick gets copies of this and he take a look at some of the studies that I've reviewed recently that have direct meaning with Imidacloprid in water colonies. So hopefully it will help you craft a decision. Thank you.

Commenter: susan entress - Comment I-42-2

From the manufacture's own safety guidelines: This product is highly toxic to bees exposed to direct treatment or residues on blooming crops/plants or weeds. Do not apply this product or allow it to drift to blooming crops/plants or weeds if bees are foraging the treatment area

Commenter: Rich Fargo - Comment I-41-1

I am a longtime resident of Grays Harbor and an avid kayak fisherman. Please for the love of God do not spray our mudflats with this ridiculously toxic chemical. Most of the decline of bee populations have been linked to Imidacloprid. Use recycled oyster shells to rehabilitate oyster beds. Do not use these chemicals that are pushed by horrible corporations with little "DIRECT RISK" . How about indirect risk. Stop trying to take the easy way out.

Commenter: Ron Figlar-Barnes - Comment I-117-1

I am not supportive of the use of Imidacloprid for ghost shrimp! This is the use of a pesticide that has been found to impact bee populations, and birds.

There have been studies (Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis) showing Imidacloprid is toxic to upland game birds--what about the ducks and other bird species associated with Willapa Bay and Grays Harbor? Imidacloprid may be very toxic to aquatic invertebrates besides ghost shrimp. In the same work mutagenic effects were noted as well as teratogenic effects on growth and skeletal structure of rats.
Imidacloprid in water is a question mark. No one can point to certainty that this pesticide will not cause harm to the Willapa Bay and Grays Harbor ecosystems. It would be prudent to use a small plot area to test the spread and the effects of imidacloprid.

My suggestions;

Use harrowing instead of a pesticide. Use fresh water to reduce the ghost shrimp population. Grow your product in naturally rocky sub-straight areas.

Specific Questions

What is the effect of imidacloprid on Dungeness crab?
What is the status of natural rocky sub-straight in Willapa Bay and Grays Harbor?
Have investigation been undertaken regarding predators and ghost shimp?
What direct investigations have been undertaken to understand the effects of pesticides use in the past in both bays?
What is the effect on salmonid populations during out migration?
What has been the effect of dredge-harvesting on ghost shrimp?

Commenter: Kirk Gardner - Comment I-293-1

NO! A thousand times NO! We don't need anymore "solutions" from the chemical industry that destroy life on our planet, most especially bees.

Commenter: James Gresham - Comment I-81-1

I am adamantly opposed to spraying this chemical anywhere. Please do not authorize this. This chemical is believed to be responsible for the decline in honey bees and would also be disastrous for all life at the lower end of the Puget Sound food chain. No!

Commenter: Jewell Hamilton - Comment I-1-1

neonicotinoid pesticides should be banned. what about the bees?! even though this chemical application permit is for tidal areas, it will impact bees. I've seen all sorts of bees on the beach during my five and a half years as a professional beach comber (I sold sea glass). Please do not allow application or use of neonicotinoid pesticides for any use. Remember Rachel Carson.

Commenter: Maggie Hawk - Comment I-313-1

Please. No imidacloprid anywhere near our beautiful state! We need every singleone of our pollinators!!!

Commenter: Debra Jaqua - Comment I-186-1

Dear DOE,

My comment is that DOE should DENY the permit to apply the pesticide Imidacloprid IN ANY Amount to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor.

My reasons are as follows:

1. Imidaclorprid is a neonicotinoid pesticide. It has deadly consequences for beneficial insects, including bees. Bees are already critically threatened from so-called colony collapse disorder. Colony collapse is thought to have more than one contributor, but among the most serious, and the most preventable, is from the use of neonicitinoids. The use of Imidacloprid is not safe to use at any strength.

2. There likely could be adverse consequences from using it in this situation which are not understood at this time that may only come to light after it is too late.

3. The Department of Ecology's mission is "protect, preserve, and enhance Washington's environment". No where in this mission statement does it say or even suggest that business interests should take priority above protecting the environment. I will presume that the reason business interests are not mentioned is that protecting our environment is more important than protecting business interests. I hope that is still the position of DOE.

Please do not permit the use of this neonicitinoid pesticide on our fragile coastal waters just to benefit a few businesses.

Commenter: Tom Jensen - Comment I-148-1

I urge Ecology to deny a permit for applying Imidacloprid to control burrowing shrimp. My sense is that this neonicotinoid chemical has too many unknowns to risk long term impact on the environment of Willapa Bay.
As with beekeeping and serious decline in those pollinators, which probably came from a

combination of issues (long-distance transport for pollination (exposing bees to new challenges faster than they can evolve defenses), fungi, mites, and more recently neonicotinoids), I worry that Imidacloprid could be one of a combination of issues causing problems in unanticipated ways with other species.
I also question the abandoning of helicopter as a proposed application method to the tidal areas. Doesn't the proposed use of boats mean application would be when areas are flooded and prone to unintended dispersal when the tide goes out? (This might be akin to cropdusting drift when it's too windy.)
The use of Imidacloprid would also seem to prevent the chance for marketing organic oysters? Here's a nearby example: http://www.organicoysters.ca/meettheguys.html
Thank you for the opportunity to comment.

Commenter: Erica Jones - Comment I-304-3

Furthermore, a recent European study reveals that three-quarters of flying insects in nature reserves across Germany have vanished in the past 25 years, which has obviously serious implications for all life on Earth. While the study is still reaching conclusions around causality, pesticides are thought to be a major contributor to the decline. Continuing down a path of indiscriminate destruction is clearly not recommended not only for the sake of other-than-human species but for our own species.

Commenter: Kevin Jones - Comment I-191-1

Deny Imidacloprid use for shrimp control in Grays Harbor & Willapa Bay. This neonicotinoid pesticide kills bees and other pollinators and can also devastate aquatic invertebrates and the animals that rely on them for food.
Sincerely,
Kevin Jones

Commenter: Una Jones - Comment I-197-2

I would never feed my family flee medicine. On top of it this pesticide kills honey bees.

Commenter: Walter Jorgensen - Comment I-190-1

Dear DOE,

Commercial shellfish beds, specif. gooeyduck, have obliterated Totten Inlet in lower Puget Sound. In addition to pre-empting the beach from any other reasonable year-round recreational or natural appreciation use, mussel barges cover a good portion of the "non-open" waters. Leave nature alone and protect it from the greed of "about a dozen oyster farmers from the Willapa Grays Harbor Oyster Growers Association (WGHOGA)." These tide lands should be held in trust for the public, with easements if necessary, and not mis-treated with pesticides to support private their aquaculture practices.

DOE should DENY the permit to apply the pesticide Imidacloprid IN ANY Amount to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor.

Here are the three major reasons:

1. Imidaclorprid is a neonicotinoid pesticide. It has deadly consequences for beneficial insects, including bees. Bees are already critically threatened from so-called colony collapse disorder. Colony collapse is thought to have more than one contributor, but among the most serious, and the most preventable, is from the use of neonicitinoids. The use of Imidacloprid is not safe to use at any strength.

2. There likely could be adverse consequences from using it in this situation which are not understood at this time that may only come to light after it is too late.

3. The Department of Ecology's mission is "protect, preserve, and enhance Washington's environment". No where in this mission statement does it say or even suggest that business interests should take priority above protecting the environment. I will presume that the reason business interests are not mentioned is that protecting our environment is more important than protecting business interests. I hope that is still the position of DOE.

Please do not permit the use of this neonicitinoid pesticide on our fragile coastal waters just to benefit a few businesses.

Commenter: Alexander Kershaw - Comment I-332-1

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology

.

Henk Tennekes, a Dutch toxicologist, has researched the effects of neonicotinoids. His book, "The Coming Disaster" explains it well. Neonics are water soluble and persist for up to 18 years and are fatal at any dose over time to all invertebrates. A recent German study of insect mass decline of 75% oer 20 years is directly tied to neonics

Commenter: Lora Leland - Comment I-354-1

Like Washington state residents and the local residents who strenuously object to bee-toxic chemicals being sprayed in their bays, I too, oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "No Action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Ross Lockridge - Comment I-263-1

(Email Submission)

I too oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid.

Take note of this recent study:
Warning of 'ecological Armageddon' after dramatic plunge in insect numbers.
https://www.theguardian.com/environment/2017/oct/18/warning-of-ecological-armageddon-after-dramatic-plunge-in-insect-numbers?CMP=share_btn_link

"Three-quarters of flying insects in nature reserves across Germany have vanished in 25 years, with serious implications for all life on Earth, scientists say."

Although the "no action" alternative is acceptable, the only effective and protective alternative is restoration of the bays' ecology.

While the SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," the SEIS fails to give adequate weight to the "knowledge gaps" it identifies. In some cases, monitoring is proposed as a way of reducing uncertainty. In order to protect the bays, facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

Crucially, the SEIS identifies uncertainties regarding the efficacy of imidacloprid for controlling burrowing shrimp. These uncertainties include questions of the extent and duration of the effect of imidacloprid, the lack of a treatment threshold, lack of data regarding resistance, lack of field research regarding clams, and efficacy of treatment in low temperature. Certainly, no use of imidacloprid can be supported without demonstrating efficacy.

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

The SEIS does not adequately address synergistic effects, including impacts of imidacloprid combined with other chemicals ("inert" ingredients, other chemicals used in the bays, and other pollutants) or other stressors. Among the organisms known to be at risk is the commercially important Dungeness crab, which has been shown to be susceptible to the effects of imidacloprid, and whose populations experience large natural fluctuations, putting them at risk of extinction.

Given the systemic mode of action of imidacloprid in crop plants, the failure to account for impacts on non-target animals consuming vegetation in treated areas is inexcusable.

Willapa Bay and Grays Harbor have been affected by human activity over the past century that has contributed to problems experienced by all who use the bays. Of the three options proposed, the No Action alternative is the best. However, what is truly necessary to address these problems is an option that was not considered in the SEIS –a plan to restore the habitat by removing stressors from streams flowing into the bays.

Thank you for your consideration.

Sincerely,

Commenter: Janis McElroy - Comment I-196-1

Mr. Rockett,
Deny Imadacloprid use for shrimp control in Grays Harbor. This neonicotinoid pesticide kills bees and other pollinators and can also devastate aquatic invertebrates and the animals that rely on them for food.
Janis McElroy

Commenter: Melinda Mueller - Comment I-136-6

These pesticides also pose significant threats to honeybees and other pollinators (5), whose productivity is crucial to Washington agriculture and ecosystems.

Commenter: Melinda Mueller - Comment I-292-2

This class of pesticides is also shown to be harmful to pollinators, many of which are already in decline, and whose loss is a threat to our state's ecosystems and agriculture (2 and 3).

Commenter: Ann&Alan Musche&Richards - Comment I-154-1

10/27/2017

We agree with Gov Inslee's veto (July, 2017), of the use of imidacloprid in Willapa bay. It is a poison with important disastrous possible effects on the inhabitants of the Bay area, especially pollinating insects, on which we humans, among others, are dependent for survival (as those insects are essential to the growth of many of our fruits and vegetables).

It took more than a dozen years, and the efforts of countless people, to finally get Carbaryl removed from Willapa Bay, in 2013, several years after it had been finally banned. Since then, some oyster growers in the Willapa Bay area want to begin using imidacloprid as another poison. Outrageously, and shockingly, public opinion reversed a DOE decision to go ahead with this poisoning, in May 2015.

But instead of changing the way they grow oysters, the growers in Willapa Bay continue to want to change to another poison. We think that it is unwise and vastly unfair that their preferences for larger profit margin, with the less labor-intensive methods, should rule the rest of us who stand to lose.

Alan Richards & Ann Musche'
250 Knappton Rd
Naselle WA 98638
[Residents of PACIFIC COUNTY]
Members of Northwest Center for Alternatives to Pesticides (NCAP)
Members of Willapa Hills Audubon Society (WHAS)

Commenter: Catherine Newland - Comment I-15-2

I am strongly against this proposal as the beaches and waters surrounding this could be affected. These pesticides have already been shown to have detrimental effects on honeybees so who knows what the effects could be on fish, crabs, clams and whales in the surrounding areas.

Commenter: Lori Northrup - Comment I-297-1

What are you trying to do? Shoot yourselves in the foot? Our salmon runs are under fire, our forests our under fire, Alaska is about to be ruined forever and you want to contribute to the catastrophe? Did you know that 3/4 of the WORLDS honey is now contaminated with pesticides? We are loosing our bee pollinators and you want to encourage the carnage! There must be another way! You MUST find another way! DENY DENY DENY for everyone's sake!

Commenter: Mary O'Brien - Comment I-368-2

I believe that there is no such thing as a safe pesticide. They are bad for the pollinators, the fish, the shrimp, the birds, etc., and the people who would eat the oysters farmed there, as well as the water quality. There are many problems associated with the farming of fish and shellfish, with pollution and bacteria commonly damaging them, and they are a risk and health hazard for the wildlife and people who eat them. In theory, aquaculture is a good idea, but in practice, it is not. Once the waters are contaminated, it's awfully difficult to rectify and restore them to cleanliness and safety.

Commenter: Kim Patten - Comment I-238-2

The effects of neonicotinoid insecticides on terrestrial insects, including non-targets, have beencomprehensively assessed and reported (e.g., Goulson 2013, Pisa et al 2014). The most controversialunintended effect of neonicotinoids has been on pollinators of agricultural crops, primarily honeybees(Pisa et al. 2014). Neonicotinoids can directly kill honeybees via spray drift during foliar applicationsagainst pest insects, or affect them indirectly when the bees forage for nectar and pollen from treatedplants. Neonicotinoids have been implicated, along with Varroa mites and several pathogens (Ellis et al.2010), as contributing to colony collapse disorder (Gill et al 2012).

Commenter: Ann Pelo - Comment I-111-1

We know that neonicotinoids are a disaster for pollinators. We think there's a good likelihood that imidacloprid adversely impacts marine invertabrates and life cycles, and probably also impacts fish and birds by wrecking their ecosystem's health. And the Department of Ecology is considering allowing it to be used on shellfish beds?!? What about the "ecology"part of the department? Beyond legal considerations, beyond commerce, beyond the " yuck" and "no way" from Seattle restauranteurs and consumers, there is an ethical obligation to the ecology of Willapa Bay.

That's what you're charged with stewarding, right? Ecology. Ecosystem health. The flourishing of the lives of tiny marine invertebrates and whales, of bees and eagles. The flourishing of life.

Not the flourishing of farmers who have disrupted the natural ecosystem by planting more shellfish than the ecosystem can sustain.

The flourishing of life.

There's such a lot more at stake than shellfish growers' commerical success right now. There's a whole lot of life and living ahead, years and decades and generations from now. The job of the Department of Ecology is to stand on the side of that life living forward.

Do not issue a permit for imidacloprid.

Sincerely,

Ann Pelo

Commenter: Tanya Pierce - Comment I-388-1

For our future and for our birds and bees!! Please don't use neonics!

Commenter: Laurie Pine - Comment I-205-1

Laurie Pine (Oral Testimony): Hi. I'm the immediate past president of the Olympia Beekeepers Association. And as a beekeeper I've become well acquainted of the impact of the neo-nicotinoid pesticides. Not only can these pesticides cause an acute legal kill to target and non-target organisms, there are also sub-lethal, chronic, and cumulative exposure considerations. And in these, for us, are shorter life spans, immune system compromise, and susceptibility to pathogens, queen failure -- and thus the colony's failure to thrive.

Fran Sant: Laurie, can you come up to the mic a little bit?

Laurie. These have significantly affected our native and our managed bee populations. And unless you know what these affects will be from Imidacloprid in the bay environment, it is a high-risk gamble as to what potential outcomes will be. These chemicals have a long half-life and can persist in soil for months and years after a single application. They can also persist in water. There is no way to maintain any application of Imidacloprid in the water. It will move and be carried with the waves and the tide. Recent research has also shown it to have cross- seasonal persistence in wetland sediment. Vegetation will be contaminated as it absorbs and takes up the pesticide. This is what's made the neonics so particularly debilitating for pollinators -- because the pesticide is systemic in nature and the chemical is taken up by the plants roots. The entire plant becomes toxic which, for bees who gather the nectar and pollen from these plants as well as the guttation water droplets -- it's a huge problem for us. Where the treated water goes, it can seep into other waterways -- ground water and other flowers and plants can take it up via the root systems even if they are a mile or more away.

What will the impact be to the non-target and yet important organisms in the application area, including the insects, worms, and other crustaceans that live in and on the bottom of the water? Will they suffer long-term or chronic consequences of these chemicals? And if so, what are these consequences. How would a decrease in diversity, abundance, and size of these organisms affect the ecosystem? How would it affect the food chain? To what degree could it affect fish and birds? Would the metabolites or residues of Imidacloprid be an issue in this ecosystem? How toxic would they be? Do you know what they are? Would Imidacloprid react in any way with current herbicide sprays used in the area and could this a more toxic pesticide cocktail, as we found to be the case with some neonics and herbicide or fungicide combinations that, together, exceed their individual toxicities?

There is a significant amount of new science and information that documents the presence and persistence of Imidacloprid in lakes, rivers, streams, and other waterways at levels that exceed toxicity levels for fresh water invertebrates. There is also evidence that these chemicals affect the growth and survival as well as behavior to aquatic species -- even at low levels. And much further research is needed.

One of the things I wanted to say was the studies that were absent when neonics were introduced to the market, with respect to bees -- both managed and native bees -- were really problematic for us. Because those studies didn't exist, and the first study that was done wasn't even -- it was flawed. If we had had more information at the beginning in terms of bees we might not be in the situation that we are in now with our pollinators. So I think that is important to remember as you consider your decision as well. The direct and indirect impacts of this application pose a risk to the short and long term ecological health of the bay. And there are too many unanswered questions. I urge you to not allow the use Imidacloprid in Grays Harbor and Willapa Bay, based on the hazards and the current scientific information. Thank you.

Commenter: Karen Powers - Comment I-285-1

Insects that pollinate our food are already in decline. I cannot emphasize enough the importance of not using Omidaclopride.

Commenter: Melissa Ropke - Comment I-315-1

As we learn more about the devastation human activity, like the use of pesticides, has caused, reports are being released about the loss of insect life in North America and in Europe. I'm writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor

Commenter: gloria sayler - Comment I-53-1

I am very much opposed to permitting use of this pesticide. The serious environmental impacts of this pesticide have been documented by numerous studies. At a time when we are so worried about the health of our Sound and ocean waters, and the massive die-offs of bees, why wouldk we allow the use of this bee-killing pesticide when there are other alternatives that would be safer.
Pl,ease deny this permit.

Commenter: Lorna Smith - Comment I-257-2

Imidacloprid is a dangerous pesticide that many scientific studies have found to causesignificant harm to nontarget species, including aquatic invertebrates. These chemicals are nowbeing linked to a world-wide decline in not only pollinators, but all insects. The use of thispesticide in Willapa Bay and Grays Harbor should not even be considered, given the globalimportance of the area for migrating shorebirds and other aquatic life.

Commenter: Sunny Speidel - Comment I-195-1

Pls deny Imidacloprid use for shrimp control in Grays Harbor. This neonicotinoid pesticide kills bees and other pollinators and can also devastate aquatic invertebrates and animals that rely on them for food.
Thank you,
Sunny Speidel

Commenter: Katherine Spence - Comment I-282-3

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species. And it could affect bee populations, which are already struggling.

Commenter: Patrick Townsend - Comment I-128-1

This class of pesticide has been implicated in bee colony collapse and should never be used in marine waters. After the salmon net pen disaster the DOE should be implementing the precautionary principle for these types of impacts on the environment. Alternatives already exist that do not require the use of this type of pesticide. There should be no allowed use of imidacloprid in Willapa Bay and Grays Harbor, or in any waters of Washington State.

Commenter: Edward Vaughn - Comment I-135-1

A recent report has indicated a massive decline in necessary insect populations---bees, butterflies, etc. The cause in almost certainly the use of pesticides. And your response to the problem in Willapa Bay and Grays Harbor is to ... inject more chemicals, specifically Imidacloprid. Precisely how much poison can the earth's system support? AND, what will this poison do to other life forms in the area? Have you no other answer, none? Not very imaginative, folks. Try again!

Commenter: Jennifer Vidal - Comment I-66-1

Imidacloprid is considered the main culprit in the collapse of our bee colonies and, in higher levels, is toxic to mammals — that means us! This is why the European Union has banned this pesticide in their waters, and we should too.

Let's think long term here. We are stewards of this land and are responsible for keeping it clean and healthy for all especially the generations that will inherit this land LONG after the restauranteurs will be gone. This would have a detrimental impact on our local environment.

Let's look for non-chemical and non-harmful alternatives, cultivating a healthier ecosystem in the entire sailish sea. With all that is facing destruction on our planet as we speak, we must stand up for sustainability, preservation and a new way of meeting challenges that is long term oriented, doesn't push a known neurotoxin into the water ways (which by the way effects all neighboring waters and tide land and their creatures.

Commenter: ROBERT WENMAN - Comment I-138-2

The NY Times reported in a European Academies Science Advisory Council report stated imidacloprid "has severe effects on a range of organisms that provide ecosystem services like pollination and natural pest control, as well as on biodiversity.

Commenter: Helen Wheatley - Comment I-187-1

Deny the permit to apply Imidacloprid to control burrowing shrimp. Neonicotinoids should be illegal. To quote the Thurston County Democratic Party: Banning the Use of Neonicotinoid Pesticides

(Adopted June 27, 2016)
WHEREAS, Neonicotinoids, one of the most widely used classes of insecticides in the world, are systemic, persistent neurotoxins and spread throughout treated plants including to pollen/nectar gathered by pollinators; and
WHEREAS, Neonicotinoid pesticides, widely used in Washington and US agriculture and horticulture, are a class of neuro-active, nicotine-based insecticides; and pollinators are critical to key Washington crops, such as tree fruit; over one-third of all agricultural production worldwide is dependent on pollinators; and
WHEREAS, An independent review of more than 800 scientific studies concluded neonicotinoids are causing significant damage to a wide range of beneficial invertebrate species and are a key factor in the decline of bees;
THEREFORE BE IT RESOLVED, That the Thurston County Democrats support and urge our State and Federal Elected officials to support a ban on the use of neonicotinoid pesticides; and urge the Environmental Protection Agency (EPA) to suspend the registration of all neonicotinoids pesticides.

Commenter: Gustave Wiegardt - Comment I-225-1

Gustave Wiegardt (Oral Testimony): My name is Gustave Wiegardt. My grandfather started farming oysters in Willapa Bay in 1874. I was involved in Wiegardt Brothers for many years. I am now retired. But I have seen the effects of ghost shrimp over the many years and I support the use of a chemical to control it. It was mentioned about bees. I have a little experience on that. I live in Pacific County, Southern Oysterville. 16 acres of tideland, and I also have a large garden next to the bay and this summer we sprayed for Japanese eelgrass and I have a lot of marionberries -- in fact, 25 plants. And we depend on the bees to pollinate the marionberries, otherwise there is no crop. This year we had a good crop. We produced enough marionberries for 80 pies and they're in the freezer. But I saw no problem with having the bees pollinate my berries. I don't know if this helps you or not but it's been mentioned before. I'd like to emphasize again , the garden is right next to the bay and we sprayed just outside of it, so I support the use of the chemical.

Commenter: Vicki Wilson - Comment O-22-3

public concerns about impacts to pollinators and crab are worth noting. Honey bees, generally considered the most important pollinator, as well as Other pollinators such as wasps, flies, butterflies and even hummingbirds rarely frequent marine tidelands. With the elimination of helicopter spraying, any perceived impacts on pollinators due to wind-drift are virtually non-existent.

Commenter: Trina Bayard - Comment O-7-5

s. Survival of bees depends on the functioning of complex behaviors withinthe colony in addition to the survival of individual bees. There is rich, scientific literature reporting that thesensitivity of colony function to pesticides is often orders of magnitude greater (i.e., at lowerconcentrations) than levels associated with traditional measures of individual survival (i.e., LD-50). Forexample, Urlacher et al. (2016) reports severe impacts on appetitive olfactory memories at concentrationsof chlorpyrifos several orders of magnitude below reported LD-50s.

Commenter: Nichelle Harriott - Comment O-5-2

EPA identified aquatic insects as the most vulnerable to imidacloprid exposures, andspecifically found that foliar spray and a combination of other application methods, includingon-the-ground applications, have "the greatest potential risks for aquatic invertebrates. . ."

Commenter: Dale Beasley - Comment O-23-3

Will have no effect on bees which do not frequent tidal areas

Commenter: richard james - Comment O-1-1

Do not issue a permit to allow the spraying of Imidacloprid in Willapa Bay, Grays Harbor or anywhere.

Spraying toxic chemicals into public waters is insane.

Honey bees are far more important than a luxury food item such as oysters.

Commenter: Laurie Pyne - Comment O-24-1

(Email Submission)

Hi Derek,

While I had been able to attend the public hearing and comment in Lacey on the proposal to spray imidacloprid in Willapa Bay and Grays Harbor, I did want to send my comments in writing as well (which I thought I was able to do through today, November 1st), particularly to drive the point home that beekeepers had no idea of the extent the damage and fallout would be and persist regarding the neonicotinoid pesticides. There was widespread use of neonicotinoids before sufficient studies had been done to determine the effects on pollinators. When the first neonicotinoid was granted a conditional registration, no significant scientific studies had been performed and the one that was done was flawed and didn't take into account normal honey bee behavior. The EPA's own scientists expressed concern about the harmful effects of neonicotinoids on bees. Now we are in a situation where the scientific information we've gained in numerous studies supports just how harmful these chemicals are to our pollinators and the damage that has contributed and is still contributing to our pollinator population declines.

DOE has the advantage of referencing a significant body of science that has documented just how toxic this class of pesticides is to invertebrates, birds and pollinators and there will be collateral damage in the bay. Knowing the significant risks and the behavior of these chemicals you have a far better position than the beekeepers of 10 years ago who learned this lesson the hard way and are still suffering the consequences as are the bee populations. Armed with that information I don't see how that kind of scale-tipping could be considered for the bay which is obviously a system already out of balance. If beekeepers had known what the potential devastating consequences of these pesticides could be, we could have taken appropriate action. We had no idea.

Thank you for your time, Derek. It was very nice to meet you in Lacey.

Very best regards,

Laurie

Commenter: Patricia Jones - Comment O-16-3

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm tonon-target species, including aquatic invertebrates. Young fish of many species including our nativesalmonids spend much of their early life cycle in estuaries where they adapt to living in a salt-waterenvironment before out-migration. These chemicals are also linked to declines in pollinators and insects.The use of this pesticide in Willapa Bay and Grays Harbor should not be considered, given the globalimportance of the area for migrating shorebirds and other aquatic life.

Commenter: Jay Davis - Comment A-2-4

Natural Resources Defense Council recently sued the EPA over the registration and use Of products that contain neonicotinoids, including imidacloprid, acetamiprid, and dinotefuran. According to the complaint, neonicotinoid pesticides pose risks to numerous species listed under the Endangered Species Act (ESA), including pollinators (bees, butterflies), birds, and fish. At least five of the federally-listed species mentioned by the Natural Resources Defense Council occur in western Washington.

Commenter: Jay Davis - Comment A-1-9

Natural Resources Defense Council recently sued the EPA over the registration and use Of products that contain neonicotinoids, including imidacloprid, acetamiprid, and dinotefuran. According to the complaint, neonicotinoid pesticides pose risks to numerous species listed under the Endangered Species Act (ESA), including pollinators (bees, butterflies), birds, and fish. At least five of the federally-listed species mentioned by the Natural Resources Defense Council occur in western Washington.

Commenter: Neil Quackenbush - Comment A-4-6

The Natural Resources Defense Council recently sued the EPA over the registration anduse of products that contain neonicotinoids, including imidacloprid, acetamiprid, anddinotefuran. According to the complaint, neonicotinoid pesticides pose risks to numerousspecies listed under the Endangered Species Act (ESA), including pollinators (bees,butterflies), birds, and fish. At least five of the federally-listed species specificallymentioned by the Natural Resources Defense Council occur in western Washington.

Comments on Avian

Commenter: Rich Andrews - Comment I-246-3

Not only the target burrowing shrimp would be affected andkilled, but serious food chain ecological damages would occur to the many other species directly and indirectly.That includes predator aquatic life, fish species, avian species, even mammals that would eat and depend upon theshrimp and other aquatic invertebrates and even aquatic and near shore plant species that would be directlypoisoned or poisonous. These non-target species would also be exposed via numerous other pathways to thesepoisons in the waters and vegetation in and littoral to the bays and estuaries and open waters.

Commenter: Ross Barkhurst - Comment I-247-5

It is recommended that WDFW immediately restore plans, this year, to survey waterfowlstopping over in Willapa Bay especially during historical peak periods. The cause of historicdeclines locally must be determined and corrected. This for example would include Novemberpeaks for ducks and geese and spring staging periods for Pacific Brant.

Commenter: Ross Barkhurst - Comment I-210-3

The next thing you see is herring -- 700 tons herring spawning mats in 2002, measured by WFW. You see it really wobbling during the Spartina spraying, down to zero. No herrings spawning in the Bay. They quit measuring herring spawning mass. At my encouragement they started up again this year. What they found in 2017 was zero. Okay? Spartina spraying stopped in 2008 -- a massive amount. And so what we're doing is removing their spawning structure, which is eelgrass. The next thing you see is waterfowl. 2002, about 100,000. By the time we were through getting most of the Spartina out of the bay about 10,000. As soon as that was over it began climbing. In 2014 you see 100,000 waterfowl again. This is the peak in November. In 2014 we start spraying eelgrass, 22,000. The next year, 14,000. Last year, about 8,000. The lowest number of waterfowl in modern history -- while the waterfowl in the fly away is doing just great. But they can't use Willapa Bay any more.

Commenter: Ross Barkhurst - Comment I-220-4

You make a statement – I'd like to know who made the statement that mammals don't go out on the shellfish beds in the daylight. When I left my house there were 3 racoons out there. They're out there all the time. And in the next pool over there was a blue heron. This is not going to affect blue herons and they're eating everything that's out there and they're eating the little fish that eat what's out there. So I just don't know how after 4 years you can come up with these kinds of statements. I see no basis for removing the high TOC zones. You're telling me that you might bring them back. How do we know? I mentioned the WAC quotes and what you're saying is even in Puget Sound they can go down 50% as long as it comes back. Understand no time frame for it to come back.

Commenter: Michaela Barrett - Comment I-5-2

Imidacloprid is a poison known to have toxic effects on not only insect pests, but also beneficial insects (bees!), birds, and marine invertebrates.

Commenter: Lisa Belleveau - Comment I-119-3

Salmon and Dungeness crab are NATIVE commercially valuable species and the use of this poison will adversely affect them. These 2 estuaries are incredibly important rest areas for shorebirds as they migrate and without productive benthos to feed on the impacts could prove to be catastrophic!

Commenter: David Beugli - Comment I-240-3

This new SEIS just like the previous FEIS demonstrates that there will be no bay-wide impacts and thatthese applications will have no direct impacts to fish, birds, marine mammals or human health.

Commenter: David Beugli - Comment I-221-3

The new SEIS – just like the previous EIS – shows that there will be no bay-wide impacts and that these applications will have no direct impacts of fish, birds, marine mammals or human health.

Commenter: Form Letter (Multiple) Deny Imidacloprid Use - Comment I-242-2

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species.

Commenter: Nathan Donley - Comment I-204-3

Will there be indirect effects to birds and fish that use these prey species that will be reduced? How may Dungeness crabs is it okay to kill before it affects the population or before it affects harvest numbers? Will Imidacloprid residues carry over to the following year and accumulate in the sediment in these areas? And these are just questions that we don't have answers to yet. But we do know that Canada's Pest Management Agency has proposed to ban Imidacloprid not due to impacts to pollinators or birds, but due to impacts to aquatics and vertebrates, specifically.

Commenter: Kim Figlar-Barnes - Comment I-165-3

The proposed application of Imidacloprid during the month of May will have irrevocable consequences to the multitude of shore birds that migrate and feed in Willapa Bay and Grays Harbor on their way to artic breeding grounds. Imidacloprid would kill the aquatic invertebrates the shore birds rely for food to continue migration to breeding grounds. The lack of food could kill many shore bird species or prevent them from having enough energy to breed. The direct ingestion of Imidacloprid by shore birds could harm or kill them, thus drastically reducing the populations of many shore bird species along the Pacific Flyway.

Commenter: Ron Figlar-Barnes - Comment I-117-5

I am not supportive of the use of Imidacloprid for ghost shrimp! This is the use of a pesticide that has been found to impact bee populations, and birds.

Commenter: Margaret Fillmore - Comment I-140-2

The eagles and other foal feed in these areas putting them at risk also

Commenter: Gail Gatton - Comment I-233-1

Gail Gatton (Oral Testimony): Thank you. My name is Gail Gatton. I'm the Executive Director for Audubon Washington, which is the statewide field office of the National Audubon Society , an organization that's been protecting birds and their habitats for the last 115 years or so. So I want to thank Ecology for holding this hearing and opportunity for public comment today. Our scientists are carefully reviewing the Supplemental , the EIS draft and we'll submit formal comments in writing. But while I was out here today to take a minute to just make a couple of comments. Other people have referenced the importance of birds in this area. More that 200 species of birds depends on the beaches, marshes, uplands and mudflats of Willapa Bay and Grays Harbor. From a bird perspective these are 2 of the most important areas in our entire state -- and they're sort of critical stopover areas for migrating birds. They support hundreds of thousands of shorebirds during the annual spring migration and they're also important nursing grounds for fisheries including the Dungeness crab we've heard about, the native salmon, and of course the large-scale shellfish production that goes on out here.

While I can't claim to be a fifth generation farmer out here I do want everyone in the room to know that my love affair with oysters goes back to being an 11-year old and winning a silver dollar for being willing to eat a raw oyster on a dare. The Audubon really appreciates the long time historical presence of the oyster industry here and it's role in providing good jobs and revenue to the region, as well as the production of seafood and the contributions that oyster growers make to the environmental quality out here. We recognize the challenges that these shrimp pose to the industry and particularly to the family farms that are out here.

Since 2014 , when the last permit was being issued we worked to understand the impacts of the chemical pesticide use on these coastal estuaries, including a visit out here this summer at the invitation of the growers. We came out here. Our science staff came out here. We continue to have reservations about the use of chemicals to control these shrimp , especially in the absence of a better understanding of conditions and factors that influence a burrowing shrimp distribution and populations. We particularly have reservations about this specific pesticide , which, Tom, as you pointed out, is demonstrably harmful to aquatic invertebrates , which in my world, we think of that as bird food. So our priorities though are to encourage lasting solutions and help create conditions amenable to ecologically and economically sustainable shellfish aquaculture. And we look to the considerable scientific, technological and natural resource management expertise in the Pacific Northwest to invest in assessing, understanding, and fairly resolving this complex set of issues that face the growers and other stakeholders out here. Thank you for the opportunity.

Commenter: Martha Hall - Comment I-151-3

Little known direct risk to fish, birds, marine mammals, and human health.Potential indirect impacts to fish and birds if food sources are disrupted.

Commenter: Laura Hendricks - Comment I-207-4

Yes, there are too many uncertainties — and in prior testimony that I understand happened in South Bend, where growers stated that things were great in Willapa. Well, the facts are: waterfowl has decreased from over 100,000 to less than 8,000 and now there is a no count. [unintelligible] populations have dramatically declined. Herring counts are down to zero. used to have herring, now you have a no count. [unintelligible] have gone from threatened to endangered. Sturgeon are now in danger.

Commenter: Blythe Horman - Comment I-133-3

The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species.

Commenter: Erica Jones - Comment I-304-2

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species.

Commenter: Brian Kingzett - Comment I-236-3

And that provides habitat complexity that mimics the natural oyster reef system and encourages the – and facilitates higher trophic levels such as fish and birds and, as we heard from the crab fisherman, juvenile crabs of economic importance

Commenter: Kathleen Moncy - Comment I-228-3

[unintelligible] work of all the farmers that are going to work for this is really important because between all of us we create a giant barrier that protects vast amounts of quantity of land which is a rare habitat for crab. It's an important area for birds and it's also an important area for fish.

Commenter: Melinda Mueller - Comment I-136-2

They are known to be toxic to birds, fish, and aquatic invertebrates other than shrimp (2, 3). "Of the neonicotinoids, imidacloprid is the most toxic to birds and fish (4).

Commenter: Form Letter (Multiple) No Imidacloprid Use for Shrimp - Comment I-252-3

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species. Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

Commenter: Mary O'Brien - Comment I-368-1

The birds that feed off the shrimps and other organisms in the area would be adversely effected, as well.
I believe that there is no such thing as a safe pesticide. They are bad for the pollinators, the fish, the shrimp, the birds, etc., and the people who would eat the oysters farmed there, as well as the water quality. There are many problems associated with the farming of fish and shellfish, with pollution and bacteria commonly damaging them, and they are a risk and health hazard for the wildlife and people who eat them. In theory, aquaculture is a good idea, but in practice, it is not. Once the waters are contaminated, it's awfully difficult to rectify and restore them to cleanliness and safety.

Commenter: Norman Olsen - Comment I-215-3

Over the last 50 years these pests have given ample exhibit as to their destructive properties. When heavily colonized and interconnected burrow systems undermine the stability of healthy substrate and their appetites deplete the sediment of healthy micro-biomes – which are the very basis of the estuary food chain – the result, if unchecked, is bare and soft sediment that is incapable of even supporting growth of key photosynthetic vegetation and supplies forage habitat for all manner of environmentally supported species, including oysters, clams, fish, juvenile and adult crabs, and a whole host of birds. Because of the limitation of the chemical Carbaryl in the 1960's to address these first grossly disproportionate shrimp numbers, it was discovered how quickly [unintelligible] was able to reestablish and support a necessary level of biodiversity. In my lifetime, even, I have witnessed the reclamation of ground once healthy, but hopelessly overrun with shrimp. Within 1 to 2 years of treatment some of these ground had returned to farm-ability and by said virtue was able to provide key habitat yet again.

Commenter: Ann Pelo - Comment I-111-3

We think there's a good likelihood that imidacloprid adversely impacts marine invertabrates and life cycles, and probably also impacts fish and birds by wrecking their ecosystem's health.

Commenter: Laurie Pine - Comment I-205-6

What will the impact be to the non-target and yet important organisms in the application area, including the insects, worms, and other crustaceans that live in and on the bottom of the water? Will they suffer long-term or chronic consequences of these chemicals? And if so, what are these consequences. How would a decrease in diversity, abundance, and size of these organisms affect the ecosystem? How would it affect the food chain? To what degree could it affect fish and birds? Would the metabolites or residues of Imidacloprid be an issue in this ecosystem? How toxic would they be? Do you know what they are? Would Imidacloprid react in any way with current herbicide sprays used in the area and could this a more toxic pesticide cocktail, as we found to be the case with some neonics and herbicide or fungicide combinations that, together, exceed their individual toxicities?

Commenter: Dick Sheldon - Comment I-201-2

Ghost Shrimp monocultures, unused by shorebirds, devo-d of eel grass, zero habitat for prey species, and benthic invertebrates with no possibility of spawning grounds for herring, sandlance, or other fishes, no depressions or vegetated tidal pools, nothing but quick sand and strings of filimus algae destined to form large mats that settle onto oyster beds poisoning every benthic creature trapped beneath it.

Commenter: Lorna Smith - Comment I-257-3

"The highlight of the Grays Harbor National Wildlife Refuge, a.k.a. Bowerman Basin, is thespring migration of shorebirds. Lying within the Pacific Northwest Coast Eco-region, therefuge's 1,500 acres of salt marsh and mudflats play host each year to tens of thousands ofshorebirds that stop to feed and rest during their 7,000 mile journey from South America to theirnesting grounds in the Arctic. One of the four most important estuaries in North America formigrating shorebirds, Grays Harbor as a whole has been named a Western HemisphereShorebird Reserve Network Site. Bowerman Basin and five other sites within the estuary havebeen designated as Washington State Important Bird Areas."

Commenter: Katherine Spence - Comment I-282-2

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species. And it could affect bee populations, which are already struggling.

Commenter: Bob Triggs - Comment I-2-2

This will have implications for juvenile salmon, steelhead, cutthroat trout, birds and other fish species

Commenter: ROBERT WENMAN - Comment I-138-4

Imidacloprid—Eradicates native ghost shrimp and could harm other benthic species. Linked to bee colony collapse disorder and subject of bans in other countries and states. Among the concerns is "...the significant risk Imidacloprid presents to aquatic invertebrates..." which, in turn, "...can also cause a cascading trophic effect, harming fish, birds, and other organisms that rely on them for sustenance." Of special concern noted is the fact that Willapa Bay and Grays Harbor "...are among the most important migratory bird stopover sites on the west coast."

Commenter: Trina Bayard - Comment O-7-2

Audubon especially has strong reservations about this specific pesticide, imidacloprid, which isdemonstrably harmful to aquatic invertebrates as well as to birds

Commenter: Trina Bayard - Comment O-7-4

Ghost shrimp are prey for large-bodied shorebirds like long-billed curlews and marbled godwits, and redknots may forage in association with shrimp burrows (See Appendix A).

Commenter: Nichelle Harriott - Comment O-5-6

Other species like migratory birds that depend on shoreline aquaticinvertebrates can also be significantly impacted. These trophic impacts are also extended toother aquatic predators in the Bay. These disruptions can have long-term cascading effects onfood webs and habitats in or near aquatic environments.

Commenter: Patricia Jones - Comment O-16-4

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm tonon-target species, including aquatic invertebrates. Young fish of many species including our nativesalmonids spend much of their early life cycle in estuaries where they adapt to living in a salt-waterenvironment before out-migration. These chemicals are also linked to declines in pollinators and insects.The use of this pesticide in Willapa Bay and Grays Harbor should not be considered, given the globalimportance of the area for migrating shorebirds and other aquatic life.

Commenter: Margaret Barrette - Comment O-17-4

The sky-rocketing populations of burrowing shrimp in Willapa Bay and Grays Harbor are alteringthe ecosystem, turning tidelands into muck, and destroying critical habitat for birds, fish,shellfish, and phytoplankton. This unchecked progression and broad environmental impactswhich the shrimp cause can only be slowed. Our members have spent much of the past decadeexploring options to address an infestation of burrowing shrimp which has left once healthyoyster growing lands, eelgrass beds, and bird feeding grounds entirely unproductive.

Commenter: Jay Davis - Comment A-1-5

Content included in the Supplemental EIS suggests that there would be no direct adverse effects to birds or fish, including those listed under the ESA. However, the Supplemental Eis does acknowledge that potential indirect effects to food webs and prey availability are a significant uncertainty, sources of prey could be reduced for shorebirds that feed exclusively on invertebrates, and granular imidacloprid pellets could be consumed and lead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds.

Commenter: Jay Davis - Comment A-2-5

Content included in the Supplemental EIS suggests that there would be no direct adverse effects to birds or fish, including those listed under the ESA. However, the Supplemental Eis does acknowledge that potential indirect effects to food webs and prey availability are a significant uncertainty, sources of prey could be reduced for shorebirds that feed exclusively on invertebrates, and granular imidacloprid pellets could be consumed and lead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds.

Commenter: Jay Davis - Comment A-1-6

Content included in the Supplemental EIS suggests that there would be no direct adverse effects to birds or fish, including those listed under the ESA. However, the Supplemental Eis does acknowledge that potential indirect effects to food webs and prey availability are a significant uncertainty, sources of prey could be reduced for shorebirds that feed exclusively on invertebrates, and granular imidacloprid pellets could be consumed and lead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds. The indirect effects to food webs potentially caused by neonicotinoids is of particular concern to the USFWS because of the numerous migratory bird species that depend on habitats Of Willapa Bay and Grays Harbor as part of their migratory pathway (Chagnon el al., 2015). Grays Harbor supports migratory bird habitats of hemispheric importance as classified by the Western Hemisphere Shorebird Reserve Network (WHSRN). Over halfa million shorebirds stage in Grays Harbor annually as they migrate along the Pacific Flyway. WHSRN has also recently designated Willapa Bay and the Long Beach Peninsula a place Of international importance because these habitats support over 10 percent of the Pacific Coast populations of dunlin (Calidris alpina), red knot (Calidris canufus), and short- billed dowitcher (Limnodromus griseus).

Commenter: Neil Quackenbush - Comment A-4-7

Content included in the Supplemental EIS suggests that there would be no direct adverseeffects to birds or fish, including those listed under the ESA. However, the SupplementalEIS does ·acknowledge that potential indirect effects to food webs and prey availabilityare a significant uncertainty, sources of prey could be reduced for shorebirds that feedexclusively on invertebrates, and granular imidacloprid pellets could be consumed andlead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds. Theindirect effects to food webs potentially caused by neonicotinoids is of particular concernto the USFWS because of the numerous migratory bird species that depend on habitats ofWillapa Bay and Grays Harbor as part of their migratory pathway (Chagnon et al., 2015).

Commenter: Douglas Steding - Comment O-20-7

With decline and then loss of their food sources and habitats, including oysterbed and eelgrass habitats, higher trophic level forms such as birds and fish willexperience reduced food resources. In more extreme cases the burrowing shrimpdominated areas may become unsuitable as foraging habitat for thesevertebrates.

Commenter: Douglas Steding - Comment O-14-5

With decline and then loss of their food sources and habitats, including oysterbed and eelgrass habitats, higher trophic level forms such as birds and fish willexperience reduced food resources. In more extreme cases the burrowing shrimpdominated areas may become unsuitable as foraging habitat for thesevertebrates.

Comments on Food Web/Prey

Commenter: Eric - Comment I-218-1

Eric (Oral Testimony): My name is Eric [unintelligible]. I live Pacific County. Lived all my life in South Bend. My family's been on the Bay for the last 5 generations. That's how we've always made a living , whether it's been salmon, crab, or oysters. I guess some of the things I wanted to address here was , you know the things that were talked about , salmon escapement, birds, crab harvests, all that those were within the last 10 years. We haven't sprayed Carbaryl since 2015. You go back 50 years , we saw rises, we saw things, we saw monster crab harvests, we saw fantastic salmon runs , I mean while we were spraying for those 50 years with a chemical that is much more toxic than Imidacloprid is. My 2nd thing is I've worked in the oyster beds for almost 40 years now. I've never seen a bee. Every place we're spraying , most of our ground , all of my ground is almost 3 miles off the beach. I've never seen any bees anywhere close to any of the beds we're spraying. I guess for me, termites , I mean, sorry , kind of relate it like your house was infested with termites. I mean, if you don't address the issue, your house falls down.

And that's what's going to happen for me. I'll lose the majority of my farm. I will no longer be in business if there isn't a chemical to spray these shrimp. And trust me, if I could do it mechanically I would gladly spend every low tide that I could there to get rid of them. But that's not an option. So if anybody can help I mean there are a lot of people who are dissenting on this whole idea if you can come up with some other way we can do it besides chemical, I think that would be fantastic. But for me, without a chemical, I'm done. I've got 2 girls. I would love to be able to pass my farm down again to my kids but that's not going to happen if there isn't a chemical. So hopefully we can come up with some kind of a spray program here. Thank you.

Commenter: Jules - Comment I-237-1

(Email Submission)

Hi Derek, I submitted the following via the on-line form, but because I believe strongly in this, I wanted to be sure the comments got to you. Thanks for you work, and good luck. Jules

(I've added the paragraph breaks to what's below.)

Thank you for considering the wealth of information provided on the importance of native burrowing shrimp, the important ecosystems which Willapa Bay and Grays Harbor make up, and the desire for shellfish growers to maximize their profits. This issue is no different than Seattle Shellfish and Taylor Shellfish believing the "only way" to grow-out geoduck seed was to use hundreds of "kiddie wading pools" in the tidelands. When that method's impact was shown to detrimental to the benthic and marine ecosystem, they easily came up with alternative growing methods. Taylor Shellfish modified mussel farm rafts and Seattle Shellfish built a floating dock to which grow-out rafts were attached. It was more expensive, but they adapted and accepted it as a cost of doing business. .

This current situation is no different. Accepting Alternative 1 (do nothing) will show that to be the case here, as it was there. Willapa Bay and Grays Harbor shellfish growers claim alternative growing methods are more expensive or not feasible, pointing to long lines "sinking" in the sediments and it being hard to walk in those sediments. While above sediment methods are more expensive, and in a few areas the sediments are soft, the current system pointed to is simply a poorly engineered system to grow oysters, and a poorly engineered system will always fail. But it does not mean alternatives are not available.

Look at Drakes Bay Oyster Company's use of racks in Drakes Estero where above sediment structures were used for years, accessed by boat, as they have been in Japan for decades (and where the nonnative Pacific oyster originated from). Pilings are driven into firm sediments which, in the case of Willapa Bay (and likely Grays Harbor) are 3 feet below what the current growers are complaining about. In turn, those pilings had stringers attached to them, over which "hangars" were draped, holding oyster spat. When mature, workers traveled to the structures by boat/barge, lifted the hangers off of the stringers and onto the barge, and returned them to the processing plant. It is only one of the alternatives available to growers. While Drakes Bay Oyster Company is not longer operating in Drakes Estero, it was not because the method used was more expensive. In addition to providing the alternative growers testified at hearings they so dearly want, this also provides a permanent structure onto which marine organisms grow, and remain. The pilings and stringers become ecosystems in and of themselves. (While oysters suspended also provide "structure", they are removed at each harvest so cannot be truly called adding to the ecosystem.) Of course there is a risk of a boater running into them. But navigational hazards are easily marked and, if significant enough, lit. And unlike other areas, these have no eelgrass to shade.

Growers state the wave energy is too strong for a robust structure such as what is described. If that is true, then there is no way on- bottom oyster growing will be able to take place, burrowing shrimp or not. As Taylor Shellfish noted in a deposition submitted when an encroachment onto state tidelands was being investigated, waves on that parcel caused oysters to be pushed to the upper tidelands, having to be retrieved by hand, and then placed back in the lower tidelands. If on bottom oyster growing may be done on these parcels after killing burrowing shrimp, then most certainly a well engineered structure may be used, avoiding the use of this pesticide, providing "ecosystem services" as well.

Other growers claim above ground structures create such an impediment to tidal and sediment flow that they result in sediment deposition, putting other beds at risk. However, they site no studies to substantiate such a claim and merely provide conjecture on whether it is significant, let alone even happens. Further, Taylor Shellfish has been using above ground methods (flip bags in this case) for years and nobody complained to DOE about sediment transport issues.

Dick Sheldon's comment expresses concerns that above ground methods result in micro-plastics in oysters. Yet testimony by "expert witnesses" for Taylor Shellfish in numerous hearings claim grow-bags are not the source of micro plastics. More importantly, the method described easily avoids the use of any plastics at all, instead, using hangers. While Mr. Sheldon should be concerned about plastic, he should be more concerned about the public's perception of his oysters, those of Willapa Bay, and those in Washington, being grown on beds and in waters where pesticide and herbicides are being applied.

Another supporter of pesticide use is from Daniel Cheney who states the use of Carbayl (Sevin) by the shellfish industry (used since 1963, unknown to most consumers of Willapa Bay oysters) to kill burrowing shrimp resulted in an increase of eelgrass due to firmer sediments. Not noted is the species most common to grow in these areas where shrimp are killed in order to grow oysters is Japanese eelgrass, an eelgrass considered a "noxious weed" by shellfish growers who have been spraying the herbicide Imazamox on to eliminate. While there were areas where the native eelgrass increased, those were predominantly in tidal pools, where water never drained and lower in tidal elevation. In short, while applying a pesticide did result in an increase in eelgrass, it was predominantly Japanese eelgrass which shellfish growers would simply spray with Imazamox, adding more chemicals to Willapa Bay.

As noted by many, Willapa Bay and Grays Harbor provide ecosystems which support a large number of native species. That support starts at the bottom of the food chain where burrowing shrimp exist. Imidacloprid is not "shrimp specific" - it will kill any marine invertebrate it comes in contact with. Derreck Rockett noted many "uncertainties" in this proposal at public hearings. There are, and those uncertainties - coupled with the very real certainty that this is a pesticide which kills marine invertebrates - should prevent this proposal from considering anything other than Alternative 1, the "do nothing" alternative.

Like the timber industry who adapted to environmental constraints, like Taylor Shellfish and Seattle shellfish adapted to alternative growing methods for geoduck, so too can Willapa Bay and Grays Harbor shellfish growers adapt profitable alternative growing methods, avoiding the taint all shellfish grown in Washington would take on if pesticides are applied to shellfish beds.

Commenter: Melissa Aaron - Comment I-6-1

We don't know enough about the effects of this pesticide on the denizens of the tidal flats (crustaceans, fish, birds, and so on). It's toxic to mammals, so endangers orcas, seals, otters, and us. It's also toxic to bees. How can we possibly think that oysters are worth that? I love them as much as the next gal, but there's a point when the harm outweighs the good. We are at that point. Please do not approve the use of this pesticide.

Commenter: INDIA ANDERSON - Comment I-79-1

Absolutely do not approve this. Using a neurotoxin on our shared tideland because they find difficulty making money on oysters is morally reprehensible. The toxin is indiscriminate, it even affects mammals, just to a lesser extent. Introducing it into the food chain where sensitive species are involved is asinine.

Commenter: valerie anderson - Comment I-52-1

If the reason the ghost shrimp are proliferating is due to radical disruption of the ecosystem, then address the health of the environment. Spraying with a neurotoxin pesticide with unknown risks to all creatures in the tide flats is not the solution. Human attempts to immediately fix problems that have been created over a long period of abuse may take time. A diverse , naturally functioning tidal zone would not have the problems that a huge monoculture oyster farming operation does. Look to the natural world to regain balance, do not continue to throw more gas on the fire !

Commenter: Rich Andrews - Comment I-246-1

(Email Submission)

Re: Use of pesticide, imidacloprid, in Willapa Bay and elsewhere

Attached is a copy of the letter I previously sent to your office on the subject proposed use of an ecologically damaging and public health threatening pesticide proposed to be directly dumped into the natural waters of the state of Washington and the United States. My previous comments submitted back in July 2017 are still totally applicable.

The latest draft supplemental EIS remains woefully inadequate, scientifically flawed, and is totally incomplete with respect to the only reasonable alternative, simply denying the use of such poisons to be dumped into natural waters. There are alternatives for the oyster producers, namely to stop using existing methods of production in the muds of the estuaries and bays...and use suspended culture methods which are proven in this same area. The use of poisons of the environment and potential food chain poisonings all the way to the human consumers of the oysters is totally wrong and unnecessary. It must not be allowed. It is a total violation of numerous applicable laws...and of common sense.

Dear Mr. Rockett: I have become aware that the issue of directly putting toxins, pesticides, into the open waters of Willapa Bay and Grays Harbor has been once again requested by some oyster farmers. Simply stated, this proposition confronts all ecological rationality and I oppose it strongly. It violates the intent and letter of the laws of our nation that are to protect the environment and public health; it violates both the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) as well as the Clean Water Act (and NPDES under that Act), and likely other federal laws, such as the Endangered Species Act. It also violates the companion primacy implementation laws and programs of the state of Washington. Other laws are likely also violated by this proposal to discharge directly pesticides into the waters of the U.S. and of the state of Washington. If the Department of Ecology would do its job, it would simply shut down any such use of poisons into the waters of the state and nation. There is no possible legal or ethical and certainly no ecological or public health justification for this proposed blatant pollution of the environment, nor for the poisoning of the many species that would be affected. The particular pesticides, from the neonicitinoid chemical class, are dangerous and indiscriminate in their poisonous effects on aquatic species in particular. These chemicals are very water soluble, easily mixed and dispersed to areas far beyond the immediate application sites. Not only the target burrowing shrimp would be affected and killed, but serious food chain ecological damages would occur to the many other species directly and indirectly. That includes predator aquatic life, fish species, avian species, even mammals that would eat and depend upon the shrimp and other aquatic invertebrates and even aquatic and near shore plant species that would be directly poisoned or poisonous. These non-target species would also be exposed via numerous other pathways to these poisons in the waters and vegetation in and littoral to the bays and estuaries and open waters. Not only would wild species be affected by this wanton and needless environmental poisoning, but the consumers of the oysters are also vulnerable to being poisoned from the pesticide residuals in the oysters. Increasing scientific and medical evidence is accumulating about the toxic effects of the neonicitinoid chemicals on humans and mammals, specifically neurotoxic effects. These affects can not only be acute but chronic and accumulative with some of the modes of toxic action in the human nervous system. The Department of Ecology must fully investigate these effects and when it does, it will find them to be dangerous, as well as illegal. A few years ago, this issue arose and the buyers and restaurateurs and the customers of the oysters from Willapa Bay and Grays Harbor arose to object to the adverse effects on the quality of the foods being produced…containing dangerous toxic pesticide residuals and toxic breakdown chemicals. These people can and will arise again to object to this ugly practice of not only poisoning the environment but to poisoning the consumers of oysters. The oyster growers do have options in their methods, notably by growing oysters in suspended systems, out of the muds where the burrowing shrimp live. It may be more costly, but protecting our world and environment and the quality of our foods does have a price. All too often corporations and business seek the easy and cheap road rather than the responsible road. This is just such a case. The only thing driving their proposal to use the neonicitinoid poisons is simply one of a short sighted view of production economics. They are not considering the external costs nor the health of their customers. And in addition, they are preventing other oyster producers in the same area from operating without having their oysters being poisoned. Safe toxic-free oyster producers have been economically harmed by the irresponsible actions of those producers using poisons in the common waters of these bays. These harmed persons and businesses should in fact be fully compensated for their incurred losses, which are not just temporary given the relatively long half lives of these poisons in the environment. Now the really dastardly element is that both the U.S. EPA and the Washington Department of Ecology have in the past been complicit in these violations of the laws they are supposed to be implementing. They have applied twisted legal arguments, incomplete and distorted, even conflict of interest compromised biological and medical science, and simply turned their backs on the laws of the state and nation. They have also not conducted legitimate scientific investigations using established scientific principles in even registering these chemicals for use. This is particularly true at the U.S. EPA level of the Office of Pesticide Programs. This is rampant, not only with neonicitinoids, but with essentially all pesticide registration and re-registration processes, establishment of tolerances, endangered species impact referrals-reviews, associated product label approvals/restrictions, etc. I would encourage the Washington Department of Ecology to directly engage with the enormous expertise of many independent scientists in this field, and also with the public watchdog non-profits who are experts in the area of pesticides, ecology and health effects. These specifically include but are not restricted to the Center for Food Safety, Xerces Society, American Bird Conservancy, Pesticide Action Network North America, Beyond Pesticides, Natural Resource Defense Council, Sierra Club, Center for Biological Diversity and others, even those regulatory agencies in several other countries that do a much better job of protecting their environments and citizens. I'm a former employee of the U.S. Environmental Protection Agency, NPDES programs, back when that agency had some respect for its mission and the actual words in the name of that agency. That was in the early 1970s. Since then, particularly pesticide so-called registration has been debased, driven by the corporations intent on manufacturing and selling their products as freely as possible. This is a shameful state of affairs, and the State of Washington must not be misled by this lack of competence and the actual corruption at the federal level. The Department of Ecology must correct these matters and gross deficiencies and protect the environment and the public health. That is its duty. It must do what the EPA is not doing by being honest and conducting legitimate scientific investigations…and until it does so, it must not allow propositions such as the application of neonicitinoid poisons to the waters of the state of Washington nor the waters of the United States. Even with existing scientific information from open peer reviewed literature, the department would deny this proposal to use neonicitinoid chemicals in Wallapa Bay and Gray's Harbor.

Commenter: W Asprey - Comment I-264-1

(Email Submission)

Sirs and maams, The past amateur pesticide uses and public notifications have been a sick joke. Applications in high winds, no boat launch notices, one blurry notice in a RAYMOND junk paper all lead me to amateur conclusions.

We moved from Grays Harbor due to these and other amateur pestcide actors over the past years. Short term gain is all these shrimp killers care for. The people are in the way of the business as usual, toxic air land water, what profits for whom??

Money talks and poison makes money, any point in saying more? I thought not. Has ecology tested neonics on spectral vertabrates and bay invertabrates? Just watch fish run away, it stinks and poisons them, salmon do not matter to these corps. farming in toxic mechanisms, selling poison as oysters and fish, killing a legacy!

Bill Asprey

PS. Have the poison fishers tried other non toxic solutions? I thought not. The wash of poison from inland, paper dioxins, and other sediment trash has already damn aged the shell fish and all of us tools. b

Commenter: Ross Barkhurst - Comment I-210-4

Ross Barkhurst (Oral Testimony): Okay, I am going to address some leading indicators we should be looking at. As to the state of the Bay, it is not as pristine and healthy as some would tell you. I'm going to [unintelligible] some salmon populations, herring, waterfowl, and Willapa Bay [unintelligible] of naturally spawned fish. And I'm going to take you through the cycle from 2002. Chump salmon started out about 108,000 dropped down to about 10,000 during the period we were spraying Spartina. I got my pesticide permit and I participated in that. It was displacing everything we had. Had to be done. The good thing was it was a one-off. We got rid of it. And now it just gets a little clean up from Mr. Nesbitt. But we've never bounced back. You can see it hovering around 20,000 which is the escapement level. There's no commercial harvest until it [unintelligible] 3 years in a row, hasn't been able to do that. Recreational fishermen harvest about 150 a year. No impact.

The next thing you see is herring -- 700 tons herring spawning mats in 2002, measured by WFW. You see it really wobbling during the Spartina spraying, down to zero. No herrings spawning in the Bay. They quit measuring herring spawning mass. At my encouragement they started up again this year. What they found in 2017 was zero. Okay? Spartina spraying stopped in 2008 -- a massive amount. And so what we're doing is removing their spawning structure, which is eelgrass. The next thing you see is waterfowl. 2002, about 100,000. By the time we were through getting most of the Spartina out of the bay about 10,000. As soon as that was over it began climbing. In 2014 you see 100,000 waterfowl again. This is the peak in November. In 2014 we start spraying eelgrass, 22,000. The next year, 14,000. Last year, about 8,000. The lowest number of waterfowl in modern history -- while the waterfowl in the fly away is doing just great. But they can't use Willapa Bay any more.

The last chart on the right shows how a Willapa Bay Chinook escapement of natural spawnings is on the ground to spawn again. There's a goal that we publish in Noah of about 4,300 and we had a little bit less than that in 2010 , the first year we had marked fish so we could tell who was wild and who wasn't. Steady drop. Steady drop, a little up, and now we're down at the lowest number of escapement spawning Chinook since we were able to tell by markings who was who in 2010. So here are 4 leading indicators that show us that we're not doing well at all. I can put a 4th chart there, for really the mother of this whole food pyramid we've been talking about all night. And that would be acres of eelgrass. But since we're spraying eelgrass, in keeping with tradition, we don't have it anymore. Hasn't been mapped since 2016.

So there's no way you can do a cumulative effects analysis , what you're calling cumulative effects does not look at these 4 leading indicators, and does not take them into account. If somebody else removed 90% of an organism -- that doesn't give you the right to move the last 10%. Means you can't remove any more. That's cumulative analysis, and we would hope that you would start taking a look at it. Thank you.

Commenter: Ross Barkhurst - Comment I-220-3

You make a statement – I'd like to know who made the statement that mammals don't go out on the shellfish beds in the daylight. When I left my house there were 3 racoons out there. They're out there all the time. And in the next pool over there was a blue heron. This is not going to affect blue herons and they're eating everything that's out there and they're eating the little fish that eat what's out there. So I just don't know how after 4 years you can come up with these kinds of statements. I see no basis for removing the high TOC zones. You're telling me that you might bring them back. How do we know? I mentioned the WAC quotes and what you're saying is even in Puget Sound they can go down 50% as long as it comes back. Understand no time frame for it to come back.

Commenter: Ross Barkhurst - Comment I-210-1

Ross Barkhurst (Oral Testimony): Okay, I am going to address some leading indicators we should be looking at. As to the state of the Bay, it is not as pristine and healthy as some would tell you. I'm going to [unintelligible] some salmon populations, herring, waterfowl, and Willapa Bay [unintelligible] of naturally spawned fish. And I'm going to take you through the cycle from 2002. Chump salmon started out about 108,000 , dropped down to about 10,000 during the period we were spraying Spartina. I got my pesticide permit and I participated in that. It was displacing everything we had. Had to be done. The good thing was it was a one-off. We got rid of it. And now it just gets a little clean up from Mr. Nesbitt. But we've never bounced back. You can see it hovering around 20,000 , which is the escapement level. There's no commercial harvest until it [unintelligible] 3 years in a row, hasn't been able to do that. Recreational fishermen harvest about 150 a year. No impact.

The next thing you see is herring -- 700 tons herring spawning mats in 2002, measured by WFW. You see it really wobbling during the Spartina spraying, down to zero. No herrings spawning in the Bay. They quit measuring herring spawning mass. At my encouragement they started up again this year. What they found in 2017 was zero. Okay? Spartina spraying stopped in 2008 -- a massive amount. And so what we're doing is removing their spawning structure, which is eelgrass. The next thing you see is waterfowl. 2002, about 100,000. By the time we were through getting most of the Spartina out of the bay about 10,000. As soon as that was over it began climbing. In 2014 you see 100,000 waterfowl again. This is the peak in November. In 2014 we start spraying eelgrass, 22,000. The next year, 14,000. Last year, about 8,000. The lowest number of waterfowl in modern history -- while the waterfowl in the fly away is doing just great. But they can't use Willapa Bay any more.

The last chart on the right shows how a Willapa Bay Chinook escapement of natural spawnings is on the ground to spawn again. There's a goal that we publish in Noah of about 4,300 and we had a little bit less than that in 2010 , the first year we had marked fish so we could tell who was wild and who wasn't. Steady drop. Steady drop, a little up, and now we're down at the lowest number of escapement spawning Chinook since we were able to tell by markings who was who in 2010. So here are 4 leading indicators that show us that we're not doing well at all. I can put a 4th chart there, for really the mother of this whole food pyramid we've been talking about all night. And that would be acres of eelgrass. But since we're spraying eelgrass, in keeping with tradition, we don't have it anymore. Hasn't been mapped since 2016.

So there's no way you can do a cumulative effects analysis , what you're calling cumulative effects does not look at these 4 leading indicators, and does not take them into account. If somebody else removed 90% of an organism -- that doesn't give you the right to move the last 10%. Means you can't remove any more. That's cumulative analysis, and we would hope that you would start taking a look at it. Thank you.

Commenter: Ross Barkhurst - Comment I-202-1

Comments on imidacloprid SEIS This is a summary of some key deficiencies of subject SEIS. These comments should be considered to be a supplement to my earlier comments on the FEIS for the previously recalled NPDES permit. I hope to be able to discuss and present them at tomorrow's workshop and hearing in South Bend. Because of the limited time there, these would not constitute all comments. 1. The significant uncertainties are certainly that. After all this time, figuring things out as you go, with the same cast of characters, should be out of the question. 2. Self monitoring by permit holders is not designed, and monitoring by an independent agency is not committed to. It would need to be by a group other than Ag who supported it, and DOE, who issued it. Ecology does not have key baselines to monitor for net loss of ecological function against. No references are presented as to how to measure, against what? This makes even the pretense of avoiding cumulative effects less than credible. 3. No IPM, no problem? IPM a failure with imazamox on eelgrass, now we could have no confidence here. At least criteria for acceptable findings and stop work for unacceptable findings would be essential in the only bays in our country with neurotoxin applied by the gallon. 4. The use of a blatant violator of Public Employee Ethics rules as the main input to this (and other) EIS is unacceptable. The use of "personal communications" in lieu of documented peer reviewed science is not up to standards expected by the public. We have documented the inaccuracy of such communications like this with respect to the Buffer Validation Test (BVT) for imazamox on eelgrass recently. Active ingredient per acre was totally misrepresented and lowered on paper when it was found to have violated the pesticide label. 5. The use of granules voids much of claims of safety and is improperly analyzed. For example, the specious claim that they dissolve on contact, along with the specious claim that zooplankton are somehow not present on shellfish beds when treatment would be made, is obviated by the fact that the granules could be applied from a boat in water full of these animals anyway. Of course many flats contain hundreds of tide pools full of eelgrass and invertebrates also. In Fall, during the proposed spray window, pools and sinks are full of waterfowl filtering invertebrates, and birds such as Blue Herons, eating the small fish. Not being a drainage or channel, it seems these could be empty of life also. They did not get the email we might get saying they could not harvest food for thirty days. 6. We can find no basis for removing previous high TOC zones where this systemic poison would invade such compounds, from the off limits of the last ill-fated permit. The bay south of the Dispersion Gap Ecology identified previously contains to this day tons of dead spartina root wads and other such matter. Much of this is on land purchased for waterfowl habitat for the public with state duck stamp funds. The removal of eelgrass and now invertebrates would be part of the trifecta of removing waterfowlers for thirty days. Old unresolved comment; can the waterfowler who cannot eat the clams or oysters on this land he purchased also not eat the ducks? Even if his blind was not sprayed what treated bed did this Mallard full of inverts come from? We will not attempt to complete the long list of unresolved issues from before, this is one obvious one. It also applies to public land under the protection of DNR, which opposed the BVT with good reason. If my next neighbors North and South treat their beds in sequence under your proposal, I cannot harvest or eat anything on my own bed for sixty days. Yet another unresolved old comment. You have no right to do this in water any more than on the land. Please advise. 7. Your WAC quotes seem to say you can not noticeably reduce habitat in Puget Sound but you can reduce it 50% in Grays Harbor and Pacific County. Really? Would not the Shoreline Management Act override this? Zeroed out forage fish spawning mass, bottomed out waterfowl numbers, and all time low Chinook natural recruitment seem to say over 50% loss already. We do not believe cumulative effects limitations mean if 90% are gone and you claim not to have caused it, you can issue an NPDES permit to take 50% of the 10% that is left. Please answer this in your workshops. Also advise if this is acceptable to your fellow agencies WDFW and DNR. 8. Your uncertainties list belies earlier claims in the same document that the same concerns are under control. For example impacts on eelgrass. We already know if shrimp go, eelgrass can move in. Under your imazamox NPDES, this means more eelgrass spraying. Cumulative effects not looked at. At first you claim estuarine invertebrates are more resistant to imidacloprid than fresh water cousins, then list estuarine vulnerability as an uncertainty. There are several other contradictions here. 9. Cumulative effects have not been addressed in any fashion that would incorporate legal precedent such as De Tienne. For example you have narrowed them to eelgrass impacts of the two different chemicals you may permit to go on eelgrass. One kills the eelgrass. The other next door kills the invertebrates in eelgrass that was not killed by imazamox yet. These are cumulative impacts where the chemicals never came together, along with the fact that imidacloprid is to open up more ground than otherwise claimed possible. If growers have the right to do this, you would need to establish that to the public, not claim it will not happen or ignore it. For a satisfactory EIS, you would need to ferret out all comparable excluded situations. The average 10 mph wind allowed by you during 10. application, will have pesticide in the flowering bushes on the bank in less than thirty seconds from spraying. Clam beds are close to shore in many locations. These calculations are for beds I am personally familiar with. The exclusion of helicopter application does not prevent airborne chemical when you allow airboats, which are not excluded here. Elsewhere you claim it would be hard to spray much acreage, not true with airboats. In the flowering bushes on our banks we find hummingbirds, bumblebees, and pollinator flies by the thousands. Many different native plants feed these native pollinators. Our plum tree, apple trees, blueberry bushes, and huckleberries are pollinated by 99.5% native pollinators, not honeybees. Still, you have ignored my previous comments about your error in claiming no honeybee hives near the bay, I know of two within 300ft of the bay nearby. This is not the only case where a Supplemental EIS is tacked on to a defective FEIS. You should not go forward with a permit. I you did, there is a lot of cleanup left. We hope not to have to delineate all of it, this here is just for discussion and the three minute drill. II. Attempts to convince the public imidacloprid will be kept out of drainages are not successful. In the imazamox Buffer Validation Test, most damage outside the buffer was "in drainages carrying water off site". When questioned about the NPDES prohibition against spraying into drainages, the Ecology response was that Patten did not, he just sprayed where water flowed into these drainages. This is a distinction without a difference. You have demonstrated that you cannot keep water out of these drainages, or the tidal pools where invertebrates, waterfowl, small fish, and herons dine. Of course plenty chemical will leave site when granules would be scattered from a boat, also proposed to be allowed. Water that floats a boat, which cannot even see drainages of pools, will go lots of places. 12. Throughout this SEIS behavior and events on the ground are treated with a broad brush, for example the false concept that that only 1.1% of bay would be treated so it will not effect the public. Clams, people, and spray would end up in the same places, as would waterfowlers and fishers near oyster beds. There are two public clamming areas within two miles of our house. Both abut directly with commercial shellfish beds. Folks here can breathe imidacloprid, or have it for dinner later. If there are signs, they can read them and leave. One of these two beds is never posted by our government when the area is closed for Pathogens now. It happens to be the one my family frequents, in addition to our own shellfish bed for oysters. I have caught county crews readying to spray eelgrass on our bed. These were good people making a mistake. They did not have permission to spray spartina here, and non is present. This is the real world, which is not reflected in the SEIS. Travel of imidicloprid off site is reported to be 13. erratic. This can easily be explained by detailed study I have seen about how films can transport pollution and chemicals far off site. A more credible literature review would have found this. I did. Much else has been overlooked or not explained. 14. When the Buffer Validation Test (BVT) was done for imazamox the public was told it could not comment on that permit on anything other than the test itself. Now how should we believe that through the life of this permit we have not seen, DOE which has the power and need to make up IPMs, monitoring programs, apparently not independent, and other changes, the public could have productive input? We see little chance under current practices. The SEIS says mammals are safe because they do not 15. frequent the flats during daylight. They do. Raccoons are there on lower tides more often than not. Dogs are there, for exercise, training, and waterfowling. At least in the case of gunnels, they pursue a same thing raccoons do. Raccoons eat lugworms and whatever they can get, all would be made easier by tetanus. Same as birds with injured life which would abound under the influence of imidacloprid. Personal communication with Patten says birds not a 16. problem because they will be scared away by applicators. Not true. If you are stirring up food they will follow you, just like they follow a tractor on land. When I am clearing a path on the beach of debris, they follow behind eating invertebrates exposed. They come much closer than normal. If the prey were paralyzed, even more attractive we expect. When the applicator leaves, paralyzed shrimp and lugworms for example would be devoured. I have a personal report this happened after carbaryl use. Tidal flushing is claimed to remove chemicals twice 17. per day. This is not so simple south of the Banas and Hickey Dispersion Gap of which you are well aware. It will slosh around for over forty five to over sixty days there. Likely long before then it will find eelgrass to be systemic with, killing invertebrate life associated with that, as it is designed to do. On one hand you are uncertain about this, on the other you would allow spike wheel experiments to continue in eelgrass because the questionable efficacy is a known problem chemical grabs the eelgrass before it can get to the shrimp. There are numerous uncertainties you list that 18. contradict other statements of no problem. Low impact on estuarine invertebrates is a big one. A.I. concentrations do not kill shrimp in the lab, but you think it will in the field where it actually be further diluted by grass, mud, and current? There would be a long list of these should you further pursue. The lack of a cumulative effects analysis on green 19. sturgeon, forage fish, waterfowl, shorebirds, salmonids, the overlooked mud shrimp which are need of recovery more than control, is sufficient to shut this project down alone. All but shorebirds are at all time or modern lows. All effects are cumulative, are they not? The lack of Marine Spatial Planning maps showing 20. public and wildlife use together with statements like 1.1% surface area will not impact the public, will not effect much, is a bad combination. Ecology also had the lead in producing these sub par maps. For example, the 1.1% of area sprayed will by design contain far more than 1.1% of sturgeon food. These errors lead to an analysis far short of preventing public or cumulative impacts. In south bay and elsewhere there are numerous areas 21. purchased with state Duck Stamp monies for waterfowl habitat and waterfowling. They clearly were picked out with this as primary purpose, yet benefit many estuarine birds. Your map allows these areas to have eelgrass and invertebrates removed, the latter during duck season. How can one department purchase this, and another spray it to remove the habitat? The inclusion of clams aggravates this situation considerably in shallower waters. No mention in the uncertain clam discussion. A waterfowler, if he finds out he cannot eat the shellfish, and cannot fish, but can hunt, or could he? He will now wonder about the mallard full of invertebrates it got on another bed that was sprayed in the last thirty days, can he eat it? How does he know where it was? Coming in for a rest from elsewhere after filling up on tetanized shrimp? Another comment never addressed before, ignored now, this is why these comments are supplemental, more so than your SEIS. Many of these public habitat intensive areas are near river and creek mouths where salmon smolts are present during the spray window. Chinook are at the lowest escapement of natural recruits in measured history in Willapa, too scarce to harvest in Grays Harbor. You did not address this. When hatchery smolts are released from the North Nemah, they slosh in and out of the North and South Nemah channels and over the flats for weeks. They are up on the warm flats in shallow water feeding on the vast array of invertebrates and using any surviving eelgrass for cover from the avian predators that indicate their presence. Similar scenes likely exist near other river mouths. None are addressed. Did WDFW clear all this?

Commenter: Jane Beattie - Comment I-268-1

(Email Submission)

Dear
Dear Mr. Rockett:
Please consider new information that should be included in the Supplemental Environmental Impact Statement for the proposal by the Willapa Grays Harbor Oyster Growers Association to apply imidacloprid to Willapa Bay and Grays Bay.
Information shows that imidacloprid cannot be safely used by oyster growers. (USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC)
EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates."
The assessment also found chronic risk concerns with imidacloprid exposure to saltwater invertebrates.
The agency evaluated an expanded universe of adverse effects data and found that acute (short-term) and chronic (long-term) toxicity endpoints are lower than previously established aquatic life benchmarks.
EPA found risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review.
These chemicals adversely affect survival, growth, emergence, mobility, and behavior of many sensitive aquatic invertebrate taxa, even at low concentrations. (Morrissey, C, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. Environment International 74: 291–303.)
Neonicotinoids have "wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats." (Van der Sluijs J.P., et al. 2014. Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environ Sci Pollut Res doi:10.1007/s11356-014-3229-5.)
Please consider this and other new scientific data in your review of the permit application by the WGHOGA.
You will find that imidacloprid cannot be used in the proposed way without harming the ecology of the bays.
Sincerely,

Ms. Jane Beattie

Commenter: Lisa Belleveau - Comment I-119-2

Salmon and Dungeness crab are NATIVE commercially valuable species and the use of this poison will adversely affect them. These 2 estuaries are incredibly important rest areas for shorebirds as they migrate and without productive benthos to feed on the impacts could prove to be catastrophic!

Commenter: David Beugli - Comment I-221-2

The new permit that we have requested represents a single and significant reduction in acres where growing shrimp will be controlled. From 2,000 acres per year in the original issued permit to our current request of 500 acres. This represents a 75% reduction in the total acres that would be treated on a yearly basis. We've also committed to not using helicopters but focus on more precise ground-based applications. The new SEIS – just like the previous EIS – shows that there will be no bay-wide impacts and that these applications will have no direct impacts of fish, birds, marine mammals or human health. These findings alone support the timely issuance of a new permit. That's all.

Commenter: Seth Book - Comment I-216-1

Seth Book (Oral Testimony): Hello. Can everybody hear me here?

Fran Sant: I think they can. Can you tell us where you live , and your name?

Seth Book: My name is Seth Book. I live in Kimilchie, Washington. Just surrounded by [unintelligible] inlets in the South Sound , South Puget Sound. I work in a water [unintelligible] field in the mid-canal region. In my free time I help my friends grow oysters in the South Puget Sound -- on a muddy tideland with burrowing shrimp. I'm a first-generation shellfish grower and I'd like to be on the record that my oysters are the best. I also would like to say that I appreciate being here today and listening to all these comments. It's actually been informative for me. I mean not only from you all but from the people like Dick. That was a very interesting story. It was very informative. I appreciate that. I also really appreciate the history of the Willapa Bay. In the last few hundred years, through the culture and the stewardship of the shellfish growers , I believe that they're real people that want to do the right thing. I also believe in the livelihoods of the people of Pacific County but I also believe in the livelihoods of other people in other counties in the state that rely on shellfish , such as Mason County, where I reside. Where I work.

So I want to also say that many of my comments that I heard tonight did echo my own concerns. I'd like to echo some of these things , like the uncertainty of impacts of us of Imida , I'm just going to say the pesticide , in the aquatic environment. That's one of my concerns. The uncertainty , or the perceived uncertainty of the persistence in this area , I think there needs to be more science in that area. I think that's a concern that should be looked at because of past things that we have done where we have not considered those persistent impacts. I'd also be interested in more about the [unintelligible] effect of this. And we won't really know about these things until we do some of them, so it's kind of like an experiment , which I think that maybe we should use more of a precautionary type of thought process and not do something until we really know more about it. So I would suggest using the option that did say no pesticide at this time. If we do find further evidence that this has no impact whatsoever , very very low impacts I would potentially be interested in looking at stuff like this because it does appear that there is a burrowing shrimp issue in Willapa Bay and whatever that reason is there should be more investigation, that matters as well.

But I think my main concern , I'm speaking as a 1st generational shellfish grower and speaking as a person that works in water quality issues that's not a big fan of chemicals applied to the aquatic environment , is that the precedent that this decision would send to the rest of the shellfish growers in the Puget Sound , and in Hood Canal, especially. I think it would be a sign to a lot of people that they potentially could do this. Because the way we do our oysters is a method that mitigates against that burrowing shrimp. If I know that we don't have the same concerns of the muds and the sands but we do have , I mean I sink up to my knees if I go out there , and so , and it's pretty much a mud flat. There's nothing there except like some worms and stuff like that. But I'm sure there are lots of other things that are edible. There's lots of cutthroat trout there actually [unintelligible]. So yeah that's it, thank you.

Commenter: Diane Boteler - Comment I-34-1

I am writing to oppose any use of imidacloprid in Puget Sound. The intentional use of toxic chemicals has no place in the ecosystem that we all depend on. It's clear that much is unknown about the collateral damage of using such a toxic chemical in our Sound. The impact on other crustaceans and parts of the food chain are unknown. It is hard to think of any neurotoxin used in the environment that doesn't end up having significant negative consequences for the ecosystem and often for humans as well. Economic risk to oyster fisherman should not override the clear risk to a commonly "owned" environment of Puget Sound.

Commenter: Linda Carroll - Comment I-265-1

To the Department of Ecology:
On the basis of recent research, neonics should not be used in Willapa Bay and Grays Harbor because of the harmful effect on numerous aquatic species whose benefits to the ecosystem have been demonstrated by research conducted by the Xerxes Society. Given that any element introduced into an aquatic environment will travel indefinitely, Graf care must be taken to ascertain that such an element will cause no harm. Unfortunately extensive research demonstrates that neonics cause great harm to many species.. Please safeguard the marine ecosystem by denying the request of oyster farmers to use neonics in this delicate environment.
Sincerely,
Linda Carroll

Commenter: Patricia Daschbach - Comment I-98-1

Do not use the neurotoxin Imidacloprid in Willapa Bay and Gray's Harbor because it is near the Columbia River feeding area for the critically endangered Southern Resident Killer Whale.

Commenter: Form Letter (Multiple) Deny Imidacloprid Use - Comment I-242-3

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species.

Commenter: Felicity Devlin - Comment I-288-1

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

Marine animals already have enough challenges to contend with.

Commenter: Form Letter (Multiple) Do Not Allow Imidacloprid - Comment I-270-1

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

While the SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," the SEIS fails to give adequate weight to the "knowledge gaps" it identifies. In some cases, monitoring is proposed as a way of reducing uncertainty. In order to protect the bays, facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

Crucially, the SEIS identifies uncertainties regarding the efficacy of imidacloprid for controlling burrowing shrimp. These uncertainties include questions of the extent and duration of the effect of imidacloprid, the lack of a treatment threshold, lack of data regarding resistance, lack of field research regarding clams, and efficacy of treatment in low temperature. Certainly, no use of imidacloprid can be supported without demonstrating efficacy.

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

The SEIS does not adequately address synergistic effects, including impacts of imidacloprid combined with other chemicals ("inert" ingredients, other chemicals used in the bays, and other pollutants) or other stressors. Among the organisms known to be at risk is the commercially important Dungeness crab, which has been shown to be susceptible to the effects of imidacloprid, and whose populations experience large natural fluctuations, putting them at risk of extinction.

Given the systemic mode of action of imidacloprid in crop plants, the failure to account for impacts on non-target animals consuming vegetation in treated areas is inexcusable.

Willapa Bay and Grays Harbor have been affected by human activity over the past century that has contributed to problems experienced by all who use the bays. Of the three options proposed, the No Action alternative is the best. However, what is truly necessary to address these problems is an option that was not considered in the SEIS –a plan to restore the habitat by removing stressors from streams flowing into the bays.

Thank you for your consideration.

Sincerely,

Commenter: Margaret Donaldson - Comment I-8-1

I am strongly against the use of Imidacloprid and all other neonicotinoid pesticides in Washington State waters. As a lifelong resident of Washington State, the health of our local environment is incredibly precious to me. Imidacloprid has three major strikes against it: not only is it toxic to all invertebrate life where it is directly applied, it can be expected to spread to adjoining areas, disrupting not just invertebrate life there but all the rest of the food chain. There is also significant uncertainty about the cumulative impacts to other marine life. I have eaten Washington State oysters all of my life. While I value the oyster grower industry in this State, these growers must find a different way of managing the problem of burrowing shrimp. The cost to us all is far too high.

Commenter: Nathan Donley - Comment I-204-2

Will there be indirect effects to birds and fish that use these prey species that will be reduced? How may Dungeness crabs is it okay to kill before it affects the population or before it affects harvest numbers? Will Imidacloprid residues carry over to the following year and accumulate in the sediment in these areas? And these are just questions that we don't have answers to yet. But we do know that Canada's Pest Management Agency has proposed to ban Imidacloprid not due to impacts to pollinators or birds, but due to impacts to aquatics and vertebrates, specifically.

Commenter: Ava Driscoll - Comment I-244-2

Biological diversity will decline. I may not see the small orange sea slug with black spots on the oyster beds any more. I also enjoy seeing hermit crab, eel, sponges, cockles, and other creatures

Commenter: Dwight Eager - Comment I-227-1

Dwight Eager (Oral Testimony): My name's Dwight Eager. I'm from Chinook, Washington. I'm here on behalf of CRCFA, which is Columbia River Crab Fishermen Association , which represents most of the crab fishers in Willapa Bay and out of the Columbia River area , Chinook, Ilwaco, and somewhere on the other side of the river , Warrenton, [unintelligible] and Astoria.

I don't know if you're aware of it but the Dungeness crab industry is the cornerstone of the commercial seafood industry that's left on the coast. So any demise to that would be pretty much the failure and exodus of most of the commercial fishing on the coast of Washington State. We understand that supplemental EIS statement discusses impact to juvenile Dungeness crab. Our president of the association , Dale Beasely, who is unable to attend today , will be submitting written comments to address the science of the matter, specifically. In the meantime, I am here to let you know that CRCFA believes the Supplemental Environmental Impact Statement supports the issuance of a national pollutant discharge elimination system permit. I think I got that right , that's worse than having 3 grandkids that all have first names that start with "t." CRCFA fully supports this control program and the oyster growers in their endeavor to maintain the valuable habitat that their shellfish beds provide. It's our opinion that shellfish beds provide valuable, three-dimensional habitat that juvenile Dungeness crabs rely on for survival. And burrowing shrimp destroy this habitat. So thank you for this opportunity to talk about this. We appreciate your effort and we fully support the oyster growers and their permit effort.

Commenter: Daniel Erlenborn - Comment I-86-1

I can't think of a more I'll considered remedy. This pesticide will affect the entire tidal food chain. There are no borders it can't cross. Please refuse this permit application. I pray these industry people are not already using this poison illegally.

Commenter: Mary Ferm - Comment I-337-1

As a Washington State resident. I strongly oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Bays like this are nurseries for many of the creatures at the base of the oceanic food web

Commenter: Kim Figlar-Barnes - Comment I-165-4

The proposed application of Imidacloprid during the month of May will also have irrevocable consequences to the multitude of fish species that utilize Willapa Bay and Grays Harbor as juvenile rearing habitats. All the Pacific Salmonid species, bottom fish, rock fish and forage fish rearing in these two water ways would be negatively impacted by the application of Imidacloprid, thus reducing the populations of these vitally important species. The proposed application of Imidacloprid would also kill other juvenile shellfish species in Willapa Bay and Grays Harbor; such as Dungeness crab, shore crabs, red crab and a host of other crab and shellfish species. Juvenile crab species are an important source of food for many species of fish, birds and other marine organisms. What will be the impacts be to the commercial and tribal Dungeness crab fishery when Imidacloprid is sprayed and kills juvenile Dungeness crab? What will the impacts of Imidacloprid application have on the commercial, tribal and recreational salmon fisheries in Willapa Bay and Grays Harbor when juvenile salmonid foraging prey are killed? These are questions that need to be answered.

Commenter: Margaret Fillmore - Comment I-140-1

Our salmon runs are dwindling, orca numbers are declining so anymore pesticides in the water will continue to kill our aquaculture. Large companies like Taylor are abusing our Tide lands with over use without concern for other wildlife. The eagles and other foal feed in these areas putting them at risk also. Cancers are on the rise please don't let them spray our food and wildlife with poison

Commenter: Diane Fink - Comment I-76-2

As a consumer I would be very concerned with this plan and how it might impact other species of marine life.

Commenter: Jennifer Finley - Comment I-184-1

October 31, 2017

To Whom It May Concern:

As a science teacher, I understand the importance of estuaries and marine waters such as Willapa Bay and Grays Harbor, and I enjoy going out to visit these sites for recreation and birdwatching. However, these waters hold more than birds: they are a complex food web of many different creatures, all with their unique niche. Mud shrimp, ghost shrimp and Dungeness crab are native species, while Pacific oysters and Manila clams are not. I am concerned about the effect of spraying to decrease these native species in order to aid the commercial growing of clams and oysters. The poster of new literature reviewed stated that in 2014, the last time spraying was allowed, nearly 100% of crabs in the area were paralyzed and killed. How can that be considered anything but a significant negative impact, especially if this chemical does not stay within the spray zone, but moves throughout the bay? Wouldn’t crabs farther off site also be killed? Ecology should not allow native species, crab and burrowing shrimp, to be impacted for a non-native species, Pacific oysters. Additionally, consideration of the negative cascade of effects on other species, if the burrowing shrimp die, must be factored in to this decision. Which organisms have evolved to live in shrimp burrows and how would the depletion of burrowing shrimp affect these organisms? A biologic report by the U.S. Fish and Wildlife Service stated: “By aerating the subsurface sediment and digging burrows protected from most predators, ghost shrimp and blue mud shrimp provide an environment attractive to commensals. Commensal and parasitic species associated with these shrimp include a blind goby, three species of pea crabs, two species of clams, a copepod, a shrimp, polynoid worms, and isopods.” (Found online) If 90% of burrows are removed from these areas, are not 90% of the organisms that inhabit these burrows also removed? Without a better understanding of the community interactions and complex food web issues in these ecosystems, how can it be said that impacts are only localized? If imidacloprid moves off site at high levels, which will have both lethal and sub-lethal effects, what are the impacts to the broader food web? Will birds have enough to eat if the invertebrates they feed on during their fall migration are killed? Will salmon and other fish have enough to sustain them? What about those that don't die: can they still reproduce? Without this information, how can Ecology determine that spraying a pesticide known to target invertebrates won't have negative impacts throughout the bay? While I want shellfish farmers to be able to farm their lands, they cannot do so by inflicting such negative impacts on everything else in the bay. Therefore, I cannot support this request to spray pesticides directly into marine waters. Restoring these aquatic ecosystems to their natural equilibrium would provide a sustainable solution. Mud shrimp and ghost shrimp are considered pioneering species. Though they will be among the first colonizers of a disrupted habitat, over time, they would give way to other species, including healthy oyster reefs. These reefs existed before overharvesting, dredging and other destructive practices began to occur. When growers continually harvest all the oysters, they return the habitat to the exact condition that attracts more shrimp colonizers, so the problem reoccurs and this chemical, lethal solution is sought. If healthy reefs were restored, shell habitat would build up, making it difficult for shrimp to burrow, thus allowing structure for young oysters to grow to harvestable size, and creating durable habitat for other species, such as crab and fish. Oyster reefs are important habitat in Willapa Bay and Grays Harbor, but their use is greatly diminished through destructive harvesting practices and through spraying a pesticide on them. Ecology should not support a pesticide application to protect oyster and clam farming when they acknowledge this solution kills most other aquatic invertebrates in and adjacent to the areas sprayed. This issue is caused by growers using practices which exacerbate this problem and will require continual pesticide application. Ecology should work with growers to promote other culturing practices that will promote sustainable farming of shellfish and have a positive impact on the bay and harbor.

Respectfully,

Jennifer Finley

Commenter: Joanne Frank - Comment I-35-1

Spraying poison directly into any natural body of water will endanger all creatures that live there. And what about the safety of people who may be in the water?

Commenter: Sherril Futrell - Comment I-260-1

The only really effective and protective alternative is restoration of the bays' ecology.

In order to protect the bays, facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

The SEIS does not adequately address synergistic effects, including impacts of imidacloprid combined with other chemicals ("inert" ingredients, other chemicals used in the bays, and other pollutants) or other stressors. Among the organisms known to be at risk is the commercially important Dungeness crab, which has been shown to be susceptible to the effects of imidacloprid, and whose populations experience large natural fluctuations, putting them at risk of extinction.

Thank you for your consideration.

Sincerely,

Commenter: Gail Gatton - Comment I-233-2

They support hundreds of thousands of shorebirds during the annual spring migration and they're also important nursing grounds for fisheries including the Dungeness crab we've heard about, the native salmon, and of course the large-scale shellfish production that goes on out here.

Commenter: Pamela Gray - Comment I-99-1

Imidacloprid should NEVER be introduced into the environment. We now know that has wide ranging effects beyond targeted species. If that's what the oyster industry needs to do to stay viable in Willapa Bay and Gray's Harbor they should give it up and relocate. Floating oyster beds work elsewhere. Those bays are just too shallow where they want to culture oysters.

Commenter: James Gresham - Comment I-81-2

This chemical is believed to be responsible for the decline in honey bees and would also be disastrous for all life at the lower end of the Puget Sound food chain. No!

Commenter: Bernice Harris - Comment I-18-1

Regarding the current proposal to spray pesticides on oyster beds:
I am opposed to the idea based on what I have read reported in the Seattle Times on the topic. The possibilities for contamination and/or destruction of other life forms in the food chain, are too great, the consequences of those possibilities too damaging, from what I can understand, and what I have seen happen over my lifetime.
Bernice Harris

Commenter: Matthew Hart - Comment I-3-1

I will try and keep this civil, but I must say it is difficult. You are talking about spraying pesticides directly into a bay of the Pacific Ocean, to appease a single oyster company? Are you kidding me? There are known, direct impacts, on a variety of invertebrates that are food for the salmon we depend on in the Pacific Northwest...this is based on your own supplemental environmental review. This has to be the most absurd idea I've ever heard. Please exercise some common sense and tell these jerks from the WGHOGA to go to hell.

Commenter: Peri Hartman - Comment I-24-1

There are natural predators of shrimp and their eggs. Among predator examples cited from some quick searches: jellyfish, herring, and even gray whales.

I believe that the state should require that a natural approach using predators should be used and that industry should completely exploit such an approach before asking to use neurotoxins.

To put more toxins in our environment, especially at the base of the food chain, couldn't be more risky.

Do not approve the use of Imidacloprid.

Commenter: Debra Healy - Comment I-28-1

Protecting oysters at the expense of a very sensitive ecosystem is intolerable. Our planet and its waterways are already being challenged by devastating environmental factors, many of which we have no control over. Intentionally injecting pesticides into a fragile ecosystem is insane. We can live without oysters on restaurant menus. PLEASE, PLEASE, PLEASE, let our waterways alone!

Commenter: Jessica Helsley - Comment I-169-4

Imidacloprid has been found to enhance adipogenesis, resulting in insulin resistance in cell culture models (Sun et al. 2016, 2017). This provides a strong concern for human health. More direct impacts from insecticide application, including the application of Imidacloprid, have been observed in marine invertebrates which are a critical food source for juvenile salmon and forage fish (Westin et al. 2014, 2015). Wild fish species of salmon and the forage fish food structure that they depend upon are critical components of coastal resiliency- culturally, economically, and ecologically. Macneale et al. 2014 and Gibbons et al. 2015 provide thorough reviews of these concerns. Application of Imidacloprid to coastal areas in the shallow areas of Grays Harbor and Willapa Bay will detrimentally impact critical marine and nearshore ecosystems while also being a human health concern. Impacts to coastal juvenile salmon and forage fish when they are feeding, resting and migrating will have negative impacts to both local salmon populations as well as to salmon populations currently listed under the Endangered Species Act that utilize Washington's coastal waters for nourishment and refugia during their migrations (Shaffer et al. 2012). Additionally, application of Imidacloprid will have a cascading impact up the food chain-impacting marine mammals that include populations also listed under the Endangered Species Act. Washington's coastal ecosystems are complex and vital to our region. We should be working to restore and protect them, not further their demise to enhance the growth of a non-native shellfish species for commercial use. The state and federal agencies are required by law, to preserve Washington State's wild species and the ecosystems upon which they depend. Application of Imidacloprid and other insecticides in coastal zones contradict this mandate and should not be permitted.

Commenter: Laura Hendricks - Comment I-207-1

Laura Hendricks (Oral Testimony): Laura Hendricks. I represent the Coalition to Protect Puget Sound. We have members throughout the state of Washington and I am physically located in Gig Harbor, WA. We appreciate the opportunity to make and provide comment but this SEIS is seriously flawed, which the process is based on. The shellfish industry is addicted to pesticides. We have seen that over the last 40 years. So where do we start with a baseline, when you have been poisoning Willapa Bay for decades, and people that have been there? Kim Patton was the primary scientist who decided over 40 times under SEIS and he was just found in violation of ethics rules because he was a shellfish grower selling shellfish to the very people that are benefiting from these chemicals. That is something ecology has known for years, because we pointed it out, but yet you still took his science and he still testified at hearings and you still allowed permits. Which should never have happened. There has been little monitoring, little testing, and no independent studies of Imidacloprid spraying directly in marine water. Our document that says there are no direct effects on mammals, fish, and birds is not correct because you're not looking at marine studies that are directly sprayed into marine waters.

Yes, there are too many uncertainties -- and in prior testimony that I understand happened in South Bend, where growers stated that things were great in Willapa. Well, the facts are: waterfowl has decreased from over 100,000 to less than 8,000 and now there is a no count. [unintelligible] populations have dramatically declined. Herring counts are down to zero. used to have herring, now you have a no count. [unintelligible] have gone from threatened to endangered. Sturgeon are now in danger. I hear something that really concerns me -- is that you're going to look at testimony of people that are going to be here to get more information that can help supplement studies, basically is what you said. You can't be taking people that have a vested interest in making money, take their information as gospel, and then put that alongside a study and say that is the same kind of information you can base a decision on. That's biased information. You need to have facts. We're not talking about a small amount. We're not talking about 1 little pond. We're talking about Willapa Bay, putting in 100's of acres, scattered all over, with a very toxic chemical. We request that a permit not be issued based on this flawed SEIS and that Representative Blake not be allowed to overstep this if you don't issue a permit-- and come in with another bill to try to let this go through as a study as you are killing mammals, as you are killing the invertebrates you are harming the birds and you are doing the kinds of things that we all know will happen. There are too many people involved. Willapa Bay is not the oyster growers' private property. This is a public bay and everyone has a voice and it cannot be used just for private enterprise. There is much too much at stake. Thank you.

Commenter: Annie Herrold - Comment I-176-1

I am a fourth generation oyster farmer in Willapa Bay and I strongly believe that the Draft SEIS supports the issuance of a Draft Permit. My family has been farming in Willapa Bay for over 100 years and we have worked to control burrowing shrimp populations since their explosion in the 1960's. Currently we are facing an infestation and without any tools to reduce the populations on our beds they are being destroyed and the estuary as a whole is beginning to see what will be devastating effects if burrowing shrimp are left unchecked. If you have taken the time to walk the beds, then you've seen the disastrous effects the shrimp are having. As a member of the local Chinook Indian tribe and a family that are long time Pacific County residents, I care deeply about the health and sustainability of Willapa Bay. Farming oysters is a way of life for us, and without a healthy balanced ecosystem our way of life would cease to exist.
Oyster growers are constantly working to protect this beautiful bay that we call home. If the science didn't support the issuance of a permit, then we wouldn't support it either. We are proposing to use only up to 8 oz an acre of the next generation, EPA approved imidacloprid on less than 1% o the total acres in Willapa Bay. It is undetectable in the water within 24 hours and will not be applied to the oysters themselves but directly to the sediment during the lowest tides of the year. The long term result would be healthy vibrant beds with an abundant diversity of species present and oysters that won't contain even a trace of imidacloprid. I am proud to farm some of the same land that my great grandpa did and it is a tradition that I hope to be able to pass down to the next generation but to do so we need a way to protect our land. Please issue the Draft Permit so that we can save our farms and preserve the delicate ecology of Willapa Bay.

Commenter: Gayle Janzen - Comment I-259-1

(Email Submission)

It is shocking that your SEIS has so many unknowns about the affects of using Imidalcoprid in Willapa Bay and if it will even achieve the desired outcome. With questions like that, how can you in all good conscience even consider using this toxic chemical in this environmentally sensitive area? Don't you think it's time to really address the problems the Bay faces by stopping the flow of pollutants into the bay from surrounding areas? If you try to put an Imidalcoprid bandaid on the problem, you are going make the situation worse and will probably kill off a lot more vegetation and animals than you could have even imagined in your extremely flawed SEIS.

Therefore, I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

While the SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," the SEIS fails to give adequate weight to the "knowledge gaps" it identifies. In some cases, monitoring is proposed as a way of reducing uncertainty. In order to protect the bays, facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

Crucially, the SEIS identifies uncertainties regarding the efficacy of imidacloprid for controlling burrowing shrimp. These uncertainties include questions of the extent and duration of the effect of imidacloprid, the lack of a treatment threshold, lack of data regarding resistance, lack of field research regarding clams, and efficacy of treatment in low temperature. Certainly, no use of imidacloprid can be supported without demonstrating efficacy.

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

The SEIS does not adequately address synergistic effects, including impacts of imidacloprid combined with other chemicals ("inert" ingredients, other chemicals used in the bays, and other pollutants) or other stressors. Among the organisms known to be at risk is the commercially important Dungeness crab, which has been shown to be susceptible to the effects of imidacloprid, and whose populations experience large natural fluctuations, putting them at risk of extinction.

Given the systemic mode of action of imidacloprid in crop plants, the failure to account for impacts on non-target animals consuming vegetation in treated areas is inexcusable.

Willapa Bay and Grays Harbor have been affected by human activity over the past century that has contributed to problems experienced by all who use the bays. Of the three options proposed, the No Action alternative is the best. However, what is truly necessary to address these problems is an option that was not considered in the SEIS –a plan to restore the habitat by removing stressors from streams flowing into the bays.

Thank you for your consideration.

Sincerely,

Commenter: Jessica Jasper - Comment I-75-1

I'm opposed to the use of this chemical. Willapa Bay and Grays Harbor are directly above the Columbia River, a scientifically documented feeding location for the critically endangered Southern Resident killer whales; we have few of them left. The salmon and food source situation is not helping. Imidacloprid is a systemic insecticide that acts as an neurotoxin -- (Imidacloprid kills everything at the bottom of the food chain). I hardly think this is the best option to control burrowing shrimp on our ecology, our US wildlife, and our own food chain. Thank you.

Commenter: Erica Jones - Comment I-304-1

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa

Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species.

Furthermore, a recent European study reveals that three-quarters of flying insects in nature reserves across Germany have vanished in the past 25 years, which has obviously serious implications for all life on Earth. While the study is still reaching conclusions around causality, pesticides are thought to be a major contributor to the decline. Continuing down a path of indiscriminate destruction is clearly not recommended not only for the sake of other-than-human species but for our own species.

Commenter: Valerie Jusela - Comment I-20-2

The use of this pesticide is dangerous to marine life and human life. It is banned in the EU for good reason. Do not allow thiis to be used in our waters.

Commenter: Janaki Kilgore - Comment I-88-1

I am a resident of Whatom County and work at a restaurant that relies on locally harvested shellfish and crab as a staple of the menu. Applying the neurotoxin Imidacloprid is NOT an appropriate way to control burrowing shrimp at shellfish farms. Negative environmental impacts on worms, shellfish and crabs will be unavoidable. Effects on animals that rely on these food sources is likely to be detrimental and definitely requires more study. A better way to control the shrimp population would be to plant and foster the growth of eelgrass, native flora that inhibit the action of burrowing shrimp and stabilize the position of the shellfish.

Commenter: Brian Kingzett - Comment I-236-1

Brian Kingzett (Oral Testimony): Hi. My name is Brian Kingzett. I am a biologist with Goose Point Oyster Company. I'm also trained as a marine biologist but I consider myself an environmentalist, a naturalist, and a [unintelligible]. So Willapa Bay is a very unique ecosystem estuary in North America. It's a true case study of industry working with nature in a sustainable manner to provide both ecological and economic benefits in this food system. Part of that is because of the practice of extensive traditional bottom culture that, as you've heard, has been practiced for many generations here in the bay. And that provides habitat complexity that mimics the natural oyster reef system and encourages the , and facilitates higher trophic levels such as fish and birds and, as we heard from the crab fisherman, juvenile crabs of economic importance. Anthropogenic changes led to the increase of a natural pest , much like climate change has encouraged the spread of the mountain pine beetle. Shrimp areas reduce biodiversity in addition to producing the economic losses that are described in the SEIS. And until nonchemical means are found to suppress and maintain shrimp populations at a healthy ecological level the science supports the issuance of the permit and the application and will provide the controls to reduce shrimp numbers on beds and the ongoing monitoring will provide the controls and checks to ensure that any applications are performed and evaluated in a responsible manner. And I add that to the comments that have been made by prior speakers. Thank you.

Commenter: Sammarye Lewis - Comment I-82-1

The deadly impact on the food chain, and thus the critically endangered Orcas, makes this a horrendous mistake. To endanger our environment for the benefit of commercial entities is a violation of public trust and good sense.

Commenter: Lynn Lloyd - Comment I-160-1

Hello,
I would like to express my concern about the spraying of Willapa Bay with pesticides. I don't see how you can regulate the consequences of such actions. The consequence of spraying will find its way around that bay and up into the food chain and out into the ocean. The "farmers" should find a physical way to solve their problems.
Thank you,
Lynn Lloyd

Commenter: Paula Mackrow - Comment I-287-1

. We agreed years ago that eelgrass is of UTMOST importance to the nearshore environment. Critical stages of all marine life live in these nearshore habitats. Industrializing this precious ecosystem has been a catastrophe for the foodchain leading to salmon recovery. I will boycott all Washington shellfish if this spray is continued.

Commenter: Kathleen Mahony - Comment I-84-1

I am opposed to any use of this chemical. It interrupts our delicate eco system.

Commenter: Stan Marriott - Comment I-146-1

What impact might this pesticide have on the migrating gray whales that feed on the ghost shrimp?

Commenter: Kathleen Moncy - Comment I-214-2

The ecology value that is being discussed today -- of crab, fish, eelgrass, and oysters – are at the highest where farmers are operating. Oyster farmers protect the ecology of the estuary and always have and always will. This is our home. We would never do anything that would degrade that home or do anything to harm it. This is our livelihood. This is where we raise our families. This is where we participate in our community. And by you supporting this permit and issuing it to us, it allows us to continue to thrive in an economy that has lots of different issues that are affecting it across the boards.

Commenter: Kathleen Moncy - Comment I-228-2

As has been spoken before, the infestation of burrowing shrimp is something that we are not looking to eradicate the species. It is a species that exists and there are predators that do exist on this – that do predate on this and so we're only looking to control a certain percentage of the estuary to create what we would consider buffer zones that would then protect large vast amounts of land. [unintelligible] work of all the farmers that are going to work for this is really important because between all of us we create a giant barrier that protects vast amounts of quantity of land which is a rare habitat for crab. It's an important area for birds and it's also an important area for fish. So collectively working together as a community and gathering up as a community and being solution oriented towards what we can move forward with is really important to the oyster growers.

Commenter: Caryn Morgan - Comment I-89-1

No!!! spreading this neurotoxin chemical will only kill off important animals in the food chain, likely endangering the food sources of the already endangered southern resident orcas. this important, unique group of orcas are already suffering from food scarcity, noise pollution, and injuries from boat strikes. do not allow this dangerous pesticide to be spread, stop this preventable disaster before it happens.

Commenter: Rich Moser - Comment I-269-1

(Email Submission)

Dear
Dear Mr. Rockett:
Please consider critical new information that should be included in the Supplemental Environmental Impact Statement for the proposal by the Willapa Grays Harbor Oyster Growers Association (WGHOGA) to apply imidacloprid to Willapa Bay and Grays Bay. Information in a new U.S. Environmental Protection Agency (EPA) aquatic risk assessment shows that imidacloprid cannot be safely used by oyster growers. (USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC) EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." The assessment also found chronic risk concerns with imidacloprid exposure to saltwater invertebrates. The agency evaluated an expanded universe of adverse effects data and found that acute (short-term) and chronic (long-term) toxicity endpoints are lower than previously established aquatic life benchmarks. EPA found risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review.
A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, and others, on the impacts of neonicotinoids in surface waters from 29 studies in nine countries finds that these chemicals adversely affect survival, growth, emergence, mobility, and behavior of many

sensitive aquatic invertebrate taxa, even at low concentrations. (Morrissey, C, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. Environment International 74: 291–303.) Neonicotinoids were also recently evaluated by a large panel of international experts chartered under the International Union for the Conservation of Nature (IUCN), which found that these chemicals have "wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats." (Van der Sluijs J.P., et al. 2014. Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environ Sci Pollut Res doi:10.1007/s11356-014-3229-5.)
I urge you to consider this and other new scientific data in your review of the permit application by the WGHOGA. I believe that if you do so, you will find that imidacloprid cannot be used in the proposed way without harming the ecology of the bays.
Sincerely,

Commenter: Melinda Mueller - Comment I-292-3

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems

Commenter: Chris Muldoon - Comment I-371-1

I am certain that you are and have been aware of the dangers to the environment of imidacloprid! To even consider using this horribly toxic chemical in Willapa Bay and Grays Bay is unthinkable. The species you want to control are native species that -- whether you choose to recognize it or not -- play an important role in the ecology of the region. The poison you use in the water will be taken up by every organism, plant and animal, whether it kills it or not. That means that anything from those bays that is eaten by people will also be adding to the burden of toxins that human consumers are already subject to.
This insanity with the reckless dependence on toxins, at any cost to people or the environment, has to stop!!! As the expression goes: THE BUCK (must) STOP HERE (with you),

Commenter: Catherine Newland - Comment I-15-1

I am strongly against this proposal as the beaches and waters surrounding this could be affected. These pesticides have already been shown to have detrimental effects on honeybees so who knows what the effects could be on fish, crabs, clams and whales in the surrounding areas. We already have negative effects from elevated mercury levels from all the old mills in Washington State. The public should be able to be able to fish and enjoy the beaches as well without worrying about this becoming a health hazard. This is a step backwards and i hope it will not be allowed.

Commenter: Leone Newmark - Comment I-286-1

This is insanity to use toxins to kill a native species so an introduced species can do better when you are ruining the water, air soil and the planet. This is shear stupidity at the least!

Commenter: Form Letter (Multiple) No Imidacloprid Use for Shrimp - Comment I-252-2

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species. Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

Commenter: Mary O'Brien - Comment I-368-3

I believe that there is no such thing as a safe pesticide. They are bad for the pollinators, the fish, the shrimp, the birds, etc., and the people who would eat the oysters farmed there, as well as the water quality. There are many problems associated with the farming of fish and shellfish, with pollution and bacteria commonly damaging them, and they are a risk and health hazard for the wildlife and people who eat them. In theory, aquaculture is a good idea, but in practice, it is not. Once the waters are contaminated, it's awfully difficult to rectify and restore them to cleanliness and safety.

Commenter: Norm Olsen - Comment I-222-2

Norm Olsen (Oral Testimony): Hi. I'm Norm Olsen. I live here in South Bend. I'm kind of speaking on behalf of my father and I both. We have a small oyster farm here in Willapa Bay – Olsen & Son Oyster Company. We've been a member of the Willapa Grays Harbor Oyster Growers Association for quite a while and we've been active in the spray activities in the past and I don't really want to belabor any points here I just kind of wanted to shed some light on our perspective on the issue. My dad, for example, his presence in the oyster industry here in Willapa spans the better part of 50 years. He has seen the impacts the shrimp can have when the infestation goes nearly unchecked. It's firmly been our belief and the belief of many other growers and potentially nongrowers in this room that the beneficial consequences of having some kind of control and, in this case, preferably a chemical control – they far outweigh the consequences of a no action policy. These consequences are far reaching economically and ecologically and we're from the belief that our benefit as growers is almost incidental in comparison to the benefit of the health and overall biodiversity of the bay. And you can't have one without the other. So that's pretty much what I had to say, thank you.

Commenter: Norman Olsen - Comment I-215-2

Over the last 50 years these pests have given ample exhibit as to their destructive properties. When heavily colonized and interconnected burrow systems undermine the stability of healthy substrate and their appetites deplete the sediment of healthy micro-biomes – which are the very basis of the estuary food chain – the result, if unchecked, is bare and soft sediment that is incapable of even supporting growth of key photosynthetic vegetation and supplies forage habitat for all manner of environmentally supported species, including oysters, clams, fish, juvenile and adult crabs, and a whole host of birds. Because of the limitation of the chemical Carbaryl in the 1960's to address these first grossly disproportionate shrimp numbers, it was discovered how quickly [unintelligible] was able to reestablish and support a necessary level of biodiversity. In my lifetime, even, I have witnessed the reclamation of ground once healthy, but hopelessly overrun with shrimp. Within 1 to 2 years of treatment some of these ground had returned to farm-ability and by said virtue was able to provide key habitat yet again.

Commenter: Robin Perry - Comment I-318-1

Spraying toxic chemicals to control burrowing shrimp is not the most effective solution for the long term.

Rather, like restoring the health of soil through managing microorganisms, so can ecosystems can be restored to achieve the end goals.

Commenter: Laurie Pine - Comment I-205-5

What will the impact be to the non-target and yet important organisms in the application area, including the insects, worms, and other crustaceans that live in and on the bottom of the water? Will they suffer long-term or chronic consequences of these chemicals? And if so, what are these consequences. How would a decrease in diversity, abundance, and size of these organisms affect the ecosystem? How would it affect the food chain? To what degree could it affect fish and birds? Would the metabolites or residues of Imidacloprid be an issue in this ecosystem? How toxic would they be? Do you know what they are? Would Imidacloprid react in any way with current herbicide sprays used in the area and could this a more toxic pesticide cocktail, as we found to be the case with some neonics and herbicide or fungicide combinations that, together, exceed their individual toxicities?

Commenter: Patrick Pressentin - Comment I-189-2

Rhetorically, would you ingest the chemical with such testing? Green Sturgeon, an endangered species, eat these shrimp and bio accumulate toxins. Will they become like the orca as the most contaminated tissue over time with a newer toxin than PCB, affecting birthrate and reducing the natural predation?

Commenter: Robert Rao - Comment I-141-1

I have lived in WA. for 40 years and have lived in Grey's Harbor for 17 years. The previous use of herbicides for ghost shrimp had far lasting impacts on a native species which is critical for food for NUMEROUS species of animals and fish. We used to be able to gather a supply of ghost shrimp for bait at bottle beach and Roosevelt beach in Greys Harbor, but they have not been found in numbers for years now. The oyster growers are just looking to expand their operations and profit at the expense of one of our most important links in the food chain for our native resources. Surf perch, Grey Whales, salmon, and numerous bottomfish need this resource. And why is it that a dangerous pesticide with little research into effects on humans or the environment is even being considered? What officials (elected and otherwise appointed_) suggested such a radical attack on our eco-system? Folks in the pockets of shellfish growers? Look at the long picture, do you want our beaches to be sterile growing mediums for the select few to profit from? or a healthy example of multi-species thriving? Robert Rao

Commenter: Paula Rotondi - Comment I-275-1

Enough. We can not allow any additional, new, or increased poisoning of our planet upon which all life including human life depends. Please reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor. We can no longer pursue policies permitting the killing of anything and everything that harms corporate profit at the expense of harming the environment upon which all life and including human health depends.
Earth's already had far too much human poisoning; we can not afford to spray thousands of acres of coastline with imidacloprid, a dangerous neonicotinoid pesticide, which can devastate aquatic invertebrates and the animals that rely on them for food as well as the oysters and clams we eat.

Commenter: Susan Rudnicki - Comment I-342-1

Numerous studies have shown the persistence of neonicotinoids in the environment, their danger to NON-target birds, arthropods, and aquatic creatures of all kinds. See this scientific paper link---https://www.frontiersin.org/articles/10.3389/fenvs.2016.00071/full Quote---" The high toxicity of these insecticides to aquatic insects and other arthropods has been recognized"

The SEIS does not adequately address synergistic effects, including impacts of imidacloprid combined with other chemicals ("inert" ingredients, other chemicals used in the bays, and other pollutants) or other stressors. The scientific understanding of synergism from so-called "inert ingredients" has shown they are often responsible for SEVERE toxic effects and have not been properly regulated to recognize the known risks. Here is a link on this effect from just ONE of dozens ----https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1764160/

Commenter: David Ryan - Comment I-235-1

David Ryan (Oral Testimony): My name is David Ryan. My wife and I live in Ocean Park. My education and experience is as a forester and natural resource manager. I have experience in managing for habitat and I support the Willapa Bay Grace Harbor Oyster Growers Association proposal to manage burrowing shrimp.

I've spoken with representatives from the shellfish industry, scientists, community members -- and I've read the reports. The more I learn, the more I know that the oyster growers have done their due diligence and are working to find the best path to a healthy bay. I understand what

Imidacloprid is. I understand the concerns around its use. I have all those same concerns. And I know that the oyster growers have those concerns too. For many human illnesses doctors prescribe medicines that are technically toxic yet people ingest these toxins that with the understanding that in the right doses and applied in the right way the body will be better. My research indicates that the proposed formulations, application method, concentrations, coverage areas, and timing are all adequate medication for the issue surrounding its use. And I believe that the result will be a healthy and balanced ecosystem.

I believe a healthy oyster industry is indicative of a healthy bay , and when it comes to stewardship of the bay the shellfish industry has proven itself to be among the most conscientious and dedicated stewards this community could hope for. They are out there more than anyone and they are the best monitors of the bay, its conditions and its changes to the environment. They are fine stewards using good science and I support their efforts. This issue is about ecosystem function, ecosystem balance, and ecosystem health. The current burrowing shrimp populations are symptomatic of an unbalanced ecosystem -- which if left unchecked will lead to a degraded and unhealthy bay. I want a healthy bay and I know the oyster growers do too. A no action alternative is unacceptable. And we must find solutions that maintain onbottom oyster growing as a viable sector of the county, economy and ecology. The current proposal is our best chance right now and we don't have time to delay.

In the early half of the 20th century Uncle Leopold traveled through the west. He addressed the laissez faire attitude he encountered regarding cheat grass. And though he writes of cheat grass, I believe the same principle applies here. He says, "I listen for clues. Whether the west has accepted cheat as a necessary evil to be lived with until Kingdom come, or whether it regards cheat as a challenge to rectify past land geese. I found a hopeless attitude almost universal. There is as yet no sense of pride in the husbandry of wild plants and animals , no sense of shame in the proprietorship of a sick landscape. We tilt windmills on behalf of conservation in halls and editorial offices , but on the back 40 we disclaim even owning the lands. I see the oyster growers fighting on the back 40 , taking pride in their husbandry and I for one will not disclaim ownership of the lands. I take mine up and stand with the oyster growers as they fight for their livelihoods and a healthy bay ecosystem. I do not want to feel the shame of allowing a sick landscape to become our legacy. They have fought this fight before and I hope we will help them do it again. It's the right thing to do. Thank you.

Commenter: Brian Sheldon - Comment I-230-1

Brian Sheldon (Oral Testimony): Hi. I'm Brian Sheldon. I live in Nahcotta, Pacific County. I'm third generation shellfish grower and actually feel like a rookie a lot of the times because there's so much history in this industry. I've lived and worked and played in Willapa. I grew up essentially in the bay , we considered that kind of our playground. You might have a park in the city you go to , well, that was our park. I'm intimately familiar with the bay having grown up with that sense of ecology and what was healthy, what was not healthy. I'm watching the bay become degraded , not just on our shellfish beds , but on public lands also. I'm watching recreational opportunities being lost. It's sad to me. I can't help the public part of it but I have to do something about our farmland. We're losing ground. I know that when we do control on our beds , having experienced that many times , that species diversity is sustained on the bed. If we don't do the control, it's lost. It's that simple. It goes from a flourishing bed with dimension and a lot of critters on the bed , everything from sculpins to sea snails to starfish to crabs to all these different species and eelgrass and every kind of fauna you can think of to like a beach -- of just sand with holes in it. And there's nothing there. We can say that the species is affected. It's destroyed. And greatly degraded and greatly reduced in species density.

I've worked to implement just about any method I can think of to control these shrimp , not just a chemical. Like most growers, we've participated with a lot of the researchers who need direction to get to the place so we observe what's going on on the bed so not only have we tried it ourselves, we've tried different methods through our cultivation practices, our harvesting practices, including mechanical harvesting and harrowing. On our farm , I can't speak for other folks' , I've seen no effect of trying to reduce density with other methods. I wish I could say there was. I've often said I would give anything to find a different control tool. Not because I find the chemical unsafe -- because I find it so political.

It's an emotional issue. It's difficult to remove that from the discussion. And I understand why people get up in arms about it but the science says it's safe and we have no other tool available to us at this time. It doesn't mean we won't continue to look for one but we just don't have a tool right now. Any tool that we could find that has met the IPM, this basic IPM success of efficacy, would be great and I'm sure embraced by the shellfish growers. There's discussion in the SEIS about , it sort of leaves it unclear about different culture methods. Mainly off bottom culture somehow being a tool you can use to farm in shrimp ground. In all my years of experience and all my discussions with every shellfish grower that's tried off bottom that is not factual at all. There are off bottom culture does not developed to farm around shrimp. It was developed to farm marginal ground, where it was exposed to high energy wind wave or tidal flows. Or just wouldn't sustain a bottom culture crop. So you could use an off bottom culture method to try to farm some of that ground. It had nothing to do with farming and shrimp. And it doesn't now. I've asked some of the , we've had a vast expansion of off bottom culture and I've asked the folks that are doing that and every one of them has told me it is not successful. Not successful farming to farm around shrimp. I'm a little concerned in the SEIS that it doesn't talk about the no , I guess I'm done. I will submit more comments. I'll just leave you with I think that the SEIS fully supports issuing this permit. Thank you.

Commenter: Brian and Marilyn Sheldon - Comment I-239-2

We believe it's important to note that burrowing shrimp have expanded out of their historicpopulation centers and have caused great damage to many areas of Willapa Bay that oncesupported a much more diverse and plentiful habitat. Based on available history, it's clear thatshrimp have only more recently expanded out of their native areas and destroyed thousands ofacres of Willapa habitat. By the time the first export of oysters from Willapa Bay occurred in1849, some form of cultivation had already been occurring on tidelands in many areas ofWillapa. Native oysters were collected and transplanted to grow out or holding areas. An

1894map produced by the United States Fisheries Department shows where natural(native) and cultivated beds were at that time, as well as where introduced oysters were planted. If shrimp had been present, these areas would not have sustained even short-termstorage of oysters.

Commenter: Dick Sheldon - Comment I-223-1

Dick Sheldon (Oral Testimony): My name is Dick Sheldon. I have Willapa Resources and I live in Pacific County. I met my first ghost shrimp at Stackpole Harbor in 1940. I was 5 years old. The natural [unintelligible] bottom shellfish of Willapa Bay are the highest rated habitat over all for marine species using Willapa Bay for their varying needs. Shrimp beds are the lowest value and are monocultures with only shrimp. The explosion of shrimp in Willapa is a recent phenomena , not a natural cycle as some claim. Both pre-history and recent history proves this. The recent shrimp explosions are a direct attack on the balance of the bay's ecosystem, from food production, protective habitat, and its ability to support the huge populations of marine species that use Willapa as a nursery , then move on into the southwest Washington marine economy. This is not an oyster vs. shrimp issue. This is a shrimp vs. Willapa ecosystem issue and it always have been.

Bottom oyster growers have always shared these beds with uncontrolled, uncountable marine creatures that utilize the same beds , unlike terrestrial farms that target the creatures or infections to their product directly, the growers are targeting shrimp that physically destroy the beds needed to support both the oysters and the invaluable habitat provided. It must be emphasized that Washington agencies own the majority of Willapa badlands -- which will go untreated for both shrimp and invasive grasses, which will be permanently lost to the Willapa imbalanced ecosystem. The economic impact to Southwest Washington marine economy will be felt and is being felt as we sit here today quibbling over the allowance of shrimp control, even only on private beds. Until recently, Willapa oyster operations were near completely owned by local families who realized that first and foremost the badlands themselves must be protected. It was self-interest, but isn't that also society's and the state's interests?

It seems the state has chosen to go political rather than environmental in their review of this issue in a lot of cases. The growers have been, for decades, Willapa Bay's primary and constant protector of its shorelines, of its water quality, against improper development, and every phase of protection affecting the bay. They've spent millions in legal defenses for the bay -- holding developers and potential polluters to high environmental standards. When the county authority weakened and DOE went silent, pulp mills never followed Willapa Bay. Spartina did not take the bay. The pacific flyway was saved because of this. 2 huge subdivisions planned on filled lakes and swamps on septic systems on the bay shore were not built , only because of the growers' opposition.

Again, the growers have paid for and created methods of control against the two top immediate threats to Willapa's ecosystem: shrimp and japonica. The science has been done and overdone. Still, the DOE demands more and more , not because it's necessary but more because of the politics. DOE must recognize the growers as allies. We always have been. Not to force the bottom growers out of the bay , losing the only natural systems that may be left in Willapa. Thank you.

Commenter: Dick Sheldon - Comment I-208-1

Dick Sheldon (Oral Testimony): My name is Dick Sheldon. I met my first ghost shrimp in 1940 at the age of 5 at Stackpole Harbor [unintelligible]. There weren't many around then. Puget Sound and Willapa Bay, both estuaries, are far apart in their function and impact. It takes 14 years for a complete saltwater change in Olympia. Willapa Bay takes 3 days. The clarity of Puget Sound water is beautiful to see. The murkiness of Willapa is food. The Sound's bottom is firm with glacier gravels. Willapa solely flanks Columbia River's sand. Puget Sound is primarily a captive ecosystem. Willapa's ecosystem extends into and supports the entire marine system of southwest Washington's marine community and economic base. Ground raised oyster beds are the highest rated habitat for the majority of marine critters in Willapa Bay. The quicksand caused by burrowing shrimp grounds contribute nothing. In fact, they subtract wholesale from the processes needed to maintain the historic balance in Willapa's now threatened ecosystem.

Untended state agency-owned bed lands have become the prevalent title lands in this negative category. Willfully given over to both shrimp and invasive japonica. They contribute little value or nothing to our system. Oystermen have had title to the lands we share with the rest of the bay's [unintelligible] communities but do not own the ecosystem that every current creature uses in common. This is what we are fighting to save. DOA insists this is a shrimp versus oyster issue. It never has been. Oysters, a proven environmental plus on their own, are a small part of the [unintelligible] community being destroyed by the shrimp imbalance in Willapa. This condition was created and fed by actions of man in taming the Columbia River. Chemical control has by far shown to have the least impact after decades of oystermen's failed experiments on non-chemical control.

We are here tonight speaking not only for our interest but for our ecosystem and its billions that inhabit it. After 150 years of oystering, Willapa Bay remains the cleanest, most pristine estuary in the continental United States. Willapa's small grower families have spent millions in defending this ecosystem. We funded a 1200-acre wetland restoration project with Washington trumpeter swans that say "stop the pulp mill." Two 1,000-lot developments to be built on filled wakes, swamps, and salt marshes were fought, stopped, and now protected forever. Every failed low-income septic system threatening Willapa waters has been fixed free of charge. Because of our growers' relentless pressure Spartina is gone from Willapa Bay. And the Pacific flyaway preserves. All this and much more -- because of these small growers' financing and dedication over the years. Now paying for the ever-changing DOE demands of this permit process has taken every cent from our 40-year old environmental fund. I ask now who will fight for Willapa's health. With the DOE support of option 1, doing nothing, it certainly won't be the Washington Department of Ecology. Thank you.

Commenter: Marilyn Sheldon - Comment I-213-1

Marilyn Sheldon (Oral Testimony): Hi. I'm Marilyn Sheldon. I live in Pacific County, Washington. First, thank you very much for holding this public hearing here this evening. I know it's your job but I also know it's a night out of your life and I appreciate it as for everyone else who came here this evening. I'm here to testify in support of option 3 of the SEIS. I believe that the findings of the draft SEIS support the issuance of a draft permit as discussed in option 3. I feel the SEIS also needs to incorporate a little more what the devastating ecological and economic impact would be of the "no action" of option 1 , because I can not stress enough the devastating impacts of not moving forward with a draft permit to both the ecology and the economy of Willapa Bay and Grays Harbor.

Bottom culture oyster beds provide invaluable 3-dimensional habitat for juvenile Dungeness crab and many other species. As you heard last Saturday at the public hearing, the Columbia River Crab Fishermen's Association acknowledged that valuable habitat. They understand the science of this permit and the use of Imidacloprid and they understand the overall net benefit. And they also support the issuance of the draft permit, as they testified to last Saturday. Bottom culture oyster beds also facilitate the growth and sustainability of native eelgrass, which is essential fish habitat. It must be recognized that burrowing shrimp, if left unchecked, will destroy this valuable habitat. Burrowing shrimp are eco-engineered and they create a monoculture -- which only serves themselves.

In Pacific County the shellfish industry is the largest private employer. It's responsible for nearly 2,000 family-wage jobs in our rural, coastal economy. Pacific County has also been recognized as the 4th most fish-dependent community in the United States. That means that the shellfish industry and the habitat we provide for other valuable fisheries in our area are the cornerstone of our economy. As of today, our company alone has lost over 29% of our most valuable oyster ground and 43% of our clam ground. That's for a total loss of over 300 acres to our farm alone, to date. As a result, we've had to reduce the volume of product that we're able to ship. We've had to let go of long-time customers. And we've had to reduce our workforce by over 4 fulltime positions. Again, I believe the findings of the draft SEIS support the issuance of a draft permit as described in option 3 and I urge you to move ahead with the issuance of this draft permit in a timely manner. Thank you very much.

Commenter: Lorna Smith - Comment I-257-4

Although imidacloprid has not been shown to kill birds directly, its use has been not only beenassociated with decline in insects, aquatic and non-aquatic, but birds have declined where ithas been used as well, as documented in several studies now. Young fish of many speciesincluding our native salmonids spend much of their early life cycle in estuaries where they adaptto living in a salt-water environment before out-migration.

Commenter: Katherine Spence - Comment I-282-4

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa

Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species. And it could affect bee populations, which are already struggling.

Commenter: AARON STECK - Comment I-91-1

Imidacloprid is a systemic insecticide that acts as an neurotoxin -- (Imidacloprid kills everything at the bottom of the food chain).

DO NOT USE IT

Commenter: A.L. Steiner - Comment I-361-1

My family & I FULLY OPPOSE the toxic spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology. The spraying of such ruinous and deadly toxins are decimating and destroying insect, bird and wildlife populations worldwide, as well as the complex ecosystems in which they're desperately trying to survive. We need these ecosystems left INTACT for continuing human survival.

Commenter: Jim Steitz - Comment I-262-1

Minimizing competition from native wildlife against an invasive, non-native oyster farming operation is not a legitimate use of an insecticide already shown to have a vast range of non-target damage.

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

While the SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," the SEIS fails to give adequate weight to the "knowledge gaps" it identifies. In some cases, monitoring is proposed as a way of reducing uncertainty. In order to protect the bays, facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

Crucially, the SEIS identifies uncertainties regarding the efficacy of imidacloprid for controlling burrowing shrimp. These uncertainties include questions of the extent and duration of the effect of imidacloprid, the lack of a treatment threshold, lack of data regarding resistance, lack of field research regarding clams, and efficacy of treatment in low temperature. Certainly, no use of imidacloprid can be supported without demonstrating efficacy.

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

The SEIS does not adequately address synergistic effects, including impacts of imidacloprid combined with other chemicals ("inert" ingredients, other chemicals used in the bays, and other pollutants) or other stressors. Among the organisms known to be at risk is the commercially important Dungeness crab, which has been shown to be susceptible to the effects of imidacloprid, and whose populations experience large natural fluctuations, putting them at risk of extinction.

Given the systemic mode of action of imidacloprid in crop plants, the failure to account for impacts on non-target animals consuming vegetation in treated areas is inexcusable.

Willapa Bay and Grays Harbor have been affected by human activity over the past century that has contributed to problems experienced by all who use the bays. Of the three options proposed, the No Action alternative is the best. However, what is truly necessary to address these problems is an option that was not considered in the SEIS –a plan to restore the habitat by removing stressors from streams flowing into the bays.

Thank you for your consideration.

Sincerely,

Commenter: Amanda Swarr - Comment I-48-1

I totally oppose the use of imidacloprid. Simply put, its unknown effects on the ecosystem are not worth the risk.

Commenter: Bob Triggs - Comment I-2-1

Under NO CIRCUMSTANCES should we allow the application of insecticides on our waters and aquatic wetlands. Especially not this chemical, not on the mudflats. All adjacent invertebrate and vertebrate species will be affected. This will have implications for juvenile salmon, steelhead, cutthroat trout, birds and other fish species. NO! NO! NO!

Commenter: Tiffany Turner - Comment I-245-1

(Email Submission)

I am a local hotel and restaurant owner in Long Beach WA. As someone who was against the first permit in 2015, I wanted to submit comment on the draft SEIS.

Since spring of 2015, I have done considerable research on the impact of burrowing shrimp on commercial oyster and clam beds as well as the health of the entire ecosystem.

The oyster and clam industry is critical to the economic health of our area, and burrowing shrimp pose a significant threat to many family farms who have been incredible stewards of the bay for generations. Many families and businesses have worked for decades and spent considerable dollars to find a less impactful solution to control burrowing shrimp.

Imidacloprid combined with integrated pest management seems to be the best solution currently available to keep oyster growers in business and create a better ecological environment in our Bay. I support this solution until a better alternative is found.

I would also encourage State funded research into continuing to find ways that we can bring the ecosystem of the Bay into greater balance and support our Oyster Industry in stewarding the environment of the Bay.

Feel free to contact me with any questions.

Commenter: Jennifer Vidal - Comment I-66-4

Let's think long term here. We are stewards of this land and are responsible for keeping it clean and healthy for all especially the generations that will inherit this land LONG after the restauranteurs will be gone. This would have a detrimental impact on our local environment.

Let's look for non-chemical and non-harmful alternatives, cultivating a healthier ecosystem in the entire sailish sea. With all that is facing destruction on our planet as we speak, we must stand up for sustainability, preservation and a new way of meeting challenges that is long term oriented, doesn't push a known neurotoxin into the water ways (which by the way effects all neighboring waters and tide land and their creatures.

Commenter: Kenichi Wiegardt - Comment I-178-2

Growing up on the tidelands of Willapa Bay I have first hand experience of what happens when an area is infested by burrowing shrimp. The ground becomes a barren wasteland, with nothing but burrowing shrimp present. Gone are all the other things that inhabit a healthy tideland. There are no crab, no eelgrass, no shellfish, no snails, no birds present. Nothing. For the people that have applied for this permit it is about much more than assuring we can grow shellfish on the ground. We care deeply about about the ground and want it to remain healthy and vibrant with a diverse amount of different animals and plants being able to utilize it.

Commenter: Kenichi Wiegardt - Comment I-241-2

Growing up on the tidelands of Willapa Bay I have first hand experience of what happens when an area is infested by burrowing shrimp. The ground becomes a barren wasteland, with nothing but burrowing shrimp present. Gone are all the other things that inhabit a healthy tideland. There are no crab, no eelgrass, no shellfish, no snails, no birds present. Nothing. For the people that have applied for this permit it is about much more than assuring we can grow shellfish on the ground. We care deeply about about the ground and want it to remain healthy and vibrant with a diverse amount of different animals and plants being able to utilize it.

Commenter: Kara Wilcox - Comment I-90-1

PLEASE do not use the pesticide imidacloprid to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor. It's so dangerous for the environment and we cannot risk losing any more critically endangered Southern Resident killer whales. Please consider another solution and don't poison our Orcas!

Commenter: Frank Wolfe - Comment I-219-1

Frank Wolfe (Oral Testimony): Let's see how this works. Can everyone hear me? As far as we know it's being recorded?

Fran Sant: Yes. You're being recorded on 2 recordings and on tv.

Frank Wolfe: My name is Frank Wolfe. I live in Pacific County in the area called Nacada , part of the unincorporated part of Pacific County. The pesticide Imidacloprid is a tool that has been proposed -- as part of the integrated pest management program to effectively and safely treat the burrowing shrimp problem in Willapa Bay. The shrimp turn over the bay bottom, creating a wasteland where productive oyster beds were previously. No attempt is contemplated to eradicate the native burrowing shrimp , but only to control its proliferation. Historically, burrowing shrimp populations were kept in check naturally by several factors. The seasonal spring [unintelligible] of the Columbia River historically created a freshwater plume offshore that when tidally entered the bay, seasonally controlling the burrowing shrimp naturally , as the shrimp are not particularly [unintelligible]. This seasonal freshwater flushing has been eliminated by the dams on the Columbia. At least for the foreseeable future, total removal of the dams seems unlikely to the large scale electrical generation and irrigation benefits the brunt of the region realizes from the dam's existence. Native fish stocks in the rivers and streams draining into Willapa Bay would also seasonally flood the bay with young fish , which would arrive in time to pee on the burrowing shrimp larvae. Unfortunately, due to compromised habitat, historical blockage of fish-bearing tributaries and state fisheries' policies that seem determined to manage our native fish stocks at the edge of extinction, rather than for more historical abundance. This one significant predation on the burrowing shrimp has been greatly reduced in effectiveness. Sturgeon in the bay have been all but extirpated in historical over-fishing. These slow-reproducing native fish once spread directly on burrowing shrimp [unintelligible] to control their numbers.

While it may be possible to mitigate for or restore some of these natural controls on burrowing shrimp , given time, money, and political will , none of these factors can be restored in a nearterm time frame. In the meantime, the oyster industry has been soldiering along in Willapa

Bay and Grays Harbor. The tool the oyster growers had , one tool the oyster growers had to accomplish this was the use of Carbaryl , a pesticide that controlled the burrowing shrimp. This was used for 60 years as an effective control, with no significant problems or demonstrated side effects. That tool was taken away in an arguably arbitrary manner.

Policies regarding regulating these controlled activities should be based on real science, not on arbitrary opinion. The science in this case is quite clear , demonstrating that Imidacloprid can be used safely and effectively as part of an integrative pest management program. The oyster farmers of Willapa Bay and Grays Harbor are true stewards of their beds , as zealous as any farmer is to the land that is not only their only source of income, but a legacy that has been passed down through several generations. They are not about to compromise the safety of their product or their lands. I wish to go on record of supporting the Willapa Bay Grays Harbor Oyster Growers Association Application for an MPDS permit and sediment impact zone authorization for use of Imidacloprid as part of an integrated pest management program. Frank Wolfe. Thank you.

Commenter: Frank Wolfe - Comment I-200-1

Remarks regarding the Willapa Grays Harbor Oyster Growers Association (WGHOGA) application for a water quality pollution discharge (NPDES) permit and sediment impact zone authorizations.

The pesticide Imidacloprid is a tool that has been proposed, as part of an integrated pest management program, to effectively and safely treat the burrowing shrimp problem in Willapa Bay. The shrimp turn over the bay bottom creating a wasteland where productive oyster beds were previously. No attempt is contemplated to eradicate the native burrowing shrimp, but only to control their proliferation. Historically, burrowing shrimp populations were kept in check naturally by several factors. The seasonal Spring freshets of the Columbia River historically created a fresh water plume offshore that would tidally enter the Bay, seasonally controlling burrowing shrimp naturally, as the shrimp are not fresh water tolerant. This seasonal fresh water flushing has been eliminated by the dams on the Columbia. At least for the foreseeable future, total removal of the dams seems unlikely, due to the large scale electrical generation and irrigation benefits that the region realizes from the dam's existence. Native fish stocks in the rivers and streams draining into Willapa Bay would also seasonally flood the Bay with young fish, which would arrive in time to feed on burrowing shrimp larva. Unfortunately, due to compromised habitat, historical blockage of fish-bearing tributaries, and State Fisheries policies that seem determined to manage our native fish stocks at the edge of extinction rather than for more historical abundance, this once significant predation on the burrowing shrimp has been greatly reduced in effectiveness. Sturgeon in the Bay have been all but extirpated by historical over-fishing. These slow-reproducing native fish once fed directly on burrowing shrimp, helping to control their numbers. While it may be possible to mitigate for or restore some of these natural controls on burrowing shrimp, given time, money and political will, none of these factors can be restored in a near-term time-frame. In the meantime, the Oyster industry has been soldiering along in Willapa Bay and Grays Harbor. One tool the oyster growers had to accomplish this was the use of Carbaryl, a pesticide that controlled the burrowing shrimp. This was used for 60-years as an effective control, with no significant problems or demonstrated side-effects. That tool was taken away in an arguably arbitrary manner. policies regarding regulating these control activities should be based on real science, not arbitrary opinion. The science in this case is quite clear, demonstrating that Imidacloprid can be used safely and effectively as part of an integrated pest management program. The oyster farmers of Willapa and Grays Harbor are true stewards of their beds, as zealous as any farmer is of the land that is not only their own source of income, but a legacy that has been passed down through several generations. They are not about to compromise the safety of their product, or their lands. I wish to go on the record as supporting the WGHOGA application for a NPDES permit and sediment impact zone authorizations for use of Imidacloprid as part of an integrated pest management program.

Frank Wolfe
Pacific County Commissioner (District 2)

Commenter: Ann Ziegler - Comment I-31-1

Spraying poison directly into any natural body of water that supports life forms other than the one being targeted by the poison, seems stupid beyond belief. After decades of marginal success in safeguarding the health of the Sound, application of insecticide would certainly be a step backward.

Organisms are more susceptible to disease and parasites when unhealthy. Those concerned with shellfish health should work to address the underlying causes of any parasite infestation, such as the degraded health of the environment in which the organism lives due to pollutants and poisons.

Let's develop solutions that will produce positive results for everyone's great-great-grandchildren, rather than just a few borrowed years for current lease-holders.

Commenter: Mary McAleer - Comment O-18-5

Washington State Department of Ecology's approval of Alternative 4 use of imidacloprid willprovide multiple environmental and economic benefits by preserving the aquaculture industry.In chapter three of the April 2015 Final Environmental Impact Statement for imidacloprid use,Ecology lists ecosystem services provided by oyster beds including "water filtration, resulting indecreased suspended solids, turbidity, and increased denitrification; habitat for epibenthicinvertebrates such as crabs; carbon sequestration; and stabilization of adjacent habitats"(Rockett, Grabowski and Peterson, 2007). Washington state's oyster population should becarefully preserved in Grays Harbor and Willapa Bay. Oysters and clams as foundation speciesameliorate conditions for other organisms important to estuarine trophic preservation including zooplankton, and boost marine biodiversity by providing clean habitat to otherenvironmental stewards such as algae and barnacles.

Commenter: Trina Bayard - Comment O-7-3

Burrowing shrimp also exert considerable influence on intertidal food webs; an unpublished estimate of Neotrypaea (ghost) shrimp biomass in Willapa Bay in2006 was close to 20,000 tons (B. Dumbauld, unpublished data). Accordingly, mud and ghost shrimp mayrepresent the largest single contributor to estuary secondary production (i.e., food for consumerorganisms) in west coast estuaries.

Commenter: Nichelle Harriott - Comment O-5-3

Sublethal effects in fish have also been observed. Growth and development in somespecies have been reported, which was attributed to a loss of the aquatic invertebrates juvenile fish rely on as a food source. Further, others have reported decreased viability and hatchingsuccess, leading them to conclude that imidacloprid is more toxic to fish in early developmentalphases, even at low concentrations.

Commenter: Center for Food Safety - Comment O-8-2

Imidacloprid has never before been approved for use in water and is nearly alwayslabeled as "highly toxic to aquatic invertebrates," including species like crabs. As expertshave recognized, spraying this toxin into bays will not just kill the native burrowingshrimp, it will also kill or harm all aquatic invertebrates it touches, and indirectly impactspecies that rely on these food sources. Further, given the significant data gaps, thisunder-studied plan should not move forward.

Commenter: Amy van Saun - Comment O-12-3

Because the screening values used in the field studies and SEIS are not supported by soundscience, the conclusions as to direct impacts to wildlife (invertebrates and vertebrates) are highlyquestionable. For the reasons described above, the 2014 field studies are of limited utility. Asdescribed below, the toxicity values used as the basis of the SEIS analysis are also flawed. Ecologymust go back to evaluate impacts based on scientifically defensible levels.

Commenter: Dale Beasley - Comment O-23-1

(Email Submission)

Please accept our letter of support and our reasons for the use of imasacolprid to control damaging ghost shrimp in coastal bays.

Commenter: Anne Shaffer - Comment O-3-3

Clearly, regardless of the size of coverage, Imidacloprid applied to coastal areas will impact criticalmarine and nearshore ecosystems, and is a human health concern. It still includes the application of ahighly toxic insecticide along shorelines used by numerous salmon and forage fish species, includingChinook and coho from as far away as Snake and Columbia River systems

(Shaffer et al 2012). Thisinsecticide will exactly impact prey species for these fish. Further, marine mammals, including killerwhales Orcinus orca, that are critically endangered due to pollution and lack of food. These killerwhales? Depend on Chinook salmon. This insecticide will therefore have a cascading impact that isexactly contraindicated to preserving and restoring our coastal ecosystem. Further, method of spraydoes not mitigate toxicity to fish, invertebrates, and coastal systems (or humans for that matter).

Commenter: Megan Dunn - Comment O-6-4

The analysis does a disservice to conservation by mostly limiting its analysis on listed species to anassessment of whether listed species would be directly impacted through toxic effects. Almostnothing is said about the impact to the prey base and ecological food web that supports theseimportant and rare species.

Commenter: Joe Breskin - Comment O-13-1

Comments on SEIS from Olympic Environmental Council

We are a 501c3 organization in Washington State that is concerned with protection and preservation of natural systems. We serve as an umbrella organization for other organizations and groups dedicated to defending natural systems. Historically, we have been active in this arena for over 25 years since the dawn of GMA process and have had to appeal several bad agency decisions.

I am sure we will not be alone in noting that absurdity of permitting non-lethal levels of insecticide, and the inevitability that this approach will predictably fail to address the deep systemic problems that the industry and the agencies have created over the past 50 years, by focusing in single issues w/o considering to potential scale or importance of the unintended consequences of the actions taken to protect an industry that is based on entirely unsustainable methods and on fundamental misunderstandings of ecosystems.

First things first: if we look at this as an ecosystem, the burrowing shrimp have coexisted in balance with the oysters in Willapa Bay forever. They have been in the estuary at high population levels since before the ice age. If population of a single species appears to be increasing rapidly the first question that needs to be asked is "Where?" And the second question is of course "Why?" The answers to both of these questions point to a long history of gross negligence by the shellfish industry.

At the turn of the century self-serving exploiters basically strip-mined the estuary and destroyed the shell reefs that had supported the oysters, kept the shrimp out of oyster territory, and kept aragonite levels in the water column ideal for oyster propagation. Since then, almost everything that has been tried has had the appearance of a macabre comedic sort of rolling catastrophe. Growers introduced numerous invasive species, each of which has complicated the situation. They introduced japanese oysters, whose means of reproduction is poorly suited to the chemical conditions in the estuary, manila clams, oyster drills, spartina, and japonica. And someone introduced the isopod parasite that is currently driving the mud shrimp to the verge of extinction on the west coast.

Historically, mats of japonica rhizomes supported vast populations of migratory waterfowl. The stuff has been called 'duckgrass' for a very long time, because ducks and geese eat the blades, roots, or both. American Wigeon, Northern Pintail, and Mallard are the three main species of ducks that eat duckgrass on Willapa Bay. These ducks are dependent on duckgrass to survive; in fact the Wigeon's diet consists of more plant matter than any other dabbling duck. The Northern Pintail is considered a common bird in steep decline.[ii] The Dusky, a goose, eats both duckgrass and marina, and on paper, the Dusky is a protected goose, due to low a population.There are several species of migratory geese that are almost totally dependent on it being here and when they fly into Willapa Bay expecting to feed and fatten for their migration, they now find barren defoliation. This is genuinely life threatening: they simply cannot survive a mistake of this magnitude. But it is not the ducks' mistake, it is the mistake of Washington State that is permitting the destruction of duckgrass and marina with Imazamox.

Since the 1980's scientists have consistently reported (see feldman 2000 review paper and excerpt below) that eelgrass keeps shrimp from burrowing in the areas where it grows. The eradication of japonica has now damaged or destroyed both species of eelgrass (marina and japonica) over vast areas of Willapa Bay and opened those areas to shrimp. The wholesale destruction of Eelgrass using the herbicide Imazamox not only reduced the shrimps' predators, who used it as habitat and hiding cover, it removed a key physical constraint - the mats of rhizomes were an obstacle to the shrimps' burrows and the destruction of the Eelgrass (to support another introduced invasive species: Manila Clams) has allowed the shrimp to move into vast areas where they could not live when the Eelgrass was there. "Field surveys have been consistent with Brenchley's (1982) findings, noting the abrupt decline and low densities of ghost shrimp burrows in Zostera rnarina beds compared to adjacent intertidal mudflats (Swinbanks and Murray 1981; Swinbanks and Luternauer 1987). Harrison (1987) reported that an expansion of Z. marina and Zostera japonica habitat was accompanied by a corresponding reduction in ghost shrimp density."

So now the industry want to poison the sediments with a different neurotoxin in an effort to paralyze the shrimp so that they will suffocate in their burrows.

A lawsuit brought against the state and industry by citizen activists to end the use of carbaryl resulted in a hard won settlement agreement with the Willapa Bay Grays Harbor Oyster Growers Association. This agreement called for the phase-out of carbaryl and gave the industry over a decade to develop and adopt an integrated pest management plan to replace their unsustainable pesticide-based shrimp control measure. This settlement agreement was based on a serious legal challenge from citizens -- not the state -- against ecosystem scale contamination. It is not what the industry PR machine is now pretending was a voluntary phase-out based on some sort of magic wand of enlightenment among the growers: they kept spraying year after year and spent hundreds of thousands of dollars (including public funds) exploring alternate chemical approaches rather than embracing non-chemical approaches to restore ecosystem balance. During that 10 year negotiated phase out, the National Marine Fisheries Services determine in 2009 that the application of carbaryl in both Willapa Bay and Grays Harbor jeopardized the continued existence of endangered salmon and adversely affected or destroyed their habitat. Also in 2009, the NMFS determined the application of carbaryl adversely affected ESA listed green sturgeon in these same bays. The spraying continued unabated.

A great deal of public money was spent exploring chemical means to control a native animal species whose growth has been facilitated by destruction of a native plant species. As far as we can tell, the use of USDA's IPM funds to develop a pesticide based approach to destroy a native animal species in support of a non-native animal species is entirely unprecedented, and is especially disturbing in the face of the population collapse of the native mud shrimp that is currently underway. It is not clear if, when, or or how the required IPM was actually adopted, but it is very clear that almost none of the usual principles of IPM are involved in the latest pesticide permit proposal. The DEIS to which this EIS is attached is deeply flawed, because it fails to address the complex interactions between species. For example, the estimates for incidental take of non target organisms are just plain wrong, and the role of crabs as oyster predators is not discussed, but millions of

Because the pacific oyster spawns into the water column, and the initial layer of shell is developed in the water column, rather than under controlled conditions inside the female oyster, as occurs in the olympia oysters that were native to these waters, water conditions are critical, if shell building is to proceed properly. In an effort to control this process, and to allow the propagation of sterile triploid oysters, the industry adopted a hatchery program to supply seed. Mismanagement of the hatcheries and misunderstanding of chemical processes involved in shell building led to the claim that ocean acidification was destroying oysters and that pacific oyster was the canary in the coalmine for ocean acidification. This was an interesting story and it played well in the press, and continues to be played by politicians, but it was based on both a serious misunderstanding of water chemistry and a willful convenient falsehood.

The real problem is that unlike the native oyster, in the waters of the pacific northwest, the pacific oyster is near the edge of its natural range and its means of reproduction in the water column is only suited to chemical and temperature conditions found in these water some of the time. When those conditions are not present, shell-building in the first 48 hours is compromised.

It is a very human trait to assume that every year is pretty much the same as the ones before it, but this assumption leads to human development along unstable slopes and riverbanks that move and so the development gets wiped away when weather conditions drift outside the normal range. Same with the oysters. Water conditions 80 years ago were perfect for them. Since that time, vast tracts of forest in the watersheds that feed the estuaries have been removed, potentially altering the pH of the water entering the estuary, the eelgrass in the bay has been eradicated, and the ecological balance has been drastically altered by ground culture methods that involve dragging the bottom of the bay with chain dredges and harrows, stirring up sediments.

We also see a very serious issue emerging in that the primary proponent of the pesticide approach has been found to be in violation of the state's ethics rules. It appears to us that the ethics board may actually have failed to follow the rules set forth in the APA that appear to us to call for agency actions taken on the basis of ethically compromised testimony to be revisited. The key presenter and salesman for this new pesticide and its permit has been censured and fined by the ethics board for his involvement with the industry [] which should raise serious concerns for agencies who have relied on his testimony and sale pitches.

What we find astonishing is that your agency and you as individuals know more than we do about what is going on. You know ALL of this and more, and many of you in the agency know that it is just plain wrong. This is willful blindness on your part and is not an acceptable defense.

It is time for you to be asking hard questions, not us.

Joe Breskin
Olympic Environmental Council

Commenter: Patricia Jones - Comment O-16-2

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm tonon-target species, including aquatic invertebrates. Young fish of many species including our nativesalmonids spend much of their early life cycle in estuaries where they adapt to living in a salt-waterenvironment before out-migration. These chemicals are also linked to declines in pollinators and insects.The use of this pesticide in Willapa Bay and Grays Harbor should not be considered, given the globalimportance of the area for migrating shorebirds and other aquatic life.

Commenter: Shari Tarantino - Comment O-4-5

Southern Resident killer whales are dietary fish-specialists and depend on abundant populationsof Chinook salmon for their survival, social cohesion and reproductive success.11Experts anticipate that climate change and ocean acidification will contribute to furthersignificant declines in regional salmon abundance during the coming decades, thus impedingSouthern Resident recovery. After over a decade of federal protection, the population 12has yet to show signs of significant recovery, with 76 members total as of October 2017— this is TWELVE members fewer than when they were initially listed. The 77th SRKWmember is Lolita, who currently resides in Miami Seaquarium . This critically endangered 13populations' survival remains in question and is far from guaranteed.14

Commenter: Margaret Barrette - Comment O-17-3

The sky-rocketing populations of burrowing shrimp in Willapa Bay and Grays Harbor are alteringthe ecosystem, turning tidelands into muck, and destroying critical habitat for birds, fish,shellfish, and phytoplankton. This unchecked progression and broad environmental impactswhich the shrimp cause can only be slowed. Our members have spent much of the past decadeexploring options to address an infestation of burrowing shrimp which has left once healthyoyster growing lands, eelgrass beds, and bird feeding grounds entirely unproductive.

Commenter: Jay Davis - Comment A-1-4

These field trials should further investigate efficacy, persistence in and long-term impacts to sediments, sub-lethal but biologically significant effects to target and non-target species, potential indirect chronic effects to target and non-target species, and potential indirect effects to food webs (predator-prey dynamics) and ecosystem functions.

Commenter: Jay Davis - Comment A-2-3

Other sources of sub-lethal effects and stress, these exposures may result in unforeseen adverse impacts to the survival, growth, or reproductive success of target and non-target species (benthic invertebrate community, free-swimming crustaceans, or zooplankton) (Chagnon et al., 2015; Morrissey et al., 2015). 'Ihe Supplemental EIS acknowledges, but does not adequately address, potential indirect effects to food webs (predator-prey dynamics) and ecosystem functions.

Commenter: Jay Davis - Comment A-1-11

Other sources of sub-lethal effects and stress, these exposures may result in unforeseen adverse impacts to the survival, growth, or reproductive success of target and non-target species (benthic invertebrate community, free-swimming crustaceans, or zooplankton) (Chagnon et al., 2015; Morrissey et al., 2015). 'Ihe Supplemental EIS acknowledges, but does not adequately address, potential indirect effects to food webs (predator-prey dynamics) and ecosystem functions.

Commenter: Neil Quackenbush - Comment A-4-2

As was stated in our previous comment letter addressing imidacloprid and these specificproposed practices (USFWS 2014), there is substantial scientific evidence documenting thepersistence of neonicotinoids in natural systems (marine, freshwater, and terrestrialenvironments), and documenting direct and indirect adverse impacts on non-target invertebratespecies, vertebrate species, and overall ecosystem functions (Chagnon et al., 2015; Gibbons etal., 2015; Morrissey et al., 2015; Health Canada 2016; EPA 2017).

Commenter: Neil Quackenbush - Comment A-4-8

Content included in the Supplemental EIS suggests that there would be no direct adverseeffects to birds or fish, including those listed under the ESA. However, the SupplementalEIS does ·acknowledge that potential indirect effects to food webs and prey availabilityare a significant uncertainty, sources of prey could be reduced for shorebirds that feedexclusively on invertebrates, and granular imidacloprid pellets could be consumed andlead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds. Theindirect effects to food webs potentially caused by neonicotinoids is of particular concernto the USFWS because of the numerous migratory bird species that depend on habitats ofWillapa Bay and Grays Harbor as part of their migratory pathway (Chagnon et al., 2015).

Commenter: Douglas Steding - Comment O-20-6

With decline and then loss of their food sources and habitats, including oysterbed and eelgrass habitats, higher trophic level forms such as birds and fish willexperience reduced food resources. In more extreme cases the burrowing shrimpdominated areas may become unsuitable as foraging habitat for thesevertebrates.

Commenter: Douglas Steding - Comment O-14-4

With decline and then loss of their food sources and habitats, including oysterbed and eelgrass habitats, higher trophic level forms such as birds and fish willexperience reduced food resources. In more extreme cases the burrowing shrimpdominated areas may become unsuitable as foraging habitat for thesevertebrates.

Commenter: George Tuttle - Comment A-3-4

The DSEIS also specifically mentions conversion of "...ecologically diverse oyster or clam beds into lessdiverse mudflats containing predominantly burrowing shrimp" (Department of Ecology DSEIS, Page 2-7).Possible conversion from an ecologically diverse community to a less diverse community is of significantconcern. In the final SEIS please describe in detail how mudflats containing burrowing shrimp are less diversethan oyster and clam beds. Please provide any relevant data sources and references that may be helpful inunderstanding how these two ecological communities differ and which one might be considered more desirablefrom an ecological perspective.

Comments on Environment general

Commenter: - Comment I-40-1

This is a terrible idea. The Sound is already in a bad state and direct application of a pesticide will harm the already fragile environment. Please protect the Sound and say no. Thank you.

Commenter: - Comment I-115-2

I own land in Willapa Bay and do not want a neurotoxin sprayed on the water or land that has the potential to pollute my property and to kill all life on it. We have laws against air pollution, second hand smoke, etc. and this is no different. This could have long-lasting impacts on the food chain and should not be permitted. Oyster farmers must change their growing methods instead of looking for a quick fix that could kill us all.

Commenter: Bill Abelson - Comment I-134-1

I'm writing to urge you to deny the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

Your agency has prudently declined this in the past, since Imidacloprid is a dangerous pesticide found to cause significant harm to species which form the basis of a healthy aquatic ecosystem. If used in Willapa Bay and Grays Harbor, the pesticide could cause serious negative impacts to these ecosystems.

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative, non-poisonous solutions that will be safe for our food chain and important ecosystems.

Thank you for your consideration.

Commenter: Bob Aegerter - Comment I-314-1

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

Thank you for your thoughtful consideration of these comments. This is a very important issue requiring detailed research and discussion.

Commenter: Daniel Alcyone - Comment I-93-1

I strongly oppose this proposal. The very idea of spraying known neurotoxins directly into tidelands is obscene and irresponsible. There is no documented study about the larger implications of using this toxin in a marine ecosystem. This is a plan to poison the entire Salish Sea for the financial interests of a few.

On behalf of our children and future generations do not allow this horrible atrocity to occur.

Commenter: Dana Allen - Comment I-355-1

Willapa Bay and Grays Harbor, with a number of unique ecosystems, and among the most important estuaries in the U.S, are once more in danger of being sprayed with the toxic neonicotinoid insecticide imidacloprid.

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid.

Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Caroline Armon - Comment I-172-1

As your own supplemental environmental review findings show numerous impacts to the entire ecosystem that cannot be mitigated.
A short term solution that will leave long term devastation to endangered and threatened species and the entire ecosystem.
Lets learn from our neighbors- this pesticide has been banned by most of the European Union and ban being considered in Canada because of it's scientifically proven severe impacts to aquatic species.
We need to consider all the species in an ecosystem, including we humans, impacts made by us and impacts to us, by use of this pesticide.
Native Olypmpic oysters are much more resilient and adaptive to this area- their natural habitat, and should be considered to replace the non-native Pacific oyster. Pacific oysters may grow faster in the short term, yet cannot withstand these environmental changes, whereas Olympic oysters can and do, becoming more abundant and profitable in the long term, beneficial to the entire ecosystem.

Commenter: W Asprey - Comment I-248-1

(Email Submission)

d et al, know this sounds Trumpish foolish, if true, failures by inspection: from grayswillapaselfish web site (from the russian):

Because no state or local agency has ever acted to control the infestation, shellfish farmers long ago assumed responsibility to protect the ecology of the bay.
Since the 1960s, shellfish farmers applied a compound called carbaryl to directly control the infestation on their shellfish beds with no negative impacts to the environment.

AND THIS IS IT. STUPID know nothing cant see it not there fake helpers of earth? Sell fish shell fish hell fish not see no fish, ecological control by personal gain losing fore! duh rest of US! CARBARYL was and is an atrocity on ecologies, us. EPAOPP is atrocious fake science work king fore! duh king.
Since '63 to '13! 50 years of toxic ecology protection bought them what? NO NEGATIVE ENVIRONMENTAL EFFECTS, trust them. Not see nothing. Move along folks, not see nothing tools bee seen here. The wetlands have been fried by right wing nuts including Imazamox herbicides, imidacloprid neuron bombs for fish and microbiota, down wind or currents. Duh. Not see is not not there.

ecology. Ecology. Carbaryl. Japanese oysters. Grays Harbor. Private gain. Public pain.

How mucho carbaryl in 50 years, or is it confidential? Are they bonded againt uncertain 'truth'? Is anyone? About 1.0431 lb per acre active in greed he wents... call it a pound, thousands of acres of wetland marshes and tidal flats, 50 years of ever-more flourishing health of the communities adds tools:

50years x 1#/acre. X 2000acre. == 50 tons carbaryl active in greed he wince.. ecologies us christ! How was this ever legal profiteering? Secrecy. Time bombs. Now let them EXPERIMENT with their bays and estuaries, no environmental harm is assured by toxicologists, the liars of science. Poisons add in synchronicity, synergetic and neuropathologic, downwind or wet, fat loving.

Do not trust toxicology, they have been selected by the toxic corps. to pretend that NO ENVIRONMENTAL DAMN AGE IS DONE!!! No matter denuding earth and civilization. The control of the message makes fake true, ask Trumputin and their greatness. Make us grate a gain. Duh. Prison grates.

Bad pesticide practice and presentation is the norm, perhaps political. Slight profits for few, wee live too, election selection zoo.

I no longer live by Grays Harbor so direct toxic degeneration of me and mine are unlikely from this crazy idea of corps. poisoning for sustainable ag. Years ago when we lived there the carbaryl was sprayed wildly in 12mph winds, with tiny blurry notices in Raymond news ONLY. The shopper thing. No notices were ever found at any boat launches either. Amateurs a twerk. We were damn aged by AMATEUR PESTICIDE USERS long ago. Secretive and unwilling to render aid, the poison users use to this day, in third world secretion, corps. profitting, tree sun, USA deletion.

Thanks for foreign species oysters.. i thnk they are unnatural Japanese oyster or clam imports, and for rain eel grass? Build that wall, submarine, keep foreign clams and grass out! I wonder if carbaryl effects salmon?? It stinks, oily, killer. Probably. They eat poisoned shrimp, wee eat them. Whales sicken from the stink? 50 tons of neurostink.

Environmental damn age wee do not see. For few. This spraying got us out of there, aid dead with so many other amateur pesticide operations... the port, the railroad, the church, the city, the county, the schools, joe citizen, the sellfisherman. Other places are often worse but local dispersion matters with pesticide abuse so common. I work toward advancing grays harbor county, still pay tax there. But, I cannot advise operations to build operations there with such toxic ambitions dominating the natural dignity. Small mistakes with nerve poisons integrate with all the other toxic corps. mistakes, flushing us down duh drain, duh trumputin train.

We will write off ever moving back if such drastic antinatural dangerous techniques remain dominant in industrial marine aqua cult sure. Soon we will be able to know what the local neighbor alee corps. has decided for our futures, and then, and now, wee can work to preserve decency in nature and nurture, agriculture.

Live well, enjoy life, avoid living near or eating conventional corps. poison foods, the fix is in, wee all been had.

Bill

PS Again, vertebrates light cycle. b
Trust only one.

Commenter: W Asprey - Comment I-249-1

(Email Submission)

D. Thanks for watching them and disclosing the carbaryl extinction. These imidicloprid neonic alter nerve function with every molecule contacting every nerve of every being during dispersion of nerve dysfunction, hyperactive for a lifetime, sorry for the farmers most affective.

The EPAOPP is frozen deer in the chemocorps. head, lights. Do not trust the dispersion relations personally used by their boss, only allowed to carry on, the bug lie of chemocorps.

The best is to define oysters and clams with shrimp burrow a delicacy. Or not, see? Do fish repell and alter beehavior when up the food, chain? How about people? Is imidicloprid good for everyone including farming? I thot not. Who owns the land and products, is it known and are they bond dead Willapa-Grays Harbor Oyster Growers Association? Totals of carbaryl spent, all in greed dients, over the years, willapa AND grays? Any paper wasted dioxin in the sand or shellfish? It is the sediments, pyrethroid, death.

Have they tried optical methods. The shrimp are UV avoid. Clams care less. I could help irradiate, distress, obliterate, patent ted. Easily applied temporary naturalish unkind energetics to decorrelate reproduction. Duh. Sunburnt shrimp. TPG shrimp destructor. Cheap easy efficient. Maybe.

The chemocompanys will not see this as good fore! them, the OP ate of dumbasses, Trumputin et all.

Have good life d. It is precious, even the shrimps among us.

Bill

BTW. DOUBLE or more the public notice for sure, these things grow like the corps., superlinear, unnatural as hell. Carbaryl on the bay was amateur at best, bad wind alee, poor public notice, blurry paper and miss sing marine postings.. Ignore rants is bliss. b

Commenter: Karen Baldauski - Comment I-336-1

HELLLLLLLLLLLLLLL-o! And, Good-bye to our natural world if you poison the estuaries. I mean, have you not learned anything....more poison is not the solution. Restoring a balanced environment naturally is the ONLY way to go. Get rid of the stressors in the feeder streams first. Avoid more contamination of our estuaries and bays. Imidacloprid means death to ecosystems...AND OUR HONEY BEES. I mean really, doesn't anyone have a broader view of things to not stand for any more usage of chemicals others have already outlawed?!

Thank you for your consideration, as I agree with Beyond Pesticides rationale which they put forward so succinctly in this letter to you.

Commenter: Lynne Bannerman - Comment I-163-1

As an environmental educator I strongly advise against granting the permit for pesticide application to deal with this problem. Humans have created conditions leading to warming temperatures and acidification of the waters. Pesticide application is a short term fix for a much longer term problem and will in the long run create further issues.

Commenter: Julian Beattie - Comment I-159-1

I am opposed to the use of this pesticide as urge the Department to deny this application. The effects on the local ecosystem have not been adequately studied. The precautionary principle holds that we should not proceed until more is known. Also, my right to a healthy ecosystem outweighs others' right to grow and consume what is in essence a luxury item. Thank you for taking my comment.

Commenter: Glynn Behmen - Comment I-317-1

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

Thank you for your thoughtful consideration of these comments. Thank you for your concern and support of American Families and Public Health.
Sincerely,
Glynn Behmen
P.S. Please support full enforcement by Congress for the Logan Act of 1799.

Commenter: Eric Bensch - Comment I-167-2

I support the two letters, comment letter from the Coastal Watershed Institute and the letter from Northwest Center for Alternatives to Pesticides, which I have attached to this file.

Commenter: Eric Bensch - Comment I-166-1

As a citizen that lives on the water of Puget Sound, I find this proposal disconcerting. My understanding is that the affects of this pesticide are far reaching and will have an overall negative impact on the immediate area and larger Puget Sound. I am strongly opposed to the use of these chemicals in our waters. Please deny this request.

Commenter: Rachel Berg - Comment I-369-1

We MUST save Nature--it cannot be allowed to be poisoned by uncaring corporations at our and the insects and animals expense.

Commenter: David Beugli - Comment I-240-2

This new SEIS just like the previous FEIS demonstrates that there will be no bay-wide impacts and thatthese applications will have no direct impacts to fish, birds, marine mammals or human health.These findings alone support the timely issuance of a new permit.

Commenter: Diane Boteler - Comment I-143-1

I am strongly opposed to any use of this dangerous neocontinoid pesticide in Puget Sound waters. The ghost shrimp population increase is clearly a symptom of an ecosystem that is not well. Adding a pesticide with known short term lethality to many collateral marine species and completely unknown long term effects is at best naïve and at worst potentially disastrous for the local ecosystem. Surely our scientists can come up with some alternative that is not so environmentally damaging..And for what gain, a short term economic benefit to a few oyster farmers. For me and I'm sure most other people in the state of Washington my sympathy goes out to these individuals, but their economics should not trump our duty to not inflict further harm to a critically ill ecosystem.
I urge you not to approve the use of this, or any other pesticide, in the waters that belong to all Washingtonians.

Commenter: Martin Bowers - Comment I-105-1

I do not support pesticide use in this case. The "pest" is native and there is collateral damage to other native species of crabs. There are other methods of shellfish culture such as bags or racks that will prevent the shellfish from suffocating in the sediment.

Commenter: Marie Browne - Comment I-194-1

Deer Mr. Rockett,
I am very concerned about the use of Imidacloprid for shrimp control in Grays Harbor.We do not

need to put more stress on the environment. I hope there is another way to solve the problem.
Thank you.
Marie Browne

Commenter: Erika Buck - Comment I-179-1

Mr. Rockett,

I am an oyster farmer in Grays Harbor WA and am very concerned about the uses of herbicides and pesticides in oyster farming. I have been in the oyster business my entire life and owned and managed one of the largest oyster farms and shucking houses on the West Coast. We grew and grow our oysters on the substrate, naturally. We work with nature to develop truly sustainable, proven farming techniques. My father and I cultivated oysters throughout the Puget sound, Hood Canal and Grays Harbor tidelands, confronting varying degrees of shrimp infestations along the way. Never did we require the use of herbicides or pesticides in our farming practices. The burrowing shrimp were a nuisance/challenge one expected as part of aquatic farming. These shrimp challenges were not considered unusual or forbidding. Growers understood that they were just part of nature and could be controlled with traditional farming techniques. These techniques are not unique or special in any way. Growers in every region understand the necessity of preparing the substrate/tidelands for the planting of crops, maintaining crops and preparing crops for harvest. We all used the process of harrowing. Harrowing is done on an outgoing tide to remove the sediments from the tidelands. The sediments came in mostly with the tide and are flushed out naturally with the tide. In the process of harrowing, some of the ghost shrimp are exposed and their natural predators, mainly fish, consume them. Through the harrowing process, balance could be restored or maintained, truly sustainability. No chemicals necessary. Please stop–there is no reason to issue a permit for the chemical control of ghost shrimp. Please instead question why some aquatic farmers would want to use chemicals such as imidacloprid to control the shrimp issues they are facing in their farming environment. What changed? Their farming techniques. The farming practices utilized by some of the growers today are not sustainable. Miles of nylon rope on plastic poles impede incoming currents are the current trend. This is called long line oyster farming. These long lines impede the natural currents in an estuary and promote the accumulations of sediment. These sediments accumulate at much faster rates than are natural to the area. This accumulation of sediment creates the perfect environment for burrowing shrimp. No longer can nature flush out these tidelands. Growers can no longer use harrows to flush out the tidal environment and rid the area working with nature of ghost shrimp. There is habitat loss happening at a rapid rate throughout our state and especially in our aquatic environment. The Orca Whales are threatened along with so many other species. Instead of issuing spray permits, why not enforce the Clean Water Act, protect public health and the environment? Why not work on restoration of our aquatic areas? If growers understand that the option for using chemicals is no longer available, the growers will change their farming techniques. Chemicals are a cheap alternative to tried and true farming practices and long-term are not sustainable or good for any one. I have invited you before and I welcome you again to come visit our farm. We invite you to see and experience firsthand the health of the tidelands, the natural aquatic diversity and see the results of our sustainable farming practices. DNR once classified our tide lands as shrimp infested and prior to our farm/DNR lease, issued permits to shrimpers to harvest shrimp from tidelands in this area. These tidelands are now cultivated. We brought the tidelands back into balance by working with nature, not against it, and most importantly without ANY use of herbicides or pesticides. We can demonstrate that chemicals are not a necessity in oyster farming. States such as California and Oregon do not allow the use of chemicals and there are many very profitable farms in those areas. There are options. The industry knows it. I sincerely hope you accept our offer to visit our farm.

Thank you for your consideration.

Erika Buck FMO

AquaCulture

Commenter: Josehp Caler - Comment I-56-1

The idea that another industry could wipe out a Species like the sand shrimp and poison the individuals like myself who enjoy eating oysters is horrible. First off there is a market to sell sand shrimp. Pump them and sell them to fishermen. Second look at what is happening around areas on land sprayed with pesticides, like hoof rot. Until impacts are know nothing should be sprayed.

I will not support any place that uses this pesticide at all. Do the right thing and ban the use of it.

Commenter: Maurine Canarsky - Comment I-328-1

According to a new study published in the Lancet Medical Journal, environmental pollution is killing more people every year than all war and violence in the world. Pollution control is a winnable battle. Be a part of the solution -- restore the habitat. It will benefit ALL of us.

Commenter: Joseph Candelaria - Comment I-387-1

None of this is news. We know that good or bad, it all ends up in the water. We need to protect our water

Commenter: Daniel Cheney - Comment I-174-1

I've been involved with various aspects of shellfish farm management in Willapa Bay and elsewhere since the 1970's. The SEIS correctly observes the difficulties farmers face in growing oysters on grounds densely colonized with burrowing shrimp. The high shrimp densities observed since the 1960's have been described as reflecting both human disturbances and changing ocean-system dynamics. The current proposal to apply imidacloprid to reduce shrimp densities on the most productive grounds in Willapa Bay and Grays Harbor, is the result of concentrated efforts since the mid-1990's to: 1) examine alternative control and culture methods; 2) study the ecology and marine chemistry of the growing areas; 3) better understand the ecosystem services provided by shellfish culture; and 4) conduct laboratory and field experiments on the effects of a range of chemical, physical and electrical tools for shrimp control.

I believe the SEIS adequately addresses the rationale and need for the application of imidacloprid, and cites current literature on this and other chemicals used or proposed for control of burrowing shrimp. The examination of the three alternatives fairly reviewed anticipated impacts for a range of treatment options; however, some readers may not have access to the more detailed available information on ecosystem changes that would result under Alternative 1 (no treatment). Aspects of these ecosystem changes were evaluated in greater detail in the 2015 FEIS, and are briefly quoted as follows:

--From FEIS – p 3-4. Deposit-feeding polychaetes, bivalves, tube-dwelling tanaids and amphipods (e.g., Corophium spp.), and other sedentary species were reduced in numbers in areas where dense populations of ghost shrimp were present.

--From FEIS – p 3-5. Burrowing shrimp act to limit eelgrass presence by disrupting the sediment and making it too soft for eelgrass roots and rhizomes (Dumbauld and Wyllie-Echeverria 2003; Hosack et al. 2006). Dumbauld and Wyllie-Echeverria found a strong increase in eelgrass abundance in areas where carbaryl was experimentally applied to burrowing shrimp.

--From FEIS – p 3-5. Oyster beds provide important ecosystem services such as water filtration, resulting in decreased suspended solids, turbidity, and increased denitrification; habitat for epibenthic invertebrates such as crabs; carbon sequestration; and stabilization of adjacent habitats and the shoreline.... Oysters grow well on hard, rocky bottom or on semi-hard mud firm enough to support their weight. Shifting sand and soft mud are usually unsuitable for oysters.

--From FEIS – p 3-28. The treatment of intertidal oysterbeds with carbaryl [a chemical treatment for shrimp control until 2013] clearly reduces abundance of shrimp in this zone and we documented the same pattern of seagrass colonization on a commercial oyster bed and lack of seagrass in an adjacent unsprayed area. Density of native seagrass Z. marina shoots was also enhanced in plots treated with carbaryl, but only at lower tidal elevations or in intertidal pools where it could survive (Dumbauld, B.R. and S. Wyllie-Echeverria. 2003. The influence of burrowing thalassinid shrimps on the distribution of intertidal seagrasses in Willapa Bay, Washington, USA. Aquatic Botany 77:27–42)

--From FEIS – p 3-48. Increased densities of burrowing shrimp could result in decreased biodiversity and increased sedimentation (Dumbauld and Wyllie-Echeverria 1997; Colin et al. 1986). High densities of burrowing shrimp have been associated with lower numbers of Dungeness crab, oysters, and other shellfish due to competitive exclusion and habitat modification caused by the shrimp (Doty et al. 1990; Brooks 1995; Dumbauld and Wyllie-Echeverria 1997)."

This information coupled with the uncertainly, production risks and high costs associated with the described alternative off-bottom oyster culture and non-chemical burrowing shrimp control methods, clearly indicate the no action Alternative 1 is not acceptable from both ecological and food production perspectives. I urge the Washington Department of Ecology to support and permit the more balanced approaches afforded by Alternatives 3 and 4.

Commenter: David Clark - Comment I-162-2

I own property on the South Sound and want to oppose the use of Imidaclorid in the South Sound and support the comments made by the Coastal Watershed Institute in its October 24, 2017 letter opposing the use of the pesticide.

Commenter: George Clyde - Comment I-108-1

I am a consumer of shellfish from Washington State, and I strongly object to use of imidacloprid, both for the environmental reasons and for the health and safety of my family and me as consumers. Best, George Clyde

Commenter: Janine Cohen - Comment I-155-1

Hello,
I was a tourist that travelled through SW Wa. and was inadvertently educated about oyster farming. It was disturbing to know that beautiful tidelands are being sprayed with pesticides for the exclusive benefit of old-fashioned, destructive oyster farming practices. Plus, it is a hidden topic. No one who I spoke with about the spraying knew of it before I mentioned it and then they were very interested in finding out more. Yes, to stop spraying would be a big change for the farmers, but this is an enlightened era where people are acting sustainably and spraying pesticides that indiscriminately kill is not popular or healthy for the environment or us. There are other ways to farm oysters that don't require pesticides. I love to eat oysters and didn't eat any in SW Wa. because of the spraying.
Janine Cohen

Commenter: Allison Conley - Comment I-37-1

Please do not allow this! Our Puget sound is polluted enough already. The fact that some producers deem this necessary after generations of not engaging in this activity probably is a testament to how filthy the sound is. I would prefer stronger protections for the Sound and more resources for clean up.

Commenter: John Conley - Comment I-173-1

No, no, no! Don't tell us that a neurotoxin (Imidacloprid) will "only" affect the shrimp and "perhaps" (definitely!) some other invertebrates (crabs, snails, etc.). It will and does affect humans as well. I will never, never, knowingly purchase or consume an oyster that has been grown in an area treated with Imidacloprid. Never. I would not dine at a restaurant or buy from a fish-monger who carried such oysters. If this poisoning is allowed, I've had my last Willapa Bay/Gray's Harbor oyster. Forever.

There are other ways to raise oysters --- in bags, or on racks --- that would avoid the "mud" problem (it's real, and I understand it) caused by the native shrimp (the oysters raised in Wilappa Bay are not natives (are any of them Olympia oysters?; don't think so), but the shrimp are natives). I cannot understand why this is not a solution to the problem, other than for financial concerns: sure, it's cheaper to just dump the oyster spat on the tidelands and then pick them up a couple of years later than it is to use racks or tethered bags. So, to make a buck, let's screw the environment, screw the Public, and just poison both the Public and the shrimp at the same time.

In 2017, who thinks spraying neurotoxins into our environment (yes, we live here with the shrimp and oysters) is a good idea? Only someone who puts profit above all else.

Please do not allow this. Aside from the very real risk to human health (for those who would consume these poisonous oysters, or those who live near the proposed spraying areas), there will be a significant economic cost to the State, as many will refuse to consume them, or do any business with restaurants and purveyors who carry them. This will not help the Washington oyster industry. It will harm it in a major way.

Thank you for considering these comments,

John Conley

Commenter: Eva Coombs - Comment I-311-1

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

As a daily oyster 'eater' this is really important to my family and me...and i am not alone

thank you!

Commenter: Sharron Coontz - Comment I-116-1

Please do not allow them to apply a known neurotoxin to the oyster beds. You know the adverse impacts to the ecosystem. And even though further research is needed, there is already plenty of evidence telling us this isn't a good idea.

Historically, we've spent a lot of time having to say, "Oops -- there were unintended consequences" and having to deal with those sometimes horrific consequences. Let's not make that mistake again on a popular food source, especially since other companies have found ways to still grow their oysters without resorting to using poison on them.

Thanks!
Sharron Coontz

Commenter: Holly D'Annunzio - Comment I-43-1

I am against the use of imidacloprid in our waters due to potential harm to our ecosystem as it impacts the environment. It is better for a change in diet if oysters are not able to be grown naturally than risking the ecosystem.

Commenter: LLyn De Danaan - Comment I-145-1

Oh, please. I can't even be sane in my response. Haven't we been here before....a thousand times...with the wishy washy assessment that there is "no known impact" or maybe some peripheral impact or ....this is simply a bad idea and ANY impact on our struggling native fish AND, btw, shellfish, is simply a bad idea. No, you must NOT issue a permit. There are unavoidable, unforeseen environmental impacts and you must deliver the sad news to proponents. Time and again, big money, big industry seeks to by pass or wiggle around our efforts in the state of Washington to have a clean environment. The coal suit is an example. People don't want it. We know the terminal on the Columbia is a bad idea. But big money will try to force it. Salmon pens rote and allow escapement. We, the people, and the state are trying VERY HARD to hold back and hold on. Please make the right decision on this and do not allow the permit.

Commenter: Pat Dick - Comment I-234-1

Pat Dick (Oral Testimony): I'm Pat Dick. I'm from Cowlitz County, inland , I'm not affiliated with the oyster growers. I can't even eat oysters. But I think they're really valuable, their culture. They filter the water and they act like the canary in the coal mine. They tell us a warning about the health of the bay. I believe the growers have the highest interest in the quality of the bay and they can be trusted because of that self-interest. Despite the stressors of acidification and rising water temperature, burrowing shrimp and lack of help by government agencies that should help them , so far they've managed to hang on. After they stopped using Carbaryl due to opposition they searched for an alternative.

Now they've proposed the current proposal. After study the government says they need more study , as if they can freeze time. [unintelligible] Let's do a full-scale test. Let's issue the permit. Let's study it in our hip waders out there. Otherwise, the degradation continues. The oysters die. The native grass deteriorates. The diversity declines. They bay deteriorates further and becomes fit only to receive septic waste from more winter and recreation homes. Thank you.

Commenter: Chris Dietrich - Comment I-319-1

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology. I hope that restoration will become part of the proposed plan for Willapa Bay and Grays Harbor.

SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," and in some cases, monitoring is proposed as a way of reducing uncertainty. SEIS stance of spray and monitor creates science experiments in living bay ecosystems—experiments can create havoc, experiments can fail.

Certainly, no use of imidacloprid can be supported without demonstrating efficacy-- crucially, the SEIS identifies uncertainties about the efficacy of imidacloprid for controlling burrowing shrimp, which include questions of the extent and duration of the effect of imidacloprid, the lack of a treatment threshold, lack of data regarding resistance, lack of field research regarding clams, and efficacy of treatment in low temperature.

And the SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sub-lethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected.

The SEIS does not adequately address synergistic effects, including impacts of imidacloprid combined with other chemicals ("inert" ingredients, other chemicals used in the bays, and other pollutants) or other stressors.

Among the organisms known to be at high risk is the commercially important Dungeness crab, which has been shown to be susceptible to the effects of imidacloprid, and whose populations experience large natural fluctuations, putting them at risk of extinction.

Given the systemic mode of action of imidacloprid in crop plants, I strongly feel that the failure to account for impacts on non-target animals consuming vegetation in treated areas is inexcusable.

Of the three options proposed, the No Action alternative is the best and I ask that you stand for protecting the Bays by choosing No Action. However, what is truly necessary to address these problems is an option that was not considered in the SEIS –a plan to restore the habitat by removing stressors from streams flowing into the bays.

Commenter: Daniel Dietrich - Comment I-110-1

Seriously? Spray a toxin into our oceans to kill a NATIVE species so a few can profit from it? Please do not even CONSIDER this preposterous request.

Commenter: Tom Douglas - Comment I-267-2

Please deny the spraying permit application for spraying Imidicloprid in our ocean. This stuff is not only toxic to the pest but to other wildlife in the area and those beds that refrain from spraying. I would also request a public hearing in the Seattle area where most of the oysters from these beds are sold.

Commenter: A E - Comment I-19-1

It is unconscionable that oyster growers and the state would consider contaminating the water and the surrounding areas with a known neurotoxin! I am appalled that this idea is even back on the table after the public outcry just an it over a year ago! There must be a better way to control the burrowing shrimp or the oyster farmers will just have to adapt to a changing environment like the rest of us. Save our clean waters and do NOT spray the noxious chemical!

Commenter: George Fairfax MD - Comment I-106-1

To Wa. State Dept. Ecology
Please deny the use of imidacloprid in Willapa bay & Grays Harbor. The long term affects are unknown and there are too many herbicides, pesticides and numerous toxic chemicals in the environment and oceans that are getting into our food chain. The affect on all aquatic life is unknown. As an example, Imidacloprid is a form of neonicotinoids which have been associated with bee colony collapse and even found in our food honey.
Thank you for your consideration
George Fairfax MD

Commenter: Teresa Ferrari - Comment I-125-1

I am dismayed and shocked that we must still be fighting against companies & corporations who can only see the value in their 'products' and the profit to be made. This view is shortsighted and does not consider long term health of our waterways, oceans, soils and air. We must not continue to use poisons. One long term view is to consider and believe that the cure for anything we face (human disease, unbalanced ecosystems, pollution) is already present on the earth and we simply need to adopt a new way of thinking and new systemic models. There are other ways to work within a healthy ecosystem to sustainably grow and harvest oysters. I oppose the use of Imidacloprid and trust that the correct action will be taken, one that does the least harm to the masses of species.
With faith,
Teresa Ferrari
CA resident
Part time resident on Tomales Bay, another 'oyster waterway'.

Commenter: Teresa Ferrari - Comment I-126-1

I am dismayed and shocked that we must still be fighting against companies & corporations who can only see the value in their 'products' and the profit to be made. This view is shortsighted and does not consider long term health of our waterways, oceans, soils and air. We must not continue to use poisons. One long term view is to consider and believe that the cure for anything we face (human disease, unbalanced ecosystems, pollution) is already present on the earth and we simply need to adopt a new way of thinking and new systemic models. There are other ways to work within a healthy ecosystem to sustainably grow and harvest oysters. I oppose the use of Imidacloprid and trust that the correct action will be taken, one that does the least harm to the masses of species.
With faith,
Teresa Ferrari
CA resident
Part time resident on Tomales Bay, another 'oyster waterway'.

Commenter: Beverly Foster - Comment I-356-1

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

DO NOT DESTROY THIS DELICATE ECOSYSTEM. We've already destroyed the planet in 150 years since the industrial holocaust that took billions to evolve. EDUCATE yourselves as to the dangers of dumping millions of tons of poison on the earth. AND DON'T DO ANYMORE.

Commenter: Liz Frazer - Comment I-277-1

Please, please, please don't allow this to happen--our environment is already struggling so please don't cause more issues with this toxic pesticide.

Commenter: Maradel Gale - Comment I-326-1

Good grief, Ecology!! It is nuts that you are even considering allowing spraying of a neonicotinoid in the marine waters of Grays Harbor and Willapa Bay.
Your own SEIS shows the likely harms from such an unprecedented activity, and yet you are considering issuing a permit for this??!! Even though the state purports to "favor" shellfish growing, it is NOT to be done at the expense of all the other values in our marine ecosystem. Therefore, I strongly oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Edgar Galvan - Comment I-177-1

I am employed in the shellfish industry in Willapa Bay. It's the only job I've ever held and I am proud of what I do. I support the use of imidacloprid to reduce the out of control burrowing shrimp population. 16 of my family members, all residing in Pacific County, also work in this industry. We have seen firsthand how the shrimp are destroying the oyster and clam beds. It is very frustrating to see the crops that we work so hard to grow sinking into the mud because of the effect of the shrimp. The shellfish industry is the largest private employer in Pacific County providing around 2000 jobs between Willapa Bay and Grays Harbor. Without a permit, the effects will be devastating to the farms, my family and our local economy. Please issue the draft permit so that we can reduce the shrimp populations to a manageable level and continue providing shellfish to consumers all over the world.

Commenter: Matthew Genaze - Comment I-323-1

Willapa Bay and Grays Harbor have been affected by human activity over the past century that has contributed to problems experienced by all who use the bays. Of the three options proposed, the No Action alternative is the best. However, what is truly necessary to address these problems is an option that was not considered in the SEIS –a plan to restore the habitat by removing stressors from streams flowing into the bays.

Future generations' resources, health and prosperity is dependent on us acting immediately, significantly and broadly. Thank you for your consideration.

Commenter: Don Gillies - Comment I-231-1

Don Gillies (Oral Testimony): My name is Don Gillies. I'm a resident of Pacific County and owner and operator/manager of Stony Point Oyster Company, established in Willapa Bay by my family in 1868. So I'm a fifth generation shellfish farmer. I want to state that I'm in full support of the issuance of this permit from Ecology to allow the shellfish community to tackle this problem. I've got a list here of points I wanted to make listening to and reading your literature that was supplied today. First of all, the point I want to make is that the Department of Ecology issued a permit in 2015. The process was completed and Ecology did their duty to evaluate the permit and the application was approved.

So I'm wondering , I know that between that time and now some minute amount of new evidence has surfaced and needs to be evaluated but over all I can't see where any of that would precipitate a change in the original decision. Ecology did not withdraw the permit on their own and so they should stand by what they decided back in 2015. The evaluation of the impact of Imidacloprid , I have a little statement here talking about crabs. But Dwight did a good job of describing that , I'm in full agreement with him. I can also tell you that crabs absolutely devastate my seed. Every year I lose 20% of my seed crop to crab predation. So we are feeding the crabs.

As far as reduction in the food source, that is a point being made by ecology. A lot of people don't understand, but if you think about it the oyster culture provides way more food source than any kind of monoculture desert land that burrowing shrimp ends up becoming. If burrowing shrimp are allowed to continue to infest the privately held oyster lands in Willapa Bay without control the oysters will disappear and the food source will disappear. So there's way more food sources available if you have an oyster culture than monoculture burrowing shrimp land.

Impact bay-wide? Certainly a concern. And due diligent by Ecology to consider and understand the impacts. It's hard for me to get my head wrapped around how much impact a temporary modification on 1% of 40,000 acres could have so , I'm just, I'm just , maybe I'm not scientifically able to understand that, but , this room. Let's say this room is 100 x 100 and 1% is 1 square of this floor. Another topic that was to try to fill in knowledge gaps and I can say from my layman's standpoint that knowledge gaps never go away. There are always knowledge gaps and I would implore the Department of Ecology to decide on the facts that are presented to them, and what the facts that they have now , and not hopefully go , . Okay. That's it.

Commenter: Anastasia Glikshtern - Comment I-345-1

While the SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," the SEIS fails to give adequate weight to the "knowledge gaps" it identifies.
The impacts are easily avoidable - if you don't spray!
These toxic pesticides should not be allowed for use anywhere on Earth.
Monitoring the poisoning doesn't help.

Commenter: Stanley Green - Comment I-103-1

I strongly object to poisoning these environments with pesticides.
If the industry can't function without poisoning the intertidal zone, they should move elsewhere or find another mode of operation.

Commenter: Paul Gruver - Comment I-152-1

Stop the use of pesticides everywhere in Washington waters, and in particular, Willapa Bay. You and the shellfish industry are well aware that profitable alternate methods are immediately available to successfully grow shellfish without destroying the environment with poisons in our waters. Stop pesticides in Washington waters!

Commenter: Stacia Haley - Comment I-306-1

I really hope that this will be blocked. No need to pollute our ocean with known toxins, we already have inflicted enough harm which we must start to fix, not cause more damage. The oceans are the cradle of life. Let us not poison them.

Commenter: Martha Hall - Comment I-151-1

Thank you for the opportunity to comment on the possible use of Imidacloprid to kill ghost shrimp.

It isn't necessary to read very much of the file before deciding that this is a very bad idea. It seems like these items in the summary provide sufficient evidence that WDFW should not be spraying Imidacloprid into the waters of Washington State:
1. Immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish to the areas treated with Imidacloprid and the nearby areas covered by incoming tides.
2. Limited impacts bay-wide, but that there is significant uncertainty about the cumulative impacts and other unknown impacts to other marine invertebrates and life cycles.
Little known direct risk to fish, birds, marine mammals, and human health.
3. Potential indirect impacts to fish and birds if food sources are disrupted.
4. There are still knowledge gaps about Imidacloprid. Further research is needed.

It is time for WDFW to take an ecosystem approach when managing our state's wildlife. Singling out and killing one species, this ghost shrimp, to help commercial oyster farms makes no sense, scientifically, when the impacts on most species is not understood. There is a chance that some endangered species, fish and birds, may be impacted. Some of the species that Imidacloprid spraying will kill are food for many other species, as are ghost shrimp.
I can't believe WDFW is even considering this approach.

Why not examine the cause of the huge increase in this species of ghost shrimp? What role in this increase can be attributed to the oyster farms, the species of oyster they raise, and/or their management practices? How has the chemistry of these bays/harbors changed over the years? What has happened to the natural food chains in these bays over the years?

Probably oyster farming has also meant the loss of habitat and numbers of many native species. Is oyster farming worth it? Would these bays be more productive if oyster farming changed or did not exist?

We keep discovering that chemicals are not the answer. They often end up destroying far more than we expect when they are approved. The spraying won't even get rid of the shrimp, and do we really want to get rid of this shrimp? Most likely the surviving shrimp will develop a resistance to this pesticide - or it will be found to be too dangerous and will be banned like the carbaryl that was previously used.

We have too many ecosystems showing stress and collapsing already. We have too many endangered species. Yet WDFW is considering use of a new pesticide in some of the most ecosystems in our state? I wonder how productive these bays would be for all citizens of WA State if oyster farms were removed?

Commenter: Linda Hanlon - Comment I-307-1

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems. Trap, harvest for use as fish and pet food, move from critical shellfish areas, etc. Burrowing shrimp are the next gold mine for local west coast watermen. Harvest and sell them. They can be vacuumed and trapped.

Commenter: Jessica Helsley - Comment I-169-2

Imidacloprid has been found to enhance adipogenesis, resulting in insulin resistance in cell culture models (Sun et al. 2016, 2017). This provides a strong concern for human health. More direct impacts from insecticide application, including the application of Imidacloprid, have been observed in marine invertebrates which are a critical food source for juvenile salmon and forage fish (Westin et al. 2014, 2015). Wild fish species of salmon and the forage fish food structure that they depend upon are critical components of coastal resiliency- culturally, economically, and ecologically. Macneale et al. 2014 and Gibbons et al. 2015 provide thorough reviews of these concerns. Application of Imidacloprid to coastal areas in the shallow areas of Grays Harbor and Willapa Bay will detrimentally impact critical marine and nearshore ecosystems while also being a human health concern. Impacts to coastal juvenile salmon and forage fish when they are feeding, resting and migrating will have negative impacts to both local salmon populations as well as to salmon populations currently listed under the Endangered Species Act that utilize Washington's coastal waters for nourishment and refugia during their migrations (Shaffer et al. 2012). Additionally, application of Imidacloprid will have a cascading impact up the food chain- impacting marine mammals that include populations also listed under the Endangered Species Act.

Washington's coastal ecosystems are complex and vital to our region. We should be working to restore and protect them, not further their demise to enhance the growth of a non-native shellfish species for commercial use. The state and federal agencies are required by law, to preserve Washington State's wild species and the ecosystems upon which they depend. Application of Imidacloprid and other insecticides in coastal zones contradict this mandate and should not be permitted.

Commenter: Parrie Henderson - Comment I-346-1

I was SHOCKED when I heard that pesticide would be used to exterminate native shrimp to protect non-native commercial Japanese Oysters. You are just BEGGING for an unforeseen enviromental disaster! And don't think that because I live in Washington, DC that I don't know what I'm talking about; consider our own poor Chesapeake Bay.

Commenter: Bonnie Henwood - Comment I-150-1

This proposal should not go through. The environmental impacts have not been studied enough and the pesticide is likely to have detrimental effects on other species. From my experience working in a lab with ghost shrimp and imidacloprid, this neonicotinoid is not even very effective against the species. Results suggested that ghost shrimp are easily immobilized (paralyzed) by IMI, but concentrations necessary to kill the shrimp exceed those for other marine invertebrates. Using it widespread would be ineffective and they would be likely to build up resistance over a short time. The more long term causes of the ghost shrimp problem need to be addressed instead. Oyster farm techniques as well as dams have affected the rise in ghost shrimp populations. Using a toxin that is likely to have severe impacts on aquatic species should not be the short or long term solution.

Commenter: John Herrold - Comment I-199-1

I am a 60 year old, 3rd generation oyster farmer. The oyster farmers have spent tens of thousands of dollars and hours to protect the environment in Willapa. If we weren't sure that Imidacloprid would not have a positive effect on the bay as a whole, we would be the first ones to speak against it.
The science differently shows that there is no evidence of detrimental effect. We need this tool.
Thank you for your time...

Commenter: Jake Hodie - Comment I-386-1

So many of our waters have already been ruined by development, drilling, pollution, and humans.
Enough is enough!
Our waters are supposed to be a place of peace and quiet for us, and the fish and wildlife which live in them and/or rely on them!
The animals are running out of places to live and be safe. Our fish and wildlife are under threat from so many angles. They desperately need to be protected, mainly from humans.
Life is hard enough for people, let alone the animals.
Can't we please offer them some much needed help?!
PLEASE save the waters for all future generations before they are permanently ruined. Some damage cannot be undone!

Commenter: Mary Hollen - Comment I-32-2

I support the draft EIS Alternative 1 No Action. As a tidelands owner myself in the state of Washington I am appalled by the prospect of this deadly material being let loose in the marine environment. The likely hazardous effects on non target species could have adverse consequences that I and my children and grandchildren will suffer from far into the future. We don't need to eat oysters to live good lives. I have suffered a career change and loss of a farm in my lifetime, so I had to change to survive. I wouldn't wish my misfortunes on anyone, but sometimes change is necessary when the alternative is far worse.

Commenter: Blythe Horman - Comment I-133-4

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative, non-poisonous alternatives that will not kill off important segments of the food chain and threaten important ecosystems.

Commenter: Lacey Hughey - Comment I-109-1

Poisoning the ocean to kill native species in order to profit from growing non-native species is unacceptable and unfair to the public citizens sharing these waterways.

Commenter: Randi Hutchinson - Comment I-333-1

What is wrong with you people?? You're supposed to be preserving these areas - not turning them into a toxic waste dump!

To protect the bays, facts need to be established BEFORE permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

Too much is uncertain regarding the efficacy of imidacloprid for controlling burrowing shrimp. These uncertainties include questions of the extent and duration of the effect of imidacloprid, the lack of a treatment threshold, lack of data regarding resistance, lack of field research regarding clams, and efficacy of treatment in low temperature. Certainly, no use of imidacloprid can be supported without demonstrating efficacy.

Knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

Commenter: Graciela Huth - Comment I-374-1

And most important factor to consider is man's ignorance of the balance of nature. We only look at profit and disregard the damage we cause to other species that need to be protected because if they are lost the ecosystem we need to make that profit is forever gone. We must start to be aware of the total picture and not use substances that will destroy those elements that when missing erase the picture. I would say harmony in nature requires a holistic approach. Without it we simple will keep destroying our enviroment and we will be left with an arid, infertile system. Please, do not use imidacloprid in the bays! Your children will thank you!

Commenter: richard james - Comment I-170-3

I support the letters from the Coastal Watershed Institute and the letter from Northwest Center for Alternatives to Pesticides. both of which are attached.

Commenter: Tom Jensen - Comment I-148-2

I also question the abandoning of helicopter as a proposed application method to the tidal areas. Doesn't the proposed use of boats mean application would be when areas are flooded and prone to unintended dispersal when the tide goes out? (This might be akin to cropdusting drift when it's too windy.)

Commenter: Brigetta Johnson - Comment I-95-1

Please stop messing with Nature and let Her regulate Herself. The environment is so f'd up thanks to us and all of our "management" already. I just don't believe adding toxic chemicals to a dynamic tidal ecosystem is a sound plan. Please stop the insanity and lead the world by our example. Let Mother Nature rebalance Herself!

Commenter: Lyn Johnson - Comment I-321-1

Please do not spray Willapa Bay and Grays Harbor with any quantity of imidacloprid. The only effective and protective alternative is restoration of the bays' ecology.

The facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor. No use of imidacloprid can be supported without demonstrating efficacy.

Commenter: Walter Jorgensen - Comment I-190-3

The Department of Ecology's mission is "protect, preserve, and enhance Washington's environment". No where in this mission statement does it say or even suggest that business interests should take priority above protecting the environment. I will presume that the reason business interests are not mentioned is that protecting our environment is more important than protecting business interests. I hope that is still the position of DOE

Commenter: Valerie Jusela - Comment I-21-1

The use of this pesticide is dangerous to marine life and human life. It is banned in the EU for good reason. Do not allow thiis to be used in our waters.

Commenter: Heidi Keller - Comment I-101-2

I oppose the use of pesticides on oyster beds out of concern for the unintended consequences it it will mean for sediment dwelling and other sea life.

Commenter: Jeremy Kelley - Comment I-58-1

Keep it natural! If you can't farm the ocean organically then replicate the conditions on land in a closed loop system.

Commenter: Linda Kennedy - Comment I-338-1

Willapa Bay and Grays Harbor have been affected by human activity over the past century that has contributed to problems experienced by all who use the bays. Of the three options proposed, the No Action alternative is the best. However, what is truly necessary to address these problems is an option that was not considered in the SEIS –a plan to restore the habitat by removing stressors from streams flowing into the bays.

We have learned the painful and devastating long term effects of pesticide distribution and we should be exploring natural management policies.

Commenter: Dennis and Susan Kepner - Comment I-372-1

We live on the East Coast where we also grow and harvest oysters in The Great Bay of NH & Maine. BUT we do not need to poison the waters to do so. These ecosystems are very fragile due to pollution from sewage, recreation, runoff from farms, and acid rain!! Cleaning up the waters will go a long way to make THEM SUITABLE FOR THE OYSTERS. Even small amounts can start killing vital organisms. Adding more chemicals will only harm other marine life, and even shore birds.
These areas are already under great stress, as are the marine life in them. PLEASE tell WGHOGA to do more research to find a safe solution to their issues and SAVE the BAYS!!

Commenter: Susan Kernes - Comment I-7-1

I reside in Seattle and frequently harvest clams, oysters and mussels in season. I strenuously object to ANY planned use of the pesticide imidacloprid to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor. I rely on our pristine waters and shoreline not only for my personal use, but for the crustaceans and other nearshore clams, oysters and mussels that live along the shore and shallow waters. Simply put, any application of pesticides, no matter how benign the claims, is completely unacceptable. Thank you for considering my objection.

Commenter: Andy Knudson - Comment I-100-1

There is no way this practice should be allowed.

Until the effects of these pesticides is fully understood there should be zero Imidacloprid applied.

The fact that this application is being considered is scary based on the lack of information concerning the potential damage to the envoironment.

Commenter: Karen Laakaniemi - Comment I-366-1

Dear Mr. Rockett: What is WRONG with these people? Don't they know that what poisons one segment of ecology will ultimately affect all other living organisms, humans included??

Commenter: Christopher Laughbon - Comment I-29-1

Please don't be spreading poison into our delicate marine environment. This seems so very fundamentally wrong it is hard to no where to start. Use of poison is not integrated pest management. Working with the environment is.

Please don't do this.

thanks

Commenter: Thomas Lawrence - Comment I-38-1

Please deny the application to apply imidacloprid to oyster beds in Washington state.

Our first priority should be protecting our environment. Economic activity at the expense of the environment is short-sighted and unsustainable. Eventually, both collapse. It's not worth the risk.

Just because imidacloprid is claimed to be safe by the manufacturer does not mean that it is. Time and time again, we have seen pesticides supposedly safe be discovered to have broader and longer ranging affects than was claimed, sometimes to the point of needing to be banned.

I don't believe imidacloprid is safe for the environment and I don't believe imidacloprid is safe for me.

Because I don't know the source of my oysters, if imidacloprid is approved, I will need to cease consuming oysters entirely, as a precaution for my own health, and because I do not want to financially support such folly.

Commenter: Jennie Lindberg - Comment I-123-1

I have reviewed the EIS and believe this plan is understudied, inadequate and fails to protect community and environmental health.

Commenter: Betina Loudermilk - Comment I-77-2

What happens in Washington makes its way to tables in California. We need to stop poisoning the earth and ourselves. Big fat NO here

Commenter: Betty Lowman - Comment I-352-1

Upsetting a natural balance could have unintended consequences, and would require maintenance to keep up the suppression of native creatures in these ecosystems. Don' spray. Leave the shrimp alone. Grow Japanese oysters in Japan.

Commenter: K Lyle - Comment I-357-1

No action, no spraying is the only smart option. I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Jacob Manning - Comment I-80-1

Stop dumping poison in OUR Oceans! It's called the "Environmental Protection Agency" for a reason.

Commenter: Priscilla Martinez - Comment I-370-1

We need to take better care of what is left of our environment, and our wildlife.

Commenter: Gina Massoni - Comment I-149-1

I support efforts to protect this fragile ecosystem from a potentially dangerous pesticide application. This plan is understudied, inadequate and fails to protect community and environmental health! Please take a look at the concerns the Northwest Center for Alternatives to Pesticides has identified. These also include suggestions for moving forward:
-The presence of data gaps undermines Ecology's conclusion of no significant adverse effects.
-Evidence for minimal impact to non-target invertebrates is lacking or contradictory.
-Field trials left many questions unanswered. There is inadequate analysis of the effects to threatened and endangered species and no recognition of potential impact to two nearby National Wildlife Refuges.
-There are impacts to Dungeness crab.
-There is uncertainty regarding important indirect effects and Ecology understates imidacloprid properties (environmental fate) in predicting effects.
-Buffers to protect against human consumption are inadequate.
-We recognize the importance of the oyster industry to Pacific County and to the state of Washington, and we support efforts to improve Integrated Pest Management (IPM) practices and research and demonstration of non-chemical alternatives.

I support timely efforts to expand promising alternatives to neonicotinoids and to increase their feasibility and effectiveness. Investments should be made in educational, technical, financial, policy, and market support to accelerate adoption of alternatives rather than continuing to rely on highly toxic pesticides. Research and demonstration are needed to determine and improve the most effective alternatives and their respective potential and feasibility for farms of different sizes, locations, shrimp population density, and access to equipment. The state should invest its resources in these efforts prior to and instead of allowing toxic contamination of state estuaries.

Department of Ecology must protect Washington's water, wildlife, public health, and local economies from the harmful impacts of toxic pesticides. The future of oyster farming in

Washington State depends on the industry's ability to adopt sustainable cultural and management strategies.

Commenter: Janet Matthews - Comment I-327-1

As a supporter of healthy wetlands on the other side of the country - in Nassau County NY - I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Eleanor Mattice - Comment I-107-1

Do not use imidicloprid in Williap Bay. I used to live on the Long Beach peninsula. Our water is too precious to put more chemicals in it. I advocate to remove the dams (as many as possible) and try to bring back the natural predators of ghost shrimp. The use of chemicals is unsustainable. We need organic solutions. I love oysters but I not buy any from Willipa bay if imidicloprid is used and will tell my friends and family about it too. Please do the right thing and come up with another way to deal with the ghost shrimp problem. (Can ghost shrimp be eaten?) Sincerely, Eleanor Mattice 633 Hall Road Colville, WA 99114

Commenter: Cristina McCutcheon - Comment I-153-1

The potential for unintended, and irreversible, consequences is great. Please do not risk the long term health of this ecosystem for relatively short term financial considerations.

Commenter: Heather McFarlane - Comment I-147-1

Why are we discussing an outmoded and dangerous treatment when other areas use above sediment methods to protect their shellfish. I believe Drakes Estero, among others, plunged either wood or metal stakes into the sediment to support cross beams from which they hung/hang product to maturity. They then simply used skiffs/boats etc to harvest among the raised, hanging platforms. Depth of sediment should determine appropriate materials for the long and strong stakes. It is ludicrous to have Washington's Ecology having to expend monies to "control" ghost shrimp, while across State lines, Oregon is studying how ghost shrimp feed salmon, etc, etc.

Commenter: Laura McGrath - Comment I-132-1

I understand that pesticides might be the most cost effective way to address this issue, but this does not consider the cost to ecosystem and human health. More effort needs to be placed on finding a more ecological friendly and less toxic solution.

Commenter: Sarah McGraw - Comment I-16-1

I love Washington shellfish, I value the industry, and I am alarmed to know the environment has changed enough to threaten the harvest. But I fail to see how introducing insecticide into that same changing environment can possibly do anything but hasten its decline. I strongly oppose this proposal, and I urge you to reject it.

Commenter: Karen Miller - Comment I-139-1

It is insane that the state is even considering allowing a pesticide that is banned in other parts of the world to be sprayed on our precious and sensitive waterways simply to improve industrial level shellfish growing that is entirely out of control throughout Western Washington. They are looking to kill a native species in order to grow/sell a non-native species. Where is the sense in this? Perhaps the native species is doing exactly what it should be doing in order to take back it's natural habitat from the invaders placed by industrial level shellfish operations. I will check with any restaurant on their source of oysters and will never purchase from any grower who uses pesticides. DOE you must put a stop to sacrificing our ecological environment for the benefit of a few growers profit margin.

Commenter: Melinda Mueller - Comment I-136-1

I oppose the use of imidacloprid to control burrowing shrimp. This shrimp species is native, not invasive, and performs important ecosystem functions (such as bioturbation). Though they are a "pest" in regards oyster farming, "Their effects may, however, have knock-on effects across the entire ecosystem, and may buffer it from the hazards of nutrient enrichment and increase primary and secondary productivity by increasing the amount of dissolved inorganic nitrogen (1)."

Furthermore, neoniconotinoid pesticides, such as imidacloprid, pose a significant threat to other species and to ecosystems as a whole. They are known to be toxic to birds, fish, and aquatic invertebrates other than shrimp (2, 3). "Of the neonicotinoids, imidacloprid is the most toxic to birds and fish (4)." These pesticides also pose significant threats to honeybees and other pollinators (5), whose productivity is crucial to Washington agriculture and ecosystems.

Finally, near-shore spraying risks pesticide contamination of shellfish that are harvested commercially and by individuals.

The use of this pesticide is not a safe or appropriate action.

(1) R. James, A. Atkinson & Alan C. Taylor (2005). "Aspects of the physiology, biology and ecology of thalassinidean shrimps in relation to their burrow environment". In R. N. Gibson, R. J. A. Atkinson & J. D. M. Gordon. Oceanography and Marine Biology: An Annual Review. 43. CRC Press. pp. 173–210. ISBN 978-0-8493-3597-6.
(2) Morrissey, Christy A., et al. "Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: a review." Environment International 74 (2015): 291-303.
(3)Fishel, Frederick M. "Pesticide toxicity profile: neonicotinoid pesticides." University of Florida, IFAS (2005). "Of the neonicotinoids, imidacloprid is the most toxic to birds and fish."
(4) Alaux, Cédric, et al. "Interactions between Nosema microspores and a neonicotinoid weaken

honeybees (Apis mellifera)." Environmental microbiology 12.3 (2010): 774-782.
(5) Henry, Mickaël, et al. "A common pesticide decreases foraging success and survival in honey bees." Science 336.6079 (2012): 348-350.

Commenter: herb nelson - Comment I-13-1

There is no need to poison native species only to line the pockets of a few farmers. This poison migrates to the ocean and kills other valuable species. there is too much poison in the ocean already. Its rediculous to reconsider something that was already curtailed.

Commenter: Jeff Nesbitt - Comment I-206-1

Jeff Nesbitt (Oral Testimony): My name's Jeff Nesbitt and I grew up on Willapa Bay. I'm a resident of Pacific County, I currently live in Chinook, WA and I work as Director of the Department of Vegetation Management for Pacific County and also as the coordinator for the Noxious Weed Control Board. So I'm here tonight as a private citizen to recommend that you select alternative 3 from the choices. In that respect I think that in a limited capacity the safe use of this chemical does not pose a large enough risk to jeopardize the livelihoods of families that are depending on the success of aquaculture in the area. Growing up in the area and knowing the bay as intimately as I do -- I lived on the bay starting at age 12 and ever since then I've lived or worked on Willapa Bay and I love the bay. The last thing I want is to see it damaged or harmed in any way. So the important thing to look at is risk, and where the true risk is. And a lot of people assume that doing nothing is less risky than taking action, when I would completely disagree with that.

A good example is to look back to the Spartina infestation that was just very recently resolved, because of human intervention. Without the time investment and the financial investment of the Willapa and Grays Harbor Oyster Growers Association, Willapa Bay would be a grass field today. These guys put in millions of dollars and hundreds of hours of their time to invest in the health of the bay and it worked. It's been one ofthe most successful restorations in recorded history - and very little drawbacks. It's been a massive success. And to tell them that now, after the success of this program, your investment was a wasted because you're not allowed to protect your crops is ludicrous. The risk is inherent in pesticide use and that's something that we all accept working in the industry and as consumers of products every day. But in this case the risk does not outweigh the potential benefit. And when safely used herbicides and pesticides are very useful tools and with strict monitoring and specifically the 5-year permit with monitoring throughout and then a re-evaluation at the end of that permit to decide maybe if some of these uncertainties have been cleared up just through monitoring over those years and then to readdress the question of whether or not to continue and who knows in that time they might find another alternative that works better. And I hope they do -- because non- chemical methods would be great. And the fact is that we currently don't have any that work.

The first 2 years that I worked in this industry I was a research assistant at Washington State University Long Beach branch and I worked under Kim Patton doing research on growing shrimp. And we spent a lot of time trying out different methods. And I actually got to ride on that big all-terrain vehicle thing and while it was fun -- didn't kill the shrimp. And I think that we should definitely not stop looking for alternative methods but at this point the proposed plan seems to be the most viable option. Thank you.

Commenter: Dave Nisbet - Comment I-198-1

I am an oystergrower that farms in the traditional way, that is planting seed directly on the ground. This is the natural way oysters are grown. Heavy ghost shrimp infestation causes the mother shell with seed spat on it to sink and smother into the ground.
Bottom culture oyster beds provide hiding and cover for small fish and crab, grasses, clams, and a myriad variety of biological species.
Treatment of heavily infested oyster beds insures that this important bay remains healthy and biodiverse. The science behind the treatment is well studied and benign as well as a very low dose.
We have a changing environment with ocean acidification and global warming, with almost no natural sets of oysters anymore. We need to support oyster growers along with their positive impact to clean water and the bay.
The treatment is over bare ground and not over oysters. It does not eradicate shrimp just helps to control it on our most product oyster bars.
Thank you.

Commenter: Mike Nordin - Comment I-229-1

Mike Nordin (Oral Testimony): I'm going to apologize ahead of time if I have some deep pauses.

Fran Sant: It's okay. We know you're fighting through some pain.

Mike Nordin: My name is Mike Nordin. I live in Pacific County, Raymond. I'm the manager of the Pacific and Grays Harbor Conservation Districts. I'm speaking on behalf of the Pacific Conservation District, which is in full support of approving this permit. So why? You've been hearing a lot of statements about why and I'm going to try to do some short points on that and I'm going to put some personal to this.

The ecology of the bay is in threat by the burrowing shrimp. This is our opinion at the Conservation District. There has been a tool for controlling the recruitment for over half a century. Without a control there will be an increase of disruption of the environment. I think that's important here. If you do nothing, if you don't let them do this, it's not just their industry that will be hurt. It will be the ecology of the bay. In my opinion it could pass a threshold it could not return. And I'll get to that in a little bit here. The thing that I've been hearing out in the community , and we have to do a lot of outreach for what we do and we try to talk about this issue with people. And one of the most disturbing comments I've heard from people , people that really are ignorant about the issue , is that quite possibly the shellfish industry and the shellfish in itself in the bay, maybe that's the natural thing to do , just let it go. And that is extremely disturbing to me and I think that is the opinion that you hear from the people that are not affected by living in this community and understanding where this economy comes from.

I'm from north Idaho, around the C'oeur d'Alene area and I've seen what happens when the natural industries go away. It gets taken over by development and the area gets destroyed. Everybody goes to north Idaho and they think it's really beautiful but it is not the same. It destroys the culture and the environment. There aren't those people any more to protect and put buffers on that development. You take these folks away , and you've heard some people say that they're in threat of going away , there is no one there to protect the bay. And the fact is, the reason why the bay is the cleanest estuary in the continental United States is because of these people -- and the people that understand what they do. If they go away there will be development around the bay so the people that are trying to stop this permit , in the long run, they are going to get exactly what they ask for. There will be destruction of the bay, make no bones about it. And that's probably the main thing that I want to emphasize here. I could go on and reiterate a lot of the different things here.

I also am disappointed that , I understand why you have to have a hearing in Olympia , but I'd be really sad if this thing gets swayed by a bunch of people up there who are not intimate with the issue and have nothing to , no pain from making that decision , going in and overriding this issue. That scares me. Down here, it's a minority. It's only a couple people. If it was a vote in this area, this would already be done. In fact, I am in pain right now and I can't believe I even have to be here right now. I want you to look at the documents by Dr. Kim Patton and Dr. Brett Dumbold and by Kathleen Sayce. They talk a lot about the ecology of the bay and what's going to happen here if you don't control this. It's not just about the shellfish. Like I said, they've been controlling it for a long time. If you take their tool away, they go away , and I hate to use the slippery slope argument but I'm pretty sure that that's what's going to happen. I've seen it happen before. Anyway, thank you.

Commenter: Mariette Nowak - Comment I-341-1

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. This action would cause great harm the native species in these areas. Furthermore, the many uncertainties regarding the immediate and long-time effects of such spraying are detailed below. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: James Nunn - Comment I-10-1

Oyster growers and other harvesters of the sea, as is true of their land-based farmer counterparts, do not own the land, the shore, the water, no matter what documents they may provide which contend otherwise. They are temporary tenants and (hopefully) consientious stewards of these resources, belonging simultaneously to everyone and to no one.
We understand the desire of these stewards to prosper, but we cannot allow a shortsighted pursuit of individual prosperity to jeopardize the long-term viability of a resource which is the rightful

and sacred inheritance of everyone--including those yet unborn. This is especially true of water, as it knows no bounds. Poison placed here is poison placed everywhere.
In short, this proposal is unconscionable, and therefore, absolutely unacceptable.

Commenter: Lisa Olsen - Comment I-171-1

DATE: October 30, 2017

TO: WA State Dept of Ecology

FROM: Lisa Olsen Citizen and Pacific County Commissioner

RE: Comment on Imidacloprid draft SEIS I am writing to encourage your department to go ahead with the permit which would allow the oyster growers in Willapa Bay and Grays Harbor to spray the burrowing mud shrimp which is infesting their grounds and eroding their farms at an alarming and emergent rate. I attended both of the public hearings on this topic earlier this month and the consensus of the testimony against the spraying was that there just wasn't enough science yet to allow it. This does not indicate a harm to the bay or the ecosystem that exists in and around it. No one that makes their home and/or living on and around this bay intends to do anything that would harm same. In fact, it seems that doing nothing would do much more harm to the bay itself than allowing the control of this infestation. And waiting for who knows how long it would take to satisfy everyone that this spray will not deleteriously effect our area will be a death knell to the oyster industry and Pacific County as a whole. And for what? To err on the side of caution in this instance will have an outcome that would never be recovered from. Continue to study by all means, but allow this industry to survive while you do so. Those that I heard contest have virtually nothing at stake and contend to destroy a history, economy and way of life of those that have everything at stake and everything to lose should the bay be poisoned – whether by infestation or chemical. Please do not allow a lack of science nor political pressure to destroy the largest economy in Pacific County.

Thank you for your careful consideration of this situation.

Commenter: Lisa Olsen - Comment I-232-1

Lisa Olsen (Oral Testimony): Hi. My name is Lisa Olsen. I am a Pacific County Commissioner here. But before that, in full disclosure, I am the matriarchal portion of Olsen & Son Oyster Company. Our family , thank you for coming here, by the way , our family has been on this space since the 1860's. We are farming some of the same ground that was done by the first generation. My husband and my son are the fifth and sixth. My grandson's the seventh. He goes out there and he works on the bay. It is an amazing life. And there's a documentary out there. It's called Oyster Farming and the Changing World. It's a 7-segment documentary done by Stony Point Pictures by a native son named Keith Cox. I would really encourage , if you haven't seen it , you to watch it. It's pretty neat. There are so many families here that have been on this bay for many years and they love it. They would not do anything to destroy what they have built and what they are trying to do.

The industry is the number one industry in Pacific County right now. Timber used to be. But after the Spotted Owl in the '80's and now the [unintelligible] the timber is severely challenged again. Especially in Pacific County we're looking at severe financial impacts on the county if this [unintelligible] goes through. If the oyster industry is impacted we might as well roll up the sidewalks. On a purely financial downhill. In the early 1900's the bay died. That's why there are Japanese oysters that were brought in. They were able to , they would be able to do that, you know. All the natives died and they brought in the Japanese oysters. That wouldn't be possible in this current scenario because the mud would be unable to be farmed if the ghost shrimp were allowed to take over.

I would ask you to please consider using a common sense approach rather than succumbing to political pressures of those who really have no stake in what we're doing here in Pacific County and Willapa Bay. The negative impacts of this being questionable at best, but the farmers are not opposed to continuing observation while they continue to farm. They are happy to work and make it better. They're ecologists at heart -- and environmentalists by the very operation of their farms. They need to stay healthy and thriving. The fact that after the years of spraying this bay continues to be productive and thriving and beautiful should be a huge testament to the fact that we can do this. We can use this only tool that we have to keep this industry going. So I would very much be in favor of this permit being approved. Thank you very much.

Commenter: Robert Paradise - Comment I-168-1

Please work for restoration of Willapa Bay and do not allow spraying of Imidacloprid.

Commenter: Eric Petit - Comment I-224-1

Eric Petit (Oral Testimony): My name is Eric Petit. I'm a small oyster farmer here on the bay. I farm a couple hundred acres. One of my [unintelligible] is, I'm on the very edges of the river, where I'm not around a lot of other growers , and everything outside of me has always been pretty much shrimp ground. So I guess I'm kind of one of the first ones that's going to see the effects of what's going to happen here. And what I'm seeing now -- I've lost about 17 acres over the last 2 years, that's not farmable. What I've seen for recruitment now , I started working for Olsen & Son almost 40 years ago and what I'm seeing for recruitment now is far beyond anything we've seen in the last 20 years. So if I don't have a tool to be able to combat shrimp on my ground then my 100-acre farm that's on the edge , it's going to disappear. I mean I don't have to even think about it , it's going to be gone. It's slowly creeping in on me. So there needs to be something. We've looked at different types of mechanical effects. There isn't anything for me that's going to work besides a chemical. So Imidacloprid is about all we have so I'm hoping there is some way we can make this work. My family has been living on this bay for the last 5 generations and I have 2 daughters that I'd like to be able to pass something on to here and I see , if there isn't a chemical , that my farm will no longer exist here. So, thank you.

Commenter: Gloria Plaggemeier - Comment I-130-1

I recommend disapproval of this permit request for the following reasons:
1. Unknown environmental impact
2. Adding yet another toxin to the environment is undesirable.
3. The mud shrimp is an endangered species that generally benefits the aquatic ecosystem.
4. The oyster growers can use an alternative method to grow and harvest oysters that will be beneficial to them (no bad press and lost revenues due to backlash) and the environment. Please review this post: https://www.cnbc.com/id/100866597.

Thank you,
Gloria V. Plaggemeier

Commenter: Jessica Plesko - Comment I-71-1

I am not sure how anyone could think this is a good idea. Please reconsider this and do not pollute our environment with more toxins.

Commenter: Penny Rand - Comment I-4-1

Please do not destroy the environment with toxic sprays. Fish farms and oyster farms have created this problem and will destroy the wild fish and oysters not to mention humanity.

Commenter: Ingrid Rasch - Comment I-175-1

I am absolutely OPPOSED to using any means of reducing the Burrowing Shrimp population. These shrimp are native to Puget Sound/Salish Sea and if anything, should be protected. Commercial shellfish farming should not eclipse native species.

Commenter: David Richman - Comment I-350-1

As a retired field biologist (Ph.D, University of Florida) I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. I find it quite unbelievable that chemical sprays would be used on any body of water, as aquatic organisms are very susceptible to unintended effects of such chemicals. As part of my duties as a professional I prepared and administered contests for FFA on applying pesticides correctly for 30 years. The manual that I used emphasized that sprays should be kept from entering water courses, ponds, lakes or any other body of water as much as possible.

Commenter: David Richman - Comment I-384-1

I am a retired field biologist who specialized in entomology (Ph.D. University of Florida). Because of this I am fairly well informed about the effects of pesticides in the environment. Aquatic systems are especially vulnerable and must be considered with great care.

Commenter: Deborah Rudnick - Comment I-281-1

It is time to recognize that continued use of toxins in our aquatic environments is the antithesis of what we should be striving for in our relationship to these important natural resources. We have got to find a way of managing our shellfisheries that does not involve poisoning our waters.

Commenter: William Kelly Rupp - Comment I-112-1

Without question, the threat to our shellfish industry from burrowing shrimp is now critical. Imidacloprid applications have been proven to be effective in containing the shrimps' spread without long-term adverse impact either to habitat or water quality. I'm a property owner on Willapa Bay without business interests in shellfish, and a strong advocate for conservation and habitat preservation; I would not support the permit approval if I believed for an instant that Imidacloprid would compromise our Willapa Bay ecosystem. I urge Ecology to approve this permit application at its earliest convenience. Thank you.

Commenter: David Ryan - Comment I-121-1

My name is David Ryan. My wife and I live in Ocean Park. My education and experience is as a forester and a natural resource manager. I have experience in managing for habitat and I support the Willapa Grays Harbor Oyster Growers Association proposal to manage burrowing shrimp.
I have spoken with representatives from the shellfish industry, scientists, community members, and I have read the reports. The more I learn, the more I know that the oyster growers have done their due diligence and are working to find the best path to a healthy bay. I understand what Imidicloprid is and what it does. I understand the concerns around its use. I have all those same concerns. And I know that the oyster growers have those concerns too.
For many human illnesses doctors prescribe medicines that are, technically toxic, yet people ingest and inject these toxins with the understanding that, in the right doses and applied in the right way, the body will be better. My research indicates that the proposed formulations, application methods, concentrations, coverage areas, timing, and monitoring protocols are all adequate mitigation for the issues surrounding its use. And I believe that the result will be a healthy and balanced ecosystem.
I believe a healthy oyster industry is indicative of a healthy bay. And when it comes to stewardship of the bay, the shellfish industry has proven themselves to be among the most conscientious and dedicated stewards this community could hope for. They are out there more than anyone and they are the best monitors of the bay, its condition, and changes to the environment. They are fine stewards using good science and I support their efforts.
This issue goes beyond a matter of native vs. non-native. This issue is about ecosystem function, ecosystem balance, and ecosystem health. The current burrowing shrimp populations are symptomatic of an unbalanced ecosystem which, if left unchecked, will lead to a degraded and unhealthy bay. I want a healthy bay and I know the oyster growers do too. A "no-action" alternative is unacceptable. And we must find solutions that maintain on-bottom oyster growing as a viable sector of the county economy and ecology. The current proposal is our best chance right now, and we don't have time to delay any more.
In the early half of the twentieth century, Aldo Leopold travelled through the west. He addressed the laissez faire attitude he encountered regarding cheatgrass. And although he writes of

cheatgrass, I believe the same principle applies here. He says:
"I listened for clues whether the West has accepted cheat as a necessary evil to be lived with until kingdom come, or whether it regards cheat as a challenge to rectify past land use.
I found the hopeless attitude almost universal. There is, as yet, no sense of pride in the husbandry of wild plants and animals, no sense of shame in the proprietorship of a sick landscape.
We tilt windmills in behalf of conservation in halls and editorial offices, but on the back forty we disclaim even owning a lance"
I see the oyster growers fighting on the back forty, taking pride in their husbandry and I, for one, will not disclaim ownership of a lance. I take mine up and stand with the oyster growers as they fight for their livelihoods and a healthy bay ecosystem. I do not want to feel the shame of allowing a sick landscape to become our legacy. They have fought this fight before with spartina and I hope we will help them do it again with burrowing shrimp. It's the right thing to do and I urge everyone to support their proposal. Thank you.
David Ryan
PO Box 338, Ocean Park, WA, 98640
dcryan28@gmail.com

Commenter: Kathleen Sayce - Comment I-118-1

It is critical to any decision-making by Ecology about pesticide usage in estuaries that science-based information be the basis for estuarine management decisions. The trend in this agency towards decisions led by public opinion is dismaying. Please get back to facts, back to science, and back to factual ecological outcomes for the shellfish industry.

In that light, as an ecologist, I support science-based management of pest species in coastal estuaries, including the use of appropriate pesticides, properly applied. I also support better management of historic predatory fish species to provide control of burrowing shrimp species in the coastal estuaries of Washington.

Commenter: James Schupsky - Comment I-331-1

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid.

Certainly, no use of imidacloprid can be supported without demonstrating efficacy.

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected.

These gaps must be filled before approving the use of the chemical.

Willapa Bay and Grays Harbor NEED: what is truly necessary to address these problems is an option that was not considered in the SEIS –a plan to restore the habitat by removing stressors from streams flowing into the bays.

Commenter: Mike Shaughnessy - Comment I-272-1

This is an absolutely crazy proposed action, with extremely dangerous environmental consequences to our NW coast and it's fish and wildlife populations.

Thank you for your thoughtful consideration of these comments, and I look forward to the termination of this dangerous proposal.

Commenter: Dick Sheldon - Comment I-201-1

I submit this testimony based upon 77 years hands-on interaction with the tide and bedlands of Willapa Bay. I met my first Ghost Shrimp at age 5 digging cohogs at Stackpole Harbor in 1940.

I've spent most of my life working the bedlands of Willapa for local oyster companies and our own Northern Oyster Company holdings. I doubled our company through observation of key tidal flows, current patterns, soil structure, stability and many other subtle indicators that those overlooked wastelands could be made productive. Every one of these bedlands were at the time quicksand, Ghost Shrimp monocultures, unused by shorebirds, devo-d of eel grass, zero habitat for prey species, and benthic invertebrates with no possibility of spawning grounds for herring, sandlance, or other fishes, no depressions or vegetated tidal pools, nothing but quick sand and strings of filimus algae destined to form large mats that settle onto oyster beds poisoning every benthic creature trapped beneath it. One year later, after a chemical treatment of Carbaryl, every treated bed was fully functional as an oyster bed. Eel grass and tidal pools were prevalent. Shorebirds, by the flock, fed on the massive populations of worms, bugs, and invertebrates. Juvenile crabs were everywhere among the oysters and tide pools. Examination of eel grass showed herring spawn on the new grass blades with Dungeness crab eating small oysters, on the beds, all indications of high usage of the beds when they were tidally submerged. This list, including juvenile flat fishes, salmon smolts, blennies, ling cod, even an occasional octopus, has rated the natural ground raised oyster beds of Willapa Bay as the baVs highest rated habitat overall including the eel grass beds. Incidentally, the digging action of high density shrimp will totally remove eel grass and its' root systems. The foregoing description was of the result of shrimp eradication on several Northern Oyster Company beds surrounding, or near, our primary bed E82 in the Stackpole area on the Northern Peninsula. Like conditions are found fairly universally baywide on similar reclaimed beds. It must be stated that with the Carbaryl treatment a bed so treated with one application, at low tide on a drained bed, would not have to be repeated for five to seven years. The bed remains the top-rated habitat for marine animals all that time. Retreatment, again a one- time event, starts the entire process over for at least another 5-year uninterrupted contribution to Willapa's ecosystem. That works out to a negative 1 to a positive 1825 positive ratio. The example stated, though based upon Carbaryl, is used to identify and compare the condition and function of the same bed with and without shrimp over a given time frame. Since the use of a control has been denied us by the Department of Ecology to date we have had to abandon use of one 42-acre bed of our Stackpole holdings to shrimp and acres of other beds are becoming critical. I've spent the last 40 or more years in defense of Willapa BaVs irreplaceable marine ecosystem. 32 years as the Willapa Bay Oyster Growers front man on shoreline development and water quality issues; both on the county and state level. I dealt directly with our federal and state representatives and agencies on the Spartina eradication in Willapa which was kept active only by the constant pressures of the Willapa Growers and Senator Sid Snyder. It is very painful for me to witness the track this permit has taken. No one can deny that politics has replaced science in this process. The Seattle news article that evolved into the growers permit retraction, the D.O.E. refusal, to reconsider refusal to accept work already completed to be applied to this permit, statements made by D.O.E. upper management about this permit's status. The craziness and dishonesty seems to be evermore like Washington D.C. than Washington State lately. D.O.E. is intentionally ignoring the impacts of surrendering Willapa Bay to burrowing shrimp. Nowhere in D.O.E. consideration is there a true assessment of what losing the bottom grown oyster industry will do to the overall ecology of our bay. Ignored is that Willapa Bay has an entirely sand base as opposed to Puget Sound's primary gravel base. That Willapa soils are all fines that shrimp will fully exploit making on bottom oystering impossible. D.O.E. and individuals from Puget Sound are praising the major companies use of piling elevated plastic structures to overbuild the quick sands of Willapa's shrimp infestation. These same people have, for years, been hammering the same companies in Puget Sound for filling their sound beds with plastic installations. until recently Willapa Bay had only low long lines on beds, too unsuitable for ground culture, now the bay has hundreds of acres of plastic plantations rising as much as 6-feet into the tide; some isolated but more often displacing what we are previously producing traditional ground grown beds. The hypocrisy of these people, some no doubt will be submitting testimony against this permit, is unbelievable. I can only hope that their testimony is judged by the science before acceptance which most opposition has not been to date. Meanwhile other D.O.E. jurisdictions have left unchallenged the unlimited use of plastics in Pacific County's shore and bed lands. Our shore line now abounds with the residues of their dereliction. Again D.O.E.'S avoidance of assessing plastics marine impact, presently the only D.O.E. blessed method of shrimp avoidance for industry within the Willapa ecosystem, endorses the impression that there is a responsible alternative with less impact than allowing ground cultivation through chemical control. Please read the "Plastics on the Half Shell" micro plastics in shellfish a B.C. Canada 2016 study -- 9/22/17 Daily Astorian. Shellfish growers do not own Willapa Bay. We only share it with all the creatures that use it for part, or all, of their existence. Man has however had the power of making drastic changes that impact everything in it. One major change was the damming of the Columbia River and the resulting reduction of spring flood waters that once turned Willapa Bay into a near freshwater lake for weeks ata time. A death sentence for the new shrimp recruits found in the upper few inches of sand. This natural control ceased with Columbia flood control and shrimp populations began exploding shortly after World War II. The much touted, but unproven theory among agencies, is that shrimp are cyclic in populations. And this present explosion is natural. I agree that shrimp are naturally cyclic, but not in the sense of being applied to present conditions. The natural control factor prior to Columbia River flood control has never been acknowledged or factored into the present shrimp explosion. Prior to damming the fresh water control likely overroad the spikes by killing the vulnerable young and due to shrimp's longevity, the population was controlled and remained fairly stable; far below the levels we have today. Historically available evidence of this still exists today. The massive native oyster reefs and stocks that supported an entire industry from 1850 to 1900 could not have existed had burrowing shrimp population not been naturally controlled. Native oyster cannot tolerate siltations. Creating siltation is the shrimp's means of survival. Shrimp must constantly dig filter and expel the fine particles of sand that they clean for food and throw out of their tunnels or the tunnels would fill and suffocate them. Which imidacloprid applies as a killing tool. A massive shell midden carbon dated to 1400 years old is located on the North Peninsula near Oysterville establishing that native stocks were always in abundance which could not have occurred with high shrimp populations. Furthermore, historically, the stable sands of the peninsula's intertidal lands north of Nahcotta to the tip of Leadbetter point were firm enough to safely drive a two-wheel drive vehicle on down to the +1" tidal elevation. I know this because I regularly did so. Before me, my grandfather did the same with his Model T Ford in the early 192% equipped with 4" wide tires. It's been impossible todo this since the 1960s due to the shrimp. These same bedlands were sold by Washington State starting in 1890s to farm tiny native oysters. They were firm and not shrimp infested as now or they could not have possible used them. There is absolutely no evidence the shrimp population we have now existed before in Willapa Bay. The exact opposite is shown by historical evidence from the 1400-year old midden, to the facts stated above; all invalidate your agency's claim that the recent population explosion within Willapa's ecosystem is cyclic and natural. It is not. It is an unnatural situation that is causing baywide ecological destruction and your agency must stop playing the fake natural card to avoid this unpleasant situation and address the true issue of shrimp up-ending the Willapa ecosystem and how they can be controlled honestly. 80th radical solutions are created by unintentional side effects of man's interference with a natural system. Your and other Washington landholding agencies constantly refuse to admit that Burrowing Shrimp are an environmental problem for Willapa 8aVs entire ecosystem. Our issue, oyster-vs-shrimp is only a documented portion of the shrimp-vs-ecosystem catastrophe that is now impacting all segments of Washington's southern coastal marine populations. Willapa Bay's ecosystem supports the base for a major portion of the near shore coastal fishery along with its' infrastructure. Recent studies find that the bawv'ide food production processes depend upon stable conditions that are completely canceled on shrimp grounds. All the while, yours and other agencies, shun your responsibility for the whole by ignoring the obvious while beating up the only group that has consistently over the past many years, put science time and much treasure into finding solutions not only for shrimp but for most every disaster facing Willapa's vulnerable ecosystem from water quality. Eradicating Spartina, fighting harmful development, restoring wetlands, to this fiasco. Local growers have always put the baVs welfare first. Enlightened regulators have realized that unintended negative consequences occur sometimes as a by-product of the best of projects and sometimes extreme measures must be taken to rect-fy the unintended consequences. Some local examples also of Columbia River origin are (1) the islands created by Army Corps dredging and rerouting attracting salmon smolt eating birds. Answer: kill birds, and (2) federal protection of sealions, now tamed by human interaction wiping out both sturgeon and endangered salmon runs. Answer: kill seals and sealions again. 80th radical solutions but created by unintended side effect of man's interference with a natural system. The imbalance caused by exploding shrimp population within the bay's ecosystem is a third example. The solution is not radical or extreme although it only applies to a small segment of the bay's bedlands it will at least salvage natural bedlands through private investment while the majority, state lands, are left to degrade. This effort by the shellfish grower is unique in pest control. Terrestrial farmers use chemicals to protect crops, to kill or control critters and diseases directly attacking their crops. The shellfish growers are not doing this. The growers have and will continue to share the space, accept predation loss while furnishing prime habitat, unrestricted, as we have for the past 160 years. The growers only goal is to be able to protect the land; not the crops, only the land. The billions of critters that will share this land have no voice here. Continuing to deny that this is a bayw-de problem may doom, even the limited grounds, that the growers may be allowed save. Hyped plastic plantations do nothing in supporting Willapa's benthic communities. Without control of burrowing shrimp, the effects will be felt throughout the southwest Washington economic and marine systems.

Not very respectfully submitted by,

Dick Sheldon
Willapa Resources
Nahcotta, Washington

Commenter: Dick Sheldon - Comment I-164-1

October 9, 2017
Mr. Derek Rockett, Project Lead
Washington Department of Ecology
Water Quality Program
PO Box 47775
Olympia, WA 98504-7775
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Not very respectfully submitted by,

Dick Sheldon
Willapa Resources
Nahcotta, Washington

Commenter: Linda Shirey - Comment I-360-1

Federal agencies always seem to choose the most dangerous and expensive ways to treat a problem. Spraying will only do additional damage to the area and I find it hard to believe that your experts and environmentalists consider this the best solutions. I will never see this area in my lifetime but I like to believe that it will be there for the future not destroyed by disfunctional agencies of the government.
Thank you for your consideration

Commenter: Alda Siebrands - Comment I-144-1

It is impossible to imagine any permitting of a substance to control (get rid of/kill) a native species in order to farm a non-native species. No application of a killing pesticide can have a happy ending, except for a very small entity - those who can make money off the elimination of their enemy, a creature that naturally has evolved to exist in those waters. And no way does the application of a pesticide kill selectively. How many studies need to be completed to provide enough information, over a long enough period of time, to finally put to rest the idea that we humans can safely and selectively apply a killer pesticide to an ecosystem with no consequences to everything else that lives in that ecosystem?

Commenter: Tenney Singer - Comment I-62-1

The use of poison, especially one with so many unknowns, is unwise. Organic growers have worked hard to find other ways to combat pests, so now it's time for the scientists and oyster farmers to find ways to deal with the burrowing shrimp without poisoning the waters, the food supply, the good crustaceans and ocean dwellers. If you poison your crop, you will not be able to sell it to very many people. Do you really think the oysters will not be affected if you pour poison into their habitat?

Commenter: Courtenay Smith - Comment I-379-1

While we have learned a great deal about the symbiotic relationships between organisms there is much yet to be discovered. Poisoning an ecosystem to protect one organism goes against the painful lessons of the past and thru relationships still unknown =may actually damage the very thing we would protect.

Commenter: Marina Smith - Comment I-69-1

Please do not approve the application of pesticides to our oysters! We do not know the long term consequences of chemicals in our waters, and we need to be doing everything we can to protect our beautiful waters and the animals who call it home. Furthermore, who wants to eat seafood that has been sprayed?! Please, please, please do not approve this!

Commenter: Jack Stansfield - Comment I-353-1

As a lifelong Washingtonian who values our unique environment, I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Nadiya Stipanovich - Comment I-183-1

I am against the use of NEUROTOXIN by the oyster farmers. We are bombarded enough with toxins all over. I think we should be more conservative and careful in using those. Especially since little known direct risk to fish, birds, marine mammals, and human health and further research is needed.

Commenter: Michael Sullivan - Comment I-161-2

support the comment letter from the Coastal Watershed Institute found here: https://commentinput.com/attachments/projectID_1001/10063/merged//12829.pdf)

Commenter: Paul Symington - Comment I-23-1

Do not allow special interest for-profit Oyster producers to poison our public salt water with any pesticides whatsoever.

It's wrong to allow for-profit special-interests to use poison in our shared public waterways. Poison will likely have unintended consequences, which will cost the environment, fisheries and public dearly while the for-profit oyster growers smugly pocket the profits.

If the oyster industry cannot sustainably produce without poisoning our waterways, then they should go out of business.

Commenter: Susan Trinidad - Comment I-102-1

Spraying toxins into -- what could go wrong?

This is a terrible idea, and one clearly driven by industry interests' desire for short-term profits. The long-term effects of this approach are not known, and the claim that it's possible to restrict this intervention to a particular area without it seeping elsewhere seems suspect. On its face, the odds are vanishingly small that there will be no unforeseen negative effects of introducing a chemical designed to kill things, and doing so in the fragile intertidal zone on which so much of the ecosystem depends.

I strongly oppose the proposed policy change. We have a lot of smart people in the State of Washington. Let's get on the burrowing shrimp issue, and figure out how to solve it without poisoning the Salish Sea.

Commenter: Larry Warnberg - Comment I-124-1

Hello Derek:
Thanks for the opportunity to comment on the Draft SEIS. It is encouraging that Ecology is raising serious questions about the adverse impacts of controlling burrowing shrimp with imidicloprid. I hope the application submitted by the Growers' Association will be denied.

There should be several corrections to the Draft SEIS, if it is accepted. I found no mention in the document that the burrowing shrimp are a native, foundation, keystone species in the estuaries, while the shellfish are invasive exotic varieties. Shrimp populations have been declining for at least a decade, possibly due to an introduced parasite. Loss of shrimp will have a devastating impact on the ecosystem. Killing shrimp with a pesticide to protect a non-native crop makes no sense. If/when shrimp get listed as Threatened or Endangered the issue of pesticide use will be moot. Contrary to claims by Growers that shrimp continue to be a threat to their crops, evidence presented by scientist John Chapman refutes their claim.

The Growers want to deliver granular imidicloprid by boat during high tide, which would lead to rapid dispersal through the estuary with adverse effects on many non-target organisms. There is no mention of dry times at low tide, buffer zones, or efforts to minimize drift off-site.

The Growers have inflated the threat from burrowing shrimp, failed to comply with a Memorandum Of Agreement with Ecology to implement an IPM plan, failed for several years to conduct annual meetings on IPM strategies with Agency personnel and stakeholders, while insisting that pesticide control of shrimp is their only option. Their hired scientist Kim Patten defended this point:
"In his conclusion, Dr. Patten states that no non-chemical approach is viable as a stand-alone treatment for burrowing shrimp due to logistics, cost, low efficacy, and/or impacts to non- target species. WGHOGA anticipates technical discussions with Ecology to evaluate whether and which non-chemical controls should be included as part of an IPM strategy approach to

controlling burrowing shrimp. Within such an IPM approach, non-chemical methods might be proposed as stand-alone controls in particular locations or conditions, or as adjuncts to imidacloprid applications designed to improve the overall effectiveness of burrowing shrimp control."

Patten's opinions should be taken with a grain or two of salt. He is not a shellfish farmer. His objectivity must be questioned after it was revealed recently that he accepted money from the Growers, and received Censure from the Washington State Ethics Commission. The Growers rely heavily on his research, which should be dismissed as biased and unreliable. I farmed oysters successfully in Willapa Bay for 25 years without using pesticide. There are many others growing shellfish with non-chemical methods, including the 2 largest companies operating in the 2 estuaries, Coast and Taylor, which opted out of the current permit application. Only a few small Growers on the entire West Coast persist with efforts to obtain a pesticide permit. If Ecology denies their application, viable alternatives exist, the industry will continue, and sustainable organic aquaculture may finally be possible.

Naturally, Larry Warnberg

Commenter: ROBERT WENMAN - Comment I-138-1

Robert Wenman, Resident
Gig Harbor, WA 98329

I am concerned that the Department of Ecology is catering to the shellfish industry for purposes that have nothing to do with the wishes of citizens of Washington State, the ecological health of Willapa Bay or human health. While others are banning the use of pesticides, such as Imidacloprid, our Department of Ecology is working closely with the aquaculture industry to expand the use of this dangerous chemical in our precious waters.

The number of agencies and retailers who are implementing a ban on the use of the pesticide imidacloprid continues to grow. Most recently, most retailers have agreed to phase out neonicotinoid pesticides, of which imidacloprid is one. The City of Portland issued an immediate ban on its use. The Oregon Legislature has bills before it which would eliminate its use. The US Fish and Wildlife agency has banned their use on wildlife refuges across the United States. The European Commission, in 2013, banned the use of imidacloprid. The NY Times reported in a European Academies Science Advisory Council report stated imidacloprid "has severe effects on a range of organisms that provide ecosystem services like pollination and natural pest control, as well as on biodiversity. Additionally, in 2015 the general public across the state of Washington together with a large coalition of restaurant owners opposed the previous permit based on numerous concerns including ecological impact and impact upon human health . Seattle Times, April, 2015

The following chemicals have been used upon Willapa Bay and Grays Harbor, altering the ecology, and endangering the health of local species and humans that consume fish, shellfish, and waterfowl that utilize these waters:

• Carbaryl—Eradicates native ghost shrimp and could harm other benthic species. Known to adversely effect salmon.

• Imazapyr—Eradicates spartina.
• Glysophate—Eradicates spartina. A recent study* on the effects of glysophate-based herbicides states: "Pesticides may be involved in oyster summer mortality events, not necessarily as a single causative agent but as an additional stressor."
• Imazamox—Eradicates Zostera japonica eelgrass, but is known to also eliminate nearby native eelgrass. Adverse effects on other aquatic vegetation are not documented at this time.
• Imidacloprid—Eradicates native ghost shrimp and could harm other benthic species. Linked to bee colony collapse disorder and subject of bans in other countries and states.

Among the concerns is "...the significant risk Imidacloprid presents to aquatic invertebrates..." which, in turn, "...can also cause a cascading trophic effect, harming fish, birds, and other organisms that rely on them for sustenance." Of special concern noted is the fact that Willapa Bay and Grays Harbor "...are among the most important migratory bird stopover sites on the west coast."

I have the following basic concerns with the SEIS:
1.The SEIS is inadequate, in that it ignores best available science; such as bay circulation patterns and sediment/plant capture of systemic poisons designed to kill invertebrates.
2.The SEIS does not consider the impact of the use of Imadacloprid on key species already in trouble. These include waterfowl, salmon, and forage fish.
3.The SEIS does not consider the cumulative impacts of this action and future permits that may further impact this water body or become a determinate on expanding this program to other waters.

Request:
1.I request that Ecology declare the SEIS to be inadequate to support drafting an NPDES permit for Imidacloprid for burrowing shrimp removal in Willapa Bay and Grays Harbor.
2.I request that application of Imazamox to kill eelgrass in Willapa Bay be suspended. The Buffer Validation Test is unreliable with respect to how much chemical was actually applied, and suspect when the plan was abandoned to have final review of damage done by an independent WDFW contractor. The latter was removed and replaced with the same Extension Agent who applied the chemical and was at the time in violation of State Ethics codes. Damage was done in drainages outside the protective buffer and evaluated as acceptable by the same conflicted person who supervised the application improperly.
3.A public task force should be set up to advise WDFW on a plan to recover the ecological state of Willapa Bay and review the ecological state of Grays Harbor. Recommendations of this task force would be incorporated in any future plans to remove or restore habitat in Willapa Bay.
4.It is recommended that WDFW immediately restore plans, this year, to survey waterfowl stopping over in Willapa Bay, especially during historical peak periods. The cause of historic declines locally must be determined and corrected. This for example would include November peaks for ducks and geese and spring staging periods for Pacific Brant. Further, WDFW should commit to monitoring herring spawning mass annually in Willapa Bay going forward, and generating a recovery plan for these forage fish. The Willapa Salmon Management Policy should be supplemented with a more robust recovery plan for these fish under current conditions, and

expanded to include recovery of both species of sturgeon historically present in large numbers.

Sincerely,

Robert Wenman

Commenter: David Wheeler - Comment I-347-1

Born and raised in Seattle, I grew up enjoying the remote beauty of southwest Washington's estuarian environment that Grays Harbor and Willapa Bay represent. I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.

Commenter: Jana Wiley - Comment I-182-1

I am writing again to strongly condemn this move to prop up the unsustainable oyster industry in Willapa Bay. These tidelands really do not support oysters without pesticides being applied. If feels wrong to poison the environment for all other lifeforms for this reason. It is time that they reconfigure their growing sites. It was in 2015 that I last wrote on this issue, and it is inconceivable to me that they can simply petition again and possibly get what they want by virtue of wearing down the public's response. Fortunately, I JUST found out about this comment period and am able to get something in under the deadline. I would hope if the public's response has been less this year, that DOE would allow a longer period for comments. Politically and socially the public has been overwhelmed by too many matters.

Commenter: James Wilkerson - Comment I-39-1

If the question is: Should we allow the application of a poison to an aquatic environment that will benefit a single industry at the expense of the environment in general, then the answer is a resounding NO! This boneheaded proposal doesn't even deserve consideration.

Commenter: Charlene Woodcock - Comment I-375-1

If our children and the diverse wildlife on our planet are to have healthy lives, we MUST stop putting poison into our air, water, and soil. Imidacloprid harms life. We have evidence that when dumped in our water supplies it is toxic to both freshwater and saltwater invertebrates.

We must not leave our children a poisoned environment.

Commenter: Chris Wrinn - Comment I-351-1

Toxins disrupt the environment, not help it recover.

Commenter: Bill Yake - Comment I-113-1

Without a fundamental change in approach, oyster culture in these areas -- Willapa Bay and Grays Harbor – they will forever remain "estuaries on drugs". 'Drugs' that indiscriminately kill native invertebrates. It's necessary to understand and reestablish the fundamental ecological structure of these waterbodies if we're ever going to have healthy aquaculture there. The EIS should advance this approach. There is a considerable body of knowledge that suggests that the bump in burrowing shrimp populations is largely due to the demise of eelgrass – and the influx of, and subsequent eradication efforts towards, Spartina. It's also likely that increases sedimentation in these watersheds – largely from poor forestry practices – plays an important role. Work should be focused on these sorts of fundamental disruptions in the ecological balance of the estuaries and their watersheds. This draft largely ignores this aspect of the problem – and, therefore, cannot solve the problem in a sound, integral, and ethical way.

Commenter: Linda Yow - Comment I-359-1

Willapa Bay and Grays Harbor have been damaged by human activity over the past century. We need to restore the habitat by removing stressors from streams flowing into the bays.

God bless you with the wisdom to do no harm, and the courage to do the restoration.

Commenter: Laura Zerr - Comment I-289-1

There is already issues in keeping run-off water clean from chemicals and pesticides, so why would we allow direct application of a dangerous neonicotinoid into our water system?

Commenter: Amy van Saun - Comment O-12-7

Given the significant unknowns, and lack of data, Ecology should not move forward with apermit to spray imidacloprid. The negative impacts are likely higher than Ecology reports in theSEIS, because one of the basic elements of this analysis, the screening levels for toxicity toinvertebrates, is flawed. The evidence suggests not only a higher negative impact, but that theimidacloprid spray plan may not be effective in the long term. Ecology failed to assess a reasonablerange of alternatives that would address the true purpose, to preserve commercial shellfish harvestwhile maintaining the health of Willapa Bay and Grays Harbor. As such, Ecology must draft a SEISthat complies with SEPA prior to moving forward with any NPDES permit. Knowing what we nowknow about neonicotinoids, it is best to end consideration of any imidacloprid spraying into marineor estuarine waters, and instead to focus on habitat restoration, including eelgrass, and sustainablemethods of restoring balance to the Bay.

Commenter: Ashley Chesser - Comment O-10-2

Department of Ecology must protect Washington's water, wildlife, public health, and local economies from the harmful impacts of toxic pesticides. The future of oyster farming in

Washington State depends on the industry's ability to adopt sustainable cultural and management strategies.

Commenter: Margaret Barrette - Comment O-9-1

The sky-rocketing populations of burrowing shrimp in Willapa Bay and Grays Harbor are altering the ecosystem, turning tidelands into muck, and destroying critical habitat for birds, fish, shellfish, and phytoplankton. This unchecked progression and broad environmental impacts which the shrimp cause can only be slowed. Our members have spent much of the past decade exploring options to address an infestation of burrowing shrimp which has left once healthy oyster growing lands, eelgrass beds, and bird feeding grounds entirely unproductive.

Commenter: Tom Davis - Comment O-2-1

On behalf of the Washington Farm Bureau, we are providing comments on the Willapa-Grays Harbor Oyster Growers Association request for a permit to use the pesticide imidacloprid to control burrowing shrimp in Willapa Bay and Grays Harbor.

As a grassroots organization with over 46,000 members, Washington Farm Bureau works to protect the interests of farm families across the state. Today, our members face unprecedented regulatory pressures that threaten the viability of their operations and their capacity to produce good local food on working lands.

We understand that the current proposal is for the use of imidacloprid on only 490 acres in the two bays – substantially less than the 2,000 acres in the prior permit request. This represents a significant reduction and one that will greatly diminish any possible concerns that were expressed by a vocal minority last time. In addition, the growers have stated the control will be applied on the tidelands with hand or ground equipment and not by aerial sprayer. This is also a substantial change from the prior permit and shows the great lengths the growers are willing to commit to reduce any potential environmental impacts.

The one thing that has not changed is the need to control burrowing shrimp. Without this essential tool, the continued viability of the shellfish industry in the Willapa Valley is at risk.

Many of these beds have a history of requiring shrimp control to remain viable for cultivation. Without the use of imidacloprid, an effective and reliable tool, many valuable multi-generational family oyster farms in these two bays could be lost. Solid research demonstrates that shellfish beds become economically unviable once infested by significant populations of burrowing shrimp.

This region relies on the economic stability of the shellfish industry, which provides hundreds of jobs, and many more indirect employment opportunities. These rural communities will be greatly impacted economically if a prohibition of imidacloprid was imposed.

For these reasons, we encourage approval of the permit.

Thank you for the opportunity to comment on this important issue.

Comments on Human Health

Commenter: - Comment I-115-1

I own land in Willapa Bay and do not want a neurotoxin sprayed on the water or land that has the potential to pollute my property and to kill all life on it. We have laws against air pollution, second hand smoke, etc. and this is no different. This could have long-lasting impacts on the food chain and should not be permitted. Oyster farmers must change their growing methods instead of looking for a quick fix that could kill us all.

Commenter: Rich Andrews - Comment I-246-5

Not only would wild species be affected by this wanton and needless environmental poisoning, but the consumersof the oysters are also vulnerable to being poisoned from the pesticide residuals in the oysters. Increasingscientific and medical evidence is accumulating about the toxic effects of the neonicitinoid chemicals on humansand mammals, specifically neurotoxic effects. These affects can not only be acute but chronic and accumulativewith some of the modes of toxic action in the human nervous system. The Department of Ecology must fullyinvestigate these effects and when it does, it will find them to be dangerous, as well as illegal.

Commenter: Hal Anthony - Comment I-373-1

It is because children matter that I write you, since everything affecting our environment negatively is not what we should pass over to them.

Commenter: April Atwood - Comment I-46-2

I vigorously oppose the use of imidacloprid to kill burrowing shrimp in oyster beds. This is a dangerous neurotoxin, deadly to bees and humans alike.

Commenter: Eric Bensch - Comment I-167-1

I support the two letters, comment letter from the Coastal Watershed Institute and the letter from Northwest Center for Alternatives to Pesticides, which I have attached to this file.

Commenter: David Beugli - Comment I-221-4

The new SEIS – just like the previous EIS – shows that there will be no bay-wide impacts and that these applications will have no direct impacts of fish, birds, marine mammals or human health.

Commenter: David Beugli - Comment I-240-4

This new SEIS just like the previous FEIS demonstrates that there will be no bay-wide impacts and thatthese applications will have no direct impacts to fish, birds, marine mammals or human health.

Commenter: Diane Boteler - Comment I-34-3

It is hard to think of any neurotoxin used in the environment that doesn't end up having significant negative consequences for the ecosystem and often for humans as well.

Commenter: Jeff Boyden - Comment I-94-2

I am concerned with unknown environmental impacts and health impacts to humans.

Commenter: Erika Buck - Comment I-179-3

There is habitat loss happening ata rapid rate throughout our state and especially in our aquatic environment. The Orca Whales are threatened along with so many other species. Instead of issuing spray permits, why not enforce the Clean Water Act, protect public health and the environment? Why not work on restoration of our aquatic areas? If growers understand that the option for using chemicals is no longer available, the growers will change their farming techniques.

Commenter: David Clark - Comment I-162-1

I own property on the South Sound and want to oppose the use of Imidaclorid in the South Sound and support the comments made by the Coastal Watershed Institute in its October 24, 2017 letter opposing the use of the pesticide.

Commenter: Margaret Clifford - Comment I-67-1

I am opposed to the use of pesticides on oyster beds. The public will not want to eat oysters that have been exposed to toxins. Oyster growers say only some of them will use it, but how will we know who? Unless you require them to pay for testing and labeling of their products it shouldn't be allowed. There are always additional unintended consequences to this kind of fix.

Commenter: George Clyde - Comment I-108-2

I am a consumer of shellfish from Washington State, and I strongly object to use of imidacloprid, both for the environmental reasons and for the health and safety of my family and me as consumers. Best, George Clyde

Commenter: John Conley - Comment I-173-3

Please do not allow this. Aside from the very real risk to human health (for those who would consume these poisonous oysters, or those who live near the proposed spraying areas), there will be a significant economic cost to the State, as many will refuse to consume them, or do any business with restaurants and purveyors who carry them. This will not help the Washington oyster industry. It will harm it in a major way.

Commenter: Sherry Daniel - Comment I-279-1

This chemical is also a carcinogen and classified as a Marine Pollutant, so using it near food sources and in proximity to water is doubly dangerous and should not even be considered under any circumstances. Check the product's Safety Data Sheet, particularly the Ecological Information and Transport Information sections.

Commenter: Chad Daniels - Comment I-44-1

We became farmers to eliminate pesticides from our family's food supply. We live in southern Ohio, so oyster farming is not really an option. If pesticides are approved for use on oyster beds that will be one more food our family will not be purchasing and we will be outspoken against at all available markets and networking events. Please take this opportunity to preserve our food supply. America has enough enemies in the world without having to worry about consuming poisoned foods.

Thank you,

Chad H. Daniels

Commenter: Melanie Drescher - Comment I-49-2

Imidacloprid is considered the main culprit in the collapse of our bee colonies and, in higher levels, is toxic to mammals — that means us!

Commenter: Margaret Fillmore - Comment I-140-3

Cancers are on the rise please don't let them spray our food and wildlife with poison

Commenter: Diane Fink - Comment I-76-1

One of the wonderful things about Seafood is that is fresh and free of poisons. I would not eat oysters that have had this substance used on them, raw or cooked. I have seen oyster beds in

Pacific County, where I used to reside, that are elevated instead of in the mud. As a consumer I would be very concerned with this plan and how it might impact other species of marine life.

Commenter: Sarah Fletcher - Comment I-45-1

I am totally against any spraying of this pesticide imidacloprid to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor. It is madness. Has the Dept of Ecology done any testing and where can one find the results? And do you know why Europe has banned this product? And if you are going to spray, I hope that there is a law that makes it that the oyster seller needs to put in clear bold letters that the oysters that we will be eating have been sprayed with this product so that we can at least make a choice as to whether we want to eat treated oysters or not. And wasn't this product not supposed to be used in water or something to that effect?

Commenter: Joanne Frank - Comment I-35-2

Spraying poison directly into any natural body of water will endanger all creatures that live there. And what about the safety of people who may be in the water?

Commenter: Mary Fraser - Comment I-320-2

Congress explicitly told the EPA to test pesticides for their effects on endangered species. That hasn't been done for this pesticide. Congress also told the EPA to test for endocrine disrupting properties of pesticides. That hasn't been done for this chemical.Why would you use a chemical that hasn't had the necessary tests done?

Commenter: Sherrill Futrell - Comment I-367-1

I guarantee that I will stop eating Willapa oysters if you allow the Growers Association to apply imidacloprid to Willapa Bay and Grays Bay. I am concerned for my health as well as the health of the environment there. Thank you.

Commenter: Martha Hall - Comment I-151-4

Little known direct risk to fish, birds, marine mammals, and human health. Potential indirect impacts to fish and birds if food sources are disrupted.

Commenter: Mary Hanneman - Comment I-271-1

I suffer from autoimmune issues caused or exacerbated by environmental toxins. It is crucial for our health to eliminated these toxins in our beautiful seafood.

Commenter: Jessica Helsley - Comment I-169-1

The Willapa/Grays Harbor Oyster Growers Association (WGHOGA), which grows non-native oysters on the Washington Coast, proposes to control native burrowing shrimp through the application of Imidacloprid.

Imidacloprid has been found to enhance adipogenesis, resulting in insulin resistance in cell culture models (Sun et al. 2016, 2017). This provides a strong concern for human health. More direct impacts from insecticide application, including the application of Imidacloprid, have been observed in marine invertebrates which are a critical food source for juvenile salmon and forage fish (Westin et al. 2014, 2015). Wild fish species of salmon and the forage fish food structure that they depend upon are critical components of coastal resiliency- culturally, economically, and ecologically. Macneale et al. 2014 and Gibbons et al. 2015 provide thorough reviews of these concerns. Application of Imidacloprid to coastal areas in the shallow areas of Grays Harbor and Willapa Bay will detrimentally impact critical marine and nearshore ecosystems while also being a human health concern. Impacts to coastal juvenile salmon and forage fish when they are feeding, resting and migrating will have negative impacts to both local salmon populations as well as to salmon populations currently listed under the Endangered Species Act that utilize Washington's coastal waters for nourishment and refugia during their migrations (Shaffer et al. 2012). Additionally, application of Imidacloprid will have a cascading impact up the food chain- impacting marine mammals that include populations also listed under the Endangered Species Act.
Washington's coastal ecosystems are complex and vital to our region. We should be working to restore and protect them, not further their demise to enhance the growth of a non-native shellfish species for commercial use. The state and federal agencies are required by law, to preserve Washington State's wild species and the ecosystems upon which they depend. Application of Imidacloprid and other insecticides in coastal zones contradict this mandate and should not be permitted.

Commenter: Mary Hollen - Comment I-32-1

I support the draft EIS Alternative 1 No Action. As a tidelands owner myself in the state of Washington I am appalled by the prospect of this deadly material being let loose in the marine environment. The likely hazardous effects on non target species could have adverse consequences that I and my children and grandchildren will suffer from far into the future. We don't need to eat oysters to live good lives. I have suffered a career change and loss of a farm in my lifetime, so I had to change to survive. I wouldn't wish my misfortunes on anyone, but sometimes change is necessary when the alternative is far worse.

Commenter: Guy Jacobson - Comment I-104-1

I'd rather eat mudshrimp than oysters from a bay poisoned with pesticides.

Commenter: richard james - Comment I-170-1

Please deny the permit to spray imidacloprid (or any pesticide) in Willapa Bay and Grays Harbor.

I support the letters from the Coastal Watershed Institute and the letter from Northwest Center for Alternatives to Pesticides. both of which are attached.

If one searches the internet, one can read and hear where growers or their allies use the term "pristine" to describe Willapa Bay & Grays Harbor.

According to Websters this is the definition of pristine:

1 :belonging to the earliest period or state :original

the hypothetical pristine lunar atmosphere

2 a :not spoiled, corrupted, or polluted (as by civilization) :pure

a pristine forest

b :fresh and clean as or as if new

used books in pristine condition

If Willapa Bay were pristine, it would NEVER have had carbaryl sprayed in it. Nor would it have EVER had imazamox sprayed in or near it. Pristine means it would not have had, nor will it again have imidacloprid sprayed into it.

Spraying toxic chemicals into a bay to kill native shrimp in order to grow non-native oysters for profit is the last thing one would do to a place they call pristine.

If growers can raise oysters without resorting to the use of toxic chemicals, without introducing uncountable pieces of PVC, HDPE and other toxic plastics into our ocean, without destroying habitat for native species, then do so.

If Willapa Bay & Grays Harbor growers are unable to practice authentic stewardship in the making of their money, then they should cease their practice.

Shellfish consumers worldwide must be made aware, and will be made aware of the practices used by growers in Willapa Bay & Grays Harbor in the state of Washington.

Deny the permit to spray toxic pesticides into Willapa Bay & Grays Harbor.

Richard James
coastodian
Tomales Bay, CA

Commenter: Sam Jennings - Comment I-158-1

If you decide to use pesticides on the oysters my family will not be eating oysters. If you do decide to use pesticides It should be labeled as such.

Commenter: Una Jones - Comment I-197-1

10/24/17
I am disgusted thinking about our beloved state allowing a pesticide I use as a flee medication on my dogs on shellfish beds. I would never buy shellfish from Willapa Bay or Grays Harbor if this is allowed. I would never feed my family flee medicine. On top of it this pesticide kills honey bees. What the hell? Why is this even being considered? The shellfish growers have plenty of money and need to figure out an alternative. Ecology shouldn't even be considering allowing poison being sprayed on our seafood. I am not in support and hope Ecology denies this application.
From Una Jones
Hoodsport, WA

Commenter: Valerie Jusela - Comment I-20-1

The use of this pesticide is dangerous to marine life and human life. It is banned in the EU for good reason. Do not allow thiis to be used in our waters.

Commenter: Dave Kisor - Comment I-365-1

To date, I have not seen a single use of neonicotinoids that didn't have a detrimental effect on the ecosystem in which it was used. What gets me is oysters are filter feeders, so whatever gets into the water goes through their system. If you add poison, the oysters will collect it and if they are grown for human consumption, you can poison them as well.

Commenter: Shannon Lackey - Comment I-61-1

I as a sportsman do not want to see this touch the bay. The water or land. Stop poisoning my food. The natural bay did its job just fine. Scale back your commercial oyster beds and open sand shrimp season up in the bay. I vote NO!

Commenter: Thomas Lawrence - Comment I-38-2

I don't believe imidacloprid is safe for the environment and I don't believe imidacloprid is safe for me. Because I don't know the source of my oysters, if imidacloprid is approved, I will need to cease consuming oysters entirely, as a precaution for my own health, and because I do not want to financially support such folly.

Commenter: Betina Loudermilk - Comment I-77-1

What happens in Washington makes its way to tables in California. We need to stop poisoning the earth and ourselves. Big fat NO here

Commenter: Laura McGrath - Comment I-132-2

I understand that pesticides might be the most cost effective way to address this issue, but this does not consider the cost to ecosystem and human health. More effort needs to be placed on finding a more ecological friendly and less toxic solution.

Commenter: Robert Nerenberg - Comment I-12-1

I'm not interested in eating shellfish exposed to a chemical that DOE thinks about in this way: "There are still knowledge gaps about imidacloprid. Further research is needed." I don't want to be a test subject and will immediately stop eating Washington oysters if this is allowed.

Commenter: Catherine Newland - Comment I-15-3

The public should be able to be able to fish and enjoy the beaches as well without worrying about this becoming a health hazard. This is a step backwards and i hope it will not be allowed.

Commenter: Peter Olive - Comment I-59-1

The use of this biocide is detrimental to the health of Shoalwater Indians and ultimately to us all. Please don't use it

Commenter: DouGlas Palenshus - Comment I-78-1

If you are permitted to spray, just know that you will have to find ignorant foreigners to buy your products. I will be 'spreading the word' far and wide and oysters will definitely be off the plates of my friends and family. Signed, a self-identified "opinion leader"

Commenter: Julia Palmer - Comment I-55-1

Stop! Stop putting poison in our food! Stop putting poison into our earth! What good are more oysters going to do if they're going to kill us anyway? All of this greed, pollution..it's sickening.

Commenter: Ira Pollock - Comment I-36-2

Aside from that, part of what makes oyster beds an ecological boon is that they remove poison from the water. If we pump more poison into their beds, they will end up consuming and storing it in their bodies, possibly making them less safe for consumption. The bottom line is that we should not be spraying any oyster beds with any pesticide.

Commenter: Penny Rand - Comment I-4-3

Fish farms and oyster farms have created this problem and will destroy the wild fish and oysters not to mention humanity.

Commenter: Gay and David Santerre - Comment I-310-1

I do not want to live, eat and breathe in an environment full of dangerous toxins...........do you want to? What legacy are we leaving our children if we continue the use of these dangerous chemicals in this shrinking world?

Commenter: Joy Schary - Comment I-378-1

We all share responsibility to future generations for supporting our ecosystems - including the current health of humans.

Commenter: Patsy Shafchuk - Comment I-382-1

The thing is, what do you think that continued exposure to these chemicals will do to children? Are you willing to call that a "risk assessment"? Me either.

Commenter: Clayton Smith - Comment I-137-1

Please prohibit the use of pesticides and herbicides on Washington State shellfish beds. It will damage the health of the shellfish industry and of humans!

Commenter: Marina Smith - Comment I-69-2

Furthermore, who wants to eat seafood that has been sprayed?! Please, please, please do not approve this!

Commenter: Nadiya Stipanovich - Comment I-183-2

am against the use of NEUROTOXIN by the oyster farmers. We are bombarded enough with toxins all over. I think we should be more conservative and careful in using those. Especially since little known direct risk to fish, birds, marine mammals, and human health and further research is needed.

Commenter: Michael Sullivan - Comment I-114-1

The shellfish industry is expanding on Harstine Island. I am a property owner in which Seattle Shelfish has made an application to install oyster bed racks. This would occur in my front yard. I do not want the application of pesticides to be aproved!!! This will set a precedense that the industry will continuously reference and agenecies will then approve.

Concerns:

How would the sprayed application once atomized be prevented from spreading to my property and my family and animals from breathing it? What are the studies on the effects of pesticide on humans that will be in the effected area? Application can not be prevented from becoming airborne and impacting local residents and animals.

What independent research has been done by DOE; not just data provided by the industry? Can you provide data?

Commenter: Michael Sullivan - Comment I-161-1

support the comment letter from the Coastal Watershed Institute found here: https://commentinput.com/attachments/projectID_1001/10063/merged//12829.pdf)

Commenter: Todd Tanner - Comment I-64-1

Hi, I'm an outdoor writer as well as a sea food lover. If you folks decide to spray toxic crap on shellfish beds, I can guarantee you that I'll be writing stories about the fact that no one in the U.S. should eat Washington oysters.

Lord, what an incredibly stupid idea. Please do not use pesticides on your shellfish beds. There's enough toxic crap in our marine environments already. Don't make it worse.

Commenter: Linda Thompson - Comment I-348-1

I am chemically sensitive and my health depends on avoiding chemicals in the environment and I my food.

Commenter: Jennifer Vidal - Comment I-66-2

Imidacloprid is considered the main culprit in the collapse of our bee colonies and, in higher levels, is toxic to mammals — that means us!

Commenter: Carol Volkman - Comment I-68-1

We do not want more chemicals in our food chain. We already have dynamic and escalating incidents of gut disorders attributed to food quality. Stop this and figure out how to protect oysters some other way

Commenter: Center for Food Safety - Comment O-8-4

Pesticides are not the only option to restore balance to Willapa Bay and Grays Harbor,but Ecology failed to evaluate any alternatives that are more environmentally protectivethan spraying imidacloprid. Simply put, the plan to spray imidacloprid is not adequatelyprotective of wildlife, water quality, or public health. I urge Ecology not to move forwardwith a spray permit for imidacloprid on shellfish beds in Willapa Bay/Grays Harbor.

Commenter: Anne Shaffer - Comment O-3-6

Clearly, regardless of the size of coverage, Imidacloprid applied to coastal areas will impact criticalmarine and nearshore ecosystems, and is a human health concern. It still includes the application of ahighly toxic insecticide along shorelines used by numerous salmon and forage fish species, includingChinook and coho from as far away as Snake and Columbia River systems (Shaffer et al 2012). Thisinsecticide will exactly impact prey species for these fish. Further, marine mammals, including killerwhales Orcinus orca, that are critically endangered due to pollution and lack of food. These killerwhales? Depend on Chinook salmon. This insecticide will therefore have a cascading impact that isexactly contraindicated to preserving and restoring our coastal ecosystem. Further, method of spraydoes not mitigate toxicity to fish, invertebrates, and coastal systems (or humans for that matter).

Commenter: Ashley Chesser - Comment O-10-1

We, the undersigned, support efforts to protect this fragile ecosystem from a potentially dangerous pesticide application. This plan is understudied, inadequate and fails to protect community and environmental health!

We support timely efforts to expand promising alternatives to neonicotinoids and to increase their feasibility and effectiveness. Investments should be made in educational, technical, financial, policy, and market support to accelerate adoption of alternatives rather than continuing to rely on highly toxic pesticides. Research and demonstration are needed to determine and improve the most effective alternatives and their respective potential and feasibility for farms of different sizes, locations, shrimp population density, and access to equipment. The state should invest its resources in these efforts prior to and instead of allowing toxic contamination of state estuaries.

Department of Ecology must protect Washington's water, wildlife, public health, and local economies from the harmful impacts of toxic pesticides. The future of oyster farming in Washington State depends on the industry's ability to adopt sustainable cultural and management strategies.

Commenter: Megan Dunn - Comment O-6-6

The buffers prohibiting harvest in proximity to treated areas—no harvest 25 feet from treated areasunder Alt. 4—are framed as mitigations against the possibility of human consumption ofimidacloprid. Once again, these are completely inadequate when we are talking about a highlysoluble, persistent chemical that will readily disperse away from treated areas.

Comments on Sediment

Commenter: Jules - Comment I-237-2

Other growers claim above ground structures create such an impediment to tidal and sediment flow that they result in sediment deposition, putting other beds at risk. However, they site no studies to substantiate such a claim and merely provide conjecture on whether it is significant, let alone even happens. Further, Taylor Shellfish has been using above ground methods (flip bags in this case) for years and nobody complained to DOE about sediment transport issues.

Commenter: Ross Barkhurst - Comment I-247-3

Inadequate SEIS which ignores best available science such as bay circulation patterns andsediment/plant capture of systemic poisons designed to kill invertebrates.

Commenter: Erika Buck - Comment I-179-2

These techniques are not unique or special in any way. Growers in every region understand the necessity of preparing the substrate/tidelands for the planting of crops, maintaining crops and preparing crops for harvest. We all used the process of harrowing. Harrowing is done on an outgoing tide to remove the sediments from the tidelands. The sediments came in mostly with the tide and are flushed out naturally with the tide. In the process of harrowing, some of the ghost shrimp are exposed and their natural predators, mainly fish, consume them. Through the harrowing process, balance could be restored or maintained, truly sustainability. No chemicals necessary.

Commenter: Form Letter (Multiple) Do Not Allow Imidacloprid - Comment I-270-6

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

Commenter: Nathan Donley - Comment I-204-4

Will there be indirect effects to birds and fish that use these prey species that will be reduced? How may Dungeness crabs is it okay to kill before it affects the population or before it affects harvest numbers? Will Imidacloprid residues carry over to the following year and accumulate in the sediment in these areas? And these are just questions that we don't have answers to yet. But we do know that Canada's Pest Management Agency has proposed to ban Imidacloprid not due to impacts to pollinators or birds, but due to impacts to aquatics and vertebrates, specifically.

Commenter: Susan Eck - Comment I-383-1

Please also consider that imidacloprid persists in the soil that it comes in contact with, to the point that trying to grow food crops is nearly impossible for years after it's application.

Commenter: Gayle Janzen - Comment I-259-2

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

Commenter: Heidi Keller - Comment I-101-1

I oppose the use of pesticides on oyster beds out of concern for the unintended consequences it it will mean for sediment dwelling and other sea life.

Commenter: Jules Michel - Comment I-188-2

Willapa Bay and Grays Harbor shellfish growers claim alternative growing methods are more expensive or not feasible, pointing to long lines "sinking" in the sediments and it being hard to walk in those sediments. While above sediment methods are more expensive, and in a few areas the sediments are soft, the current system pointed to is simply a poorly engineered system to grow oysters, and a poorly engineered system will always fail. But it does not mean alternatives are not available.

Commenter: Laurie Pine - Comment I-205-2

Recent research has also shown it to have cross- seasonal persistence in wetland sediment.

Commenter: Amy van Saun - Comment O-12-2

The screening value for imidacloprid in sediment is the same as the practical quantitationlimit. Therefore, this screening value does not identify a safe level of exposure; it is simply a result ofthe limits of the detection equipment used. That should be more clearly outlined in the draft SEIS,perhaps with the statement: "Undetected imidacloprid in sediment is not an indication that the levelsare safe for invertebrates, therefore the sediment data can only be used to identify when levels ofimidacloprid are harmful, not when they are safe."

Commenter: Jennifer McDonald Carlson - Comment A-5-2

Based on our review of the document, the DSEIS lacks a full assessment of the potentialecological ramifications of targeting these two species of burrowing shrimp. Burrowing shrimpprovide a suite of ecological functions in West Coast estuaries. They rework intertidal andshallow subtidal bottom sediments during the normal course of their feeding, sheltering, andother activities. Burrowing and deposit-feeding by ghost shrimps affect the geochemicalproperties of the sediments, including grain size, nutrient exchange, and organic deposition. Theycreate a unique habitat beneath the surface that supports more than a dozen different species.

Commenter: Megan Dunn - Comment O-6-3

) That tidal flushing will soon dilute dissolved imidacloprid to undetectable levels. While thefield studies do show that dilution occurs, concentrations in sediments and sedimentporewater appear to remain higher than levels known to be acutely or chronically toxic toaquatic invertebrates for as long as 56 days. Furthermore, limits of detection are not the sameas toxicity endpoints.

Commenter: Shari Tarantino - Comment O-4-3

While it is known that imidacloprid breaks down rapidly in water in the presence of light, itstill remains persistent in water in the absence of light. It has a water solubility of .61 g/L,which is relatively high. In the dark, at pH between 5 and 7, it breaks down very slowly, 4and at pH 9, the half-life is about 1 year. In soil under aerobic conditions, imidacloprid ispersistent with a half-life of the order of 1–3 years. On the soil surface the half-life is 39days. Major soil metabolites include imidacloprid nitrosamine, imidacloprid desnitro and 5imidacloprid urea, which ultimately degrade to 6-chloronicotinic acid, CO2, and boundresidues. , , Chloronicotinic acid is recently shown to be mineralized via a nicotinic acid 6 7 8(vitamin B3) pathway in a soil bacterium.9

Commenter: Jay Davis - Comment A-1-2

As was stated in our previous comment letter addressing imidacloprid and these specific proposed practices (USFWS 2014), there is substantial scientific evidence documenting the persistence of neonicotinoids in natural systems (marine, freshwater, and terrestrial environments), and documenting direct and indirect adverse impacts on non-target invertebrate species, vertebrate species, and overall ecosystem functions (Chagnon et al., 2015; Gibbons et al., 2015; Morrissey et al., 2015; Health Canada 2016; EPA 2017). New scientific evidence compiled and reviewed by Ecology, including the findings from field trials conducted during 2012 and 2014, establishes with certainty that these proposed practices would have acute adverse impacts to sediments and sediment quality, the benthic community, and free-swimming crustaceans and zooplankton, both on and off of (i.e.. adjacent to) the treated shellfish beds (Ecology 2017).

Commenter: Jay Davis - Comment A-2-2

o According to an internal memorandum, Ecology's Toxics Cleanup Program evaluated the findings from field trials conducted during 2012 and 2014 and concluded that they represent threshold exceedances of the State's Sediment Management Standards (SMS). "Monitoring results show that acute endpoints have been exceeded both on-plot (in 2012 and 2014) and off-plot (2012)." (Toxics Cleanup Program 2017) There were, "...unavoidable adverse impacts in high total organic carbon (TOC) areas , Ecology and WGHOGA did not See adequate recovery of the benthic invertebrate population." (Toxics Cleanup Program 2017) Ecology's Toxics Cleanup Program has stated that these practices are likely to cause exceedances ofthe SMS where TOC is high (North Willapa Bay, Cedar River vicinity; South Willapa Bay), and that such exceedances should not be allowed under a SIZ authorization issued pursuant to the State's sediment management regulations.

Commenter: Neil Quackenbush - Comment A-4-3

New scientific evidence compiled and reviewed by Ecology, including the findings from field trials conducted during 2012 and 2014, establishes with certainty that these proposed practices would have acute adverseimpacts to sediments and sediment quality, the benthic community, and free-swimming crustaceans and zooplankton, both on and off of (i.e .. adjacent to) the treated shellfish beds(Ecology 2017). This scientific evidence also points to significant information gaps anduncertainties regarding a number of important issues and potential consequences (e.g., efficacy,persistence, sub-lethal effects, indirect and chronic effects (Health Canada 2016; EPA 2017)),some of which are not adequately described or addressed in the Supplemental EIS.

Commenter: Douglas Steding - Comment O-20-5

As ghost shrimp recruit to intertidal areas damage from their bioturbationincreases, with resulting loss of the benthic fauna and flora (Attachment A, Fig.16) through continual disturbance and reductions in primary productivity (asdescribed above). First of the critical intertidal biological elements to bedisplaced would be the benthic diatoms and their biofilm, followed by decreasesin grazer invertebrates due to lack of food or inability to survive on the shiftingsediments. Sediment instability with loss of finer sediment fractions woulddamage or destroy existing eelgrass, plus prevent any new seeds from sprouting.

Commenter: Douglas Steding - Comment O-14-3

The burrowing ghost shrimp, Neotrypaea californiensis, through bioturbation,deleteriously disturbs and continually modifies the intertidal sediments. Theseactions thereby reduce or eliminate the benthic diatoms and their biofilm habitat,disrupting primary productivity essential to create and maintain the food web inthe estuary.

Commenter: George Tuttle - Comment A-3-2

During our review we identified a specific area of the DSEIS where we recommend additional discussion.The DSEIS references the Marine Sediment Quality Standards (WAC 173-204-320) but does not identify howEcology would implement the sediment management standards if a new NPDES permit and sediment impactzones (SIZ) were issued

Comments on Benthic Organisms/Invertebrates

Commenter: Jules - Comment I-237-3

As noted by many, Willapa Bay and Grays Harbor provide ecosystems which support a large number of native species. That support starts at the bottom of the food chain where burrowing shrimp exist. Imidacloprid is not "shrimp specific" - it will kill any marine invertebrate it comes in contact with. Derreck Rockett noted many "uncertainties" in this proposal at public hearings. There are, and those uncertainties - coupled with the very real certainty that this is a pesticide which kills marine invertebrates - should prevent this proposal from considering anything other than Alternative 1, the "do nothing" alternative.

Commenter: Rich Andrews - Comment I-246-4

Not only the target burrowing shrimp would be affected andkilled, but serious food chain ecological damages would occur to the many other species directly and indirectly.That includes predator aquatic life, fish species, avian species, even mammals that would eat and depend upon theshrimp and other aquatic invertebrates and even aquatic and near shore plant species that would be directlypoisoned or poisonous. These non-target species would also be exposed via numerous other pathways to thesepoisons in the waters and vegetation in and littoral to the bays and estuaries and open waters.

Commenter: Ross Barkhurst - Comment I-247-4

Inadequate SEIS which ignores best available science such as bay circulation patterns andsediment/plant capture of systemic poisons designed to kill invertebrates.

Commenter: Ross Barkhurst - Comment I-220-2

Your use of granules avoids much as it claims that there are no zooplankton on the oyster beds when you're applying this stuff. It appears that you said you can apply granules from a small shallow draft boat – guaranteed zooplankton will be there. And I've talked to some of you before hand, the zooplankton is there when the water is gone, too.

Commenter: Ross Barkhurst - Comment I-202-4

It will slosh around for over forty five to over sixty days there. Likely long before then it will find eelgrass to be systemic with, killing invertebrate life associated with that, as it is designed to do. On one hand you are uncertain about this, on the other you would allow spike wheel experiments to continue in eelgrass because the questionable efficacy is a known problem chemical grabs the eelgrass before it can get to the shrimp

Commenter: Michaela Barrett - Comment I-5-3

Imidacloprid is a poison known to have toxic effects on not only insect pests, but also beneficial insects (bees!), birds, and marine invertebrates.

Commenter: Jane Beattie - Comment I-268-3

Information shows that imidacloprid cannot be safely used by oyster growers. (USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC)EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." The assessment also found chronic risk concerns with imidacloprid exposure to saltwater invertebrates.

Commenter: Lisa Belleveau - Comment I-119-1

I do NOT support the use of pesticide in the estuaries of Willapa or Grays Harbor!! I commented against this a couple years ago and the permit was withdrawn just to have them try to push it through again!
I do NOT approve of the killing of a native species, via poisoning the ecosystem, so that a non-native oyster can flourish! Imidacloprid will kill more than just the target invertebrate and cause damage to these delicate estuarine systems. Many species rely on these productive systems (specifically the benthic invertebrates) to survive; such as salmon, crab, and shorebirds. Salmon and Dungeness crab are NATIVE commercially valuable species and the use of this poison will adversely affect them. These 2 estuaries are incredibly important rest areas for shorebirds as they migrate and without productive benthos to feed on the impacts could prove to be catastrophic! This particular insecticide has been linked to declines in bee populations which could impact many other valuable crops in the near future. There is more to think about here than the decline of one non-native species farming operation. What about the decline in salmon and crab populations? They too are extremely valuable commodities. Perhaps there could be another solution, such as enhancement of oyster beds by the addition of gravels instead of poison. It could potentially cost a similar amount and have a MUCH less detrimental impact on the delicate ecosystem. There must be a way to work WITH the system rather than destroy it for the benefit of a non-native aquiculture operation.
I STRONGLY oppose the approval of this permit and hope that the Department of Ecology denies this application.

Commenter: Katie Bunnell - Comment I-193-2

Please deny Imidacloprid use for shrimp control in Grays Harbor. This neonicotinoid pesticide kills bees and other pollinators and can also devastate aquatic invertebrates and the animals that rely on them for food.

Commenter: Cherry Champagne - Comment I-192-2

Imidacloprid use for shrimp control in Grays Harbor is harmful to bees and other pollinators and can also devastate aquatic invertebrates. Do not allow its use in this sensitive area.
Thank you.

Commenter: John Conley - Comment I-173-2

No, no, no! Don't tell us that a neurotoxin (Imidacloprid) will "only" affect the shrimp and "perhaps" (definitely!) some other invertebrates (crabs, snails, etc.). It will and does affect humans as well. I will never, never, knowingly purchase or consume an oyster that has been grown in an area treated with Imidacloprid. Never. I would not dine at a restaurant or buy from a fish-monger who carried such oysters. If this poisoning is allowed, I've had my last Willapa Bay/Gray's Harbor oyster. Forever.

Commenter: Form Letter (Multiple) Deny Imidacloprid Use - Comment I-242-1

(Email Submission)

I'm writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species.

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

Thank you for your thoughtful consideration of these comments.

Commenter: Form Letter (Multiple) Do Not Allow Imidacloprid - Comment I-270-2

While the SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," the SEIS fails to give adequate weight to the "knowledge gaps" it identifies. In some cases, monitoring is proposed as a way of reducing uncertainty. In order to protect the bays, facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

Commenter: Margaret Donaldson - Comment I-8-2

Imidacloprid has three major strikes against it: not only is it toxic to all invertebrate life where it is directly applied, it can be expected to spread to adjoining areas, disrupting not just invertebrate life there but all the rest of the food chain.

Commenter: Nathan Donley - Comment I-204-6

Will there be indirect effects to birds and fish that use these prey species that will be reduced? How may Dungeness crabs is it okay to kill before it affects the population or before it affects harvest numbers? Will Imidacloprid residues carry over to the following year and accumulate in the sediment in these areas? And these are just questions that we don't have answers to yet. But we do know that Canada's Pest Management Agency has proposed to ban Imidacloprid not due to impacts to pollinators or birds, but due to impacts to aquatics and vertebrates, specifically.

Commenter: Mark Emrich - Comment I-211-2

And I'm concerned with the really small creatures in this particular act as far as zooplankton. And a lot of the microbiomes that are the feed for these oysters and mussels and a lot of other species that are out there that rely on them as well.

Commenter: Kim Figlar-Barnes - Comment I-165-1

Studies have shown (Morrissey, c, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk of aquatic invertebrates: A review. Environment International 74: 291-303) The water soluble Imidacloprid is toxic to wildlife and highly toxic to aquatic invertebrates (listed on the label for Protector 0.5G and Protector 2F); it affects the survival, growth, emergence, mobility and behavior of many sensitive aquatic invertebrate taxa, even in low concentrations. Spraying or applying Imidacloprid in any manner will have a negative biological and ecological impacts on a wide range of non-targeted invertebrates in aquatic, marine and benthic habitats. Imidacloprid will damage the diverse and unique marine ecosystems of Willapa Bay and Grays Harbor causing a cascading trophic effect, harming a multitude of juvenile and adult fish species (federally endangered/threatened green sturgeon, bull trout, Columbia River Chinook, Columbia River Chum, Columbia River Coho and Steelhead, and Yelloweye Rockfish), birds (federally endangered snowy plover) and a host of other wildlife species that rely on these estuaries for sustenance.

The proposed application of Imidacloprid during the month of May will have irrevocable consequences to the multitude of shore birds that migrate and feed in Willapa Bay and Grays Harbor on their way to artic breeding grounds. Imidacloprid would kill the aquatic invertebrates the shore birds rely for food to continue migration to breeding grounds. The lack of food could kill many shore bird species or prevent them from having enough energy to breed. The direct ingestion of Imidacloprid by shore birds could harm or kill them, thus drastically reducing the populations of many shore bird species along the Pacific Flyway.

The proposed application of Imidacloprid during the month of May will also have irrevocable consequences to the multitude of fish species that utilize Willapa Bay and Grays Harbor as juvenile rearing habitats. All the Pacific Salmonid species, bottom fish, rock fish and forage fish rearing in these two water ways would be negatively impacted by the application of Imidacloprid, thus reducing the populations of these vitally important species.

The proposed application of Imidacloprid would also kill other juvenile shellfish species in Willapa Bay and Grays Harbor; such as Dungeness crab, shore crabs, red crab and a host of other crab and shellfish species. Juvenile crab species are an important source of food for many species of fish, birds and other marine organisms. What will be the impacts be to the commercial and tribal Dungeness crab fishery when Imidacloprid is sprayed and kills juvenile Dungeness crab? What will the impacts of Imidacloprid application have on the commercial, tribal and recreational salmon fisheries in Willapa Bay and Grays Harbor when juvenile salmonid foraging prey are killed? These are questions that need to be answered.

Considering pesticides are generally not allowed on shellfish beds in Puget Sound, this same practice needs to be applied in Willapa Bay and Grays Harbor. The use of Imidacloprid to control ghost shrimp will be detrimental to the marine and ecological environments of Willapa Bay and Grays Harbor. Other practices such as harrowing have shown great results in reducing the populations of ghost shrimp without the use of pesticides. Sacrificing the multitude of marine organisms and other commercial, tribal and recreational fisheries in Willapa Bay and Grays Harbor to benefit oyster growers is not acceptable.

Commenter: Ron Figlar-Barnes - Comment I-117-2

Imidacloprid may be very toxic to aquatic invertebrates besides ghost shrimp. In the same work mutagenic effects were noted as well as teratogenic effects on growth and skeletal structure of rats.

Commenter: Gail Gatton - Comment I-233-4

We particularly have reservations about this specific pesticide – which, Tom, as you pointed out, is demonstrably harmful to aquatic invertebrates – which in my world, we think of that as bird food. So our priorities though are to encourage lasting solutions and help create conditions amenable to ecologically and economically sustainable shellfish aquaculture. And we look to the considerable scientific, technological and natural resource management expertise in the Pacific Northwest to invest in assessing, understanding, and fairly resolving this complex set of issues that face the growers and other stakeholders out here. Thank you for the opportunity.

Commenter: Katie Gaut - Comment I-120-1

I do NOT support this new permit to use the pesticide imidacloprid to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor. I agree with the Northwest Center for Alternatives to Pesticides that:
1) The Toxicity to Non-Target Aquatic Invertebrates is Addressed in SEIS, but Evidence for Minimal Impact is Lacking or Contradictory in the SEIS
2) There are significant Data Gaps that Undermines Ecology's Conclusion Of No Significant Adverse Effects
3) That there was No Recognition of Potential Impact to Two Nearby National Wildlife Refuges
4) Uncertainty Regarding Important Indirect Effect
5) Monitoring Required Under The Permit is Inadequately Described

I recognize the importance of aquaculture to the state of Washington, but adequate research and evaluation must be performed to allow for pesticide use in our tidelands and waters. The consequences are far too great to allow operation with this amount of uncertainty. Thank you for your time and consideration and do not hesitate to contact me for additional comments or questions.

Thank you,
Katie Gaut

Commenter: Martha Hall - Comment I-151-2

Limited impacts bay-wide, but that there is significant uncertainty about the cumulative impacts and other unknown impacts to other marine invertebrates and life cycles.

Commenter: Matthew Hart - Comment I-3-2

There are known, direct impacts, on a variety of invertebrates that are food for the salmon we depend on in the Pacific Northwest...this is based on your own supplemental environmental review.

Commenter: Laura Hendricks - Comment I-207-7

We request that a permit not be issued based on this flawed SEIS and that Representative Blake not be allowed to overstep this if you don't issue a permit— and come in with another bill to try to let this go through as a study as you are killing mammals, as you are killing the invertebrates you are harming the birds and you are doing the kinds of things that we all know will happen.

Commenter: Bonnie Henwood - Comment I-150-2

This proposal should not go through. The environmental impacts have not been studied enough and the pesticide is likely to have detrimental effects on other species. From my experience working in a lab with ghost shrimp and imidacloprid, this neonicotinoid is not even very effective against the species. Results suggested that ghost shrimp are easily immobilized (paralyzed) by IMI, but concentrations necessary to kill the shrimp exceed those for other marine invertebrates.

Commenter: Blythe Horman - Comment I-133-1

I'm writing to urge you to deny the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

Your agency has prudently declined this before, due to the fact that Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to target and non-target species, including aquatic invertebrates, which form the basis of a healthy aquatic ecosystem. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species. It seems unlikely that reducing the acreage involved, as the new request proposes, will mitigate the adverse impacts, since the pesticide will disperse unimpeded through the harbor and bay waters.

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative, non-poisonous alternatives that will not kill off important segments of the food chain and threaten important ecosystems.

Thank you for your thoughtful consideration of these comments.

Sincerely,

Commenter: Kevin Jones - Comment I-191-2

Deny Imidacloprid use for shrimp control in Grays Harbor & Willapa Bay. This neonicotinoid pesticide kills bees and other pollinators and can also devastate aquatic invertebrates and the animals that rely on them for food.
Sincerely,

Commenter: Gina Massoni - Comment I-149-4

Evidence for minimal impact to non-target invertebrates is lacking or contradictory.

Commenter: Gloria McClintock - Comment I-363-1

Please consider critical new information that should be included in the Supplemental Environmental Impact Statement for the proposal by the Willapa Grays Harbor Oyster Growers Association (WGHOGA) to apply imidacloprid to Willapa Bay and Grays Bay. Information in a new U.S. Environmental Protection Agency (EPA) aquatic risk assessment shows that imidacloprid cannot be safely used by oyster growers. (USEPA. 2017. Preliminary Aquatic Risk

Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC) EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates."

The assessment also found chronic risk concerns with imidacloprid exposure to saltwater invertebrates. The agency evaluated an expanded universe of adverse effects data and found that acute (short-term) and chronic (long-term) toxicity endpoints are lower than previously established aquatic life benchmarks.

EPA found risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review.

A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, and others, on the impacts of neonicotinoids in surface waters from 29 studies in nine countries finds that these chemicals adversely affect survival, growth, emergence, mobility, and behavior of many sensitive aquatic invertebrate taxa, even at low concentrations. (Morrissey, C, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. Environment International 74: 291–303.) Neonicotinoids were also recently evaluated by a large panel of international experts chartered under the International Union for the Conservation of Nature (IUCN), which found that these chemicals have "wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats." (Van der Sluijs J.P., et al. 2014. Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environ Sci Pollut Res doi:10.1007/s11356-014-3229-5.)

I urge you to consider this and other new scientific data in your review of the permit application by the WGHOGA. I believe that if you do so, you will find that imidacloprid cannot be used in the proposed way without harming the ecology of the bays.

Commenter: Janis McElroy - Comment I-196-2

Deny Imadacloprid use for shrimp control in Grays Harbor. This neonicotinoid pesticide kills bees and other pollinators and can also devastate aquatic invertebrates and the animals that rely on them for food.

Commenter: Jules Michel - Comment I-188-4

As noted by many, Willapa Bay and Grays Harbor provide ecosystems which support a large number of native species. That support starts at the bottom of the food chain where burrowing shrimp exist. Imidacloprid is not "shrimp specific" - it will kill any marine invertebrate it comes in contact with. Derreck Rockett noted many "uncertainties" in this proposal at public hearings. There are, and those uncertainties - coupled with the very real certainty that this is a pesticide which kills marine invertebrates - should prevent this proposal from considering anything other than Alternative 1, the "do nothing" alternative.

Commenter: Rich Moser - Comment I-269-2

A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, and others, on the impacts of neonicotinoids in surface waters from 29 studies in nine countries finds that these chemicals adversely affect survival, growth, emergence, mobility, and behavior of many sensitive aquatic invertebrate taxa, even at low concentrations.

Commenter: Melinda Mueller - Comment I-136-3

They are known to be toxic to birds, fish, and aquatic invertebrates other than shrimp (2, 3). "Of the neonicotinoids, imidacloprid is the most toxic to birds and fish (4).

Commenter: Melinda Mueller - Comment I-292-1

I'm writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates (1). The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species: "Of the neocotinoids, imidacloprid is the most toxic to birds and fish (2)."

This class of pesticides is also shown to be harmful to pollinators, many of which are already in decline, and whose loss is a threat to our state's ecosystems and agriculture (2 and 3).

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

Thank you for your thoughtful consideration of these comments.

(1) Morrissey, Christy A., et al. "Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: a review." Environment International 74 (2015): 291-303.
(2)Fishel, Frederick M. "Pesticide toxicity profile: neonicotinoid pesticides." University of Florida, IFAS (2005).
(3) Alaux, Cédric, et al. "Interactions between Nosema microspores and a neonicotinoid weaken honeybees (Apis mellifera)." Environmental microbiology 12.3 (2010): 774-782.
(4) Henry, Mickaël, et al. "A common pesticide decreases foraging success and survival in honey bees." Science 336.6079 (2012): 348-350.

Commenter: Form Letter (Multiple) No Imidacloprid Use for Shrimp - Comment I-252-1

Please reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species.

Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems.

Thank you for your thoughtful consideration of these comments.

Commenter: Kim Patten - Comment I-238-3

A total of 60 analyses were conducted to examine the response of 6 taxonomic assemblages(polychaetes, non-juvenile polychaetes only, mollusks, non-juvenile mollusks only, andcrustaceans, and all invertebrates combined). The response was significant ($p < 0.05$) among 51of the analyses, but interpretation was often confounded by significant differences betweentreated and control assemblages before treatment. In general, the response of the treatedassemblages relative to the control assemblage usually did not change much over time,indicating a minimal treatment effect on the assemblage as a whole. Only 6 PRCs of 60 showeda significant negative effect from imidacloprid application. Five of the 6 PRCs representedmollusks, which represented < 2% of all organisms sampled among all sites and years.Crustaceans were negatively affected in one of 8 studies. Polychaetes, both with and withoutjuveniles, were never negatively affected. The large majority of PRCs showed no significanteffect from imidacloprid application, a neutral treatment effect, or ostensibly a "positive"treatment effect. The overall minimal response was likely due to exposure to low concentrationsof imidacloprid for limited times, physiological tolerance to imidacloprid for some species, andmultiple life history strategies to rebound from natural disturbance and adaptation to a highlyvariable environment. These strategies include high mobility and dispersal behaviors, highintrinsic rates of reproduction, and rapid development. The highly variable environment wasreflected in the response as variation among years, sites, replicates, and perhaps haphazardmovements of individuals, particularly juvenile bivalves.

Commenter: Ann Pelo - Comment I-111-2

We think there's a good likelihood that imidacloprid adversely impacts marine invertabrates and life cycles, and probably also impacts fish and birds by wrecking their ecosystem's health.

Commenter: Laurie Pine - Comment I-205-4

What will the impact be to the non-target and yet important organisms in the application area, including the insects, worms, and other crustaceans that live in and on the bottom of the water? Will they suffer long-term or chronic consequences of these chemicals? And if so, what are these consequences. How would a decrease in diversity, abundance, and size of these organisms affect the ecosystem? How would it affect the food chain? To what degree could it affect fish and birds? Would the metabolites or residues of Imidacloprid be an issue in this ecosystem? How toxic would they be? Do you know what they are? Would Imidacloprid react in any way with current herbicide sprays used in the area and could this a more toxic pesticide cocktail, as we found to be the case with some neonics and herbicide or fungicide combinations that, together, exceed their individual toxicities?

Commenter: Patrick Pressentin - Comment I-189-1

Law Office of
PATRICK E. PRESSENTIN
1001 Fourth Avenue Plaza, Suite 4400
Seattle, WA 98154-1065

Patrick E. Pressentin (206) 587-0066
Pressentin@aol.com FAX: (206) 389-1708

November 1, 2017
By email only: http://ws.ecology.commentinput.com/?id=acfUM

Derek Rocket, Permit Writer
Washington State DOE
Water Quality Program
P.O. Box 47775
Olympia, WA 98504-7775
Re: Imidacloprid use on Willapa Bay tideland
Dear Sir:
This is a public comment on the use of the toxin imidacloprid in areas of Willapa Bay. I assume the economic consequences of denying the permit, much as I would assume that there were economic consequences to the prohibition of DDT. Nevertheless I oppose all use of this product on Willapa based on the Draft Environmental Report: "There are still knowledge gaps about imidacloprid." Of utmost importance are the unknown cumulative effects of Imidacloprid and its breakdown products throughout the bay in areas whether applied or not. Neurotoxins are not specific and the report indicates that the benthic and invertebrate populations will be affected to an unknown extent, particularly on a cumulative basis which is a required finding. Measurements after a 4 hour window do not provide a scientific basis for approval.
Rhetorically, would you ingest the chemical with such testing? Green Sturgeon, an endangered species, eat these shrimp and bio accumulate toxins. Will they become like the orca as the most contaminated tissue over time with a newer toxin than PCB, affecting birthrate and reducing the natural predation?
My background is local and practical and includes the UW Wetland Certificate course, environmental law practice in the litigation and cleanup of hazardous waste sites in Washington

and Alaska, and continuous voluntary work over 30 years in restoration of contaminated sites. I visit Willapa Bay annually, have for over 40 years. I eat oysters (I applaud Taylor Seafoods since they have decided NOT to use this chemical.). I enjoy Oysterville and purchasing oysters there. Who cleans up after this chemistry is used for 10 years? Not the small users, but the taxpayers. Are the breakdown products and cumulative effects of Carbaryl applications still in the watershed and flora and fauna? Is there not cumulative and synergistic effects to the populations affected aside from "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish to the areas treated". Pulp mills in Washington and Alaska left legacy sites that cannot be cleaned entirely, decimating benthic, invertebrate, and fish populations by cumulative effects ignored at the permit stage. The cleanups exceed the economic value conveyed in the long run and the environment will not fully recover for decades. And these pollutants were not neurotoxins, but effluent, sulfuric acid, industrial PAHs that will eventually break down naturally.
There are "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish to the areas treated". This says nothing of cumulative impact.
I must comment on the proponents website protectwillapabay.org, where they defend the use of imidacloprid as "A Responsible, Ecologically-Conscious Integrated Pest Management Program" and
an ecological necessity for the plan. "An ecosystem imbalance that's not natural that has caused proliferation of the shrimp and turned the bay into a wasteland, where nothing else can live or grow." This is their lawyer talking, an advocate without scientific basis. The "imbalance" is not historical, nor an imbalance. The shrimp are native unlike the Spartina grass. The Pacific oysters are the invaders, the result of Japanese natives introduced here and now the users are insisting on draconic change, much the way Atlantic salmon have edged their way into our environment and now the users place the taxpayers and owners (Public Trust ownership) of our waters at risk. The mud tidelands are not deserts of biology but simply an alternative ecology of the most natural kind. Wetlands were once regarded as wastelands because of lack of knowledge and are now protected because of their economic value; these mud flats are biologically diverse and have their own value and economic assets to the larger ecosystems that are not explored in the Draft EIS. The artificial reduction of these shrimp by the use of a neurotoxin is not reasonable. Unexplored options as alternatives exist (floating or hanging cultures like Penn Cove) but have not been proposed due to economic considerations. Toxins are not the answer if we are to look to a sustainable, healthy food source.

Yours truly,
/s/ Patrick E. Pressentin

Commenter: Form Letter (Multiple) Protect Willapa & Grays Harbor - Comment I-253-1

Dear Mr. Rockett:

Please consider critical new information that should be included in the Supplemental Environmental Impact Statement for the proposal by the Willapa Grays Harbor Oyster Growers Association (WGHOGA) to apply imidacloprid to Willapa Bay and Grays Bay. Information in a new U.S. Environmental Protection Agency (EPA) aquatic risk assessment shows that imidacloprid cannot be safely used by oyster growers. (USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC) EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." The assessment also found chronic risk concerns with imidacloprid exposure to saltwater invertebrates. The agency evaluated an expanded universe of adverse effects data and found that acute (short-term) and chronic (long-term) toxicity endpoints are lower than previously established aquatic life benchmarks. EPA found risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review.

A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, and others, on the impacts of neonicotinoids in surface waters from 29 studies in nine countries finds that these chemicals adversely affect survival, growth, emergence, mobility, and behavior of many sensitive aquatic invertebrate taxa, even at low concentrations. (Morrissey, C, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. Environment International 74: 291–303.) Neonicotinoids were also recently evaluated by a large panel of international experts chartered under the International Union for the Conservation of Nature (IUCN), which found that these chemicals have "wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats." (Van der Sluijs J.P., et al. 2014. Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environ Sci Pollut Res doi:10.1007/s11356-014-3229-5.)
I urge you to consider this and other new scientific data in your review of the permit application by the WGHOGA. I believe that if you do so, you will find that imidacloprid cannot be used in the proposed way without harming the ecology of the bays.

Sincerely,

Commenter: Form Letter (Multiple) Protect Willapa from Neonics - Comment I-254-1

Findings of Ecology's SEIS, taken together with the Environmental Protection Agency's (EPA) recent aquatic risk assessment, make it imperative that Ecology deny the permit to use imidacloprid to control burrowing shrimp in Willapa Bay and Grays Harbor. Ecology finds that use would result in "Immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides."

EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." The assessment also found chronic risk concerns with imidacloprid exposure to saltwater invertebrates. The agency evaluated an expanded universe of adverse effects data and found that acute (short-term) and chronic (long-term) toxicity endpoints are lower than previously established aquatic life benchmarks. EPA found risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review.

A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, and others, on the impacts of neonicotinoids in surface waters from 29 studies in nine countries finds that these chemicals adversely affect survival, growth, emergence, mobility, and behavior of many sensitive aquatic invertebrate taxa, even at low concentrations. Neonicotinoids were also recently evaluated by a large panel of international experts chartered under the International Union for the Conservation of Nature (IUCN), which found that these chemicals have "wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats."

I urge you to consider this and other new scientific data in your review of the permit application by the WGHOGA. I believe that if you do so, you will find that imidacloprid cannot be used in the proposed way without harming the ecology of the bay.

Commenter: Jennifer R - Comment I-251-1

Dear Mr. Rockett:
Please consider critical new information that should be included in the Supplemental Environmental Impact Statement for the proposal by the Willapa Grays Harbor Oyster Growers Association (WGHOGA) to apply imidacloprid to Willapa Bay and Grays Bay. Information in a new U.S. Environmental Protection Agency (EPA) aquatic risk assessment shows that imidacloprid cannot be safely used by oyster growers. (USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC) EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." The assessment also found chronic risk concerns with imidacloprid exposure to saltwater invertebrates. The agency evaluated an expanded universe of adverse effects data and found that acute (short-term) and chronic (long-term) toxicity endpoints are lower than previously established aquatic life benchmarks. EPA found risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review.
A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, and others, on the impacts of neonicotinoids in surface waters from 29 studies in nine countries finds that these chemicals adversely affect survival, growth, emergence, mobility, and behavior of many sensitive aquatic invertebrate taxa, even at low concentrations. (Morrissey, C, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. Environment International 74: 291–303.) Neonicotinoids were also recently evaluated by a large panel of international experts chartered under the International Union for the Conservation of Nature (IUCN), which found that these chemicals have "wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats." (Van der Sluijs J.P., et al. 2014. Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity

and ecosystem functioning. Environ Sci Pollut Res doi:10.1007/s11356-014-3229-5.)
I urge you to consider this and other new scientific data in your review of the permit application by the WGHOGA. I believe that if you do so, you will find that imidacloprid cannot be used in the proposed way without harming the ecology of the bays.
Sincerely,

Mrs. Jennifer R

Commenter: Dick Sheldon - Comment I-201-3

Ghost Shrimp monocultures, unused by shorebirds, devo-d of eel grass, zero habitat for prey species, and benthic invertebrates with no possibility of spawning grounds for herring, sandlance, or other fishes, no depressions or vegetated tidal pools, nothing but quick sand and strings of filimus algae destined to form large mats that settle onto oyster beds poisoning every benthic creature trapped beneath it.

Commenter: Lorna Smith - Comment I-257-1

(Email Submission)

Hello, Derek Rockett,
Please find attached a letter regarding intention to spray imidacloprid in Willapa Bay and Grays Harbor.
I am strongly oppposed to the issuance of such a permit.

Thank you
Lorna Smith

I'm writing to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor. Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. These chemicals are now being linked to a world-wide decline in not only pollinators, but all insects. The use of this pesticide in Willapa Bay and Grays Harbor should not even be considered, given the global importance of the area for migrating shorebirds and other aquatic life. "The highlight of the Grays Harbor National Wildlife Refuge, a.k.a. Bowerman Basin, is the spring migration of shorebirds. Lying within the Pacific Northwest Coast Eco-region, the refuge's 1,500 acres of salt marsh and mudflats play host each year to tens of thousands of shorebirds that stop to feed and rest during their 7,000 mile journey from South America to their nesting grounds in the Arctic. One of the four most important estuaries in North America for migrating shorebirds, Grays Harbor as a whole has been named a Western Hemisphere Shorebird Reserve Network Site. Bowerman Basin and five other sites within the estuary have been designated as Washington State Important Bird Areas." From Bird Web Although imidacloprid has not been shown to kill birds directly, its use has been not only been associated with decline in insects, aquatic and non-aquatic, but birds have declined where it has been used as well, as documented in several studies now. Young fish of many species including our native salmonids spend much of their early life cycle in estuaries where they adapt to living in a salt-water environment before out-migration. The following is a quote from a recent study published in the scientific journal Environmental Science and Pollution Research International: “Imidacloprid and fipronil were found to be toxic to many birds and most fish, respectively. All three insecticides exert sub-lethal effects, ranging from genotoxic and cytotoxic effects, and impaired immune function, to reduced growth and reproductive success, often at concentrations well below those associated with mortality. Use of imidacloprid and clothianidin as seed treatments on some crops poses risks to small birds, and ingestion of even a few treated seeds could cause mortality or reproductive impairment to sensitive bird species”. Instead of allowing this dangerous pesticide to be sprayed, I urge the Department of Ecology to work with growers to find creative alternatives to imidacloprid that will not threaten important ecosystems. Thank you for your thoughtful consideration of these comments.

Commenter: Sunny Speidel - Comment I-195-2

Pls deny Imidacloprid use for shrimp control in Grays Harbor. This neonicotinoid pesticide kills bees and other pollinators and can also devastate aquatic invertebrates and animals that rely on them for food.
Thank you,

Commenter: Katherine Spence - Comment I-282-1

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to nontarget species, including aquatic invertebrates. The use of this pesticide in Willapa Bay and Grays Harbor could result in serious unanticipated negative impacts to these ecosystems, including imperiled fish and bird species. And it could affect bee populations, which are already struggling.

Commenter: Bob Triggs - Comment I-2-3

All adjacent invertebrate and vertebrate species will be affected.

Commenter: ROBERT WENMAN - Comment I-138-3

Imidacloprid—Eradicates native ghost shrimp and could harm other benthic species. Linked to bee colony collapse disorder and subject of bans in other countries and states.

Among the concerns is "...the significant risk Imidacloprid presents to aquatic invertebrates..." which, in turn, "...can also cause a cascading trophic effect, harming fish, birds, and other organisms that rely on them for sustenance." Of special concern noted is the fact that Willapa Bay and Grays Harbor "...are among the most important migratory bird stopover sites on the west coast."

Commenter: Austin Wilson - Comment O-11-1

As You Sow is a national 501c3 non-profit that has researched and promoted corporate responsibility for over 25 years. We advocate for long-term sustainability programs that benefit shareholders, companies, and the communities in which they do business. We work with major food companies to develop sustainable agriculture policies that meet current needs while securing future supply.

Imidacloprid is a dangerous neurotoxin. It is well-established that invertebrates quickly develop resistance to neonicotinoid pesticides, including imidacloprid. The pesticide applications in this proposal will only kill 60-80 percent of the shrimp in a plot, which will accelerate imidacloprid resistance, rendering the program ineffective. This pesticide will wreak havoc on the local system for a few years of relief.

We urge the Department to determine why burrowing shrimp are overgrowing in these regions and seek proposals that are sustainable for oyster farmers, local communities, and all other stakeholders.

Austin Wilson
Environmental Health Program Manager
As You Sow

Commenter: Trina Bayard - Comment O-7-6

Burrowing shrimp have been described as ecosystem engineers because of how their burrowing activityaffects nutrient and carbon fluxes and alters benthic communities. Numerous peer reviewed studiessuggest that permeable sediments, such as those formed by inhabitation by ghost shrimp, enhance removalof nitrogenous nutrients and reduce coastal turbidity, thereby improving overall water quality and reestablishhealthier intertidal benthic environments.5,6,7 Burrowing shrimp also exert considerable influenceon intertidal food webs; an unpublished estimate of Neotrypaea (ghost) shrimp biomass in Willapa Bay in2006 was close to 20,000 tons (B. Dumbauld, unpublished data). Accordingly, mud and ghost shrimp mayrepresent the largest single contributor to estuary secondary production (i.e., food for consumerorganisms) in west coast estuaries.

Commenter: Nichelle Harriott - Comment O-5-7

The finding highlighted by the Washington State Department of Ecology that use ofimidacloprid would result in "Immediate adverse, unavoidable impacts to juvenile worms,crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas coveredby incoming tides" is consistent with research on imidacloprid and other neonicotinoidinsecticides. A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, andothers, on the impacts of neonicotinoids in surface waters from 29 studies in nine countriesfinds that these chemicals adversely affect survival, growth, emergence, mobility, andbehavior of many sensitive aquatic invertebrate taxa, even at low concentrations.18Neonicotinoids were also recently evaluated by a large panel of international experts charteredunder the International Union for the Conservation of Nature (IUCN), which found that thesechemicals have "wide ranging negative biological and ecological impacts on a wide range ofnon-target invertebrates in terrestrial, aquatic, marine and benthic habitats."19

Commenter: Center for Food Safety - Comment O-8-5

Imidacloprid has never before been approved for use in water and is nearly alwayslabeled as "highly toxic to aquatic invertebrates," including species like crabs. As expertshave recognized, spraying this toxin into bays will not just kill the native burrowingshrimp, it will also kill or harm all aquatic invertebrates it touches, and indirectly impactspecies that rely on these food sources. Further, given the significant data gaps, thisunder-studied plan should not move forward.

Commenter: Amy van Saun - Comment O-12-4

Because the screening values used in the field studies and SEIS are not supported by sound science, the conclusions as to direct impacts to wildlife (invertebrates and vertebrates) are highly questionable. For the reasons described above, the 2014 field studies are of limited utility. As described below, the toxicity values used as the basis of the SEIS analysis are also flawed. Ecology
must go back to evaluate impacts based on scientifically defensible levels.

Commenter: Anne Shaffer - Comment O-3-2

EIS states that this action will result in:
adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish to the areas treated with Imidacloprid and the nearby areas covered by incoming tides.
environmental impacts and other unknown advserse
impacts to other marine invertebrates and life cycles.

Commenter: Brian Kingzett - Comment O-19-2

We have successfully restored previously abandoned tidelands where high densities of shrimp had created muddy barrens of low diversity into productive eelgrass beds that support the bottom culture of oysters and associated marine invertebrates, fish and waterfowl that use the bay.

Commenter: Jennifer McDonald Carlson - Comment A-5-4

Impacts to the untargeted benthic community is likely to be higher than described in the 2015final EIS and the 2017 DSEIS. The 2014 Field investigations Experimental Trials forImidacloprid Use in Willapa Bay (Hart Crowser, 2016) described a sampling protocol we believeinsufficient to accurately determine the magnitude of effects to benthic invertebrates. Theseexperimental trials included megafauna sampling which focused on Dungeness crab. Accordingto Hart Crowser (2016), "The average across all sites and treatments was 2 affected crab peracre." We believe this number does not accurately represent the total number of crabs affectedbecause the study was not performed throughout the 90 acre sprayed test plot.

Instead,observations were taken only on the inside and outside edge of a 7-meter perimeter along thespray zone. Within this smaller peripheral zone, 4 crabs were observed alive, 44 were observedexperiencing tetany, and 93 crabs were found dead. It could be anticipated that there would havebeen much higher numbers if more timely and full systematic surveys were conducted throughout the test area. The DSEIS addressed this by estimating a high-end value of 18 crabsaffected per acre sprayed. We are concerned with the degree of uncertainty surrounding theseestimates.

Commenter: Megan Dunn - Comment O-6-2

Chronic toxicity to freshwater aquatic invertebrates is also discussed in the EPA 2017 risk assessment, with values of 0.01 - 1,800 ppb presented (some are LOAEC values, but not the 0.01 value). Only two studies explore saltwater aquatic invertebrate chronic toxicity values, with the most
sensitive value (NOAEC) attributed to mysid shrimp at 0.163 ppb. Mysid shrimp are not just laboratory animals. Mysids are found throughout the world in both shallow and deep marine waters
where they can be benthic or pelagic, and they are also important in some freshwater and brackish
ecosystems.2 Mysid shrimp are also documented as occurring in Willapa Bay

Commenter: Patricia Jones - Comment O-16-5

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm tonon-target species, including aquatic invertebrates. Young fish of many species including our nativesalmonids spend much of their early life cycle in estuaries where they adapt to living in a salt-waterenvironment before out-migration. These chemicals are also linked to declines in pollinators and insects.The use of this pesticide in Willapa Bay and Grays Harbor should not be considered, given the globalimportance of the area for migrating shorebirds and other aquatic life.

Commenter: Jay Davis - Comment A-1-3

As was stated in our previous comment letter addressing imidacloprid and these specific proposed practices (USFWS 2014), there is substantial scientific evidence documenting the persistence of neonicotinoids in natural systems (marine, freshwater, and terrestrial environments), and documenting direct and indirect adverse impacts on non-target invertebrate species, vertebrate species, and overall ecosystem functions (Chagnon et al., 2015; Gibbons et al., 2015; Morrissey et al., 2015; Health Canada 2016; EPA 2017). New scientific evidence compiled and reviewed by Ecology, including the findings from field trials conducted during 2012 and 2014, establishes with certainty that these proposed practices would have acute adverse impacts to sediments and sediment quality, the benthic community, and free-swimming crustaceans and zooplankton, both on and off of (i.e.. adjacent to) the treated shellfish beds (Ecology 2017).

Commenter: Jay Davis - Comment A-1-10

Other sources of sub-lethal effects and stress, these exposures may result in unforeseen adverse impacts to the survival, growth, or reproductive success of target and non-target species (benthic invertebrate community, free-swimming crustaceans, or zooplankton) (Chagnon et al., 2015; Morrissey et al., 2015). 'Ihe Supplemental EIS acknowledges, but does not adequately address, potential indirect effects to food webs (predator-prey dynamics) and ecosystem functions.

Commenter: Douglas Steding - Comment O-20-4

Dr. Richard Wilson, a WGHOGA member, has spent decades sampling anddocumenting invertebrates and plankton associated with Willapa Bay, and in particular,the effects of burrowing shrimp on the ecology and primary productivity of the bay.Much of his work has focused on the benthic diatoms, which are important primaryproducers that form the base of the food web in these shallow estuarine systems. Byforming a "biofilm" on the sediment surface, benthic diatoms can be a major food sourcefor some birds (e.g., western sandpipers and dunlin, Mathot et al 2010), and indirectlyfor many other birds by supporting invertebrates they feed on (e.g., amphipods andbenthic copepods), that, in turn, feed on the diatoms. Dr. Wilson's work on this subjectis detailed in Attachment A. This Attachment constitutes a part of WGHOGA'scomments on the SEIS.

Commenter: Douglas Steding - Comment O-14-2

Without the ability to treat the tidelands, not only will there be loss of ecological value within these benthic habitats, there will be significant economic impacts to the region.

Commenter: George Tuttle - Comment A-3-3

Regarding the results from the most recent monitoring studies
conducted in 2014 the DSEIS specifically states that, "... as in previous years, variability in benthic abundance
collections was high and statistical power was weak" (Department of Ecology DSEIS - Appendix A, Page A-22).
Because there is an extremely high degree of variability inherent in the intertidal systems of Willapa Bay and
Grays Harbor it is not practical to require the shellfish growers to produce additional monitoring studies that may
lack the adequate level of confidence required to determine whether changes in benthic abundance are caused by
applications of imidacloprid.

Comments on Water Quality

Commenter: - Comment I-63-1

Please do not allow - control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington. We have far too many pesticides in our waters now.We are spending millions of dollars trying to clean up the Puget Sound. It is wasteful to allow this action which counters the work being done.

Commenter: Jane Beattie - Comment I-268-2

Information shows that imidacloprid cannot be safely used by oyster growers. (USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC)EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." The assessment also found chronic risk concerns with imidacloprid exposure to saltwater invertebrates.

Commenter: Daniel Cheney - Comment I-174-2

Oyster beds provide important ecosystem services such as water filtration, resulting in decreased suspended solids, turbidity, and increased denitrification; habitat for epibenthic invertebrates such as crabs; carbon sequestration; and stabilization of adjacent habitats and the shoreline.... Oysters grow well on hard, rocky bottom or on semi-hard mud firm enough to support their weight. Shifting sand and soft mud are usually unsuitable for oysters.

Commenter: Timothy Coleman - Comment I-301-1

As a Washington resident who eats seafood and who cares about the health of our fresh and salt water ecosystems, I urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor.

Commenter: susan entress - Comment I-42-1

Please continue to be vigilant in opposing the potential contamination of two of WA State's most valuable natural resources, our ocean water and our tidelands. It is not in the best interest of our state for these resources to become secondary to corporate profit.

From the manufacture's own safety guidelines:
This product is highly toxic to bees exposed to direct treatment or residues on blooming crops/plants or weeds. Do not apply this product or allow it to drift to blooming crops/plants or weeds if bees are foraging the treatment area.

This chemical demonstrates the properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

https://www.backedbybayer.com/~/media/BackedByBayer/Product Labels - pdf/Merit 2 F.ashx

Commenter: Gayle Janzen - Comment I-259-4

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

Commenter: Rich Moser - Comment I-269-3

"[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates."

Commenter: Laurie Pine - Comment I-205-3

Where the treated water goes, it can seep into other waterways — ground water and other flowers and plants can take it up via the root systems even if they are a mile or more away.

Commenter: Ira Pollock - Comment I-36-1

I vehemently oppose the proposal to use pesticides in oyster beds in order to control burrowing shrimp populations. Oyster beds are an important restoring of marine ecosystems. They purify the water, something desperately needed in the Puget Sound. Accordingly, growing oysters is one of the very few industries out there that is actually good for our waterways. Pumping points on into the waterway to make way for oysters completely offsets the ecological justification for the proliferation of oyster beds. I, for one, will no longer eat oysters if this becomes common practice. We shouldn't have to poison the environment to grow or food.

Aside from that, part of what makes oyster beds an ecological boon is that they remove poison from the water. If we pump more poison into their beds, they will end up consuming and storing it in their bodies, possibly making them less safe for consumption. The bottom line is that we should not be spraying any oyster beds with any pesticide.

Commenter: James Schupsky - Comment I-331-3

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected.

Commenter: Scott Shaffer - Comment I-47-1

We need to look into ways to reduce chemicals from our waters not add even more. Please do not allow this neurotoxin use.

Commenter: Mary McAleer - Comment O-18-2

Oysters and clams as foundation speciesameliorate conditions for other organisms important to estuarine trophic preservation including zooplankton, and boost marine biodiversity by providing clean habitat to otherenvironmental stewards such as algae and barnacles.

Commenter: Joe Breskin - Comment O-13-3

Comments on SEIS from Olympic Environmental Council We are a 501c3 organization in Washington State that is concerned with protection and preservation of natural systems. We serve as an umbrella organization for other organizations and groups dedicated to defending natural systems. Historically, we have been active in this arena for over 25 years since the dawn of GMA process and have had to appeal several bad agency decisions. I am sure we will not be alone in noting that absurdity of permitting non-lethal levels of insecticide, and the inevitability that this approach will predictably fail to address the deep systemic problems that the industry and the agencies have created over the past 50 years, by focusing in single issues w/o considering to potential scale or importance of the unintended consequences of the actions taken to protect an industry that is based on entirely unsustainable methods and on fundamental misunderstandings of ecosystems. First things first: if we look at this as an ecosystem, the burrowing shrimp have coexisted in balance with the oysters in Willapa Bay forever. They have been in the estuary at high population levels since before the ice age. If population of a single species appears to be increasing rapidly the first question that needs to be asked is "Where?" And the second question is of course "Why?" The answers to both of these questions point to a long history of gross negligence by the shellfish industry. At the turn of the century self-serving exploiters basically strip-mined the estuary and destroyed the shell reefs that had supported the oysters, kept the shrimp out of oyster territory, and kept aragonite levels in the water column ideal for oyster propagation. Since then, almost everything that has been tried has had the appearance of a macabre comedic sort of rolling catastrophe. Growers introduced numerous invasive species, each of which has complicated the situation. They introduced japanese oysters, whose means of reproduction is poorly suited to the chemical conditions in the estuary, manila clams, oyster drills, spartina, and japonica. And someone introduced the isopod parasite that is currently driving the mud shrimp to the verge of extinction on the west coast. Historically, mats of japonica rhizomes supported vast populations of migratory waterfowl. The stuff has been called 'duckgrass' for a very long time, because ducks and geese eat the blades, roots, or both. American Wigeon, Northern Pintail, and Mallard are the three main species of ducks that eat duckgrass on Willapa Bay. These ducks are dependent on duckgrass to survive; in fact the Wigeon's diet consists of more plant matter than any other dabbling duck. The Northern Pintail is considered a common bird in steep decline.[ii] The Dusky, a goose, eats both duckgrass and marina, and on paper, the Dusky is a protected goose, due to low a population.There are several species of migratory geese that are almost totally dependent on it being here and when they fly into Willapa Bay expecting to feed and fatten for their migration, they now find barren defoliation. This is genuinely life threatening: they simply cannot survive a mistake of this magnitude. But it is not the ducks' mistake, it is the mistake of Washington State that is permitting the destruction of duckgrass and marina with Imazamox. Since the 1980's scientists have consistently reported (see feldman 2000 review paper and excerpt below) that eelgrass keeps shrimp from burrowing in the areas where it grows. The eradication of japonica has now damaged or destroyed both species of eelgrass (marina and japonica) over vast areas of Willapa Bay and opened those areas to shrimp. The wholesale destruction of Eelgrass using the herbicide Imazamox not only reduced the shrimps' predators, who used it as habitat and hiding cover, it removed a key physical constraint - the mats of rhizomes were an obstacle to the shrimps' burrows and the destruction of the Eelgrass (to support another introduced invasive species: Manila Clams) has allowed the shrimp to move into vast areas where they could not live when the Eelgrass was there. "Field surveys have been consistent with Brenchley's (1982) findings, noting the abrupt decline and low densities of ghost shrimp burrows in Zostera rnarina beds compared to adjacent intertidal mudflats (Swinbanks and Murray 1981; Swinbanks and Luternauer 1987). Harrison (1987) reported that an expansion of Z. marina and Zostera japonica habitat was accompanied by a corresponding reduction in ghost shrimp density." So now the industry want to poison the sediments with a different neurotoxin in an effort to paralyze the shrimp so that they will suffocate in their burrows. A lawsuit brought against the state and industry by citizen activists to end the use of carbaryl resulted in a hard won settlement agreement with the Willapa Bay Grays Harbor Oyster Growers Association. This agreement called for the phase-out of carbaryl and gave the industry over a decade to develop and adopt an integrated pest management plan to replace their unsustainable pesticide-based shrimp control measure. This settlement agreement was based on a serious legal challenge from citizens -- not the state -- against ecosystem scale contamination. It is not what the industry PR machine is now pretending was a voluntary phase-out based on some sort of magic wand of enlightenment among the growers: they kept spraying year after year and spent hundreds of thousands of dollars (including public funds) exploring alternate chemical approaches rather than embracing non-chemical approaches to restore ecosystem balance. During that 10 year negotiated phase out, the National Marine Fisheries Services determine in 2009 that the application of carbaryl in both Willapa Bay and Grays Harbor jeopardized the continued existence of endangered salmon and adversely affected or destroyed their habitat. Also in 2009, the NMFS determined the application of carbaryl adversely affected ESA listed green sturgeon in these same bays. The spraying continued unabated. A great deal of public money was spent exploring chemical means to control a native animal species whose growth has been facilitated by destruction of a native plant species. As far as we can tell, the use of USDA's IPM funds to develop a pesticide based approach to destroy a native animal species in support of a non-native animal species is entirely unprecedented, and is especially disturbing in the face of the population collapse of the native mud shrimp that is currently underway. It is not clear if, when, or or how the required IPM was actually adopted, but it is very clear that almost none of the usual principles of IPM are involved in the latest pesticide permit proposal. The DEIS to which this EIS is attached is deeply flawed, because it fails to address the complex interactions between species. For example, the estimates for incidental take of non target organisms are just plain wrong, and the role of crabs as oyster predators is not discussed, but millions of

You make a statement , I'd like to know who made the statement that mammals don't go out on the shellfish beds in the daylight. When I left my house there were 3 racoons out there. They're out there all the time. And in the next pool over there was a blue heron. This is not going to affect blue herons and they're eating everything that's out there and they're eating the little fish that eat what's out there. So I just don't know how after 4 years you can come up with these kinds of statements. I see no basis for removing the high TOC zones. You're telling me that you might bring them back. How do we know? I mentioned the WAC quotes and what you're saying is even in Puget Sound they can go down 50% as long as it comes back. Understand no time frame for it to come back.

You've had a look at cumulative effects as they are well established in legal precedent such as DTM. You've just looked at synergistic effects between 2 chemicals acting on 1 plant. You have to look at how much eelgrass are you removing with Imazamox and how much zooplankton are you removing from the eelgrass that wasn't removed by Imazamox and add it all up. And you haven't done that. The average 10-mile per hour wind [unintelligible] you haven't precluded air boats. The average 10-mile per hour wind in my oyster beds and shellfish beds next to me will have this chemical on the bank in three months flowering plants and pollinators in 30 seconds. You didn't cover that. And they're native pollinators in there. Your attempts to make us belief that Imidacloprid will be kept out of drainages aren't adequate. And the buffer validation test for Imazamox it got into the drainage , that was the source for offsite damage. So what you said in that one was well we didn't spray into a drainage, we sprayed into water that went into a drainage. That's a distinction without a difference. You shouldn't be using it here.

You treat behavior with a broad brush. You're only spraying 1.1% of the base so it won't affect the public. You would be spraying commercial beds next to public shellfish beds , 2 of them within a mile of my house, one of which I frequent. When those beds are posted for "Pathogens, Stay Off" one of the beds, never posted. You report that Imidacloprid travel off-site has never happened. In your literature search you didn't see apparently anything about how films can transport pollutants , including chemicals , far off a site. I mention mammals. The mammals are all over the beds in daylight. And they will be there at night eating what you kill during the daylight so it doesn't really matter.

Fran Sant: Ross, you're going to need to wrap up.

Ross Barkhurst: Okay. The statement , personal communication with Mr. Patton that when you're applying it's going to scare the birds away so there won't be impact. That isn't the way it works. The birds follow you around and eat what you're killing and eat what you're stirring up. I have a number of other comments and I'll give them to you afterwards. Thank you.

Commenter: Ross Barkhurst - Comment I-247-1

(Email Submission)

I am writing to let you know that the subject SEIS cannot support the drafting of a permit as has been supposed by DOE (Ecology). I also ask that you consider the lack of public information on comments to date from WDFW on how fish and wildlife would be put at risk, and impacts cumulative to date from events including
other spray campaigns. These include the ongoing campaign which authorizes removal of all eelgrass from shellfish beds containing any Zostera japonica in Willapa Bay.
I am a graduate of the US Naval Academy with a major in Naval Science and a second major in Oceanography. Following graduation I spent six years as an officer in the US Naval nuclear submarine service. Following my service I worked for thirty years at increasing levels of responsibility in the nuclear electric utility business. I served at all levels starting as a System Engineer, culminating as President and CEO of a Nuclear Generating Company. I worked at three large power plants, all on rivers, two in tidal zones, one including the Columbia River. We have owned land on Willapa Bay for forty years. I retired in 2002 and have lived full time on Willapa Bay in Pacific County since then. I personally sprayed Spartina sp on my oyster bed under an NPDES permit held by WA Dept of Agriculture from 2004 through 2008. I have closely followed generation of NPDES permits to spray eelgrass and burrowing shrimp in Willapa Bay and Grays Harbor. I have given lectures on my view of all three of these permits. While working previously at three different Nuclear Steam Electric Generating Stations, I was responsible for many and ultimately all aspects of NPDES and Environmental Monitoring Program compliance and in two cases for obtaining approval for these permits. I have given talks to various government bodies concerning the attributes of these permits. I have signed requests for changes to these permits. I have served on an industry advisory committee to the US Secretary of Energy.
I would refer you to details of my twenty plus detailed comments recently submitted to Ecology. Those who did not get them will see them shortly. My purpose here is to communicate the big picture at your level of the State of Willapa Bay and its deteriorated Net Ecological Function. WDFW Commission and director have received a number of more detailed reports over the past few years.
The SEIS is a step backwards from the former FEIS it purports to supplement when it comes to dilution and flushing of pollutants such as imidacloprid. It claims that large tidal exchange, and tidal flushing, rapidly remove pollutants from the estuary. These do not do this. I have previously described the attributes of a vertical or horizontal boundary estuary and how a fairly closed loop of circulation is set up. In your workshop (Ecology) on the original EIS for imidacloprid you referenced a paper and posted a map from a Banas and Hickey study of Willapa Bay circulation. This showed the exact characteristics of a vertical boundary estuary. It showed counter clockwise closed loop rotation North of a Dispersion Gap, and a more stagnant zone south of this gap where water average age varies from 45 days in mid bay to over 60 days South of Long Island in the USFWS Refuge. This Refuge was originally created for waterfowl.
North of the dispersion gap, which runs roughly from below Nahcotta on the peninsula on the West to Sandy Point on the East, the average age of water during the SEIS spray window is 7 days. This means in three half lives, or 21 days, 12.5% o suspended pollutants will remain. In mid bay, after three half lives, 135 days, 12.5% wll remain. Of course after 45 days 50% wuld

still be there. It generally takes five half lives to remove a substance " almost completely" to 3.13%. he SEIS statements about big tide ranges and tidal flushing removing pollutants are wrong, and shocking after having reviewed this before with the same team of Bartlett, Toteff, Doenges, and Rockett. One can imagine the odds of an organic carbon (TOC) loving pesticide like imidacloprid ever leaving South Bay. Just three half lives are 180 days. Five are 300 days. Seems clear all will find a home in some dead or alive TOC before ever being flushed from below the Dispersion Gap. We have run this road before, I understand the proponents for trying again, but cannot accept Ecology role in this. It is time to face reality. EIS' are required to support permits, yet in workshops we were told if there were a permit it would be designed to take care of such problems as may surface, including "uncertainties" which are listed for the SEIS. This is not how it has to work. A permit must rest on top of and implement the assumptions of a solid EIS. You do not have one.
Historically Ecology and WDFW have started out with inadequate baselines and done inadequate monitoring. Where a waterfowl baseline did exist prior to eelgrass spraying, and waterfowl numbers fell through the bottom, the only action has been to quit counting waterfowl. No cause has been communicated for this unprecedented decline, and no corrective action. An inadequate eelgrass baseline from 2006, after spartina spraying had already been underway, has been followed by eleven years of no baywide eelgrass mapping. After eleven years of no herring spawning mass surveys while spawning beds are now subject to spray permits, I have a verbal report spawning mass has been surveyed at zero in 2017. No written report has been forthcoming.
A review of my State of the Bay reports will show Chinook escapement, waterfowl, herring spawning mass, ESA listed green sturgeon, and white sturgeon all still declining and in trouble. My review of WDFW and Ecology actions finds no change to habitat loss, or recovery plan other than that in the Willapa Salmon Management Policy, which is not being honored in spirit or with actions the public can see. Chum salmon have not recovered as required to allow commercial harvest, and with eelgrass they constitute a large part of the base of our food pyramid here.
In short, although we" manage to three H's", habitat, harvest, and hatcheries, in practice we do not, not without recovery plans that include habitat and cumulative effects analysis to match before removing more. It can no longer be acceptable to ignore past losses while proposing more. A WDFW that " cannot afford" to survey waterfowl any more cannot support further eelgrass removal, or new losses of invertebrates, unquantified under false draft Ecology claims that pesticide flushes smartly out to sea.

In the past Ecology has taken lack of formal comment or concern by WDFW to mean that all is well with the next NPDES permit. It has used this lack of comment by WDFW to override public comment. This is not valid, any more than the claim that WDFW cannot afford to monitor. If we cannot monitor conditions under a permit, we cannot have a permit.
Claims and lectures provided by our Ag Extension office saying no problem with imazamox buffer zones or imidacloprid in estuaries are not acceptable if that office has been selling shellfish to the WGHOGA rep it is inputting on an EIS. Neither are these claims acceptable when not backed up by independent opinions from WDFW, who owns the wildlife responsibility. When WDFW contractors are removed from the evaluation and replaced by the conflict of interest office in Agriculture you cannot continue the last permit. When we cannot

find any substantial review of imidacloprid EIS by WDFW, you cannot continue towards another. Should WDFW comment publicly now before November 1, we would not have the benefit of such words or the ability to review them for our comments.
WDFW has the lead in protecting and managing fish and wildlife. It has the obligation to track the health and welfare of same. As stated in its Forage Fish Management Policy, it is especially important to survey spawning mass where human activity may cause impacts. Implicit in this is a recovery plan when losses are found, not no comment when more may be anticipated with yet another chemical. Young herring eat either plant life susceptible to herbicide or invertebrates susceptible to pesticide, or both. These chemicals in the vicinity of known herring habitat have no place if we lack ability to monitor annually and no recovery plan. Same for waterfowl and two of our salmon species. At least one of our now empty herring spawning beds lies below the dispersion gap.

Summary

Silence on impacts on Fish and Wildlife, concurrent with failure for whatever cause to monitor, plan, and recover such wildlife, can no longer be seen by Ecology as acceptability of yet another EIS for yet another NPDES permit. No burrowing shrimp pesticide permit can be drafted for key reasons:
1. Inadequate SEIS which ignores best available science such as bay circulation patterns and sediment/plant capture of systemic poisons designed to kill invertebrates.
2. WDFW lack of meaningful input, and public statements that it cannot monitor or in season manage impacts on key species already in trouble. These include waterfowl, salmon, and forage fish.
3. There is a total lack of cumulative impacts analysis, and no apparent acceptance that all causes count in such a score card, not just the next impact, in this case with uncertainties abounding.

Requests and Recommendations

1. I am asking that Ecology declare the uncertain SEIS to be inadequate to support drafting an NPDES permit for imidacloprid for burrowing shrimp removal in Willapa Bay and Grays Harbor.
2. I am asking that application of imazamox to kill eelgrass in Willapa Bay be suspended. The Buffer Validation Test is unreliable with respect to how much chemical was actually applied, and suspect when the plan was abandoned to have final review of damage done by an independent WDFW contractor. The latter was removed and replaced with the same Extension Agent who applied the chemical and was at the time in violation of State Ethics codes. Damage was done in drainages outside the protective buffer and evaluated as acceptable by the same conflicted person who supervised the application improperly.
3. A public task force should be set up to advise WDFW on a plan to recover the State of Willapa Bay and review the State of Grays Harbor. Recommendations of this task force would be incorporated in any future plans to remove or restore habitat in Willapa Bay.
4. It is recommended that WDFW immediately restore plans, this year, to survey waterfowl stopping over in Willapa Bay especially during historical peak periods. The cause of historic

declines locally must be determined and corrected. This for example would include November peaks for ducks and geese and spring staging periods for Pacific Brant. Further, WDFW should commit to monitoring herring spawning mass annually in Willapa Bay going forward, and generating a recovery plan for these forage fish. The Willapa Salmon Management Policy should be supplemented with a more robust recovery plan for these fish under current PDO conditions, and expanded to include recovery of both species of sturgeon historically present in large numbers.

Respectfully,

Ross P. Barkhurst, South Bend, Washington

Commenter: birch berman - Comment I-26-1

There are too many unknowns around the use of this chemical. Please do NOT allow its use.

Commenter: Jennifer Boelter - Comment I-70-1

Without a complete study on the adverse effects of this pesticide to the environment and sea life, it should not be introduced to the Puget Sound.
Please do not allow this pesticide to be used in our waters.

Commenter: Seth Book - Comment I-185-1

I appreciate the opportunity to submit written formal comments for the proposed use of pesticide on Washington State tidelands, specifically about the use of the pesticide imidacloprid on commercial shellfish beds in Willapa Bay and Grays Harbor.

I support Alternative 1 of the Imidacloprid draft Supplemental Environmental Impact Statement (DEIS). I am a biologist by trade and live on a peninsula surrounded by intensive shellfish aquaculture in South Puget Sound. I also help grow oysters above knee-deep muddy substrate with great success by using alternative shellfish growing methods. Attached are questions for the Washington State Department of Ecology concerning the DEIS.

1.Do we know the full extent of food web impacts from the use of the pesticide Imidacloprid in estuarine ecosystems?
1a. What are the impacts to the adult and juvenile crab?
1b. Is juvenile crab more susceptible to impacts due to their use of near shore habitats?
1c. What are the impacts to other crustaceans that are important food sources for biota?
1d. Will the use of Imidacloprid reduce the food source of vertebrates at or around application sites? If so, what types of vertebrates and for how long?
1e. Do mud shrimp provide ecosystem services? If so, what impacts are associated with the control of these organisms?

2. If the use of pesticide on tidelands is approved, I am concerned this decision will be a precedent that this approved use can be applied to other aquatic ecosystems in Washington State. Will the approval of Imidacloprid use increase the use of pesticide in aquatic ecosystems throughout Washington State?

3. Shellfish have a positive societal image due to the advocacy of shellfish growers and consumers. How will the use of Imidacloprid impact the perception that shellfish aquaculture is a green industry? What impact would the use of Imidacloprid on a food source (oysters) have on consumers as well as other shellfish growers outside of Willapa Bay and Grays Harbor? If there is an impact to the shellfish harvest due to the reduction in demand how would this reduction impact the ecosystem services of commercial aquaculture in Washington State?

4. What impact will the proposed use have on humans associated with Willapa Bay and Grays Harbor? Would the proposed use have an impact on Native American tribe's diet?

5. What is the fate and transport potential of Imidacloprid once added to estuarine ecosystems? If applied to estuarine ecosystems will Imidacloprid and its breakdown products move outside the application area? If so, what are the impacts?

6. What is the half-life of Imidacloprid and associated breakdown products in estuarine environments, especially in organic rich embayments?

7. What impact would Imidacloprid application have on pollinators?

Thank you,

Seth Book

Commenter: Seth Book - Comment I-216-2

So I want to also say that many of my comments that I heard tonight did echo my own concerns. I'd like to echo some of these things – like the uncertainty of impacts of us of Imida – I'm just going to say the pesticide – in the aquatic environment. That's one of my concerns. The uncertainty – or the perceived uncertainty of the persistence in this area – I think there needs to be more science in that area. I think that's a concern that should be looked at because of past things that we have done where we have not considered those persistent impacts.

Commenter: Jeff Boyden - Comment I-94-1

I am concerned with unknown environmental impacts and health impacts to humans. I do not want to see a science experiment in our waters. I do not support use of pesticides in this manner.

Commenter: Daniel Cheney - Comment I-174-3

This information coupled with the uncertainly, production risks and high costs associated with the described alternative off-bottom oyster culture and non-chemical burrowing shrimp control methods, clearly indicate the no action Alternative 1 is not acceptable from both ecological and food production perspectives. I urge the Washington Department of Ecology to support and permit the more balanced approaches afforded by Alternatives 3 and 4.

Commenter: Candace Christensen - Comment I-329-1

Please don't put toxins in the Bay, especially since the effects aren't entirely known. It's a dangerous experiment.

Commenter: Form Letter (Multiple) Do Not Allow Imidacloprid - Comment I-270-3

While the SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," the SEIS fails to give adequate weight to the "knowledge gaps" it identifies. In some cases, monitoring is proposed as a way of reducing uncertainty. In order to protect the bays, facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

Commenter: Margaret Donaldson - Comment I-8-4

There is also significant uncertainty about the cumulative impacts to other marine life.

Commenter: Nathan Donley - Comment I-204-1

Nathan Donley (Oral Testimony): Great, thank you. My name is Nathan Donley. I am a senior scientist at the Center for Biological Diversity and a Washington state resident. On behalf of our more than 1 h million members and supporters nationwide -- including more than 40,000 in the state of Washington -- I urge you to deny this permit to spray Imidacloprid on our shoreline. First, I do want to thank you for the analysis that you've done. A lot of work has been put in to this and it is a very in-depth piece of work. So thank you for that. But ultimately you have to make a decision on what you know. And right now we know very little. I think there are so many data gaps and so much uncertainty in this analysis that to make a competent and informed decision would be near impossible. Will there be synergistic effects with other pollutants in these areas? Will there be indirect effects to birds and fish that use these prey species that will be reduced? How may Dungeness crabs is it okay to kill before it affects the population or before it affects harvest numbers? Will Imidacloprid residues carry over to the following year and accumulate in the sediment in these areas? And these are just questions that we don't have answers to yet. But we do know that Canada's Pest Management Agency has proposed to ban Imidacloprid not due to impacts to pollinators or birds, but due to impacts to aquatics and vertebrates, specifically. And there is a lot of agriculture in Canada and we know that insects are very good at developing resistance to neonics. This proposal seeks to spray Imidacloprid at levels that will eventually kill around 60-80% of the shrimp in the plot. This is tailor-made for chemical resistance to develop. Over 5 years, all that will happen is the resistant shrimp will be selected for and expanded and before you know it Imidacloprid is ineffective and we're back to square one.

At best, this is an ill-advised mandate that will provide temporary relief. And at worst, this will wreak havoc on these ecosystems in ways that are difficult to predict with the data we have now. Nowhere in either of the environmental impact statements is there mention of why burrowing shrimp are overgrown in these regions in the first place. We do know that it is likely human-caused. But we're here focusing on alleviating the symptom when we should be focusing on fixing the problem. We've been on the path of killing a native species so we can largely grow a non-native one, and it's a path that leads to nowhere.

Again, I urge you to deny this permit. Thanks

Commenter: Ava Driscoll - Comment I-244-1

(Email Submission)

Attn: Derek Rockett, Permit Writer

I am writing to comment on the Environmental Impact Statement for Control of Burrowing Shrimp using Imadacloprid on Commercial Oyster and Clam beds on Willapa Bay and Grays Harbor, Washington, Draft. I oppose any Permit to use Imadacloprid on the mudflats for the following reasons.

Cons:
1) Lack of information regarding the effect of Imadacloprid on the environment.
2) Lack of Integrated Pest Management (IPM).
3) Sturgeon and crab will be adversely affected if exposed to Imadacloprid.
4) Imadacloprid may be a skin irritant
5) The tide flow will disperse Imacloprid to a greater area than intended.
6) Imadacloprid was not intended to be used in water.
7) Shrimp will develop an immunity to Imadacloprid the more it is used.
8) There may be other harmful chemicals included in the Imadacloprid solution.
9) Biological diversity will decline. I may not see the small orange sea slug with black spots on the oyster beds any more. I also enjoy seeing hermit crab, eel, sponges, cockles, and other creatures.

Predators and hazards besides shrimp that kill oysters:
1) Starfish have died off suddenly and mysteriously.
2) Oyster drills (Ceratostoma inornatum)
3) Green crab
4) Runoff from clear cutting, fertilizing, and pesticides

Manual Methods:
1) Breaking and scattering oysters to keep them from sinking in the mud
2) Other methods of growing oysters, such as rafts or bags may be used.
3) Beneficial birds and fish may be used in controlling the shrimp. I have seen photos of Western Grebe eating shrimp.
4) Other crops or uses may be considered -- scallops, abalone, sea weed (if legal), mussels. Shell can be used to make other products.

I strongly oppose any permit for the application of pesticides, such as Imadacloprid, in Willapa Bay.

Ava Driscoll

Commenter: Ron Figlar-Barnes - Comment I-117-4

What is the effect of imidacloprid on Dungeness crab?What is the status of natural rocky sub-straight in Willapa Bay and Grays Harbor?Have investigation been undertaken regarding predators and ghost shimp?What direct investigations have been undertaken to understand the effects of pesticides use in the past in both bays?What is the effect on salmonid populations during out migration?What has been the effect of dredge-harvesting on ghost shrimp?

Commenter: Sarah Fletcher - Comment I-45-2

Has the Dept of Ecology done any testing and where can one find the results? And do you know why Europe has banned this product? And if you are going to spray, I hope that there is a law that makes it that the oyster seller needs to put in clear bold letters that the oysters that we will be eating have been sprayed with this product so that we can at least make a choice as to whether we want to eat treated oysters or not. And wasn't this product not supposed to be used in water or something to that effect?

Commenter: Katie Gaut - Comment I-120-2

I do NOT support this new permit to use the pesticide imidacloprid to control burrowing shrimp on commercial shellfish beds in Willapa Bay and Grays Harbor. I agree with the Northwest Center for Alternatives to Pesticides that:
1) The Toxicity to Non-Target Aquatic Invertebrates is Addressed in SEIS, but Evidence for Minimal Impact is Lacking or Contradictory in the SEIS
2) There are significant Data Gaps that Undermines Ecology's Conclusion Of No Significant Adverse Effects
3) That there was No Recognition of Potential Impact to Two Nearby National Wildlife Refuges
4) Uncertainty Regarding Important Indirect Effect
5) Monitoring Required Under The Permit is Inadequately Described

Commenter: Don Gillies - Comment I-231-2

Impact bay-wide? Certainly a concern. And due diligent by Ecology to consider and understand the impacts. It's hard for me to get my head wrapped around how much impact a temporary modification on 1% of 40,000 acres could have so – I'm just, I'm just – maybe I'm not scientifically able to understand that, but – this room. Let's say this room is 100 x 100 and 1% is 1 square of this floor. Another topic that was to try to fill in knowledge gaps and I can say from my layman's standpoint that knowledge gaps never go away. There are always knowledge gaps and I would implore the Department of Ecology to decide on the facts that are presented to them, and what the facts that they have now – and not hopefully go – . Okay. That's it.

Commenter: Laura Hendricks - Comment I-207-6

Yes, there are too many uncertainties — and in prior testimony that I understand happened in South Bend, where growers stated that things were great in Willapa. Well, the facts are: waterfowl has decreased from over 100,000 to less than 8,000 and now there is a no count. [unintelligible] populations have dramatically declined. Herring counts are down to zero. used to have herring, now you have a no count. [unintelligible] have gone from threatened to endangered. Sturgeon are now in danger.

Commenter: Christine Hoepfner - Comment I-261-1

(Email Submission)

Spraying Willapa Bay and Grays Harbor with any quantity of imidacloprid is not a sound approach, as the "knowledge gaps" mentioned in the SEIS indicate. The best alternative the SEIS offers is "No Action;" however what is really needed is to restore the bays' basic ecology.

A useful guide in addressing these kinds of situations is "first, do no harm." To be in accord with this aim, as the SEIS' reference to "knowledge gaps" makes clear, more needs to be known about the toxic effects of spraying imidacloprid before it might realistically be considered as an option. Monitoring may provide this information--but too late to undo any damage that was not anticipated.

There is far too much that isn't known about the negative effects of spraying imidacloprid. At the same time, there remain "knowledge gaps" about the efficacy of imidacloprid for achieving the intended results in situations like Willapa Bay and Grays Harbor.

Risking deep ecological damage without sufficient assurance of benefit does not make political, economic, or ecological sense. This leave the "No Action" alternative as the best of the three options proposed in the SEIS. Yet this alternative is not adequate to address the situation in Willapa Bay and Grays Harbor. In fact, the SEIS did not present the best option: the habitat needs to be restored, and protecting the streams flowing into the bays is the best way to begin to achieve the most desirable result.

Thank you for your consideration.

Sincerely,

Commenter: Walter Jorgensen - Comment I-190-2

There likely could be adverse consequences from using it in this situation which are not understood at this time that may only come to light after it is too late.

Commenter: Robert Keyse - Comment I-50-1

The report says on page 2-22 that the only good areas in the region "... have low enough shrimp densities to provide for secure anchoring for off-bottom culture." So secure piles are what? Unsightly?

Commenter: Janaki Kilgore - Comment I-88-2

Negative environmental impacts on worms, shellfish and crabs will be unavoidable. Effects on animals that rely on these food sources is likely to be detrimental and definitely requires more study

Commenter: Edward Kolodziej - Comment I-122-1

Dear Department of Ecology,

Please note that I think this proposed pesticide action is a bad idea for humans and the environment. As a specialist who makes a career in the fate and transport of organic contaminants, this proposed action seems to pose an unacceptably high, and poorly understood, risk of adverse consequences for non-target organisms and humans.

Please lets get past the point where spreading lethal concentrations of toxic compounds throughout our jointly owned environment is considered to b a good idea. There are other ways to address this problem that do not involve the use of toxic chemicals on our aquatic environment. This is a bad idea.

Dr. Edward P. Kolodziej

Commenter: Thomas Lawrence - Comment I-38-3

Just because imidacloprid is claimed to be safe by the manufacturer does not mean that it is. Time and time again, we have seen pesticides supposedly safe be discovered to have broader and longer ranging affects than was claimed, sometimes to the point of needing to be banned.

Commenter: Gina Massoni - Comment I-149-3

There is uncertainty regarding important indirect effects and Ecology understates imidacloprid properties (environmental fate) in predicting effects.

Commenter: Jules Michel - Comment I-188-3

As noted by many, Willapa Bay and Grays Harbor provide ecosystems which support a large number of native species. That support starts at the bottom of the food chain where burrowing shrimp exist. Imidacloprid is not "shrimp specific" - it will kill any marine invertebrate it comes in contact with. Derreck Rockett noted many "uncertainties" in this proposal at public hearings. There are, and those uncertainties - coupled with the very real certainty that this is a pesticide which kills marine invertebrates - should prevent this proposal from considering anything other than Alternative 1, the "do nothing" alternative.

Commenter: Bowen Mikell - Comment I-30-1

This should absolutely NOT be permitted. Saying that there is "no known danger" is not enough when it comes to spraying neurotoxins in the water, for this to be tolerable you'd have to know 100% tat there would be no adverse side effects. And the fact that this would affect crustaceans and other marine life in the immediate vicinity of the spraying(s) only helps to make things worse for this bill. Companies cannot be allowed to pollute our waters. The delicate ecosystem of the Pacific Northwest's waters is not something to be exploited for the purpose of corporate or state profit, and must be protected no matter the cost.

Commenter: Caitlin Morrison - Comment I-11-1

I am an environmental epidemiologist. We do not want to spray these beds with imidacolprid. There is not enough data yet on the long term effects of use. There is not enough specificity yet in how they would spray (for example: only limit spraying to one section for the first ten years). We cannot afford to run experiments in our natural environment. We can not afford to put something in our water annually where we are not extremely confident in the outcomes, especially with neurotoxins.

Commenter: Ann and Douglas Morten - Comment I-362-1

Please take more time and effort in studying the immediate and future impacts of using Imidaclopride to control the invasive burrowing shrimp species attacking the oysters in Willapa Bay and Grays Harbor. The Environmental Impact Statement of 2015 needs to be updated, as often products are released into the environment only to find they are doing more harm that good. These studies take time. Please do not allow this chemical until it's safety is proven.

Commenter: Douglas Morten - Comment I-255-1

Please take more time and effort in studying the immediate and future impacts of using Imidaclopride to control the invasive burrowing shrimp species attacking the oysters in Willapa Bay and Grays Harbor. The Environmental Impact Statement of 2015 needs to be updated, as often products are released into the environment only to find

they are doing more harm that good. These studies take time. Please do not allow this chemical until it's safety is proven.

Thank you

Commenter: Robert Nerenberg - Comment I-12-2

I'm not interested in eating shellfish exposed to a chemical that DOE thinks about in this way: "There are still knowledge gaps about imidacloprid. Further research is needed." I don't want to be a test subject and will immediately stop eating Washington oysters if this is allowed.

Commenter: Cavin Richie - Comment I-256-1

(Email Submission)

Hello-
I am writing to put my 2 cents of opinion concerning the neurotoxin imidacloprid. I am against spraying it on the oyster beds. Scientists admit they don't know the risks and that it has immediate adverse impacts on the tidal critters. Add that to the fact that it will kill only 60to 80% o the ghost shrimp which means the resulting shrimp will have resistance to imidacloprid. This band aid approach is unacceptable. Our marine waters have too many pollutants as it is. I will quit eating oysters if this chemical is used.
Please reject this plan.
Thank you,
Cavin Richie

Commenter: EM Ryan - Comment I-258-1

(Email Submission)

Of the three alternatives, the "no action" is best. Nature can clean itself up if given the chance. It can't clean itself up (or a lot slower) if abused by pesticides, herbicides, and other toxins.

Your own research shows uncertainties as to whether spraying will work. And research did not look at how spraying combines with other chemicals and pollutants ... others stressors on the bays ... or other plants and animals at risk, such as Washington's famous Dungeness crab.

How will Washington fare economically when people don't buy its seafood or travel to its wild areas because of spraying toxic chemicals?

In fact, SEIS should adopt a fourth choice: actively restoring the region's ecosystem. This would restore the ecological balance you're concerned about, provide jobs, help the environment for the long term, and add to the area's usefulness for recreation and tourism as well as farming and similar uses.

Commenter: James Schupsky - Comment I-331-2

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected.

Commenter: Holly Shull Vogel - Comment I-96-1

Have these oyster farmers tried any other method of management of the ghost shrimp? Seems to me other methods should be exhausted before toxic chemicals are even considered. I see according to Monterey Bay Aquarium, in California, fisherment harvest ghost shrimp:
"Fishermen collect ghost shrimp for bait by using a plunger that sucks the shrimp out of their burrows. In 1980, it was estimated that 5,953 pounds (2,700 kg) of shrimp are taken yearly in the San Diego and Los Angeles areas alone."
Why can't this be done here?

Commenter: Paul Symington - Comment I-23-2

It's wrong to allow for-profit special-interests to use poison in our shared public waterways.Poison will likely have unintended consequences, which will cost the environment, fisheries and public dearly while the for-profit oyster growers smugly pocket the profits.

Commenter: Jim Walsh - Comment I-217-1

Jim Walsh (Oral Testimony): Hi. I'm Jim Walsh. I'm one of the representatives for the 19th legislative district which includes both Grays Harbor and Pacific County. I guess what I want to say mostly tonight, with regard to the draft , the SEIS , is I am concerned a little bit with some of the methodology questions I've heard raised by people really from both sides of the issue, who are suggesting different alternatives as a solution. But I would ask you consider those questions that have been raised about the methodology of the EIS. I guess we can talk about some small points of the science and the thing, but the thing that struck me is that the scoping of looking at the effects of Imidacloprid. It seems , and I've seen other EIS's where the scope of the impacts is extremely broad -- even global. And this seems to be very tight and I think some of the issues the oyster growers have raised , the farmers have raised , about the diversity of the Willapa Bay, particularly , and that their small application might only not hurt the biodiversity of the Bay but actually help it in total is something that might be clarified better in the EIS, if you adjusted the scope of some of the discussion, the effects of the pesticide. So that's about it. Take a look at the methodology you used there and listen to what some of these people have said. Thanks.

Commenter: Kristen Wolff - Comment I-25-1

I am strongly opposed to this plan. While WGHOGA members want to spray imidacloprid for economic reasons, they fail to grasp the unintended economic consequences of spraying. If a neurotoxin is purposely sprayed into the waters off Washington, I will no longer eat any oysters or other shellfish harvested from those Washington waters. I am confident that I am not alone in holding this position.

Commenter: Vicki Wilson - Comment O-22-4

One of the areas of uncertainty mentioned was not enough scientific information and field studies in marine environments. We agree there are unanswered questions and believe that this smaller-acreage proposal offers an ideal opportunity for empirical research and observation to help answer these questions and to do so on a small, but still commercially viable, level.

Commenter: Tim Hamilton - Comment O-21-2

The Advocacy opposes adoption of the Draft Supplemental Environmental Statementas currently written. The document is plagued with numerous inadequacies anduncertainties. The draft is also excessively reliant upon the work product of an individualwho openly admits to being biased on behalf of WGHOGA and its members.

Commenter: Neil Quackenbush - Comment A-4-5

New scientific evidencecompiled and reviewed by Ecology, including the findings from field trials conducted during2012 and 2014, establishes with certainty that these proposed practices would have acute adverseimpacts to sediments and sediment quality, the benthic community, and free-swimming crustaceans and zooplankton, both on and off of (i.e .. adjacent to) the treated shellfish beds(Ecology 2017). This scientific evidence also points to significant information gaps anduncertainties regarding a number of important issues and potential consequences (e.g., efficacy,persistence, sub-lethal effects, indirect and chronic effects (Health Canada 2016; EPA 2017)),some of which are not adequately described or addressed in the Supplemental EIS.

Comments on SEPA

Commenter: Brian Kingzett - Comment O-19-3

This alternative, which is smaller in scope and different in method from the 2015 SEPA process, reflects best available science and a refined scope. The proposed mitigation measures and monitoring proposed will adequately offset the potential impacts and provide information for future refinements.

Comments on ESA

Commenter: Shari - Comment I-73-1

We cannot continue to pollute an environment that is critical to the survival of the Southern Resident Killer Whales. Please deny this permit.

Commenter: Rich Andrews - Comment I-246-2

It violates the intent and letter of the laws of our nation that are toprotect the environment and public health; it violates both the Federal Insecticide, Fungicide, Rodenticide Act(FIFRA) as well as the Clean Water Act (and NPDES under that Act), and likely other federal laws, such as theEndangered Species Act.

Commenter: Caroline Armon - Comment I-172-2

A short term solution that will leave long term devastation to endangered and threatened species and the entire ecosystem.

Commenter: Ross Barkhurst - Comment I-210-2

The next thing you see is herring -- 700 tons herring spawning mats in 2002, measured by WFW. You see it really wobbling during the Spartina spraying, down to zero. No herrings spawning in the Bay. They quit measuring herring spawning mass. At my encouragement they started up again this year. What they found in 2017 was zero. Okay? Spartina spraying stopped in 2008 -- a massive amount. And so what we're doing is removing their spawning structure, which is eelgrass. The next thing you see is waterfowl. 2002, about 100,000. By the time we were through getting most of the Spartina out of the bay about 10,000. As soon as that was over it began climbing. In 2014 you see 100,000 waterfowl again. This is the peak in November. In 2014 we start spraying eelgrass, 22,000. The next year, 14,000. Last year, about 8,000. The lowest number of waterfowl in modern history -- while the waterfowl in the fly away is doing just great. But they can't use Willapa Bay any more.

Commenter: Form Letter (Multiple) Do Not Allow Imidacloprid - Comment I-270-7

The SEIS does not adequately address synergistic effects, including impacts of imidacloprid combined with other chemicals ("inert" ingredients, other chemicals used in the bays, and other pollutants) or other stressors. Among the organisms known to be at risk is the commercially important Dungeness crab, which has been shown to be susceptible to the effects of imidacloprid, and whose populations experience large natural fluctuations, putting them at risk of extinction.

Commenter: Mary Fraser - Comment I-320-1

Congress explicitly told the EPA to test pesticides for their effects on endangered species. That hasn't been done for this pesticide. Congress also told the EPA to test for endocrine disrupting properties of pesticides. That hasn't been done for this chemical.
Why would you use a chemical that hasn't had the necessary tests done?

Commenter: Sherril Futrell - Comment I-260-2

Among the organisms known to be at risk is the commercially important Dungeness crab, which has been shown to be susceptible to the effects of imidacloprid, and whose populations experience large natural fluctuations, putting them at risk of extinction.

Commenter: Jessica Helsley - Comment I-169-3

Imidacloprid has been found to enhance adipogenesis, resulting in insulin resistance in cell culture models (Sun et al. 2016, 2017). This provides a strong concern for human health. More direct impacts from insecticide application, including the application of Imidacloprid, have been observed in marine invertebrates which are a critical food source for juvenile salmon and forage fish (Westin et al. 2014, 2015). Wild fish species of salmon and the forage fish food structure that they depend upon are critical components of coastal resiliency- culturally, economically, and ecologically. Macneale et al. 2014 and Gibbons et al. 2015 provide thorough reviews of these concerns. Application of Imidacloprid to coastal areas in the shallow areas of Grays Harbor and Willapa Bay will detrimentally impact critical marine and nearshore ecosystems while also being a human health concern. Impacts to coastal juvenile salmon and forage fish when they are feeding, resting and migrating will have negative impacts to both local salmon populations as well as to salmon populations currently listed under the Endangered Species Act that utilize Washington's coastal waters for nourishment and refugia during their migrations (Shaffer et al. 2012). Additionally, application of Imidacloprid will have a cascading impact up the food chain-impacting marine mammals that include populations also listed under the Endangered Species Act. Washington's coastal ecosystems are complex and vital to our region. We should be working to restore and protect them, not further their demise to enhance the growth of a non-native shellfish species for commercial use. The state and federal agencies are required by law, to preserve Washington State's wild species and the ecosystems upon which they depend. Application of Imidacloprid and other insecticides in coastal zones contradict this mandate and should not be permitted.

Commenter: Laura Hendricks - Comment I-207-5

Yes, there are too many uncertainties — and in prior testimony that I understand happened in South Bend, where growers stated that things were great in Willapa. Well, the facts are: waterfowl has decreased from over 100,000 to less than 8,000 and now there is a no count. [unintelligible] populations have dramatically declined. Herring counts are down to zero. used to have herring, now you have a no count. [unintelligible] have gone from threatened to endangered. Sturgeon are now in danger.

Commenter: Gina Massoni - Comment I-149-5

Field trials left many questions unanswered. There is inadequate analysis of the effects to threatened and endangered species and no recognition of potential impact to two nearby National Wildlife Refuges.

Commenter: Patrick Pressentin - Comment I-189-3

Rhetorically, would you ingest the chemical with such testing? Green Sturgeon, an endangered species, eat these shrimp and bio accumulate toxins. Will they become like the orca as the most contaminated tissue over time with a newer toxin than PCB, affecting birthrate and reducing the natural predation?

Commenter: Frank Wolfe - Comment I-200-2

Sturgeon in the Bay have been all but extirpated by historical over-fishing. These slow-reproducing native fish once fed directly on burrowing shrimp, helping to control their numbers. While it may be possible to mitigate for or restore some of these natural controls on burrowing shrimp, given time, money and political will, none of these factors can be restored in a near-term time-frame.

Commenter: Frank Wolfe - Comment I-219-2

Sturgeon in the bay have been all but extirpated in historical over-fishing. These slow-reproducing native fish once spread directly on burrowing shrimp [unintelligible] to control their numbers.

Commenter: Mary McAleer - Comment O-18-3

Alternative 4's permit conditions and associated mitigation measures would be protective ofWashington state surface water quality standards—some of the most stringent in the nation—and of ESA-listed salmonids and green sturgeon.

Commenter: Dale Beasley - Comment O-23-4

Treated areas support creation of Marina eel grass which also provides cover forjuvenile salmon and other fin fish not found in untreated shrimp infested areas of thebays providing additional long-term benefits for salmon

Commenter: Jennifer McDonald Carlson - Comment A-5-3

Potential effects to Green sturgeon forage on burrowing shrimp and other benthic organisms areeasily discerned in the treated areas (Hart Crowser 2016). However, the impacted area willextend beyond the area directly treated, as the pesticide will clearly be transported off site bywater, as has been shown with limited water quality monitoring at Willapa Bay.

Commenter: Shari Tarantino - Comment O-4-4

On November 18, 2005, after evaluating the five listing factors of the Endangered SpeciesAct, 16 U.S.C. §§ 1531-1544, the National Marine Fisheries Service (NMFS) issued a finalruling listing the Southern Resident Killer Whales (SRKWs), as endangered under the Act.The southern resident population is comprised of three pods (identified as J-, K-, and Lpods)and is arguably the most familiar killer whale population to the general public. ItOrca Conservancy • PO Box 16628 • Seattle, WA 98116occurs primarily in the Georgia Basin and Puget Sound from late spring to fall, when it typicallycomprises the majority of killer whales found in Washington. The population travelsmore extensively during other times of the year to sites as far north as the Queen CharlotteIslands in British Columbia and as far south as Monterey Bay in California. As NMFS 1recently acknowledged, "new information ... confirms that ... [S]outhern [R]esidents spendsubstantial time in coastal areas of Washington, Oregon and California and utilize salmonreturns to these areas." These coastal waters are recognized as an essential foraging area 2for this critically endangered population in the winter and spring, and are currently underconsideration to be designated as critical habitat for the SRKW.

Commenter: Jay Davis - Comment A-2-7

Content included in the Supplemental EIS suggests that there would be no direct adverse effects to birds or fish, including those listed under the ESA. However, the Supplemental Eis does acknowledge that potential indirect effects to food webs and prey availability are a significant uncertainty, sources of prey could be reduced for shorebirds that feed exclusively on invertebrates, and granular imidacloprid pellets could be consumed and lead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds.

Commenter: Jay Davis - Comment A-1-8

Content included in the Supplemental EIS suggests that there would be no direct adverse effects to birds or fish, including those listed under the ESA. However, the Supplemental Eis does acknowledge that potential indirect effects to food webs and prey availability are a significant uncertainty, sources of prey could be reduced for shorebirds that feed exclusively on invertebrates, and granular imidacloprid pellets could be consumed and lead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds.

Commenter: Neil Quackenbush - Comment A-4-9

Content included in the Supplemental EIS suggests that there would be no direct adverseeffects to birds or fish, including those listed under the ESA. However, the SupplementalEIS does

·acknowledge that potential indirect effects to food webs and prey availabilityare a significant uncertainty, sources of prey could be reduced for shorebirds that feedexclusively on invertebrates, and granular imidacloprid pellets could be consumed andlead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds. Theindirect effects to food webs potentially caused by neonicotinoids is of particular concernto the USFWS because of the numerous migratory bird species that depend on habitats ofWillapa Bay and Grays Harbor as part of their migratory pathway (Chagnon et al., 2015).

Comments on Monitoring

Commenter: Form Letter (Multiple) Do Not Allow Imidacloprid - Comment I-270-4

While the SEIS and other studies identify "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides," the SEIS fails to give adequate weight to the "knowledge gaps" it identifies. In some cases, monitoring is proposed as a way of reducing uncertainty. In order to protect the bays, facts need to be established before permitting the use of another toxic chemical in Willapa Bay and Grays Harbor.

Commenter: Laura Hendricks - Comment I-207-3

There has been little monitoring, little testing, and no independent studies of Imidacloprid spraying directly in marine water. Our document that says there are no direct effects on mammals, fish, and birds is not correct because you're not looking at marine studies that are directly sprayed into marine waters.

Commenter: Brian Kingzett - Comment I-236-4

And until nonchemical means are found to suppress and maintain shrimp populations at a healthy ecological level the science supports the issuance of the permit and the application and will provide the controls to reduce shrimp numbers on beds and the ongoing monitoring will provide the controls and checks to ensure that any applications are performed and evaluated in a responsible manner.

Commenter: Jim Sayce - Comment I-203-2

The EDC supports alternative 3 of the SEIS – otherwise known as the 500-acre proposal. With IPM I must say that monitoring is key to a good IPM. So good monitoring means good IPM.

Commenter: Vicki Wilson - Comment O-22-2

In 2015, Ecology issued a permit for use of Imidacloprid on 2,000 acres using helicopter aerial spraying. Ecology included conditions and monitoring requirements that it believed were sufficient to mitigate any potential significant unavoidable adverse impacts and thus meet clean water requirements. There was nothing in the updated SEIS research and literature reviews to indicate that the same could not be true for the current "reduced acreage-ground based application" option. Similar to 2015, we believe appropriate conditions, monitoring requirements, and experiential-based adaptive management can address any new findings/concerns.

Commenter: Brian Kingzett - Comment O-19-4

This alternative, which is smaller in scope and different in method from the 2015 SEPA process, reflects best available science and a refined scope. The proposed mitigation measures and monitoring proposed will adequately offset the potential impacts and provide information for future refinements.

Commenter: Douglas Steding - Comment O-20-3

Burrow Monitoring - Accurate monitoring of the population densities ofburrowing shrimp are fundamental to all aspects of decision making in the IPMplan. WGHOGA will continue to monitor burrow counts on all beds coveredunder the NPDES permit on a yearly basis. Yearly monitoring will include date ofsurvey, bed name, location, burrow counts, sediment characteristics, and nativeseagrass presence.

Comments on Economics

Commenter: Rich Andrews - Comment I-246-7

The oyster growers do have options in their methods, notably by growing oysters in suspended systems, out of themuds where the burrowing shrimp live. It may be more costly, but protecting our world and environment and thequality of our foods does have a price. All too often corporations and business seek the easy and cheap roadrather than the responsible road. This is just such a case. The only thing driving their proposal to use theneonicitinoid poisons is simply one of a short sighted view of production economics. They are not considering theexternal costs nor the health of their customers.

Commenter: David Beugli - Comment I-240-5

The Willapa Grays Harbor Oyster Growers Association was founded in 1959 as a way for shellfishfarmers to work together to solve common problems. Current membership includes about 20 farmslocated in Willapa Bay and Grays Harbor. The majority of these farms are family owned and have beenfarmed by the same families for multiple generations. The shellfish industry is the single largest privateemployer in Pacific County responsible for nearly 2000 family wage jobs. This represents over 100million dollars in economic output on a yearly basis. In addition, Willapa Bay and Grays Harborrepresent the largest oyster growing areas in the US producing nearly 25% of the nation's oysters.

Commenter: David Beugli - Comment I-221-1

David Beugli (Oral Testimony): David Beugli, Clatsop County. So first thank you for the opportunity to comment on the new Supplement Environmental Impact Statement to control burrowing shrimp, using Imidacloprid. The Willapa Grays Harbor Oyster Growers Association was founded in 1959 as a way for shellfish farmers to work together to solve common problems. Currently, membership includes about 20 farms located in Willapa Bay and Grays Harbor. The majority of these farms are family owned and have been farmed by the same families for multiple generations. The shellfish industry is the single largest employer of Pacific County , responsible for nearly 2,000 family-wage jobs. This represents over $100 million of economic output on a yearly basis. In addition, Willapa Bay and Grays Harbor represent the largest oyster growing area in the U.S. , producing nearly 25% of the nations oysters.

The new permit that we have requested represents a single and significant reduction in acres where growing shrimp will be controlled. From 2,000 acres per year in the original issued permit to our current request of 500 acres. This represents a 75% reduction in the total acres that would be treated on a yearly basis. We've also committed to not using helicopters but focus on more precise ground-based applications. The new SEIS , just like the previous EIS , shows that there will be no bay-wide impacts and that these applications will have no direct impacts of fish, birds, marine mammals or human health. These findings alone support the timely issuance of a new permit. That's all. Thank you.

Commenter: Edgar Galvan - Comment I-177-2

The shellfish industry is the largest private employer in Pacific County providing around 2000 jobs between Willapa Bay and Grays Harbor. Without a permit, the effects will be devastating to the farms, my family and our local economy. Please issue the draft permit so that we can reduce the shrimp populations to a manageable level and continue providing shellfish to consumers all over the world

Commenter: Gail Gatton - Comment I-233-3

The Audubon really appreciates the long time historical presence of the oyster industry here and it's role in providing good jobs and revenue to the region, as well as the production of seafood and the contributions that oyster growers make to the environmental quality out here. We recognize the challenges that these shrimp pose to the industry and particularly to the family farms that are out here.

Commenter: Tim Hamilton - Comment I-209-1

Tim Hamilton (Oral Testimony): Hi. For the record my name is Tim Hamilton. I live in McCleary, Washington. I am president of Twin Harbor's Fish and Wildlife Advocacy, which is a nonprofit organization. I've spent a lot of time in fisheries management and sat in on a lot of different advisory boards with the Department of Fish and Wildlife. I've also spent 35 years , from congress to state , 14 state, city, county, and local, and including DOE as an advisor coming from the small business sector of petroleum. So I'm a problem. I never did get the answer to my question. Though I appreciate, Dereck, your response.

Who provided you this information -- that there was no economically viable option, other than spraying? Where did it come from? If I was an oyster grower in another part of the state could I come to you and say "I don't think I can use 20% of my oyster beds unless you let me spray" would that be allowable? Would you go for that? Would you go with me if I come along and say I need to cut my timber and you say don't do that. [unintelligible] Is Willapa and Grays Harbor in the state of Washington? Why are we doing this? The other part, that is most important, is it doesn't end here. As a small businessman, a small businessperson, all my life I can tell you it won't end with you. You're going to cause a fight. If you go forward with this the key will be to explain to the citizens who have the right to know whether their seafood is being sprayed. That will put those who are trying to grow in a different more practical manner environmentally at a disadvantage. People in Kansas won't be able to tell a difference between a sprayed Willapa oyster but they will remember the state of Washington. You can help these people, -- I really appreciate that , but the solutions that you're coming to are going to cause more harm to them and to our reputation in our Bay than you can imagine. So if your goal is to help oyster farmers you have to treat them equally the same and don't put one at a competitive disadvantage with the other. That's just the premarket price. That's free enterprise. There are going to be people who will pickpocket on these burrowing permits and those who don't use it will get tagged with the same negative reactions as others. If you don't think the public is that strong, walk down the Safeway aisle and look at the word "organic." Look at it. Watch how people , you do not have a long-term sustainable purpose using spray. I'm not an oyster guy, I wish I had a solution for you. But this sure as heck isn't it. Thank you.

Commenter: Brian Kingzett - Comment I-236-2

So Willapa Bay is a very unique ecosystem estuary in North America. It's a true case study of industry working with nature in a sustainable manner to provide both ecological and economic benefits in this food system.

Commenter: Eileen McCabe - Comment I-278-1

From an economic standpoint, this could also threaten the livelihoods of fisherman in the area.

Commenter: Kathleen Moncy - Comment I-214-1

Kathleen Moncy (Oral Testimony): My name is Kathleen Moncy and I reside in Pacific County. Thank you again for the opportunity to come and testify in front of you guys today. This permit is about a powerful local tradition, our rural economy, and ecological stewardship. As a mother, active committee member, and a multi-generational farmer in Willapa Bay, I strive for a healthy estuary that promotes growth in a rural economy. Burrowing shrimp threatens the livelihood of our community. After a decade of research with over half of those in universities, and millions of dollars later, this is the only viable solution we have to implement. We need to support this permit as we continue to innovate and evolve together.

The ecology value that is being discussed today -- of crab, fish, eelgrass, and oysters , are at the highest where farmers are operating. Oyster farmers protect the ecology of the estuary and always have and always will. This is our home. We would never do anything that would degrade that home or do anything to harm it. This is our livelihood. This is where we raise our families. This is where we participate in our community. And by you supporting this permit and issuing it to us, it allows us to continue to thrive in an economy that has lots of different issues that are affecting it across the boards.

We would like to continue to be able to thrive in this community and have the next generation of oyster farmers that's available for our children and hopefully for our children's children. As only a 2nd generational farmer, I hope that my kids can stand up here some day as a 5th generation farmer, like we have in the background. Willapa Bay has been the estuary that it has and it's been that way because oyster farmers have been operating there for over 150 years. If you ask anybody who has been defending the bay and protecting the bay for that 150 years, you come down to our community and it will be people saying the oyster farmers have been there.

So I please ask you to issue this permit so we can continue to support and thrive and to also continue to work with us to look at other innovate solutions , because this is our future and this is what we really need to look at so we can continue to be there for the next 150 years. Thank you.

Commenter: Kathleen Moncy - Comment I-228-1

Kathleen Moncy (Oral Testimony): A little bit shorter than the rest. Kathleen Moncy from Bay Center in Pacific County. I am a 2nd generation in the oyster farming business. I grew up oyster farming with my dad in Willapa Bay. Our current family farm exists only in Willapa Bay. We have no other source of what we work on , all of our oysters will be coming out of Willapa Bay.

Our community is an extremely important community here in a rural area. The oyster industry is the largest economic employer in our area , second to the government. And we are the ones that employ a lot of the people that are existing in our local school districts. We are the ones that are being sport coaches. We are the ones that are really holding and fueling our community and pushing it forward. Without something that we can build to control the burrowing shrimp infestation we really have no tool that we can manage on our farms and we can be able to be successful for the future. As a second generation coming into this business, it's absolutely important that we have a mechanism to control burrowing shrimp for the future , for my generation and hopefully for the future of my kids' generation. That people would take into consideration that we would do anything to negatively harm the area that provides our sole source of income is absolutely beyond something that I can think about.

I have 3 young children and as a mother I take pride in what I do for a living and the farm that supports our businesses , our business and the people that work for our businesses. This is our community. These are our homes. These are our livelihoods and we are currently seeking a permit so that we can be able to apply Imidacloprid on our farms as a control measure so we can continue farming into the future. As a 5-year permit , that's a very short window into the one farming cycle that we'll be able to utilize , but it's a really short window of something that we're not constantly have to be looking at other ways and constantly improving ourselves or going after another permit for the same thing for the next [unintelligible] years.

This is not the only issue that we are currently facing. It is one that is the most important because it has a significant current impact on our farms in being able to take away our ability to farm. But we've got issues like ocean acidification that are coming at us -- things that we have no control over. And we can't spend our time and resources looking at other alternative of how we're going to move our farms and businesses forward when we don't have a current permit to implement the solution to an issue that's viable to the success of our farms.

As has been spoken before, the infestation of burrowing shrimp is something that we are not looking to eradicate the species. It is a species that exists and there are predators that do exist on this , that do predate on this and so we're only looking to control a certain percentage of the estuary to create what we would consider buffer zones that would then protect large vast amounts of land. [unintelligible] work of all the farmers that are going to work for this is really important because between all of us we create a giant barrier that protects vast amounts of quantity of land which is a rare habitat for crab. It's an important area for birds and it's also an important area for fish. So collectively working together as a community and gathering up as a community and being solution oriented towards what we can move forward with is really important to the oyster growers. How we're really looking to work with the department of ecology to be able to put together this permit and have it be able to work within our current community. I would also look for ways to constantly improve our selves. Because being innovative in our industry, we always have to look for better solutions. And this is really important for what our oyster growers need to do to move forward so we can continue to have a successfully community , not only for our industry, but for the other industries that exist around us. Thank you.

Commenter: Mike Nordin - Comment I-229-2

And one of the most disturbing comments I've heard from people – people that really are ignorant about the issue – is that quite possibly the shellfish industry and the shellfish in itself in the bay, maybe that's the natural thing to do – just let it go. And that is extremely disturbing to me and I think that is the opinion that you hear from the people that are not affected by living in this community and understanding where this economy comes from.

Commenter: Lisa Olsen - Comment I-232-2

The industry is the number one industry in Pacific County right now. Timber used to be. But after the Spotted Owl in the '80's and now the [unintelligible] the timber is severely challenged again. Especially in Pacific County we're looking at severe financial impacts on the county if this [unintelligible] goes through. If the oyster industry is impacted we might as well roll up the sidewalks.

Commenter: Lisa Olsen - Comment I-171-2

Those that I heard contest have virtually nothing at stake and contend todestroy a history, economy and way of life of those that have everything atstake and everything to lose should the bay be poisoned – whether byinfestation or chemical.Please do not allow a lack of science nor political pressure to destroy thelargest economy in Pacific County.

Commenter: Norm Olsen - Comment I-222-1

Norm Olsen (Oral Testimony): Hi. I'm Norm Olsen. I live here in South Bend. I'm kind of speaking on behalf of my father and I both. We have a small oyster farm here in Willapa Bay , Olsen & Son Oyster Company. We've been a member of the Willapa Grays Harbor Oyster Growers Association for quite a while and we've been active in the spray activities in the past and I don't really want to belabor any points here I just kind of wanted to shed some light on our perspective on the issue. My dad, for example, his presence in the oyster industry here in Willapa spans the better part of 50 years. He has seen the impacts the shrimp can have when the infestation goes nearly unchecked. It's firmly been our belief and the belief of many other growers and potentially nongrowers in this room that the beneficial consequences of having some kind of control and, in this case, preferably a chemical control , they far outweigh the consequences of a no action policy. These consequences are far reaching economically and ecologically and we're from the belief that our benefit as growers is almost incidental in comparison to the benefit of the health and overall biodiversity of the bay. And you can't have one without the other. So that's pretty much what I had to say, thank you.

Commenter: Norman Olsen - Comment I-215-1

Norman Olsen (Oral Testimony): Good evening. My name is Norm Olsen. I'm from South Bend out of Pacific County. I'm here on behalf of Olsen & Son Oyster Company and we are and always have been a small family-owned business. I'm here tonight to give a brief testimony and hopefully some insight on the struggles being faced by the ecology and economy of Willapa Bay and Grays Harbor estuary as well as their respective communities. These struggles are the direct result of the over-propagation of burrowing shrimp and the current lack of a viable control method.

I would like to share with everyone here tonight that my family's presence in the oyster industry in Willapa dates back to the 1850's, when my 3rd great grandfather settled at Stony Point and claimed a portion of the bay for himself upon the realization of its vast stocks of native oysters. You're one of history's oyster prophet sons , my great great grandfather. [unintelligible] 180 acres of ground that I currently farm today and hope to some day pass on to my children if they choose to take it. In the subsequent generations from then to now, oyster harvesting in Willapa Bay and Grays Harbor has seen much necessity for adaptation.

From massive unexplainable crop mortalities, to stifling [unintelligible] infestations or Spartina, our common denominator in survival has been our sheer willingness to innovate and overcome. It is important to understand that over these many years a growing need to adapt has nurtured a continually-growing understanding that our well-being is chiefly unattainable without that of our estuaries. Having now set the stage I would like to point out the magnitude of detriment these shrimp pose to our marine ecology and all those that depend on it.

Over the last 50 years these pests have given ample exhibit as to their destructive properties. When heavily colonized and interconnected burrow systems undermine the stability of healthy substrate and their appetites deplete the sediment of healthy micro-biomes , which are the very basis of the estuary food chain , the result, if unchecked, is bare and soft sediment that is incapable of even supporting growth of key photosynthetic vegetation and supplies forage habitat for all manner of environmentally supported species, including oysters, clams, fish, juvenile and adult crabs, and a whole host of birds. Because of the limitation of the chemical Carbaryl in the 1960's to address these first grossly disproportionate shrimp numbers, it was discovered how quickly [unintelligible] was able to reestablish and support a necessary level of biodiversity. In my lifetime, even, I have witnessed the reclamation of ground once healthy, but hopelessly overrun with shrimp. Within 1 to 2 years of treatment some of these ground had returned to farm-ability and by said virtue was able to provide key habitat yet again.

I work amongst many contemporary farmers whose production levels take place on these largely reclaimed grounds that were once uninhabitable. And with further inaction, we'll helplessly watch it become so again , as we are currently seeing the leading edge of what appears to be near-historic level recruitment. In the last few years, since the retraction of our permit , our last Imidacloprid permit , I know many farmers who have already begun to lose significant, at the very least tens , tens, if not more , acres per year and are continuing to do so at that rate. The point I hope to impress to those here tonight is that without a functional control, in this case Imidacloprid for lack of another [unintelligible] over the course of the last 50 years of experimentation. Mechanical alternatives is another that has fallen short of feasibility. The viability of our marine health and the integrity of our local economy here based on the oyster industry is in great jeopardy and I wish to share that with everyone. I would like to implore you guys to consider approving this permit for us. Thank you.

Commenter: Kim Patten - Comment I-238-5

This section of the SEIS details estimated economic damage to the industry if chemical control is not anoption. It states $50 million in cumulative losses by 2022. These estimates were made by the industryprior to knowing the population dynamics of shrimp on their beds over the next 5 years. That populationis based on the number of recruits that have survived and grown into adults that can cause damage. WSULong Beach and USDA have done extensive population monitoring for the past several years to try tounderstand what those populations will be in the future.

Commenter: David Ryan - Comment I-235-2

I want a healthy bay and I know the oyster growers do too. A no action alternative is unacceptable. And we must find solutions that maintain onbottom oyster growing as a viable sector of the county, economy and ecology. The current proposal is our best chance right now and we don't have time to delay.

Commenter: Jim Sayce - Comment I-203-1

Jim Sayce (Oral Testimony): I want you to know this is my 90 second version because that's what you told us in South Bend , so if I go over a little bit that's okay.

I'm Jim Sayce. I'm Executive Director of Pacific County Economic Council. I live in Seaview, Pacific County. A decade of undergraduate and graduate studies in Ecology and 3 decades work in Pacific County at Land Use Regional Planning Community Development History and, finally, Economic Development have brought me full circle into our sustainable reality. The Pacific County economy faces the vagaries of nature and that's definitely inclusive of Willapa Bay , which is the ecotone, which is the boundary between land and ocean and is where all the action is in terms of dynamic forces. Our economy is grown by natural resources , whether recreation or production. Our survival strategy is ultimately to be generalists with a suite of tools that allows us to face uncertain conditions and thrive. And that "uncertain conditions" includes the anthropogenic forces of global warming -- which are quite fascinating and quite an irony because here we are talking about dealing with forces that are caused by ourselves, ultimately.

The EDC accepts the SEIS conclusions regarding economic impact of a shellfish industry -- most importantly, the Taylor Shellfish Company's observation. Fact: Shrimp control is necessary to maintain a healthy and viable bottom culture shucked meat oyster industry in Willapa Bay and Grays Harbor. This also saves family farms. One of the reasons it saves family farms is the capitalization of the bottom culture isn't as costly. Or I should say bottom culture is more expensive in some cases than un-bottom culture.

The EDC supports alternative 3 of the SEIS , otherwise known as the 500-acre proposal. With IPM I must say that monitoring is key to a good IPM. So good monitoring means good IPM. Finally, having a suite of oyster culture types represents a strategy against change. We are sustainable because of the choices we have accepted and made. We live close at hand to the sea and the land. And I'm going to close by saying I'm really familiar with the use of tractive forces and physical equipment in Willapa Bay. In the early aughts I experimented extensively with devices to work in Willapa Bay , a low pressure ground contractive force equipment , and there is yet to be a device invented to work on that level of muddy environment that could, say, crush or manipulate that sediment such to negatively impact shrimp. What that means is, you can't go out there and plow like you can a wheat field -- and particularly on an annual basis. And the cost of that is extraordinary and the physical damage that would result in is equally extraordinary. I believe that the SEIS is based on good science and the best available science as it attempts to mitigate risk. But I do want to say that Willapa is a dynamic system. It is so dynamic that any particular species is going to have extraordinary variability on its impact , due to what we would commonly call natural forces but now we get to call them anthropogenic forces. I will submit risks in testimony but thank you very much.

Commenter: Jim Sayce - Comment I-226-1

Jim Sayce (Oral Testimony): My name is Jim Sayce. I'm the Executive Director of the Pacific County Economic Development Council and I've been a life-long resident of Pacific County in Seaview, Washington , except for a decade I spent in college. I want to point out , I have some brief comments , Pacific County's economy is basically driven by the natural resources, inclusive of the seasonality and the vagaries of geophysical forces , weather, climate. And that affects both the production side , forestry, fishing, agriculture , and the recreation side. And words cannot express how that seasonality causes the ebb and flow of the economy. We feel it every year. As was noted and I will reiterate, the shellfish industry in Pacific County results in a total output of over $100 million. The labor force alone is a value of about $45,000,000 and represents about 205 of our workforce. So that's pretty significant, very significant. And those statistics come from the SEIS's reference to the economic analysis to support marine spatial planning in Washington. I'll submit more comprehensive comments but I do want to close with , the Economic Development Council supports its proposal alternative 3, which is the 500-acre Imidacloprid proposal , which is why I clarified, I didn't want to get the wrong one. Thank you very much.

Commenter: Dick Sheldon - Comment I-201-4

Without control of burrowing shrimp, the effects will be felt throughout the southwest Washington economic and marine systems.

Commenter: Marilyn Sheldon - Comment I-213-2

In Pacific County the shellfish industry is the largest private employer. It's responsible for nearly 2,000 family-wage jobs in our rural, coastal economy. Pacific County has also been recognized as the 4th most fish-dependent community in the United States. That means that the shellfish industry and the habitat we provide for other valuable fisheries in our area are the cornerstone of our economy. As of today, our company alone has lost over 29% of our most valuable oyster ground and 43% of our clam ground. That's for a total loss of over 300 acres to our farm alone, to date. As a result, we've had to reduce the volume of product that we're able to ship. We've had to let go of long-time customers. And we've had to reduce our workforce by over 4 fulltime positions.

Commenter: Tiffany Turner - Comment I-245-2

The oyster and clam industry is critical to the economic health of our area, and burrowing shrimp pose a significant threat to many family farms who have been incredible stewards of the bay for generations. Many families and businesses have worked for decades and spent considerable dollars to find a less impactful solution to control burrowing shrimp.

Commenter: Kenichi Wiegardt - Comment I-241-1

(Email Submission)

I appreciate to opportunity to comment on the SEIS and the burrowing shrimp NPDES permit.

I urge Dept. of Ecology to issue this permit. The option of "No action" in the SEIS is not an option at all. If this path is chosen the economic as well as ecological damage will be immense.

The people who have applied for this permit are all long time residents on Willapa Bay, with many of them being multi generational. Unlike large companies who grow shellfish in many locations along the West coast of the United States Willapa Bay is all these growers have. Personally I have kept it this way for my company because this bay and surrounding community is my home, I'm proud of my family's history here. If this permit is not issued myself and many others will be forced to close our doors. Hundreds of full time employees along with their families will have to find employment elsewhere, most likely outside of Pacific County. Local school districts will be severely affected, as enrollment will drop as families once supported by shellfish will be forced to go elsewhere.

Growing up on the tidelands of Willapa Bay I have first hand experience of what happens when an area is infested by burrowing shrimp. The ground becomes a barren wasteland, with nothing but burrowing shrimp present. Gone are all the other things that inhabit a healthy tideland. There are no crab, no eelgrass, no shellfish, no snails, no birds present. Nothing. For the people that have applied for this permit it is about much more than assuring we can grow shellfish on the ground. We care deeply about about the ground and want it to remain healthy and vibrant with a diverse amount of different animals and plants being able to utilize it.

Again I urge Dept. of Ecology to issue the NPDES permit for burrowing shrimp control.

Commenter: Kenichi Wiegardt - Comment I-178-1

11/1/2017

To: Derek Rocket

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Again I urge Dept. of Ecology to issue the NPDES permit for burrowing shrimp control.

Sincerely,

Kenichi Wiegardt

Commenter: Mary McAleer - Comment O-18-4

Of all global estuarinehabitats, 85% of oyster reefhabitat has been lost globallyover the past 130 years (Lotzeet al. 2006, Beck et al. 2011).Meanwhile, Grays Harbor andPacific Counties struggle tocompete with other economicregions of Washington statewith the second- and thirdhighestunemploymentpercentages statewide.Supplying 25% of the nation'soyster market, the area'sfamily-wage jobs—and theinfrastructure, services andeconomic activity theysupport—are welldocumentedin the DSEIS.

Commenter: Dale Beasley - Comment O-23-5

Imidacloprid use leads to an improved economy in rural communities that have someof the worse demographics in the state without any significant adverse impacts to thebay and in fact improve the overall functionality of the bays healthy ecology.

Commenter: Margaret Barrette - Comment O-17-2

Our members representmultiple generations of families who, through their farms, provide much needed economiccontribution to our rural coastal communities. For example, the oyster industry is the largestprivate employer in Pacific County, accounting for approximately 1,700 family-wage jobs.

Commenter: Tim Hamilton - Comment O-21-4

As an example, the document does not adequately review the economic impacts on smallbusinesses. WDOE is fully aware that media reports on spraying in Willapa Bay and GraysHarbor resulted in a "backlash" of negative reactions from the public at a level high enoughthe applicants withdrew their previous permit. Boycotts of shellfish from Twin Harborsimmediately surfaced. The "Brand Value" of Willapa Bay was significantly impacted.Adoption of this flawed document will further damage those shellfish growers on the coastand elsewhere in the state and at the same time, diminish WDOE's public support by onceagain creating the only area of the nation wherein shellfish beds are allowed to be treatedwith insecticides.

Commenter: Douglas Steding - Comment O-20-2

Willapa Bay is the largest producer of farmed oysters in the United States. Combinedwith Grays Harbor, this area along the southwest Washington coast producesapproximately 25 percent of all oysters in the United States. Willapa Bay is also acrucial component of the shellfish economy in Washington State, producingapproximately 65 percent of the oysters and 13 percent of the clams harvested inWashington State. Shellfish aquaculture is the largest private employer in Pacific County and a significant private employer in Grays Harbor County. It is one of themajor industries in southwest Washington, and has increased in relative importancefollowing declines in the timber and fishing industries.

Comments on Cumulative Impacts

Commenter: Ross Barkhurst - Comment I-210-5

So there's no way you can do a cumulative effects analysis – what you're calling cumulative effects does not look at these 4 leading indicators, and does not take them into account. If somebody else removed 90% of an organism -- that doesn't give you the right to move the last

10%. Means you can't remove any more. That's cumulative analysis, and we would hope that you would start taking a look at it.

Commenter: Ross Barkhurst - Comment I-247-2

I also ask that you consider the lack of public information oncomments to date from WDFW on how fish and wildlife would be put at risk, and impactscumulative to date from events includingother spray campaigns.

Commenter: Ross Barkhurst - Comment I-220-6

You've had a look at cumulative effects as they are well established in legal precedent such as DTM. You've just looked at synergistic effects between 2 chemicals acting on 1 plant. You have to look at how much eelgrass are you removing with Imazamox and how much zooplankton are you removing from the eelgrass that wasn't removed by Imazamox and add it all up. And you haven't done that. The average 10-mile per hour wind [unintelligible] you haven't precluded air boats. The average 10-mile per hour wind in my oyster beds and shellfish beds next to me will have this chemical on the bank in three months flowering plants and pollinators in 30 seconds

Commenter: Seth Book - Comment I-216-3

So I want to also say that many of my comments that I heard tonight did echo my own concerns. I'd like to echo some of these things – like the uncertainty of impacts of us of Imida – I'm just going to say the pesticide – in the aquatic environment. That's one of my concerns. The uncertainty – or the perceived uncertainty of the persistence in this area – I think there needs to be more science in that area. I think that's a concern that should be looked at because of past things that we have done where we have not considered those persistent impacts.

Commenter: Margaret Donaldson - Comment I-8-5

There is also significant uncertainty about the cumulative impacts to other marine life.

Commenter: Mark Emrich - Comment I-211-3

So if you do have wheat beds, any kind of low vegetation that is also around the beds that are being treated, that's going to be absorbed and that's going to have a long-lasting effect on the area – because it's going to continue to leach this stuff out. It becomes part of the plant. Until the plant dies, it's going to be there.

Commenter: Ed Gullekson - Comment I-302-1

We do not yet know the long-term effects of these chemicals and what we do know is that they have very bad side effects. While the application of the chemicals is "limited" the effects spread beyond the initial boundaries and because it is a biological system we don't know final damage until too late.

Commenter: Gayle Janzen - Comment I-259-3

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

Commenter: Randall Potts - Comment I-290-1

Pesticides and coastal waters are toxic mixture that will have far ranging and long term unanticipated consequences even after the pesticide is gone.

Commenter: Patrick Pressentin - Comment I-189-4

There are "immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish to the areas treated". This says nothing of cumulative impact. I must comment on the proponents website protectwillapabay.org, where they defend the use of imidacloprid as "A Responsible, Ecologically-Conscious Integrated Pest Management Program" and an ecological necessity for the plan.

Commenter: Form Letter (Multiple) Protect Willapa & Grays Harbor - Comment I-253-3

The agency evaluated an expanded universe of adverse effects data and found that acute (short-term) and chronic (long-term) toxicity endpoints are lower than previously established aquatic life benchmarks. EPA found risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review.

Commenter: Form Letter (Multiple) Protect Willapa from Neonics - Comment I-254-2

The agency evaluated an expanded universe of adverse effects data and found that acute (short-term) and chronic (long-term) toxicity endpoints are lower than previously established aquatic life benchmarks. EPA found risks from imidacloprid exposure to ecologically important organisms not previously evaluated as part of its regulatory review.

Commenter: Amy van Saun - Comment O-12-6

To provide some context, imidacloprid products are not approved for use in water in anyother context, and to the contrary, labels on most neonicotinoid products strictly prohibit use in wateror in places that could drift into water, noting the high toxicity to aquatic invertebrates. Accordingly,most aquatic studies are looking at concentrations that have drifted/run off from terrestrial sourcesof neonic-use, like in coated crop seeds or liquid drenches of ornamental plants, and not direct usein water. The plan proposes not just to spray imidacloprid in water, but to do so at a rate of 0.5 lba.i./acre, the highest application rate allowed for imidacloprid on any agriculture crop in the U.S. Infact, this application rate for oyster beds in the state of WA is higher than any other agriculturalcommodity in this country for application methods other than chemigation.19 Simply put, this willresult in some of the highest concentrations of imidacloprid allowed on land in the U.S., but in water(where all other uses are prohibited).

Comments on Toxicity

Commenter: Eric - Comment I-218-3

You go back 50 years – we saw rises, we saw things, we saw monster crab harvests, we saw fantastic salmon runs – I mean while we were spraying for those 50 years with a chemical that is much more toxic than Imidacloprid is.

Commenter: Melissa Aaron - Comment I-6-2

It's also toxic to bees.

Commenter: Rich Andrews - Comment I-246-6

Not only would wild species be affected by this wanton and needless environmental poisoning, but the consumersof the oysters are also vulnerable to being poisoned from the pesticide residuals in the oysters. Increasingscientific and medical evidence is accumulating about the toxic effects of the neonicitinoid chemicals on humansand mammals, specifically neurotoxic effects. These affects can not only be acute but chronic and accumulativewith some of the modes of toxic action in the human nervous system. The Department of Ecology must fullyinvestigate these effects and when it does, it will find them to be dangerous, as well as illegal.

Commenter: Michaela Barrett - Comment I-5-4

Imidacloprid is a poison known to have toxic effects on not only insect pests, but also beneficial insects (bees!), birds, and marine invertebrates. It is unconscionable to deliberately apply this poison to an uncontained aquatic environment solely for economic gain.

Commenter: Diane Boteler - Comment I-34-2

The intentional use of toxic chemicals has no place in the ecosystem that we all depend on. It's clear that much is unknown about the collateral damage of using such a toxic chemical in our Sound.

Commenter: Sharon Burdick - Comment I-87-1

It is a terrible idea to spread a known toxic poison on the beach for any reason.

Commenter: Rebecca Dale - Comment I-54-1

The public already said NO, and we still mean NO. We do not want Imidacloprid or any other toxic spray in our water. It is not cool to bring this up again.

Commenter: Form Letter (Multiple) Do Not Allow Imidacloprid - Comment I-270-5

The SEIS finds a number of knowledge gaps concerning the direct effects of spraying imidacloprid, including accumulation in sediments, long-term toxic impacts, impacts on zooplankton, sublethal effects, impacts on vegetation, impacts of degradation products, and the area that would be affected. These gaps must be filled before approving the use of the chemical.

Commenter: Margaret Donaldson - Comment I-8-3

Imidacloprid has three major strikes against it: not only is it toxic to all invertebrate life where it is directly applied, it can be expected to spread to adjoining areas, disrupting not just invertebrate life there but all the rest of the food chain.

Commenter: Tom Douglas - Comment I-267-1

(Email Submission)

Please deny the spraying permit application for spraying Imidicloprid in our ocean. This stuff is not only toxic to the pest but to other wildlife in the area and those beds that refrain from spraying. I would also request a public hearing in the Seattle area where most of the oysters from these beds are sold.

Commenter: Melanie Drescher - Comment I-49-3

NO WAY! Do NOT do this! "Imidacloprid is considered the main culprit in the collapse of our bee colonies and, in higher levels, is toxic to mammals — that means us! This is why the European Union has banned this pesticide in their waters, and we should too."

Commenter: susan entress - Comment I-42-3

From the manufacture's own safety guidelines: This product is highly toxic to bees exposed to direct treatment or residues on blooming crops/plants or weeds. Do not apply this product or allow it to drift to blooming crops/plants or weeds if bees are foraging the treatment area

Commenter: George Fairfax MD - Comment I-106-2

Please deny the use of imidacloprid in Willapa bay & Grays Harbor. The long term affects are unknown and there are too many herbicides, pesticides and numerous toxic chemicals in the environment and oceans that are getting into our food chain.

Commenter: Rich Fargo - Comment I-41-2

I am a longtime resident of Grays Harbor and an avid kayak fisherman. Please for the love of God do not spray our mudflats with this ridiculously toxic chemical.

Commenter: Kim Figlar-Barnes - Comment I-165-2

Studies have shown (Morrissey, c, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk of aquatic invertebrates: A review. Environment International 74: 291-303) The water soluble Imidacloprid is toxic to wildlife and highly toxic to aquatic invertebrates (listed on the label for Protector 0.5G and Protector 2F); it affects the survival, growth, emergence, mobility and behavior of many sensitive aquatic invertebrate taxa, even in low concentrations.

Commenter: Ron Figlar-Barnes - Comment I-117-3

Imidacloprid may be very toxic to aquatic invertebrates besides ghost shrimp. In the same work mutagenic effects were noted as well as teratogenic effects on growth and skeletal structure of rats.

Commenter: Katie Gaut - Comment I-120-3

The Toxicity to Non-Target Aquatic Invertebrates is Addressed in SEIS, but Evidence for Minimal Impact is Lacking or Contradictory in the SEIS

Commenter: Laura Hendricks - Comment I-207-2

We're not talking about 1 little pond. We're talking about Willapa Bay, putting in 100's of acres, scattered all over, with a very toxic chemical.

Commenter: richard james - Comment I-170-2

Spraying toxic chemicals into a bay to kill native shrimp in order to grow non-native oysters for profit is the last thing one would do to a place they call pristine.

Commenter: Brigetta Johnson - Comment I-95-2

Please stop messing with Nature and let Her regulate Herself. The environment is so f'd up thanks to us and all of our "management" already. I just don't believe adding toxic chemicals to a dynamic tidal ecosystem is a sound plan. Please stop the insanity and lead the world by our example. Let Mother Nature rebalance Herself!

Commenter: Edward Kolodziej - Comment I-122-2

Please lets get past the point where spreading lethal concentrations of toxic compounds throughout our jointly owned environment is considered to b a good idea. There are other ways to address this problem that do not involve the use of toxic chemicals on our aquatic environment. This is a bad idea.

Commenter: Gina Massoni - Comment I-149-2

I support timely efforts to expand promising alternatives to neonicotinoids and to increase their feasibility and effectiveness. Investments should be made in educational, technical, financial, policy, and market support to accelerate adoption of alternatives rather than continuing to rely on highly toxic pesticides.

Commenter: Laura McGrath - Comment I-132-3

I understand that pesticides might be the most cost effective way to address this issue, but this does not consider the cost to ecosystem and human health. More effort needs to be placed on finding a more ecological friendly and less toxic solution.

Commenter: Melinda Mueller - Comment I-136-4

Furthermore, neoniconotinoid pesticides, such as imidacloprid, pose a significant threat to other species and to ecosystems as a whole. They are known to be toxic to birds, fish, and aquatic invertebrates other than shrimp (2, 3). "

Commenter: Kim Patten - Comment I-238-4

Almost all data related totoxicity of neonicotinoids to aquatic invertebrates come from laboratory and mesocosm studies thatfeature freshwater. Exposure of estuarine invertebrates to any insecticide is almost always associatedwith run-off or leaching from upland agricultural use rather than from direct application (e.g., Kuivial andHladik 2008, Morrisey et al. 2015). The authors of a recent comprehensive review of neonicotinoidimpacts of non-target invertebrates reported, "There are no published works regarding the marineenvironmental contamination of neonicotinoids" (Pisa et al 2015).

Commenter: Laurie Pine - Comment I-205-7

There is a significant amount of new science and information that documents the presence and persistence of Imidacloprid in lakes, rivers, streams, and other waterways at levels that exceed toxicity levels for fresh water invertebrates.

Commenter: Form Letter (Multiple) Protect Willapa & Grays Harbor - Comment I-253-2

Washington DC) EPA found, "[C]oncentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates."

Commenter: Penny Rand - Comment I-4-2

Please do not destroy the environment with toxic sprays. Fish farms and oyster farms have created this problem and will destroy the wild fish and oysters not to mention humanity.

Commenter: David Ryan - Comment I-121-2

For many human illnesses doctors prescribe medicines that are, technically toxic, yet people ingest and inject these toxins with the understanding that, in the right doses and applied in the right way, the body will be better. My research indicates that the proposed formulations, application methods, concentrations, coverage areas, timing, and monitoring protocols are all adequate mitigation for the issues surrounding its use. And I believe that the result will be a healthy and balanced ecosystem.

Commenter: David Ryan - Comment I-235-3

For many human illnesses doctors prescribe medicines that are technically toxic yet people ingest these toxins that with the understanding that in the right doses and applied in the right way the body will be better.

Commenter: Holly Shull Vogel - Comment I-96-2

Have these oyster farmers tried any other method of management of the ghost shrimp? Seems to me other methods should be exhausted before toxic chemicals are even considered.

Commenter: Todd Tanner - Comment I-64-2

Hi, I'm an outdoor writer as well as a sea food lover. If you folks decide to spray toxic crap on shellfish beds, I can guarantee you that I'll be writing stories about the fact that no one in the U.S. should eat Washington oysters

Commenter: Jennifer Vidal - Comment I-66-3

Imidacloprid is considered the main culprit in the collapse of our bee colonies and, in higher levels, is toxic to mammals — that means us! This is why the European Union has banned this pesticide in their waters, and we should too.

Commenter: Landry Wildwind - Comment I-330-1

I oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology.
Imidacloprid is one of many chemicals whose known effects are sufficiently toxic that its use cannot be supported, in my opinion.

Commenter: Nichelle Harriott - Comment O-5-4

Sublethal effects in fish have also been observed. Growth and development in somespecies have been reported, which was attributed to a loss of the aquatic invertebrates juvenile fish rely on as a food source. Further, others have reported decreased viability and hatchingsuccess, leading them to conclude that imidacloprid is more toxic to fish in early developmentalphases, even at low concentrations.

Commenter: Center for Food Safety - Comment O-8-3

Imidacloprid has never before been approved for use in water and is nearly alwayslabeled as "highly toxic to aquatic invertebrates," including species like crabs. As expertshave recognized, spraying this toxin into bays will not just kill the native burrowingshrimp, it will also kill or harm all aquatic invertebrates it touches, and indirectly impactspecies that rely on these food sources. Further, given the significant data gaps, thisunder-studied plan should not move forward.

Commenter: Amy van Saun - Comment O-12-5

As described below, the toxicity values used as the basis of the SEIS analysis are also flawed. Ecology must go back to evaluate impacts based on scientifically defensible levels.

Commenter: Dale Beasley - Comment O-23-2

Has low toxicity

Commenter: Anne Shaffer - Comment O-3-4

Further, method of spraydoes not mitigate toxicity to fish, invertebrates, and coastal systems (or humans for that matter).

Commenter: richard james - Comment O-1-2

Spraying toxic chemicals into public waters is insane.

Commenter: Ashley Chesser - Comment O-10-3

Department of Ecology must protect Washington's water, wildlife, public health, and local economies from the harmful impacts of toxic pesticides. The future of oyster farming in Washington State depends on the industry's ability to adopt sustainable cultural and management strategies.

Commenter: Megan Dunn - Comment O-6-5

The analysis does a disservice to conservation by mostly limiting its analysis on listed species to anassessment of whether listed species would be directly impacted through toxic effects.

Almostnothing is said about the impact to the prey base and ecological food web that supports theseimportant and rare species.

Commenter: Joe Breskin - Comment O-13-4

Comments on SEIS from Olympic Environmental Council We are a 501c3 organization in Washington State that is concerned with protection and preservation of natural systems. We serve as an umbrella organization for other organizations and groups dedicated to defending natural systems. Historically, we have been active in this arena for over 25 years since the dawn of GMA process and have had to appeal several bad agency decisions. I am sure we will not be alone in noting that absurdity of permitting non-lethal levels of insecticide, and the inevitability that this approach will predictably fail to address the deep systemic problems that the industry and the agencies have created over the past 50 years, by focusing in single issues w/o considering to potential scale or importance of the unintended consequences of the actions taken to protect an industry that is based on entirely unsustainable methods and on fundamental misunderstandings of ecosystems. First things first: if we look at this as an ecosystem, the burrowing shrimp have coexisted in balance with the oysters in Willapa Bay forever. They have been in the estuary at high population levels since before the ice age. If population of a single species appears to be increasing rapidly the first question that needs to be asked is "Where?" And the second question is of course "Why?" The answers to both of these questions point to a long history of gross negligence by the shellfish industry. At the turn of the century self-serving exploiters basically strip-mined the estuary and destroyed the shell reefs that had supported the oysters, kept the shrimp out of oyster territory, and kept aragonite levels in the water column ideal for oyster propagation. Since then, almost everything that has been tried has had the appearance of a macabre comedic sort of rolling catastrophe. Growers introduced numerous invasive species, each of which has complicated the situation. They introduced japanese oysters, whose means of reproduction is poorly suited to the chemical conditions in the estuary, manila clams, oyster drills, spartina, and japonica. And someone introduced the isopod parasite that is currently driving the mud shrimp to the verge of extinction on the west coast. Historically, mats of japonica rhizomes supported vast populations of migratory waterfowl. The stuff has been called 'duckgrass' for a very long time, because ducks and geese eat the blades, roots, or both. American Wigeon, Northern Pintail, and Mallard are the three main species of ducks that eat duckgrass on Willapa Bay. These ducks are dependent on duckgrass to survive; in fact the Wigeon's diet consists of more plant matter than any other dabbling duck. The Northern Pintail is considered a common bird in steep decline.[ii] The Dusky, a goose, eats both duckgrass and marina, and on paper, the Dusky is a protected goose, due to low a population.There are several species of migratory geese that are almost totally dependent on it being here and when they fly into Willapa Bay expecting to feed and fatten for their migration, they now find barren defoliation. This is genuinely life threatening: they simply cannot survive a mistake of this magnitude. But it is not the ducks' mistake, it is the mistake of Washington State that is permitting the destruction of duckgrass and marina with Imazamox. Since the 1980's scientists have consistently reported (see feldman 2000 review paper and excerpt below) that eelgrass keeps shrimp from burrowing in the areas where it grows. The eradication of japonica has now damaged or destroyed both species of eelgrass (marina and japonica) over vast areas of Willapa

Bay and opened those areas to shrimp. The wholesale destruction of Eelgrass using the herbicide Imazamox not only reduced the shrimps' predators, who used it as habitat and hiding cover, it removed a key physical constraint - the mats of rhizomes were an obstacle to the shrimps' burrows and the destruction of the Eelgrass (to support another introduced invasive species: Manila Clams) has allowed the shrimp to move into vast areas where they could not live when the Eelgrass was there. "Field surveys have been consistent with Brenchley's (1982) findings, noting the abrupt decline and low densities of ghost shrimp burrows in Zostera rnarina beds compared to adjacent intertidal mudflats (Swinbanks and Murray 1981; Swinbanks and Luternauer 1987). Harrison (1987) reported that an expansion of Z. marina and Zostera japonica habitat was accompanied by a corresponding reduction in ghost shrimp density." So now the industry want to poison the sediments with a different neurotoxin in an effort to paralyze the shrimp so that they will suffocate in their burrows. A lawsuit brought against the state and industry by citizen activists to end the use of carbaryl resulted in a hard won settlement agreement with the Willapa Bay Grays Harbor Oyster Growers Association. This agreement called for the phase-out of carbaryl and gave the industry over a decade to develop and adopt an integrated pest management plan to replace their unsustainable pesticide-based shrimp control measure. This settlement agreement was based on a serious legal challenge from citizens -- not the state -- against ecosystem scale contamination. It is not what the industry PR machine is now pretending was a voluntary phase-out based on some sort of magic wand of enlightenment among the growers: they kept spraying year after year and spent hundreds of thousands of dollars (including public funds) exploring alternate chemical approaches rather than embracing non-chemical approaches to restore ecosystem balance. During that 10 year negotiated phase out, the National Marine Fisheries Services determine in 2009 that the application of carbaryl in both Willapa Bay and Grays Harbor jeopardized the continued existence of endangered salmon and adversely affected or destroyed their habitat. Also in 2009, the NMFS determined the application of carbaryl adversely affected ESA listed green sturgeon in these same bays. The spraying continued unabated. A great deal of public money was spent exploring chemical means to control a native animal species whose growth has been facilitated by destruction of a native plant species. As far as we can tell, the use of USDA's IPM funds to develop a pesticide based approach to destroy a native animal species in support of a non-native animal species is entirely unprecedented, and is especially disturbing in the face of the population collapse of the native mud shrimp that is currently underway. It is not clear if, when, or or how the required IPM was actually adopted, but it is very clear that almost none of the usual principles of IPM are involved in the latest pesticide permit proposal. The DEIS to which this EIS is attached is deeply flawed, because it fails to address the complex interactions between species. For example, the estimates for incidental take of non target organisms are just plain wrong, and the role of crabs as oyster predators is not discussed, but millions of

Commenter: Tim Hamilton - Comment O-21-3

A review by the Washington State Executive Ethics Board of a complaint filed against Mr.Kim Patten has resulted in an ethics citation for activities related to WGHOGA's pursuit ofspraying permits in Willapa Bay1 In his written response to questioning by the Board2,Mr. Patten refers to WGHOGA and its members as his "clients". Individual members ofWGHOGA are referenced as "friends". When reviewed in entirety, Mr. Patten's commentsleaves a clear impression that he considered getting approval of spraying applications as hisown personal goal.

Comments on Full Comment

Commenter: David Beugli - Comment I-240-1

(Email Submission - See Attached PDF)

Derek,
Thanks for all you hard work.
David

October 7, 2017

Derek Rockett, Water Quality Program

Washington State Dept. of Ecology

SW Regional Office

PO Box 47775

Olympia, WA 98504

Thank you for providing an opportunity to comment on this new Supplemental Environmental Impact Statement for the control of burrowing shrimp using imidacloprid.

The Willapa Grays Harbor Oyster Growers Association was founded in 1959 as a way for shellfish farmers to work together to solve common problems. Current membership includes about 20 farms located in Willapa Bay and Grays Harbor. The majority of these farms are family owned and have been farmed by the same families for multiple generations. The shellfish industry is the single largest private employer in Pacific County responsible for nearly 2000 family wage jobs. This represents over 100 million dollars in economic output on a yearly basis. In addition, Willapa Bay and Grays Harbor represent the largest oyster growing areas in the US producing nearly 25% of the nation's oysters.

The new permit represents a significant reduction in acres where burrowing shrimp will be controlled from 2000 acres per year in the originally issued permit, to the current request of 500 acres. This represents a 75% reduction in the total acres that would be treated on a yearly basis. We have also committed to not using helicopters but focusing on more precise ground based applications. These focused ground based applications will result in less acres being treated annually and reduce the need for imidacloprid.

This new SEIS just like the previous FEIS demonstrates that there will be **no bay-wide impacts** and that these applications will have **no direct impacts to fish, birds, marine mammals or human health**.

These findings alone support the timely issuance of a new permit.

Thank you again for the opportunity to provide comment on this important issue.

David Beugli

Commenter: Kim Patten - Comment I-238-1

(Email Submission)

Please find attached my comments for the SEIS for imidacloprid. The first attachment are my comments on the SEIS, the second is supporting documentation.

Kim Patten

(Email Submission)

Please find attached my comments for the SEIS for imidacloprid. The first attachment are my comments on the SEIS, the second is supporting documentation.

Comment on: ‘Supplemental Environmental Impact Statement for Control of Burrowing Shrimp Using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington – Draft’

From: Kim Patten, Ph.D., Extension Professor, Washington State University Long Beach Research and Extension Unit.

Date: 11/1/2017

Thank you for the opportunity to comment on the Draft SEIS. It is a well prepared document. Below I have supplied comments in eight separate areas for your consideration.

 # 1. USE OF THE TERM ‘AERIAL’

1.6.2 Summary of Impacts of and Mitigation Measures:
Alternatives 1, 3 and 4, pages 1-22 to 1-31.

The Draft SEIS, under Alternative 4, consistently uses the word "aerial application" as the application method used under this alternative. This is not correct. Aerial refers to application by air (airplane or helicopter). This is not allowed under Alternative 4. The wording should be replaced with ground-based broadcast boom or hand application for the 2F product, and hand, ground or boat spreader-based application for the 0.5 G product. The uses of "aerial" for Alternative 4 puts the growers in legal jeopardy with the label (See bolded relevant section of the 2F label below).

PROTECTOR 2F LABEL
"RESTRICTIONS: Do not harvest shellfish within thirty days after treatment. All ground must be properly staked and flagged to protect adjacent shellfish and water areas. **For aerial applications, the corners of each plot must be marked so the plot is visible from an altitude of at least 500 ft. Aerial applications must be on beds exposed at low tide.** A single application of imidacloprid per year is allowed. No adjuvants or surfactants are allowed with the use of this product. All applications must occur between April 15 and December 15. **A 100-foot buffer zone must be maintained between the treatment area and the nearest shellfish to be harvested when treatment is by aerial spray;** a 25 foot buffer zone is required if treatment is by hand spray. Do NOT apply when winds are greater than 10 mph or during temperature inversions. **Do not apply aerially during Federal holiday weekends. During aerial applications, all public access areas within one quarter (1/4) mile and all public boat launches within a quarter (1/4) mile radius of any bed scheduled for treatment shall be posted**. Public access areas shall be posted at 500 feet intervals Draft Label at those access areas more than 500 feet wide. Signs shall be a minimum of 8 ½ x 11 inches in size, and be made of a durable weather-resistant, white material. The sign will say “Imidacloprid will be applied for burrowing shrimp control on [date] on commercial shellfish beds. Do not Fish, Crab or Clam within one-quarter mile of the treated area. The location of the treated area will be included on the sign ...."

By the SEIS using the word "aerial" for Alternative 4, it could be legally inferred from the label that the grower would need to comply with all the label requirements stated in the label for aerial application by helicopters, e.g. need 100' buffer, etc.

I don't think it was the intention of the Department of Ecology to use wording in the SEIS that would equate backpacking spraying to aerial application by helicopters; however, in a court of law, such an inference could be made. To avoid costly lawsuits defending the permit, I would suggest adjusting the wording so that there is no confusion in the application terminology and so that it is consistent with the label, and the intent with which it will be used. Consider replacing ‘aerial’ with ‘ground-based broadcast boom’ or ‘hand application’ for the 2F product, and ‘hand, ground or boat spreader-based application’ for the 0.5 G product, or some other wording that won’t legally compromise Ecology and the growers when the NPDES permit is issued.

 # 2. CAUSE OF THE PROBLEM

2.4 History and Background

This section of the SEIS states that the shrimp population dynamics in Willapa Bay and Grays Harbor are poorly studied and not known.

"The factors controlling burrowing shrimp populations are not well known, in part because long-term data on burrowing shrimp numbers in Willapa Bay and Grays Harbor are not available. Several authors (e.g., Stevens 1929, Feldman et al. 2000, Sanford 2012), have hypothesized that human-related impacts may have contributed to changes in Willapa Bay which led to increased burrowing shrimp populations. These potentially include excessive harvest of native Olympia oysters during the 1900s, land use changes in the watersheds (e.g. logging, farming), disturbance associated with current shellfish farming (including chemical and physical efforts to reduce burrowing shrimp), and other human activities. Changes in climate and oceanic conditions may also have altered conditions in ways that are favorable for burrowing shrimp."

While the purpose of the SEIS is not to provide a complete review of population dynamics of burrowing shrimp in SW coastal WA, it should at least reflect recent population trends reported by Dumbauld and others. There were major recruitment events in 1989, 1993 and 1994, followed by 17 years of little to no recruitment that continued until 2012. The past several years have all had consistent solid recruitment (see WSU 2017 data presented in the economic section below). The important aspect of this to consider is that, since ghost shrimp are long-lived as adults (>10 years), any major recruitment event will refresh the adult population. Consequently the upsurge in recent recruits will pose a significant long-term pest threat level not seen in the past 2 decades. This is germane as it relates to the economic section below.

The SEIS also speculates that overall shrimp population in the bay could be associated with historic and current shellfish harvesting and farming. This is a significant overreach. There is also no mention of over-fishing, or the damming of the Columbia River and its impact on fresh water purges of the bays. Both of these variables are mentioned frequently as causative in historic population trends, but are not mentioned in the SEIS.

 # 3. POTENTIAL IMPACT OF THE PROBLEM BASED ON 2017 RECRUITMENT DATA.

Section 2.6 Economics.

This section of the SEIS details estimated economic damage to the industry if chemical control is not an option. It states $50 million in cumulative losses by 2022. These estimates were made by the industry prior to knowing the population dynamics of shrimp on their beds over the next 5 years. That population is based on the number of recruits that have survived and grown into adults that can cause damage. WSU Long Beach and USDA have done extensive population monitoring for the past several years to try to understand what those populations will be in the future.

The need to control burrowing shrimp is based on the population of adult shrimp that is responsible for bioturbation. The standard economic threshold for treatment has been 10 burrows/m^2. This is an adult shrimp population of ~ 6 to 7 adults/m^2. An adult population of burrowing shrimp at any one time is based on natural mortality and recruitment rate of juvenile shrimp. Adults can live >10 years. Prior to 2014 there were many years with very low recruitment of new juvenile shrimp. This meant that the need to control burrowing shrimp in Willapa Bay was moderate and limited to sites with residual populations of adult shrimp. WSU sampling of recruitment populations over the last 4 years, however, has indicated that there have been significant new populations of juvenile shrimp settling across most of the tideflats in the bay. This has been especially noticeable on shellfish beds near the mouth of the bay. For example, on one bed we have been monitoring (bed A40), there were 140, 340 and 50 new recruits/m^2 in 2015, 2016 and 2017 respectively. Mean population of ghost shrimp by recruit age class for three growing areas in Willapa Bay, based on extensive sampling in September 2017, is provided in Table 1. These data indicate that recruitment numbers were slightly down for 2017 for the northern part of the bay but up for the southern part of the bay. The data also indicate that there was a decent survival rate of previous years' recruits. The sub-adult population of ghost shrimp is very high in all these regions and represents a very real threat to the future of the shellfish industry in Willapa Bay for 2018 to 2022. If these recruitment trends continue, it is likely that the economic impact stated in the SEIS could be a low estimate (Section 2-6, page 60). Furthermore, based on samples collected 10/31/17, there appeared to be continued episodes of significant recruitment during October 2017 (see footnote in Table 1).

Table 1. Mean density of ghost shrimp by age class in three shellfish growing regions in Willapa Bay based on sampling done in late September 2017*

Location	Ghost shrimp density (#/m^2) **				
	2014 recruits	2015 recruits	2016 recruits	2017 recruits	Total population of sub-adult shrimp***
Tokeland/Cedar River area	112	88	137	35	372
Stackpole area	16	28	54	50	148
Nahcotta Flats & Middle Is. Sands	41	16	21	104****	182

*Data are means from replicated coring over multiple locations within each region.

**Recruit age is approximate, based on carapace length: 2014 recruit ~ 7.65 mm to 12.5; 2015 recruit ~ 6.6 to 7.6 mm; 2016 recruit 4.5 to 6.5 mm; 2017 recruit <4.5 mm.

*** Total population of non-adult shrimp is the sum density of all shrimp <12.5 cm carapace sampled in September 2017.

**** Four sites off the Nahcotta Flats were resampled in 10/31/17 to assess if there was on-going recruitment occurring during the fall. At those sites, the mean density of 2017 recruits was 244 ± 21, n=13 with 95% of them having a carapace <2mm. Three locations that were sampled 10/7/17 were resampled on 10/31/17. The was a >60% increase in new recruit density during that time period ($94/m^2$ to $230/m^2$). **# 4. 2017 DATA ON MECHANICAL CONTROL**

2.8.5.1 Mechanical Control Methods

This section evaluates mechanical control options for the industry and suggests that they have limited options. At the time of its writing, however, there was no hard data on harrowing or dredging. Mechanical harrowing or dredging has been suggested by the public and others as a method to control young burrowing shrimp that are near the surface. It has been claimed that harrowing from a barge dislodges or destroys young- shallow- tender recruits and could, if practiced aggressively, be used by the industry as an alternative to chemical control. Prior attempts to gather data on efficacy of this method have been hampered due to the lack of juvenile shrimp populations in adequate density to conduct research. In recent years, populations of recruits have been high enough to allow that research to be conducted. WSU Long Beach conducted two studies in 2017 to assess efficacy of harrowing and cleanup dredging (see Studies 1 and 2 below). These studies indicate that these efforts slightly reduced the population of new/young shrimp compared to untreated sites, but those reductions were not statistically significant and did not reduce the populations to levels that would be consider of practical value.

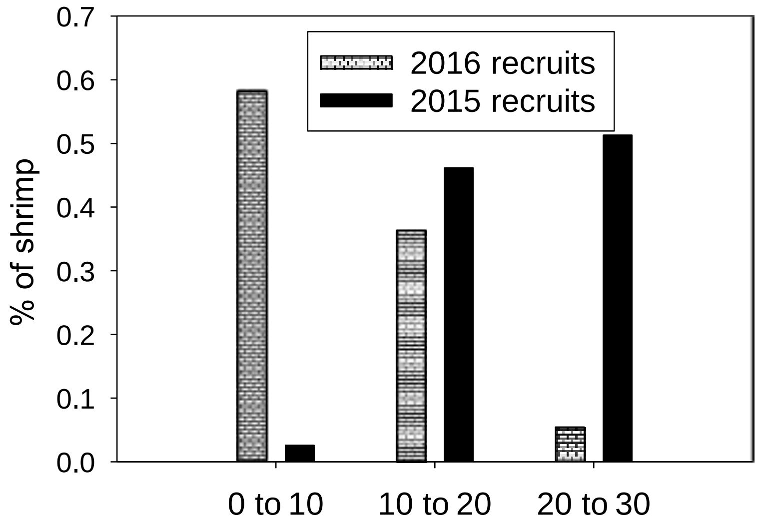
<u>Study 1: Deep harrowing</u>
Site: Bed A40 Cedar River, sandy sediment, Goose Point Oyster bed, recruit population May 2017 ~200/ m^2 range.
Experiment design: Randomized complete block, 0.5 by 1.5 m plot size, 3 replications.
Treatments: Untreated control and hand harrowing. An aquatic weed rake with a set of six -25 cm long x
2.5 mm wide tines was pulled by hand through the treated plots down to the 20 cm depth in the sediment, 3 times in each direction. This was done in 0.3 to 0.5 m of water during an incoming tide. New recruits were noted as swimming off the disturbed treated plots.
Assessment: Sixteen days post-treatment the plots were cored (2 cores/plot, 10 cm diameter by 40 cm depth), and recruits collected by sieving (2 mm mesh) and measured to the nearest 0.01 mm carapace size. Data were analyzed by ANOVA for the total number (between 2 and 6 mm carapace, and within each mm size bracket of carapace). Data were also collected on recruit density and size by depth (0 to 10 cm, 10 to 20 cm, and 20 to 30 cm) within the plots.
Results: There were no differences in shrimp densities due to treatment for all size brackets (Table 2). There was a slight trend for harrowing to numerically reduce the density of recruits, but these differences were not close to being statistically different or of practical relevancy. A significant portion (>40%) of new 2016 recruits were deeper than 10 cm and >95% of the 2015 recruits were deeper than 10 cm (Figure 1). Surface dredging or harrowing from a barge is unlikely to get much deeper than 10 cm. *Summary:* Deep harrowing, far in excess of the depth that would be achieved by barge harrowing, provided no relevant control of new recruits.

Table 2. The efficacy of deep harrowing on the population density of young burrowing shrimp in May 2017.

	# burrowing shrimp by size class/m^2				
Treatment	2-3 mm	3-4 mm	4-5 mm	5-6mm	total 2-6 mm

Untreated control	62	68	68	5	203
20 cm deep harrowing	26	62	26	10	124
F test value	1.8	0.0	2.0	0.5	2.1
Probability of significance	0.3	0.9	0.2	0.5	0.2

Figure 1. Distribution of recruits by sediment depth (cm) on bed A40



Study 2: Barge dredging

Site: Bed A55 Cedar River, sandy/silty sediment Taylor bed, recruit population moderately high (May 2017 ~100 to 200/m^2 range).

Experimental design: Whole bed, pseudo-replicate, comparison of inside and outside a 20- acre bed that was dredged during winter 2016.

Treatment: The bed was dredged to remove transplanted oysters between 10/24/2016 and 12/15/2016. There were twelve 3-hour dredging sessions. The total cost to dredge the sites was estimated by the grower to be $24,000.

Assessment: Three transects (replications) that ran inside and outside the dredged bed were compared. Transects were sampled (4- 10 cm diameter cores 30 cm deep) for recruit density at 17 m and 33 m inside and outside the bed. Data were pooled (inside vs. outside along each transect (replication n=3)) to compared density of 2015 and 2016 recruits. Recruit density was analyzed by one-sample Wilcoxon signed rank test for non-parametric data; a Mann-Whitney Rank Sum Test for the data did not pass the Shapiro-Wilk normality test.

Results: There were no differences in shrimp densities due to treatment for all recruit ages (Table 3). There was a slight trend for dredging to numerically reduce the density of recruits, but these differences were not close to being statistically different or of practical relevancy. In addition, the study was neither truly randomized nor replicated. The dredged bed had a residual shell base and was siltier sediment than the comparison zones immediately outside the bed. The difference in treatment could have been due to site rather than dredging.

Summary: Cleanup dredging to remove transplant oysters left behind did not statistically reduce recruit densities. The nonsignificant difference between treatments could have been site difference. Regardless, the recruit density in the dredged beds was still too high to be of practical control value.

Table 3. The efficacy of cleanup dredging on the population density of young burrowing shrimp in May 2017.

	# burrowing shrimp by size class/m^2		
Treatment	2016	2015	2015+2016
Untreated control	129	75	163
20 cm deep harrowing	204	34	279
Probability of significance	0.24	0.15	0.10

 # 5. THE NEED FOR BETTER DATA RELATING TO SPATIAL & TEMPORAL EXPOSURE OF IMIDACLOPRID IN WATER.

3.0 Affected Environment, Potential Impacts, and Mitigation Measures

The draft SEIS uses water exposure data developed during commercial-size applications in Willapa Bay. That is a good data set that provides expected maximum exposure concentration for a risk assessment immediately following an application. This assessment is fine for species that are exposed in that first 510 cm of tidal inundation. However, it is not realistic for fauna, such as fish or Dungeness crab megalopae. These fauna would be exposed to the concentration of imidacloprid that is found in the actual water column, not the wetting front. Unfortunately, we have very little data on what those values are because the former SAPs and NPDES required data only from the first 10 cm of the wetting front. We have no idea about the extent of dilution of imidacloprid over time in the water column. While it is important to have a conservative approach to risk assessment, it is equally important to use realistic exposure data. This point may want to be addressed in the SEIS, and/or considered later when developing the SAP and NPDES for monitoring.

#6. A MAJOR IMPACT FACTOR NOT CONSIDERED FOR THE 'NO ACTION ALTERNATIVE'

The SEIS does a good job detailing the potential impacts of the four alternatives. One consideration that was not addressed with the No Action Alternative (#1) is that if this alternative is selected then there will be no future NPDES. Without an NPDES, there is no possibility for anyone to obtain an Experimental Use Permit (EUP) for future research. "A Washington State Experimental Use Permit is required for all experiments involving pesticides that are not registered, and for all experiments involving uses not allowed by the pesticide label". Coverage under a NPDES permit is required whenever an experimental pesticide is going to be applied to an aquatic environment. One of the conditions of the previous NPDES was to allow for new research to be conducted on alternative chemical control on a limited scale (<1 acre). Based on conversations with WSDA and Dept. of Ecology, there are no exceptions to this rule, regardless of how small the plot is or how environmentally benign the treatment may be. Since a pesticide is defined by EPA as "Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest," then virtually all future burrowing shrimp control options would be considered pesticides and prohibited from being evaluated. By definition the following could be considered pesticides: subsurface injection with fresh water, ultra-sound and electro-shocking. These three methods have been tested in the lab with some marginal suppression of burrowing shrimp, but now could not be tested in the field. Any new chemistries with selective control in the lab and with the potential for minimal non-target impact, that might be found in the future, would also not be able to be evaluated in the field.

If Dept. of Ecology does not choose Alternative Four, the No Action Alternative is the default. One of the unintended consequences of the No Action Alternative would be to virtually eliminate any future research on burrowing shrimp control, other than mechanical control. Mechanical control has been well vetted over the past 70 years, and has been found to have very limited potential. In addition, due to potential impacts to eelgrass, it is unlikely it would even be allowed under the new restrictive Nationwide Permit imposed by the Army Corps of Engineers. Under the current burrowing shrimp recruitment conditions, and with few options for research on new control methods, the long-term consequences to the shellfish industry in Willapa Bay under the No Action Alternative would be grim.

I realize that there is serious opposition to Alternative Four by many stakeholders. These stakeholders insist that the No Action Alternative is the only sane choice and the industry should find other methods to control burrowing shrimp. Unfortunately, the No Action Alternative slams the door on the industry's ability to find alternative control methods, other than mechanical/cultural methods. The extensive research over 70 years has yet to even hint that there are any good mechanical methods to manage adult shrimp populations and the industry can not all convert to off-bottom culture.

In summary, a major research effort will be needed to find and test other options for control. However, it is impossible to make a valid inference on efficacy without field testing. You can't field test without an EUP. You can't get an EUP without an NPDES. Since you can not get an NPDES under the No Action Alternative, you virtually eliminate the ability to conduct research on alternative controls. Unfortunately the unintended consequences of the No Action Alternative will mean no future control for burrowing shrimp will likely ever be developed.

To that end, the shellfish industry in Willapa Bay will go through a major decline over the next several decades.

#7. IMPACT ON BENTHIC INVERTEBRATES

Information on the potential impacts of imidacloprid on benthic invertebrates is presented in the 2015 FEIS (Chapter 3, Section 3.2.5, pages 3-48 through 3-49). Some new additional analysis is included in this SEIS. PSI and WSU recently reassessed the data sets obtained under previous SAP studies in Willapa Bay using Principal Response Curve Analysis (PRC). PRC analysis is a multivariate ordination technique that was derived from Redundancy Analysis, primarily to simplify assessment of pesticide treatments on abundances of aquatic invertebrates in mesocosms and has since become fairly standard for such experimental systems. We are in the process of submitting this analysis for publication to either Nature or Coastal Shelf and Estuary Science.

One of the major points of this analysis is to highlight the fact that the default response of estuarine epibenthic and benthic invertebrates to imidacloprid is neutral, rather than negative. In fact only 6 PRCs out of 60 showed a significant negative effect. The large majority of PRCs showed no significant effect from imidacloprid application, a neutral treatment effect, or ostensibly a "positive" treatment effect.

I've attached the current draft of that paper. Below is the title and abstract

Response of Estuarine Benthic Invertebrates to Large Scale Field Applications of Imidacloprid.

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Washington State University Long Beach Extension Unit[2], Long Beach WA 98631, Washington State University Vancouver[3] WA 98686

A total of 60 analyses were conducted to examine the response of 6 taxonomic assemblages (polychaetes, non-juvenile polychaetes only, mollusks, non-juvenile mollusks only, and crustaceans, and all invertebrates combined). The response was significant ($p < 0.05$) among 51 of the analyses, but interpretation was often confounded by significant differences between treated and control assemblages before treatment. In general, the response of the treated assemblages relative to the control assemblage usually did not change much over time, indicating a minimal treatment effect on the assemblage as a whole. Only 6 PRCs of 60 showed a significant negative effect from imidacloprid application. Five of the 6 PRCs represented mollusks, which represented < 2% of all organisms sampled among all sites and years. Crustaceans were negatively affected in one of 8 studies. Polychaetes, both with and

without juveniles, were never negatively affected. The large majority of PRCs showed no significant effect from imidacloprid application, a neutral treatment effect, or ostensibly a "positive" treatment effect. The overall minimal response was likely due to exposure to low concentrations of imidacloprid for limited times, physiological tolerance to imidacloprid for some species, and multiple life history strategies to rebound from natural disturbance and adaptation to a highly variable environment. These strategies include high mobility and dispersal behaviors, high intrinsic rates of reproduction, and rapid development. The highly variable environment was reflected in the response as variation among years, sites, replicates, and perhaps haphazard movements of individuals, particularly juvenile bivalves.

#8. EFFECTS OF BURROWING SHRIMP ON CLAMS

1.7 Areas of Controversy and Uncertainty, and Issues to be Resolved

"Research on the effects of burrowing shrimp on commercial shellfish beds has been done where oysters are the primary crop. Field research data are lacking regarding how burrowing shrimp affect clams, and the threshold for damage to clam beds."

The SEIS is correct in stating that there have been no studies showing the direct impact of burrowing shrimp on commercial clam production. We have attempted to collect economic threshold data several times, but have not been successful. The main reason for this failure is due to the fact that we could not maintain gravel on the surface long enough to conduct an experiment. Gravel is much denser than oysters, and rapidly sinks in areas infested with burrowing shrimp. If you don't have gravel, you don't have clams. We have also attempted to place mature clams on sites with different densities of burrowing shrimp and assess thresholds, but because clams are very mobile, we have never been able to find them at the conclusion of the study. In addition, the average harvest cycle for commercial clams in Willapa Bay is 3 to 4 years. Because population dynamics of burrowing shrimp are not steady, determining accurate economic thresholds for burrowing shrimp over that 3 to 4 year duration is exceedingly difficult. It would be reasonably easy to design an experiment that examines the sinking rate of gravel as a function of burrowing shrimp density. From that, a threshold for treating burrowing shrimp could be developed. However, I would be uncertain as to what timeframe should be used to determine the threshold for sinking (6, 12 or 36 months), especially when shrimp populations are not constant.

The point I want to make is that what seems like a simple data request – "shrimp treatment threshold for clam production" – is exceedingly difficult to obtain. We don't even have an accurate method for quantifying burrowing shrimp density, other than excavating and sifting sediment down to a meter in depth. Because the total acreage for treatment is very limited (500 acres), I think it would be realistic to set the threshold similar to what has worked for oysters (10 burrows/m^2), and let the industry decide where their treatment priority areas are based on the economic impact it will have to their farms.

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Response of Estuarine Benthic Invertebrates to Large Scale Field Applications of Imidacloprid

Steven R. Booth[1], Kim Patten[2] and Leslie New[3] [1]

[2]

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keywords
burrowing shrimp, estuarine benthic invertebrates, imidacloprid, principal response curve, Willapa Bay

Abstract

The response of estuarine benthic invertebrates to the neonicotinoid insecticide imidacloprid following large scale field applications in Willapa Bay, Washington (U.S.A.) was examined using Principal Response Curve Analysis. A total of 60 analyses were conducted to examine the response of 6 taxonomic assemblages (polychates, non-juvenile polychaetes only, mollusks, non-juvenile mollusks only, and crustaceans, and all invertebrates combined). The response was significant ($p < 0.05$) among 51 of the analysis, but interpretation was often confounded by significant difference between treated and control assemblages before treatment. In general, the response of the treated assemblages relative to the control assemblage usually did not change much over time, indicating a minimal treatment effect on the assemblage as a whole. Only 6 PRCs of 60 showed a significant negative effect from imidacloprid application. Five of the 6 PRCs represented mollusks, which represented < 2% of all organisms sampled among all sites and years. Crustaceans were negatively affected in one of 8 studies. Polychaetes, both with and without juveniles, were never negatively affected. The large majority of PRCs showed no significant effect from imidacloprid application, a neutral treatment effect, or ostensibly a "positive" treatment effect. The overall minimal response was likely due to exposure to low concentrations of imidacloprid for limited times, physiological tolerance to imidacloprid for some species, and multiple lifehistory strategies to rebound from natural disturbance and adaptation to a highly variable environment. These strategies include high mobility and dispersal behaviors, high intrinsic rates of reproduction, and rapid development. The highly variable environment was reflected in the response as variation among years, sites, replicates, and perhaps haphazard movements of individuals, particularly juvenile bivalves.

1. Introduction

The selective nature of neonicotinoid insecticides towards insects has helped make them the most widely used class of insecticide in the world. Neonicotinoids are agonists of the primary neurotransmitter of the cholinergic nervous system, acetocholine (Ach) (Tomizawa and Casida 2003). That is; they block the transmission of nerve impulses along the central nervous system. Because the molecular structure of the nicotinic receptor site differs between insects and other animals and because they are metabolized differently by insects and other animals, they are selectively more toxic to insects than other animals, particularly vertebrates. Neonicotinoids act systemically so are most effective against pests that feed directly on plant tissues, thus applications are usually foliar or seed dressings (Goulson 2013). Neonicotinoids are "reduced risk" insecticides (Ehler and Bottrll 2000) and are compatible with many integrated pest management programs in a variety of cropping systems.

The effects of neonicotinoid insecticides on terrestrial insects, including non-targets, have been comprehensively assessed and reported (e.g., Goulson 2013, Pisa et al 2014). The most controversial unintended effect of neonicotinoids has been on pollinators of agricultural crops, primarily honeybees (Pisa et al. 2014). Neonicotinoids can directly kill honeybees via spray drift during foliar applications against pest insects, or affect them indirectly when the bees forage for nectar and pollen from treated plants. Neonicotinoids have been implicated, along with Varroa mites and several pathogens (Ellis et al. 2010), as contributing to colony collapse disorder (Gill et al 2012).

Reported effects on non-target aquatic invertebrates are much less common. Almost all data related to toxicity of neonicotinoids to aquatic invertebrates come from laboratory and mesocosm studies that feature freshwater. Exposure of estuarine invertebrates to any insecticide is almost always associated with run-off or leaching from upland agricultural use rather than from direct application (e.g., Kuivial and Hladik 2008, Morrisey et al. 2015). The authors of a recent comprehensive review of neonicotinoid impacts of non-target invertebrates reported, "There are no published works regarding the marine environmental contamination of neonicotinoids" (Pisa et al 2015).

The singular large scale insecticidal use in an estuary, worldwide, has featured applications of the broad spectrum carbamate insecticide, carbaryl, to control burrowing shrimp in coastal estuaries of Oregon and Washington in the U.S.A. (Feldman et al. 2000). Burrowing shrimp (*Neotrypaea californiensis*, *Neotrypaea gigas*, *Upogebia pugettensis*) reside in burrows where they disrupt the structural integrity of sediments, causing surface dwelling organisms, including ground-cultivated oysters, to sink and die. Annual applications of carbaryl to mostly non-contiguous commercial oyster beds were begun in the early 1960s. Use was controversial since inception and a near 50 year search for alternative management tactics ultimately lead to the neonicotinoid compound, imidacloprid (Booth 2010).

We examined the response of epibenthic and benthic invertebrates to large scale field trials of the neonicotinoid imidacloprid ((2E)-1-[(6-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine) (IMI) that targeted burrowing shrimp. A total of 8 trials were conducted in 2011, 2012, and 2014 under state and federal experimental use permits in partial fulfillment of requirements for Federal labels and Washington state permits (Booth et al. 2011, Booth and Rassmussen 2011, Booth and Rassmussen 2013, and Booth et al. 2015). Here, we consolidated those studies to describe the response of 6 assemblages of benthic invertebrates at each study and when data from all studies were pooled. Results were interpreted in terms of the physiological susceptibility of particular taxa and the resilience of the taxonomic assemblages in light of adaption to a dynamic and highly variable environment. Relevant life history strategies include high mobility and dispersal behaviors, high reproductive rates, and rapid development. The results also reflected the highly variable environment in terms of differences among study years, sites, and replicates, but also the high variability among species life histories, and perhaps haphazard movement of individuals.

2. Methods

2.1. Experimental design

The experimental design was a "before-after-control-impact" (BACI) approach (Green 1979) that featured plots that were treated with liquid formulated IMI (Nuprid® 2F; NuFarm US or Protector ®), granular formulated IMI (Mallet ® 0.5G), or were left untreated to serve as a control plot. In general, a liquid IMI plot and a granular treated plot were compared to a single control plot within a study area. Plots were separated by at last 500m. Application rate for all imidacloprid treatments was 0.5 lb a.i./ac. Over the course of 3 years, a total of eight trials were conducted among 5 study areas (Figure 1). In 2011, the triple plot design was used at one study area (Bay Center), but only a liquid IMI plot was compared to a control plot at a second area (Cedar River). Triple plots were used at two study areas in 2012 (Leadbetter and Palix). In 2014, 36ha of contiguous tidelands were treated with liquid IMI but an internal 4 ha plot was compared to a 3.6ha control plot located 4 km distant. Imidacloprid treatments were applied in July or August. The liquid formulation was applied aerially using helicopters when plot surfaces were fully exposed during extreme low morning tides The granular formulation was applied using an ATV equipped with a granular spreader during ebb flow prior to full surface exposure during extreme low morning tides (water depth ~ 5 cm).

2.2. Imidacloprid sampling

Comprehensive descriptions of procedures to sample, handle, and analyze samples are presented elsewhere (Booth and Rassmussen 2013, Grue and Grassley 2013, Booth et al. 2015, Patten 2015). Briefly, concentrations of IMI and its breakdown product, olefin, were measured in surface waters, substrate pore water, and sediments before and after treatment according to protocols that were fairly well standardized among study sites and years. Briefly, samples were taken along each of 4 to 6 transects that radiated from plot center and extended up to 480 m off plot, primarily in the direction of tidal currents. Water was sampled at one or two hours after IMI application as the tide inundated the plot treated with the liquid formulation or as it flowed off of the plot treated with the granular formulation, then at 6, 12, and 24 hr later. Porewater and sediments were sampled at 1, 14, 28, and 56 days after treatment according to an iterative process that depended on the results of the previous sample. Seagrass, *Zostera marina*, was also sampled and analyzed for concentrations of IMI.

2.3. Invertebrate sampling

Treated and control plots were sampled at the day before and at 14 and 28 days after treatment (DAT). In 2012, the plot treated with liquid IMI and associated control were also sampled at 56 DAT at one of the two study sites, but only mussels and crustaceans were enumerated. Plot sizes, primary sediment composition, vegetation, treatment dates, and sample sizes characteristics are presented in th Appendix (Table A.1).

Invertebrates were sampled using a 10.2 cm internal diameter corer to a depth of 10 cm. In 2011 and 2012, cores samples and identification labels were placed inside one gallon Ziploc® storage bags, transported in coolers from the study sites, and sieved one or two hours later in salt water through 0.5 mm mesh to save time during sampling. In 2014, cores were sieved on site immediately after sampling. Sieved samples were fixed in 10% buffered formalin.

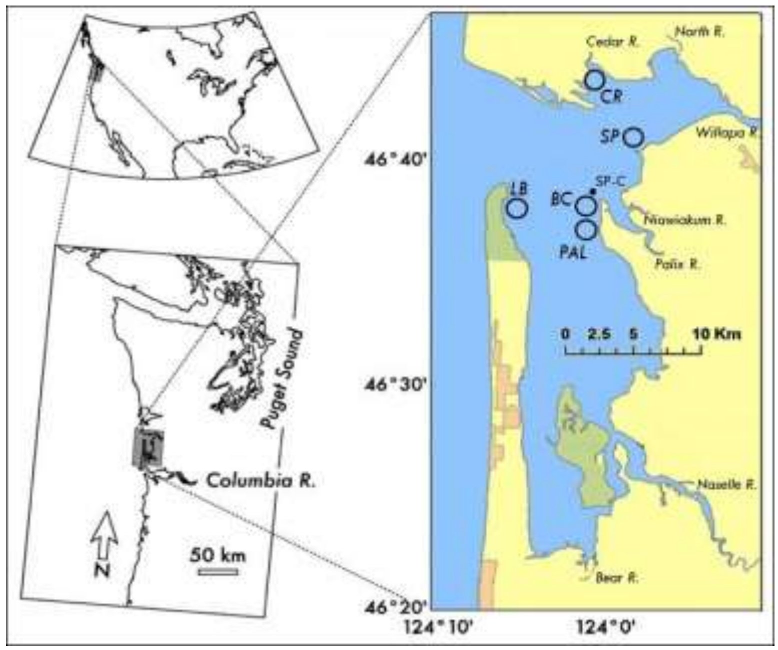

Figure 1. Willapa Bay, WA study sites: Cedar River (CR - 2011), Stony Pt. (SP - 2014), Stony Pt. Control (SP-C - 2014), Bay Center (BC - 2011), Leadbetter (LB - 2012), Palix (PAL - 2012).

2.4. Sample identification

After at least two weeks, samples were re-sieved through 100 µm mesh using freshwater, transferred to 70% isopropyl alcohol, stained with rose Bengal, and stored until further processing. Invertebrates were sorted from bits of algae, eelgrass, and debris. Polychaetes were identified, mostly to species, and enumerated by Ruff Systematics, Inc. Crustaceans and mollusks were identified and enumerated by PSI staff to the most specific taxonomic level possible (identifiable taxonomic unit (ITU)).

2.5. Data analysis

Principal Response Curve (PRC) analysis is a multivariate ordination technique that was derived from Redundancy Analysis (RDA), primarily to simplify assessment of pesticide treatments on abundances of aquatic invertebrates in mesocosms (Van den Brink and Ter Braak 1999) and has since become fairly standard for such experimental systems (e.g., Colville et al. 2008, Lopez-Mancisidor et al. 2008, Mohr et al. 2012). PRC's have also been used to interpret biomonitoring data (e.g., Leonard et al. 2000, Cuppen et al. 2000) and has been favorably compared to other multivariate techniques (Van den Brink et al. 2009). In PRC analysis, effects due to time (conditioned variance) are partialled out, leaving treatment effects plus effects due to the treatment × time interaction (constrained variance) and remaining residual (unconstrained) variance. Removing time from the equation allows the response of a treated species assemblage to be compared to an untreated control assemblage along a horizontal time axis, greatly simplifying interpretation of results. As in RDA, the maximum constrained variance among a set of samples is extracted and projected onto a primary axis, the maximum constrained variance that is uncorrelated with the primary axis is projected onto a second axis, the maximum constrained variance that is uncorrelated with either primary or secondary axes is projected onto a third axis, and so forth, until all constrained variance has been projected. The Principal Response at each sample time is a canonical coefficient (c_{dt}) that represents the maximum variance of species abundances in the treated assemblage relative to the control assemblage that is explained by a single (usually the primary) RDA axis (axis 1). An increase in the canonical coefficient over time represents increasing abundance of the treated assemblage relative to a control assemblage; a decrease in the coefficient over time represents a decrease in abundance. The amount of total variation that is captured by axis 1 axis can be assessed for significance over the entire time series using a Monte Carlo permutation test. An additional Monte Carlo permutation test can be used to determine if the treatment effect (e.g., IMI application) and treatment × time interaction are significant at each sample time. Finally, PRC analysis presents a coefficient (b_k) that expresses the correlation of each species, or taxa, with the basic response pattern of the entire taxon assemblage. The relative abundance of a given ITU at a given sample time = $c_{dt} \times b_k$. Highly weighted taxa (high values of b_k) are highly positively correlated with the basic PRC pattern (e.g. abundances resembles the basic pattern) while taxa with negative taxonomic weights are negatively correlated (abundances resemble the opposite pattern of the entire assemblage).

Principal Response Curve analyses were conducted using the ‘vegan’ package (v 2.3-3) for the R programming language (v 3.2.2) (R Core Team 2016). PRCs were created and analyzed for a total of six metric assemblages of benthic invertebrates (polychaetes, mollusks, and crustaceans, non-juvenile polychaetes, non-juvenile mollusks, and assemblage of all invertebrates categorized by family as the most specific taxon. Studies of liquid and granular formulated IMI were analyzed separately. PRC analyses were conducted on log-transformed abundance data (ln (x) +1, where x = number of individuals per m^2 per taxa. Separate analyses were conducted for each individual test (year, study site, and formulation), and for all sites and years pooled. In addition to the curve, the analysis determined the amount and proportion of conditioned variance (time effects), constrained variance (explained by treatment plus treatment x time effects), or unconstrained (unexplained) variance. Monte Carlo permutation F-type ANOVA (number of permutations = 999) was used to test the significance of a) the amount of constrained variance (e.g., conditional variance was removed as part of the PRC analysis so was expressed in the ANOVA as 0), and b) the response of each treated assemblage relative to the control assemblage at each sample date. PRC analysis output included the amount of constrained variance displayed on PRC. A second Monte Carlo test determined the significance of the PRC diagram (null hypothesis: axis 1 does not represent a significant proportion of the total variance).

3. Results

3.1. Field concentrations of imidacloprid

Concentrations of IMI in surface waters, porewaters, sediments, eelgrass, and associated field and laboratory controls are detailed elsewhere (Booth and Rassmussen 2013, Grue and Grassley 2013, Booth et al. 2015, Patten 2015). A very general summary comparison was that IMI concentrations varied substantially among years and study areas, with a notable difference between formulations (Table A.5).

Because on-plot surface waters were sampled on the first post-treatment inundation tide (10 cm deep, ~ 2 hours after treatment (HAT)), and because granular IMI was applied to shallow standing water near the end of the out-going tide, concentrations were generally lower than in samples from the plots treated with liquid IMI while the plot was fully exposed. Concentrations also varied substantially within plots. Concentrations in surface waters also rapidly dissipated. Imidacloprid was detected in only 1 of 10 surface water samples taken at 6 HAT in 2011 and never at any longer post-treatment intervals. Consequently, surface waters were not sampled past 6 HAT in 2012 or 2014.

Concentrations of IMI in porewater declined precipitously according to power functions from initial concentrations (1 hr post-treatment) of 12 ppb in 2010 and 2011 (combined) (Grue and Grassley 2012), ~100 ppb in 2012 (Grue and

Grassley 2012), and ~ 150 ppb in 2014 (Booth et al. 2015) to ~ 1 ppb at 14 DAT and to barely or non-detectable (0.04 ppb) concentrations at 28 and 56 DAT (all studies).

Concentrations of IMI in sediment sampled from 5 treated plots at 1 DAT in 2012 averaged 21.4 ppb (range was 6.3 to 89 ppb) (Grue and Grassley 2012) and 57.5 ppb (range was 57 – 64 ppb) among 4 sediment samples from the plot treated in 2014 (Booth et al. 2015). Concentrations of a primary metabolite of IMI, olefin, were orders of magnitude lower, if detected at all, in both water and sediment. Based on an application rate of 0.5 lb a.i./ac, sample depth, specific gravity, and percent moisture, the theoretical maximum concentration of IMI in porewater was 1121 ppb (Grue and Grassley 2012), far higher than sampled here. Most of the difference was due to dissipation into surrounding waters during tidal exchange. Off-site water samples indicated that IMI was sometimes transported several hundred meters from the treated plot, but at extremely low concentrations and only in the first few days after treatment (Grue and Grassley 2012) (Booth et al. 2015). Imidacloprid concentrations were further reduced by molecular binding to the sediments (Grue and Grassley 2012). Binding rates approached 90% in sediments with high amounts of total organic carbon.

3.2. Identifiable taxonomic units

A total of 95 invertebrates were identified to species or the most specific identifiable taxonomic unit (ITU) (Appendix, Table A.2a).

3.3. Partitioned variances and treatment effects

The percentage of total variance that is conditioned (attributed to time effects), constrained (attributed to treatment effects plus treatment x time interaction effects), and unconstrained (attributed to replicate, site, or unexplained effects) is presented in the Appendix for each PRC analysis (Table A.3) and the significance of the treatment and treatment x time interaction effects are presented in Table 4. Axis 1 displayed a significant amount of the constrained variance in 51 of the 60 PRCs. Analyses with lower percentages of unconstrained variance were those that were less diverse (i.e., all studies at Bay Center and Cedar River in 2011). Treatment effects were significant in 54 of the 60 analysis (Table 4). Both treatment effects and axis 1 were significant in 49 of the 60 analysis.

The canonical coefficient (principal response) of the test assemblage was significantly different from the control assemblage before treatment in 40 of the 60 analyses. Hence, a significant treatment effect over all sample dates, as determined by Monte Carlo ANOVAs, was not always informative. Furthermore, the treatment effect was often significant even when the overall proportion of constrained variance (variance due to treatment effects plus treatment x time interaction effects) was low (< 10%). Low constrained variance may be an artifact of the ordination analysis (e.g., the “arch effect” (Gauch 1982)), and have “nothing to do with nature” (Palmer 2016), but analyses with higher proportions of constrained variation are intuitively more explanatory. The more informative analyses were those with a significant percentage of constrained variance and an axis 1 that displayed a significant proportion of the constrained variance. Forty-nine of the 60 PRCs meet these criteria. Unconstrained variance was >75% for 31 and < 50% for 12 of the 49 more informative PRCs.

3.4. Principal response curves

The 60 PRCs are presented in the Appendix (Figures A.5 – A.14), arranged by study site and year, as trajectories of the principal response were often consistent among the 6 taxonomic assemblages at each study site and year. Response trajectories were less consistent among studies within a given assemblage. Each of the more informative PRCs had one of 3 potential outcomes based on the position of the principal response at the final sample date relative to the pre-treatment sample date (the end response): 1) a negative end response, in which principal response of the test assemblage relative to the control assemblage was lower at the final sample date compared to before treatment (e.g. Figure 2), 2) a positive end response, in which the principal response of the test assemblage relative to the control assemblage was higher at the final sample date compared to before treatment (e.g., Figure 3), and 3) a neutral end point, in which the principal response of the test assemblage relative to the control assemblage was the same at the final sample date compared to before treatment (e.g., Figure 4). Another potential scenario, indicative of a severe negative effect, with a response that is significantly higher than the control before treatment but is significantly lower than the control at both post-treatment sample dates was not realized in our studies.

The status of the end response (negative, positive, or neutral) of each of the 49 PRCs with both a significant percentage of constrained variance and an axis 1 that displayed a significant proportion of that variance is presented in the appendix as Table A.6. The end responses of 6 significant PRCs were negative, 5 of which were either mollusks with or without juveniles included, while 1 of the 6 was the assemblage of crustaceans treated with granular IMI at Palix, 2012 (Figure 2). Four of the 6 were from studies of the liquid formulation of IMI. Two of the 5 PRCs with a positive end responses were polychaetes in the combined liquid IMI studies, with juveniles both included and excluded (Figure 3). Three of the 5 featured mollusks. Three of the 5 were from studies of the granular formulation of IMI. The end response of 38 of the 49 PRCs with both significant treatment effects and a significant axis 1 was neutral. The trajectories of 34 of the 38 PRCs were essentially flat. That is, the response was significantly lower for the treated assemblage than the control assemblage at all sample date (e.g., Figure 4), significantly greater for the treated than the control at all sample dates (also Figure 4), or not significantly different between the treated and control assemblage at all sample dates. The trajectories of 4 PRCs shifted either up or down at 14 DAT, but returned to pre-treatment status at 28 DAT. Nineteen of the 38 PRCs with a neutral end response were from studies of the liquid formulation of IMI and 19 were from studies of the granular formulation.

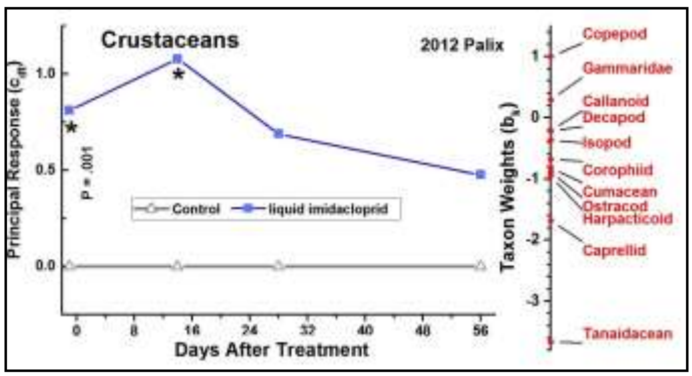

Figure 2. Principal Response Curve of crustaceans before and after treatment with liquid imidacloprid at Palix, 2012. P is probability that the primary axis (response) is significant. Asterisk (*) indicates the response at each sample date is significantly different from the control (p < 0.05). Weights indicate taxa that are positively or negatively correlated with the shape of the curve.

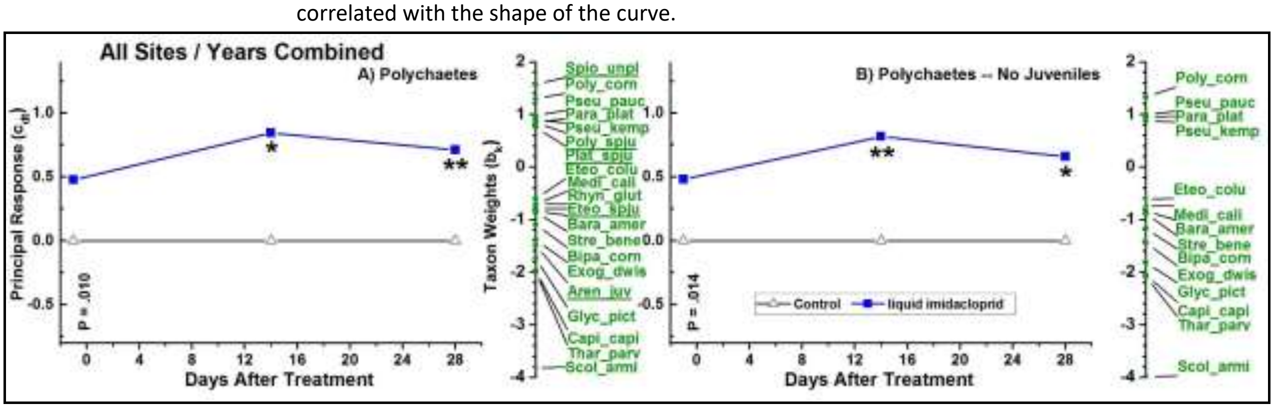

Figure 3. Principal Response Curve of A) all polychaetes (underlined taxa are juveniles) and B) non-juvenile polychaetes before and after treatment with liquid imidacloprid, pooled study sites and years. P is probability that axis 1 (Principal Response) is significant. Asterisks indicate the response at each sample date is significantly different from the control (*, p < 0.05; **, p < 0.01). Weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -.06 and < 0.06 are not shown). Table A.2 lists polychaete full names and

Both the trajectory and the end response of all non-juvenile polychaete PRCs were very similar to thoseabbreviations.

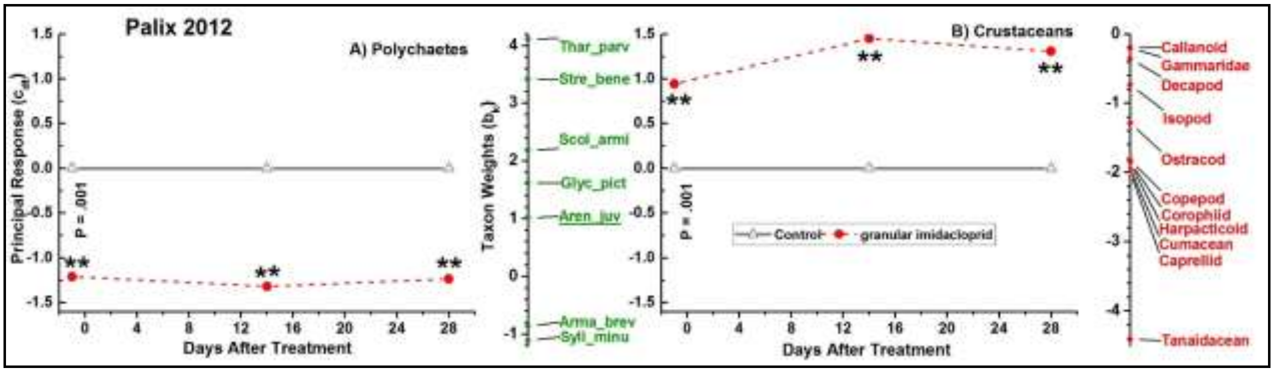

Figure 4. Principal Response Curves of A) Polychaetes (underlined taxa are juveniles) and B) Crustaceans at granular imidacloprid and control plots at Palix in 2012. P is probablility that axis 1 (response) is significant. Asterisks (**) indicate the response at each sample date is significantly different from the control ($p < 0.01$). Weights indicate taxa that are positively or negatively correlated with the shape of the curve (polychaete weights > -.06 and < 0.06 are not shown). Table A.2 lists polychaete full names and abbreviations.

that included juveniles. However, the flat trajectory of non-juvenile polychaetes treated with granular IMI at Leadbetter in 2011 was higher than the control, whereas the flat trajectory was lower than the control at all sample dates when juveniles were included in the analysis. The trajectory or end response of nonjuvenile mollusks was different than mollusks with juveniles included in 6 of the 8 comparisons, perhaps most notably in the PRC of all studies combined; the end response was positive with juveniles included, but negative with juveniles excluded from analysis.

Weights of individual species or ITUs were generally not consistent among PRCs of the same taxonomic assemblage among different studies. For example, weights of harpacticoid crustaceans were positive at Bay Center and Cedar River in 2011 and at Stony Pt in 2014, but were negative at Palix and Leadbetter in 2012. Sedentary polychaetes (Sub Class Sedentaria) were not affected more than mobile polychaetes.

In summary, only 6 PRCs of 60 showed a significant negative effect from IMI application, representing studies of both granular and liquid formulations at the 2012 Palix study area and of each formulation when all studies across all years were combined. Five of the 6 PRCs represented mollusks, which represented < 2% of all organisms sampled among all sites and years. Crustaceans were negatively effected in one of 8 studies and polychaetes were never negatively effected. The large majority of PRCs showed no significant effect from IMI application, a neutral treatment effect, or ostensibly a “positive” treatment effect.

4. DISCUSSION

4.1. Toxicological effects

The minor and transitory effects from IMI indicated by the PRC analyses were at least partly due to limited exposure to potentially toxic concentrations. Imidacloprid demonstrably affected estuarine aquatic benthic invertebrates in controlled laboratory arenas. Toxicity tests of standard saltwater test crustaceans report LC_{50} values of 10,440 *u*g/L for water flea (*Daphnia magna*) and 361,230 *u*g/L for 4th naupliar stage brine shrimp (*Artemia* sp.) (static 48 hr tests, Song et al. 1997). These values were substantially higher than the field concentrations sampled in our studies. LC_{50} values were 10 *u*g/L and 1,112 *u*g/L for blue crab (*Callinectes sapidus*) megalope and juveniles, respectively (static 24 hr test, Osterberg et al 2012) and were 309 *u*g/L and 566 *u*g/L for larval and adult grass shrimp (*Palaemonetes pugio*), respectively (static 96 hr test, Key et al. 2007). There are no published laboratory studies of IMI effects on polychaetes, but the freshwater oligochaete *Lumbriculus variegatus* suffered 35% mortality after 10 days of exposure to 500 *u*g/kg (ppb) IMI in spiked soil samples (Sardo and Sores 2010). These controlled tests feature exposure to concentrations for much longer time periods than those experienced by organisms in our field trials, as IMI quickly dissipated into surrounding waters or bound to sediments.

Because carbaryl has been the only other insecticide applied to manage estuarine burrowing shrimp, it is a useful reference to assess for relative toxicity to non-insect invertebrates. Very few, if any, studies have been published that directly compared the toxicities of IMI and carbaryl to non-insect invertebrates, but comparisons between generally similar studies showed carbaryl to be much more toxic. An LC_{50} of 137 *u*g/L was reported for 24 hr old *Artemia salina* (Barahona and Sanchez-Fortun 1999) in an experimental system similar to that used by Song et al. (1997) and an LC_{50} of 43 *u*g/L of carbaryl was reported for the grass shrimp (*P. pugio*) (Chung et al. 2008) in an experimental system similar to that used by Key et al. (2007). LC_{50} values of carbaryl ranged between 5.6 and 16.4 *u*g/L among 9 studies of toxicity to *D. magna* (Toumi et al. 2016).

4.2. Disturbance effects

Although estuarine benthic invertebrates survived IMI applications by virtue of limited exposure or physiological tolerance, they were also able to withstand the applications due to adaptation to a variety of natural disturbances. Simenstad and Fresh (1995) assessed the effects of disturbance from 5 intertidal aquaculture practices, including carbaryl applications against burrowing shrimp in Willapa Bay, on the epibenthic and benthic communities in Pacific Northwest estuaries. They noted that individual species differ in their susceptibility to disturbance, especially short term (e.g., 2 days post disturbance) but that the epi-benthic and benthic infaunal assemblages are quite resilient long-term (51 days). They concluded that the ability of these communities to rebound from aquaculture related disturbances stems from the communities' natural adaptation to the highly dynamic estuarine environment. A study of the sediment impact zone related to the carbaryl applications similarly showed that minimal effects in terms of both distance from the treated plot (< 180 m) and time since treatment (< 1 yr) (Booth 2006). "Scant" or "moderate" effects of harvest activities associated with geoduck clam (*Panopea generosa*) aquaculture, which in Puget Sound, Washington (VanBlaricom et al. 2015). Cultured geoduck are harvested by liquifying the sediments that surround each clam within a radius of 15 – 30 cm and a depth of 30 cm or more. The authors noted strong seasonal trends in the structure of benthic communities and that organisms are adapted to not only normal seasonal events, but also more haphazard events such as floods, storms, and even small tsunami and submarine landslides. As noted by Dumbauld et al. (2009), natural disturbance is essential to maintain community structure in many ecosystems, and that aquaculture is generally in the same scale.

The intertidal environment of Willapa Bay is particularly dynamic at both spatial and temporal scales. Salinity is especially variable in Willapa Bay and was characterized as "extremely unsteady" in salt balance, both between and within seasons (Banas et al. 2004). The estuary itself is relatively shallow, which leads to especially large maximum and minimum tides (Emmett et al. 2012). Velocities of receding and advancing tides can reach several meters/second where gradients are smooth (Patten and PSI pers. obs.). Associated laminar flows transport and distribute sediments across the tideflats (Wheatcroft et al 2013) to erodable channels that carry "orders of magnitude" greater loads of suspended sediments during peak tidal flows (Wiberg et al 2013). Major drainage channels are often displaced by 100s of meters by the spring following a series of winter storms (Patten and PSI, pers. obs.). Water temperatures also vary widely and can reach 40°C within a few hours in shallow puddles left during low tides on sunny summer days in Willapa Bay (Pacific Shellfish Institute monitoring data). Because the mouth of the estuary and 5 of the 7 primary rivers that flow into Willapa Bay are located in the northern portion of the estuary, currents generally circulate from north to south (reversible to south-north) so general gradients in sediment type, salinity, and productivity are also north-south (Banas et al. 2004). The amount and type of vegetation and detritus also vary at more local scales according to differences in tidal elevation, aspect, and proximity to rivers and other upland inputs. As noted above, and seconded in the VanBlaricom article, the highly variable estuarine habitat made it hard to identify suitable reference sites and replicate sample stations in Willapa Bay and Puget Sound.

The variable estuarine habitat was reflected in our PRC analyses as percentage unconstrained variance.

Unconstrained variance represents differences among samples, replicates, or sites (e.g., Cuppen et al 2000). The percentage of unconstrained variance was usually higher than those reported in most controlled mesocosm studies, which ranged from ~20% (Cuppen et al. 2000) or more typically ~40% (Maund et al. 2009, Mohr et al. 2012, Van den Brink and Braak 1999) or ~55% (Colville et al. 2008, LopezMancisidor et al. 2008). However, unconstrained variance was 75% and 70% in a study of pesticide runoff effects on aquatic arthropods near conventionally managed and organic orchards in Germany (Schafers et al. 2008), which is more in line with percentages in our analyses.

Percentage of unconstrained variance was greatest in the analyses of combined study sites and years, reflecting the inherent variability therein. Uncontrollable experimental conditions, particularly annual weather conditions and seasonal trends, varied among years and study areas. The inconsistent patterns of taxon weights across study years and sites also reflected both the variable estuarine environment and the various life history strategies among estuarine species (or ITUs). For example, species vary in response (break from diapause, developmental rate) to water temperature.

Estuarine epibenthic and benthic invertebrates have evolved several life history strategies to deal with both seasonal and abrupt environmental changes. They are highly prolific, fecund, and often produce multiple generations per year. Most are mobile, with pelagic juvenile life stages that move not only within an estuary, but among estuaries via ocean currents. In addition to dispersal during dedicated larval, postlarval, or juvenile life stages, frequent small scale movements over long time periods by settled benthic invertebrates lends resilience in soft-sediment communities at a much larger spatial scale (Pilditch et al. 2015). Immigration, albeit simulated, has been shown to greatly accelerate the ability of a freshwater aquatic macroinvertebrate community to recover after pesticide exposure (Maund et al. 2009).

We suspect that dispersal, high reproductive rates, rapid growth, and perhaps haphazard movement likely accounted for the “positive” treatment effects of IMI. Movement or growth of juvenile bivalves, *Macoma* spp. in particular, onto the plots treated with granular IMI post-treatment may have accounted for the positive end point of the PRC of pooled studies and the negative end point in PRC when juveniles were discarded. Small bivalves reside at shallow substrate depths and are easily dislodged and transported with sediments disturbed by storms or extreme tidal currents (Norkko et al. 2001, Beukema et al. 2002). The juvenile myids and mytillids in our studies were the size of large grains of sand so were particularly prone to dispersal by sediment transport. Harpacticoid crustaceans were 4 times more abundant on the test plot than the control plot at Stony Pt. in 2014, perhaps due to slightly warmer water temperatures that could have accelerated development, reproduction, and aggregation. Slight differences in the density and development of vegetative cover could have also enhanced the production of meiofauna and associated small benthic infauna (Dumbauld et al. 2001).

4.3. Long-term effects of imidacloprid via burrowing shrimp

Long term effects of IMI used to manage burrowing shrimp and culture bivalves is expected to lead to a more diverse community of benthic invertebrates compared to otherwise similar estuarine ground with high densities of burrowing shrimp. Burrowing shrimp, via bioturbation, are ecosystem engineers (Jones et al. 1994), (alternatively termed bioengineers (Posey et al. 1991, Dumbauld et al. 2001) of soft-sediment intertidal habitats in many northeastern Pacific estuaries (Dumbauld et al. 2009) and thus control the structure and development of the immediate benthic community. Species diversity was lowest in ghost shrimp dominated habitat compared to six other inter-tidal habitat types (Ferarro and Cole 2007, Ferraro and Cole 2012). The very low relative abundance of mollusks found in our studies also demonstrated the ability of burrowing shrimp to control the local habitat. Suppression of burrowing shrimp allows other benthic organisms, primarily bivalves, to establish, followed by meiofauna that adhere to the bivalve and associated small benthic infauna (Dumbauld et al. 2001). Cultured bivalves in North American West Coast estuaries, including oysters in Willapa Bay and Grays Harbor managed with carbaryl to suppress burrowing shrimp, did not reduce the capacity of the larger ecosystem to adapt to disturbance (Dumbauld et al. 2009). The same conclusion would hold given the smaller treatment area and lower toxicological impact from a burrowing shrimp management program using imidacloprid.

APPENDIX

Table A.1. Study site / field plot characteristics.

Year	Site	Treatment	Application Date	Plot Size (ha)	Substrate	Vegetation[1]	Cores / Plot[2]
2011	Bay Center	liquid IMI	July 14	4.2	sand	bare	20
		granular IMI	July 14	4.1	sand	sparse *Z. japonica*	16
		control		4.1	sand	bare	16
	Cedar River	liquid IMI	July 14	2.0	silt	sparse *Z. marina*	16
		control	July 14	0.9	sand	bare	16
2012	Palix	liquid IMI	August 2	3.4	sand	sparse *Z. marina*	15
		granular IMI	August 2	3.4	sand /silt	bare	15
		control		3.4	sand	sparse *Z. marina*	15
	Leadbetter	liquid IMI	August 5	3.2	sand	bare	13
		granular IMI	August 5	2.0	sand	patchy *Z. japonica*	15
		control		2.4	sand	bare	16
2014	Stony Pt	liquid IMI	July 28	4.0	sand	patchy *Z. marina*	15
		control		3.6	sand	patchy *Z. marina*	21

[1] sparse, % cover < 20%; patchy, % cover > 20% and < 1 m and > 5m apart.

[2] Sample sizes are smaller than previously reported due to time-series blocking requirements for permutation tests.

Table A.2a. List of 96 taxa identified and enumerated from all samples at all sites and years. Table A.2b lists polychaete abbreviations.

Phylum Annelida
Class Polychaeta
Sub-Class Errantia
Order Eunicida
Family Dorvilleidea
Dorvillea annulata. 01
Order Phyllodocida
Family Polynoidea
Harmothoe imbricata.. 02
Family Goniadidae
Glycinde picta.. 03
Glycinde sp. [juv]. 04
Family Chrysopetalidae
Paleanotus bellis. 05
Family Hesionidae
Micropodarke dubia.. 06
Microphthalmus sp... 07
Family Nereididae
Neanthes limnicola. 08
Neanthes virens. 09
Neanthes sp. [juv]. 10
Nereis vexillosa 11
Nereis sp. [juv]. 12
Platynereis bicanliculata. . . 13
Platynereis sp. [juv]. 14
Family Syllidae
Exogone dwisula.. 15
Exogone sp... 16
Sphaerosyllis californiensis. 17
Sphaerosyllis sp. N-1. 18
Syllides minutes. 19
Syllides longocirrata.. 20
Syllides sp. [juv]. 21
Family Nephtyidae
Nephtys caeca. 22
Nephtys cornuta.. 23
Nephtys sp. unindent. (juv). 24
Bipalponephtys cornuta. . . 25
Family Phyllodocidae
Eumida longicornuta. 26
Eteone californica.. 27
Eteone fauchaldia. 28
Eeone sp. (juv). 29
Phyllodoce hartmanae.. . . . 30
Phyllodoce sp. [juv]. 31

Sub-Class Sedentaria Order Orbiniida
Family Orbiniidae
Leitoscololos pugettensis. . . . 32
Leitoscloplos sp... 33
Paraonella platybranchia.. . . . 34
Scoloplos armiger.. 35
Scoloplos sp. (juv).. 36
Order Sabedellida
Family Sabelidae
Unidentifed Sabelid [juv].. . . . 37
Family Oweniidae
Owenia sp.. 38

Table A.2b. Polychaete name abbreviations. Table A.2a lists full name.

Sub-Class Errantia
Order Eunicida
Family Dorvilleidea
Dorv_annu. 01
Order Phyllodocida
Family Polynoidea
Harm_imbri. 02
Family Goniadidae
Glyc_pict.. 03
Glyci_spju.. 04
Family Chrysopetalidae
Pale_bell.. 05
Family Hesionidae
Micro_dubi.. 06
Micro_sp.. 07
Family Nereididae
Nean_limn. 08
Nean_vire.. 09
Nean_ spju. 10
Nere_vexl. 11
Nere_spju.. 12
Plat_bica.. 13
Platy_sp. 14
Family Syllidae
Exog_dwis.. 15
Exog_sp.. 16
Spha_cali. 17
Spha_N-1. 18
Sylli_minu.. 19
Sylli_long. 20
Sylli_spju.. 21
Family Nephtyidae
Neph_caec. 22
Neph_corn. 23
Neph_unid. 24
Bipa_corn. 25
Family Phyllodocidae
Eumi_long.. 26
Eteo_cali.. 27
Eteo_fauc. 28
Eteo_spju. 29
Phyl_hart. 30
Phyl_spju. 31
Sub-Class Sedentaria Order Orbiniida
Family Orbiniidae
Leit_puge. 32
Leit_sp.. 33
Para_plat. 34
Scol_armi. 35
Scol_spju.. 36
Order Sabedellida
Family Sabelidae
Unid_Sabe. 37
Family Oweniidae
Owen_sp.. 38
Order Spionida
Family Spionidae
Dipo_quad. 39
Poly_corn. 40
Pseu_kemp.. 41
Pseu_pauc 42
Pygo_cali.. 43
Pygo_eleg.. 44
Rhyn_glut. 45
Scol_squa. 46
Scol_spju.. 47
Spio_unid 48
Spio_norr. 49
Spio_bomb.. 50
Spio_spju. 51
Streb_bene.. 52
Order Terebellida
Family Terebellidae
Poly_sp.. 53
Unid_Tere.. 54
Order Cirratulida
Family Cirratulidae
Thar_parv.. 55
Order Opheliida
Family Opheliidae
Poly_sp.. 56
Arma_brev. 57
Ophe_lima. 58
Thor_mucr. 59
Unid_Ophe.. 60
Order Capitellida
Aren_juv. 61
Family Capitellidae
Bara_amer. 62
Capit_capi.. 63
Mage_hobs.. 64
Hete_fili. 65
Noto_tenu. 66
Noto_spju.. 67
Medi_cali 68
Family Maldanindae
Saba_elon.. 69

Table A.3. Percentage variance partitioned by RDA and Monte-Carlo permutation F tests for significance of primary axis (axis 1).

				% Var. Attributed to:			% Trt. Var. Captured	PRC Permutation Test Statistics		
Year	Site	Formulation	Metric	Time[1]	Treatment[2]	Residual[3]	by axis 1	F	Pr(>F)	Sig.[4]
2011	BC	liquid	All Polychaetes	22.6	16.0	61.4	43.3	2.36	.057	NS
			No juv Poly	24.7	15.4	59.9	41.1	2.21	.121	NS
			Mollusks	16.2	17.3	66.5	63.0	3.44	.047	*
			No juv Moll	17.1	14.9	68.0	75.3	3.46	.118	*
			Crustaceans	17.0	15.2	67.8	56.3	2.66	.266	NS
					37.9	42.8	77.7			
					41.6	38.2	80.6			

			All Invertebrates	24.3	61.5	65.9	2.81	.019	
		granular		25.8	59.8	76.2	12.34	.031	
				33.5	57.3	69.6			
				36.4	50.1	73.6			
				38.1	44.9	71.9			
				40.2	46.8	74.8	9.34	.027	
2011	CR	liquid		12.0	50.0	62.4	10.97	.027	
				13.5	53.1	69.7			
				56.6	27.9	91.3			
				52.5	33.0	88.3			
				8.7	87.6	80.8	25.31	.028	*
2012	LB	liquid		8.9	87.4	81.3	6.99	.007	**
				2.8	95.0	69.5			
				3.2	95.1	84.4			
				3.6	92.2	71.2			
				5.5	91.6	68.4		.037	*
				7.6	88.7	70.1		.008	**
		granular		7.7	88.5	70.6			
				7.6	89.7	86.9			
				11.4	86.8	90.7			
				8.3	89	49.5			
				7.6	89.9	63.8		.003	**
				8.4	81.3	83.8		.001	***
2012	BC	liquid		9.1	79.9	87.5			
				4.6	90.1	64.9			
				5.6	88.9	71.1			
				8.3	79.5	71.8	6.61	.001	***
				8.3	83.9	74.2	21.45	.001	***
		granular		17.4	70.8	90.8			
				18.6	69.0	91.5			
				4.5	88.5	68.6			
				8.9	87.4	74.8	22.24	.001	***
				26.8	66.6	91.7	26.84	.001	***
				19.9	73.3	88.3			
				20.9	73.3	82.7			
				18.9	74.6	81.3			
				17.0	80.2	83.5			
				1.9	96.6	84.7			
				15.0	82.7	85.4			
				19.2	77.2	86.3			
20.3			14.3	65.4	61.2*				
			All Polychaetes						19.3*
			No juv Poly			20.215.80		.033	*
			Mollusks			14.24.69		.026	*
			No juv Moll			14.45.90		.026	*
			Crustaceans			9.27.33		.032	*

			All Invertebrates 13.5*							
			All Polychaetes							17.0*
			No juv Poly			13.011.60			.034	*
			Mollusks			38.02.69			.086	NS
			No juv Moll			33.43.19			.112	NS
			Crustaceans			15.533.40			.026	*
			All Invertebrates 14.5							
			All Polychaetes	3.7						
			No juv Poly			3.77.20			.005	**
			Mollusks			2.21.83			.514	NS
			No juv Moll			1.72.56			.423	NS
			Crustaceans			4.22.57			.210	NS
			All Invertebrates			2.93.61				
			All Polychaetes			3.75.60				
			No juv Poly			3.85.73			.006	**
			Mollusks			2.75.40			.003	**
			No juv Moll			1.811.12			.001	**
			Crustaceans			2.74.39			.036	*
			All Invertebrates			2.55.00				
			All Polychaetes			10.38.29				
			No juv Poly			11.09.50			.001	***
			Mollusks			5.33.68			.020	*
			No juv Moll			5.55.16			.025	*
			Crustaceans			12.27.87			.001	***
			All Invertebrates	7.8						
			All Polychaetes	11.8						
			No juv Poly			12.423.60			.001	***
			Mollusks			7.05.40			.010	**
			No juv Moll			3.77.56			.006	**
			Crustaceans			6.635.51			.001	***
			All Invertebrates	6.8						
2014	SP	liquid	All Polychaetes	5.8						
			No juv Poly			6.523.50			.001	***
			Mollusks			2.820.72			.001	***
			No juv Moll			1.522.57			.001	***
			Crustaceans			2.37.87			.001	***
			All Invertebrates	3.6	24.53	.001	*** All	All	liquid	All Polychaetes
1.3	2.8	95.9	84.9	9.21	.010	**				
			No juv Poly	1.4	2.8	95.8	85.0	8.84	.014	**
			Mollusks	2.1	1.8	96.1	76.4	5.25	.032	*
			No juv Moll	1.3	2.5	96.2	82.1	8.14	.005	*
			Crustaceans	3.5	1.6	94.9	73.1	4.54	.109	NS
			All Invertebrates	1.1					.045	*
			2.0	96.9	79.6	5.78			.008	**
			No juv Poly	3.3	4.6	92.1	88.5	9.57	.008	**
			Mollusks	1.6	3.7	94.7	77.8	6.70	.012	*
			No juv Moll	1.8	5.0	93.2	76.5	9.08	.004	*
			Crustaceans	2.6	8.2	89.2	81.4	16.59	.001	***
			All Invertebrates	2.1	5.6	92.3	77.4	10.05	.003	**

granular	All Polychaetes	3.2	4.4	92.4	71.9	9.12

[1] Conditioned Variation; partialed out of PRC diagaram

[2] Constrained Variantion; includes treatment x time interaction

[3] Unconstrained Variation; due to site effects, replicate effects, and unexplained variation

[4] Significance of axis 1 relative to other axis: *, p > 0.05; **, p > 0.01; ***, p > 0.001

Table A.4. Monte Carlo permutation tests for main treatment effects (IMI) and interaction effects (IMI x time).

Year	Site	Formulation	Group	Terms	F	Pr (>F)	Sig.[1]
2011	BC	liquid	All Polychaetes	IMI	1.81	.037	*
				IMI * Time	1.82	.023	*
			Non juv Polychaetes	IMI	2.16	.024	*
				IMI * Time	1.61	.038	*
			All Mollusks	IMI	2.76	.047	*
				IMI * Time	1.35	.124	NS
			Non juv Mollusks	IMI	3.09	.058	NS
				IMI * Time	0.75	.562	NS
			Crustaceans	IMI	2.05	.016	*
				IMI * Time	1.34	.193	NS
			All Invertebrates	IMI	1.69	.026	*
		granular	All Polychaetes				
			Non juv Polychaetes				
			All Mollusks				
			Non juv Mollusks				
			Crustaceans				
			All Invertebrates				
2011	CR	liquid	All Polychaetes				
			Non juv Polychaetes				
			All Mollusks				
			Non juv Mollusks				
			Crustaceans				
			All Invertebrates				

2012	PX	liquid	All Polychaetes		1.46		IMI * Time .052	NS
					12.13		IMI .030	*
			Non juv Polychaetes	IMI * Time	1.91	0.03	*	
				IMI	15.57	.033	*	
			All Mollusks	IMI * Time	2.02	.033	*	
				IMI	4.33	.030	*	
			Non juv Mollusks	IMI * Time	1.39	.064	NS	
				IMI	5.29	.03	*	
			Crustaceans	IMI * Time	1.23	.217	NS	
				IMI	6.78	.028	*	
			All Invertebrates	IMI * Time	1.87	0.28	*	
					1.84	IMI	9.43	.032
				*	10.43			
				IMI * Time .032			*	
				IMI .031			*	
				IMI * Time	2.41	.031	*	
				IMI	11.34	.027	*	
				IMI * Time	2.08	.027	*	
				IMI	1.92	.030	*	
				IMI * Time	1.20	.371	NS	
				IMI	2.61	.030	*	
				IMI * Time	0.98	.404	NS	
				IMI	32.15	.030	*	
				IMI * Time	2.21	0.30	*	
				IMI	24.53	.033	*	
				IMI * Time	2.07	.033	*	
				IMI	8.07	.001	***	
				IMI * Time	0.09	.313	NS	
				IMI	9.30	.001	***	
				IMI * Time	0.81	.490	NS	
				IMI	3.58	.005	**	
				IMI * Time	0.92	.512	NS	
				IMI	4.88	.005	**	
				IMI * Time	1.13	.296	NS	
					1.20	IMI	7.64	.001
				***	21.42			
				IMI * Time	1.37	.112	NS	
				IMI	6.51	.001	***	
				IMI * Time .120			NS	
		granular	All Polychaetes	IMI .001			***	
				IMI * Time	1.11	.018	*	

Non juv Polychaetes IMI 23.59 .001 ***
IMI * Time 1.10 .022 *

All Mollusks IMI 5.31 .005 **
IMI * Time 1.28 .170 NS

Non juv Mollusks IMI 6.48 .003 **
IMI * Time 1.81 .065 NS
IMI
6.69
.005

Crustaceans IMI 34.56 .001 ***
IMI * Time 2.10 .001 ***
**

All Invertebrates IMI 22.03 .001 ***
IMI * Time 1.58 .001 ***
IMI * Time 0.98
.112
NS

2012 LB liquid All Polychaetes
IMI 6.91 .003 **
IMI * Time 0.98 .115 NS
Non juv Polychaetes
IMI 1.40 .303 NS
All Mollusks
IMI * Time 0.61
.695 NS 5.58 .008 **
Non juv Mollusks
1.21 .024 *
IMI
5.71 .006 **
2.45
Crustaceans
.158 NS 1.21 .019 *
IMI * Time 0.30
5.31 .003 **
All Invertebrates
.827 NS 1.28 .129 NS
IMI
10.61 .002 **
1.53

granular All Polychaetes
0.82 .349 NS
.289 NS
4.27 .017 *
IMI * Time 1.04
Non juv Polychaetes
.224 NS 2.30 .002 **
4.82 .001 ***
All Mollusks
IMI
1.50 .004 ***
3.27
25.76 .001 ***
Non juv Mollusks
.031 *
IMI * Time 1.00
3.36 .001 ***
Crustaceans
.203 NS
22.95 .001 ***
IMI
IMI * Time 2.95 .001 ***
All Invertebrates
19.80 .001 ***
IMI
IMI * Time 2.12 .001 ***

2014 SP liquid All Polychaetes
IMI 22.48 .001 ***
IMI * Time 2.09 .012 *
Non juv Polychaetes
IMI 7.66 .001 ***
IMI * Time 1.37 .116 NS
All Mollusks
IMI 24.51 .001 ***
IMI * Time 1.95 .001 ***
Non juv Mollusks
IMI
IMI * Time IMI
Crustaceans
IMI * Time IMI
IMI * Time IMI
All Invertebrates
IMI * Time IMI
IMI * Time IMI
IMI * Time IMI
IMI * Time

All Years All Sites liquid All Polychaetes IMI 8.78 .014 **
IMI * Time 1.03 .001 ***

Non juv Polychaetes IMI 8.49 .018 *

		IMI * Time	0.86	.263	NS
	Crustaceans	IMI	4.14	.125	NS
		IMI * Time	0.70	.090	NS
	All Invertebrates	IMI	5.73	.061	NS
		IMI * Time	0.76	.006	**
granular	All Polychaetes	IMI	9.07	.010	**
		IMI * Time	0.65	.086	NS
	Non juv Polychaetes	IMI	9.53	.010	**
		IMI * Time	0.64	.093	NS
	All Mollusks	IMI	6.21	.007	**
		IMI * Time	1.20	.055	NS
	Non juv Mollusks	IMI	7.67	.006	**
		IMI * Time	2.10	.011	*
	Crustaceans	IMI	15.54	.002	***
		IMI * Time	2.42	.001	***
	All Invertebrates	IMI	9.70	.003	**
		IMI * Time	1.64	.001	***
		IMI * Time	0.96	.001	***
	All Mollusks	IMI	5.01	.021	*
		IMI * Time	0.78	.241	NS
	Non juv Mollusks	IMI	7.89	.002	**

1 Significance of effect: *, p > 0.05; **, p > 0.01; ***, p > 0.001

Table A.5. Concentrations of imidacloprid (0 ± S.E., N), confidence intervals (C.I.), and ranges among sites of differing formulation during large scale field trials, 2011, 2012, and 2014.

Formulation	Site[1]	Concentration (ppb)	95 % C.I.	Range	Reference
liquid IMI	Bay Center	11 ± 3, 5	4 – 18	4 – 19	Patten 2011
	Cedar River	1250 ± 150, 2	-656 – 3156	1100 – 1400	Patten 2011
	Leadbetter	1500 ± 0, 1			Patten 2011
	Palix	2400 ± 0, 1			Grue and Grassly 2012
	Stony Pt	796 ± 260, 5	75 – 1715	180 – 1600	Booth et al. 2014
	Coast	230 ± 0, 1			Booth et al. 2014
	Nisbett	290 ± 0, 1			Booth et al. 2014
granular IMI	Bay Center	52 ± 9, 5	26 – 78	27 – 82	Patten 2011
	Cedar River	24 ± 8, 2	-72 – 119	16 – 32	Patten 2011
	Leadbetter	73 ± 0, 1			Patten 2011
	Palix	490 ± 0, 1			Grue and Grassly 2012
liquid IMI	All	685 ± 186, 16	288 – 1082	4 – 2400	
granular IMI	All	97 ± 50, 9	-18 – 211	16 – 490	

[1] Two treated sites not sampled for benthic invertebrates: Coast, adjacent to and treated simultaneoulsy with Stony Pt. with less vegetation and more uniform substrate; Nisbett (2014), N. Willapa near Cedar River, silty substrate.

Table A.6. Number of PRCs with a negative[1] , positivie[2], or neutral[3] position of the principal response at the final sample date compared to pre-treatment (PRC end response) for each of 49 PRC analysis with both significant treatment effects and a significant axis 1.

PRC End Response	Year – Study Site – Formulation	No. of PRCs	Taxonomic Assemblage
Negative	2012 – Palix – Liquid	2	Mollusk
			Crustaceans
	All Years, Sites – Liquid	2	Mollusk
			Non-juvenile Mollusk
	2012 – Palix – Granular	1	Non-juvenile Mollusk
	All Years, Sites – Granular	1	Non-juvenile Mollusk
	Total	**6**	
Positive	All Years, Sites – Liquid	2	Polychaetes
			Non-juvenile Polychaetes
	2011 – Bay Center -- Granular	1	Mollusks
	2012 – Leadbetter – Granular	1	Mollusks
	All Years, Sites – Granular	1	Mollusks
	Total	**5**	
Neutral	2011 – Bay Center – Liquid	2	Mollusk
			All Families
	2011 Cedar River – Liquid	4	Polychaetes
			Non-juvenile Polychaetes
			Crustaceans
			All Families
	2012 – Palix – Liquid	4	Polychaetes
			Non-juvenile Polychaetes
			Non-juvenile Mollusks
			All Families
	2012 – Leadbetter – Liquid	3	Polychaetes
			Non-juvenile Polychaetes
			All Families
	2014 – Stony Pt – Liquid	6	Polychaetes
			Non-juvenile Polychaetes
			Mollusks
			Non-juvenile Mollusks
			Crustaceans
			All Families

2011 – Bay Center – Granular	5	Polychaetes
		Non-juvenile Polychaetes
		Non-juvenile Mollusks
		Crustaceans
		All Families
2012 – Palix – Granular	5	Polychaetes
		Non-juvenile Polychaetes
		Mollusks
		Crustaceans
		All Families
2012 – Leadbetter – Granular	5	Polychaetes
		Non-juvenile Polychaetes
		Non-juvenile Mollusks
		Crustaceans
		All Families
All Years, Sites – Granular	4	Polychaetes
		Non-juvenile Polychaetes
		Crustaceans
		All Families
Total	**38**	

[1] Response of the test assemblage relative to the control was lower at the final sample date compared to before.

[2] Response of the test assemblage relative to the control was higher at the final sample date compared to before.

[3] Response of the test assemblage relative to the control assemblage was the same at the final sample date compared to before.

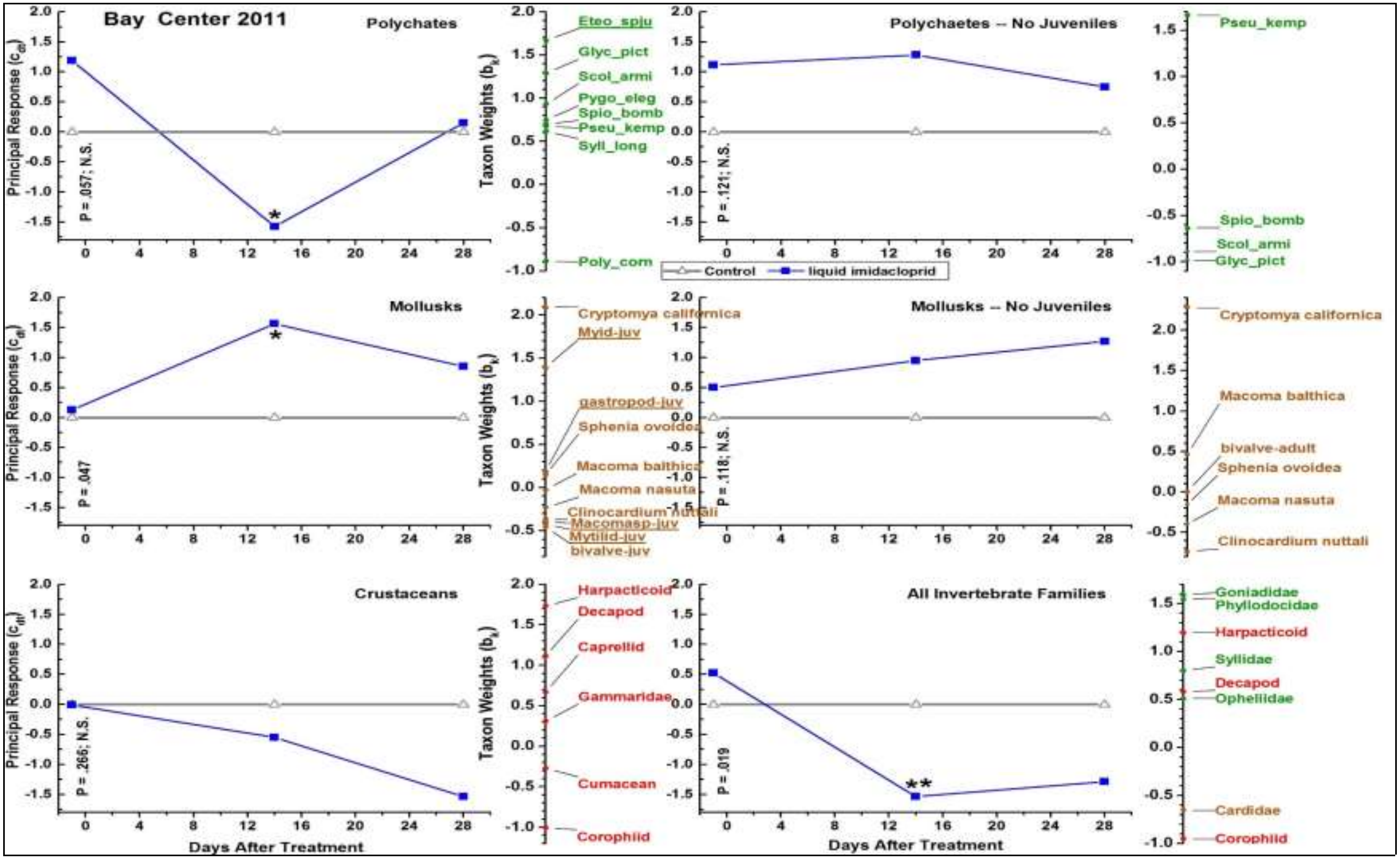

Figure A.5. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Bay Center in 2011. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each

sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

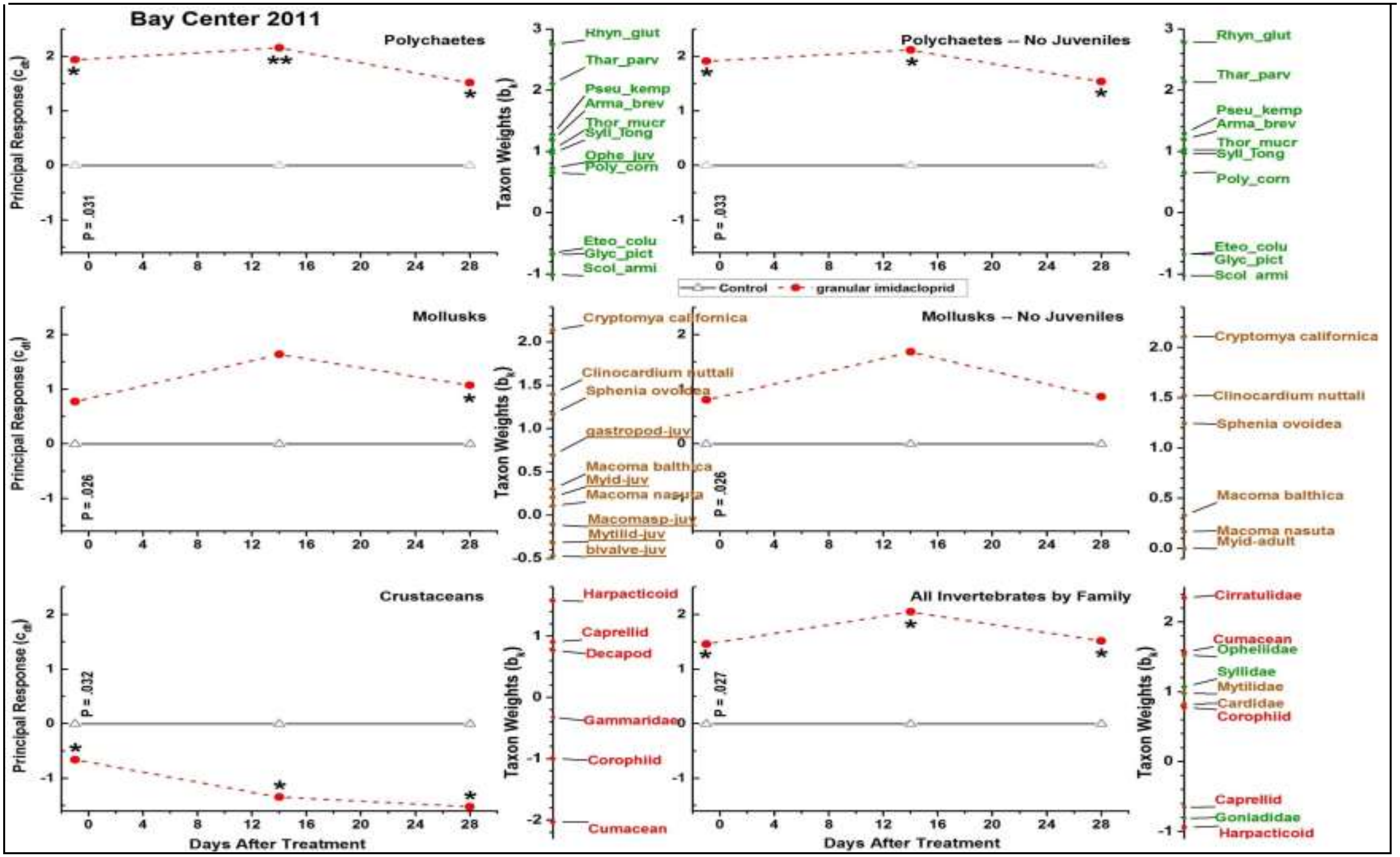

Figure A.6. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at granular imidacloprid and control plots at Bay Center in 2011. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each

sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

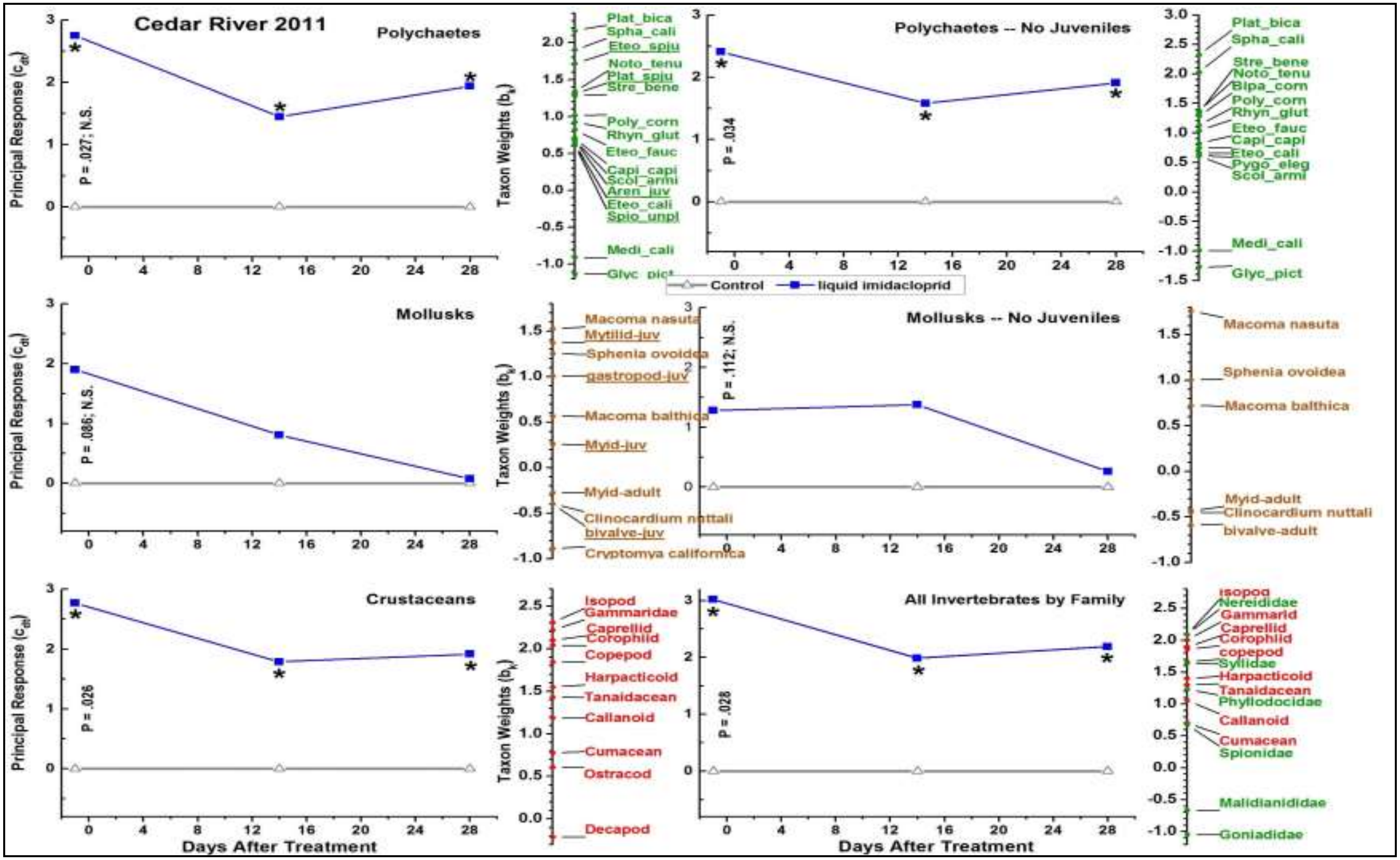

Figure A.7. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Cedar River in 2011. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each

sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

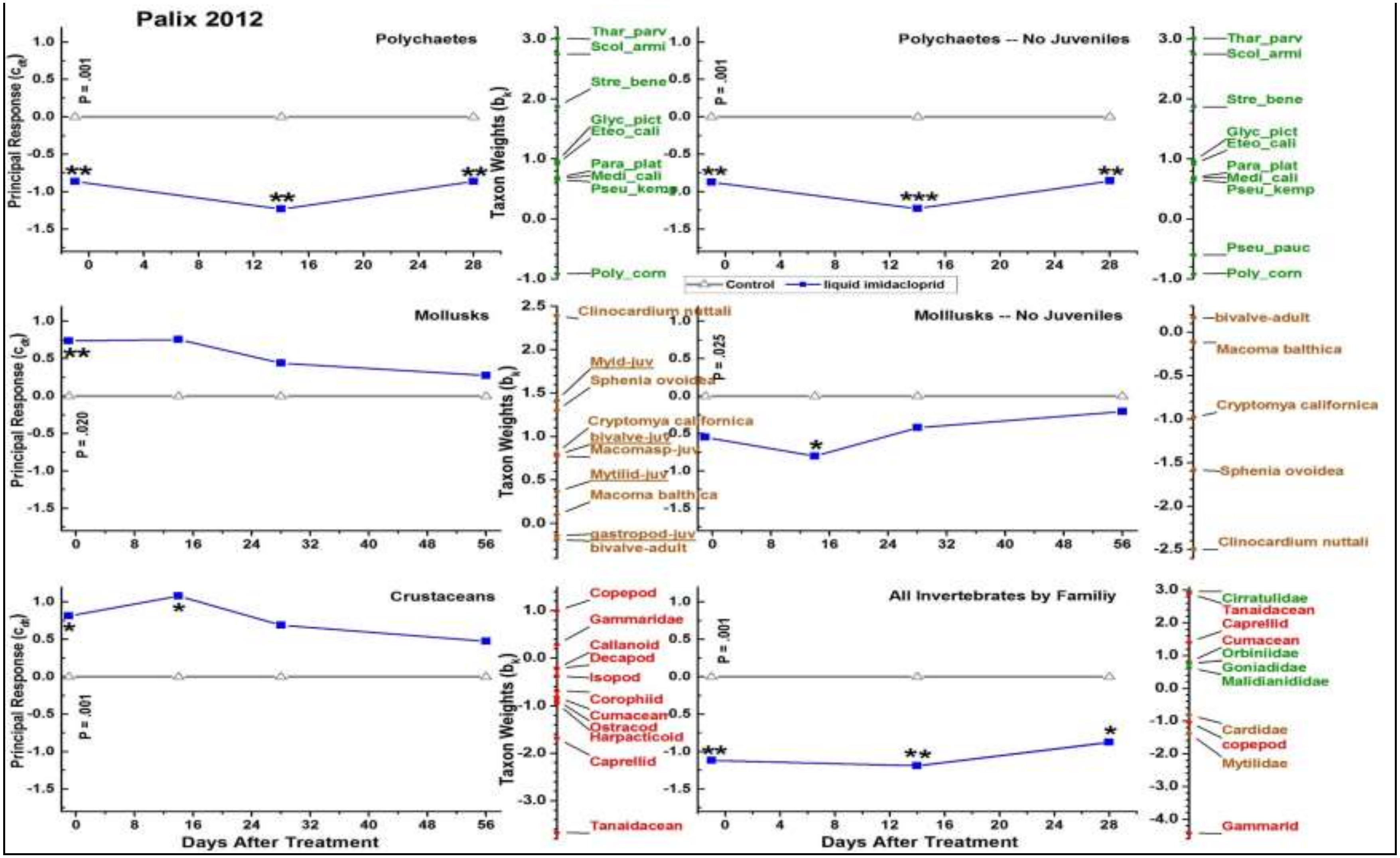

Figure A.8. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Palix in 2012. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

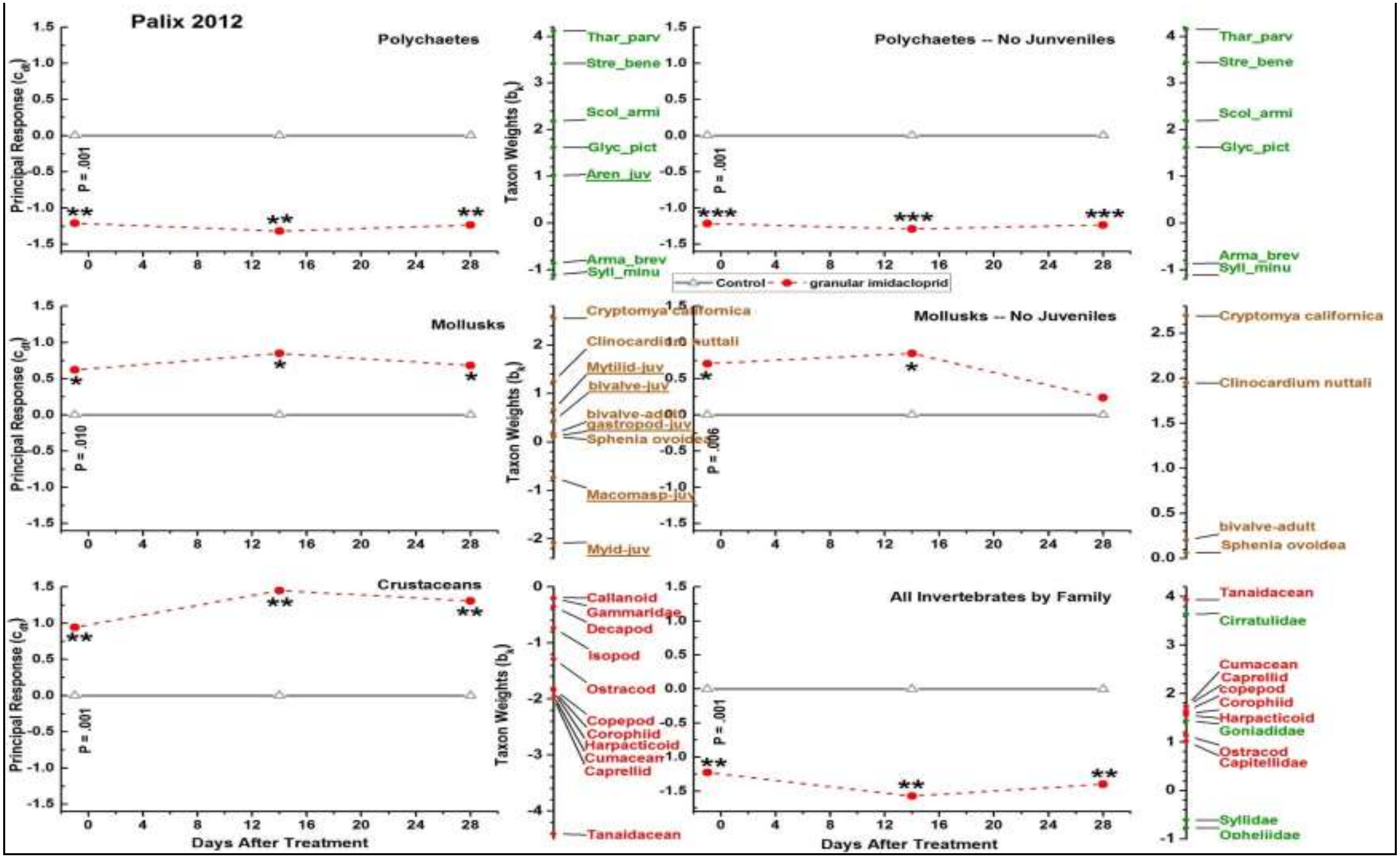

Figure A.9. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at granular imidacloprid and control plots at Palix in 2012. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

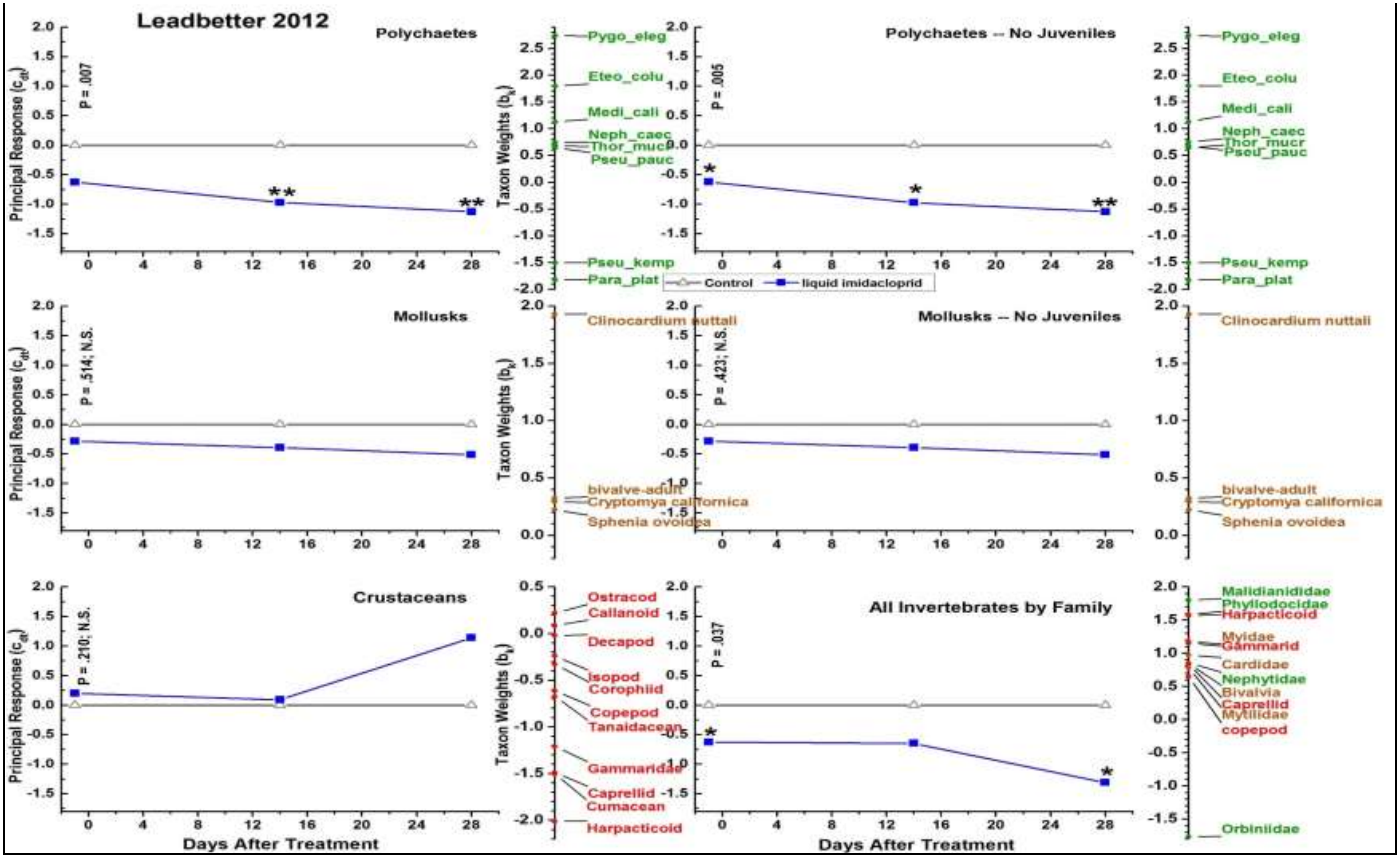

Figure A.10. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Lead Better in 2012. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

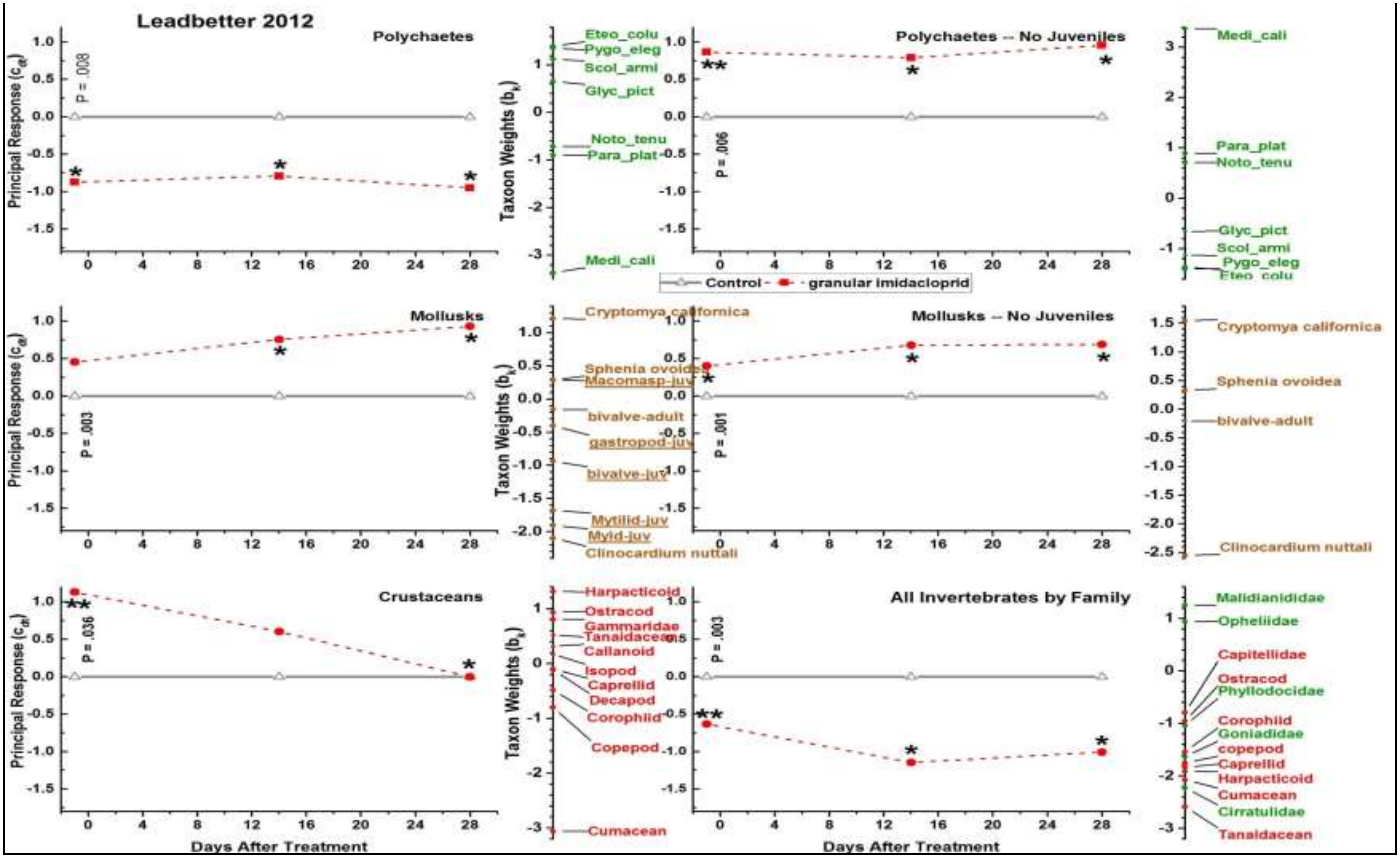

Figure A.11. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at granular imidacloprid and control plots at Leadbetter in 2012. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, p < 0.05; **, p < 0.01; ***, p < 0.001). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

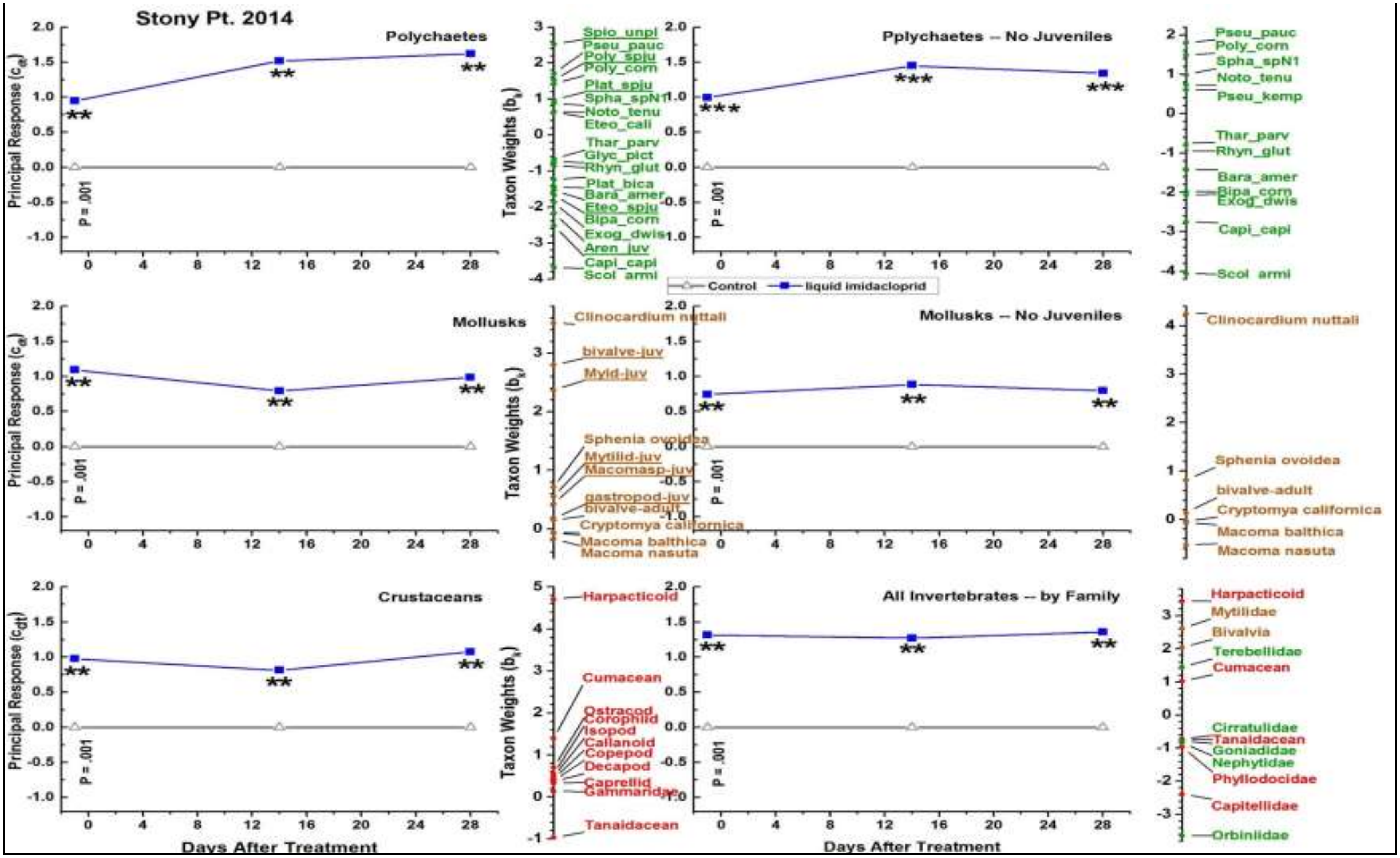

Figure A.12. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Stony Pt in 2014. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

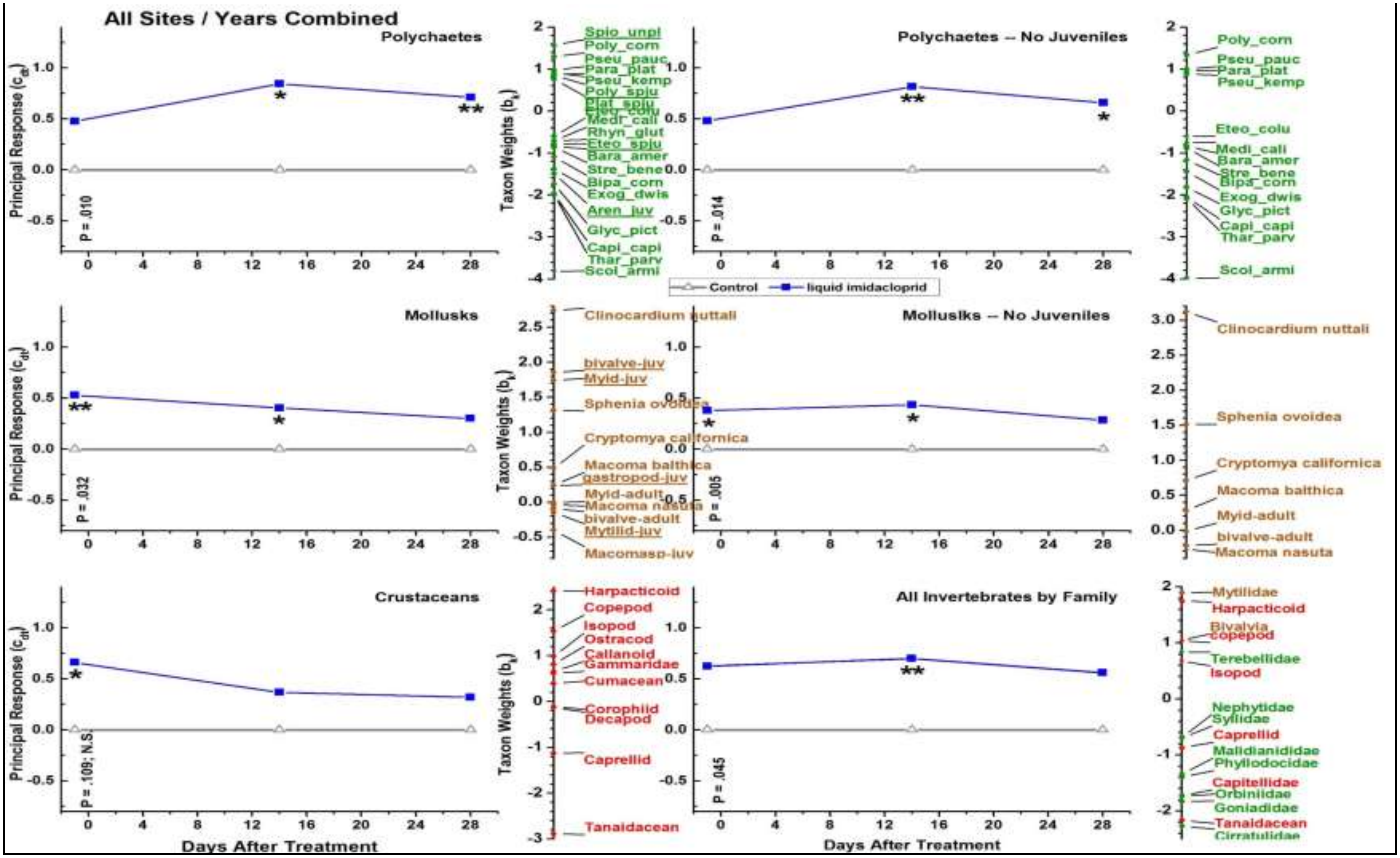

Figure A.13. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots with all sites and years combined. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

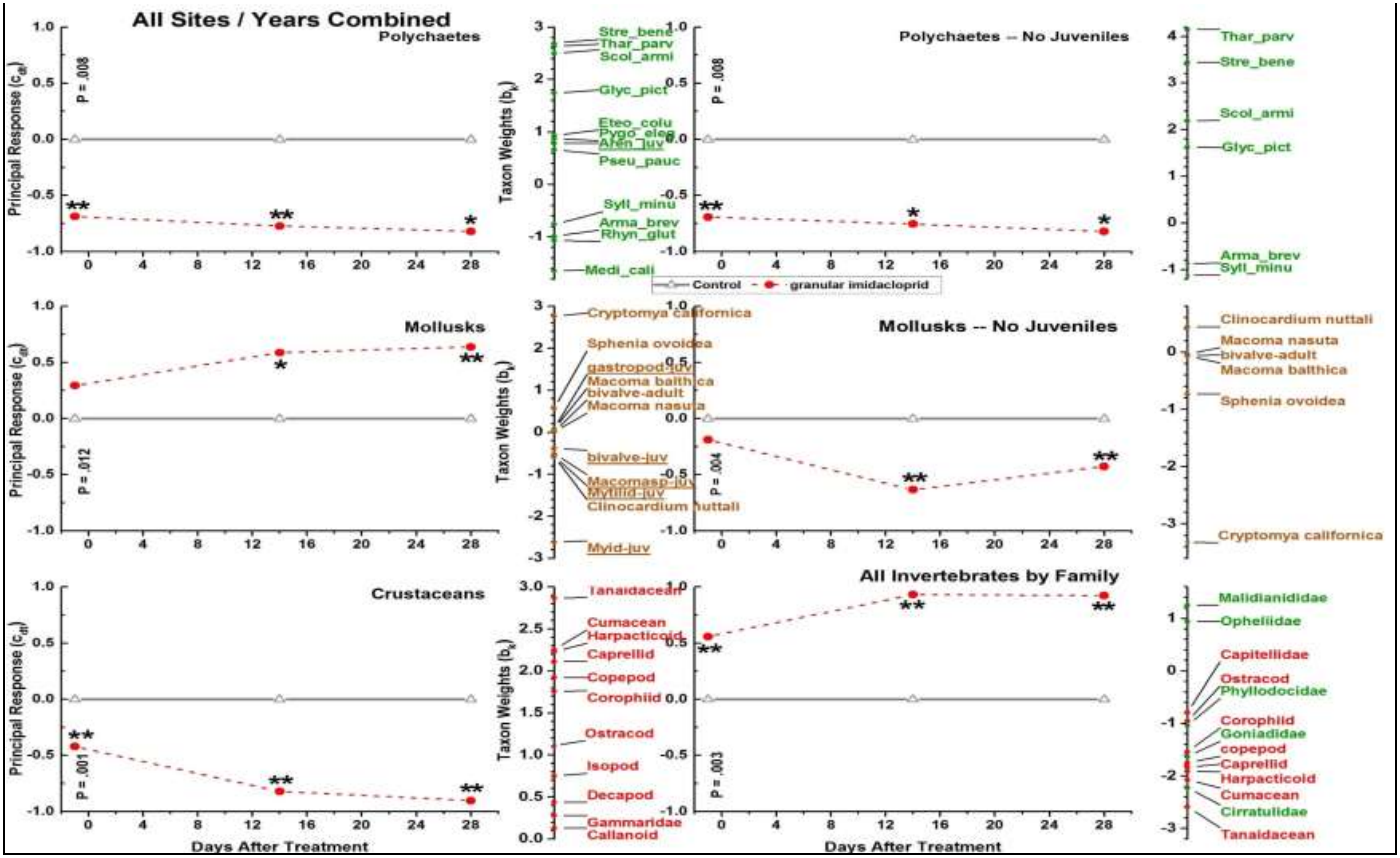

Figure A.14. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at graunular imidacloprid and control plots with all sites and years combined. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A.2 lists polychaete full names and abbreviations.

Acknowledgments

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Commenter: Brian and Marilyn Sheldon - Comment I-239-1

(Email Submission)

Please find attached our comments regarding the Draft SEIS for the use of Imidacloprid on burrowing shrimp in Willapa Bay and Grays Harbor.

We appreciate the opportunity to comment.

November 1, 2017
Derek Rockett
Water Quality Program
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Dear Mr. Rockett,

We appreciate the opportunity to provide comment on the draft Supplemental Environmental Impact Statement (SEIS) for the use of imidacloprid to control burrowing shrimp in Willapa Bay and Grays Harbor. These written comments are in addition to the verbal input we provided on this subject at the October 7, 2017. Having reviewed the SEIS, prior EIS, and many other documents, we find that these documents support the issuance of an NPDES permit to allow the control of burrowing shrimp on shellfish beds in Willapa Bay and Grays Harbor.

Over the past many years, we've been monitoring the impacts of shrimp on our most prime shellfish farm lands. At the end of summer 2017 we had lost a total of 110 acres (30%) of our most productive oyster farm lands, and 103 acres (43%) of our clam farm lands due to shrimp infesting our farmlands. These lands are critical to our ability to operate and meet the needs of the markets we serve. As we've lost this critical habitat, we've been forced to reduce our staffing commensurate with the percentage of our acreage losses. We are seeing not only larger adult shrimp move laterally into our beds, but more alarmingly we are seeing shrimp larva settling out across our beds. These juvenile shrimp take 2 to 3 years to become large enough to do significant damage, and we've seeing them infest our beds annually for the past 3 years. The bed substrate is becoming alarmingly soft across entire sections of our farm, and it's clear that we have a very short time before we will begin losing land at an even faster rate. It's important to note that our beds support a vast amount of other species, and the habitat they depend on is being lost as well.

We believe it's important to note that burrowing shrimp have expanded out of their historic population centers and have caused great damage to many areas of Willapa Bay that once supported a much more diverse and plentiful habitat. Based on available history, it's clear that shrimp have only more recently expanded out of their native areas and destroyed thousands of acres of Willapa habitat. By the time the first export of oysters from Willapa Bay occurred in 1849, some form of cultivation had already been occurring on tidelands in many areas of Willapa. Native oysters were collected and transplanted to grow out or holding areas. An 1894 map produced by the United States Fisheries Department (see attached) shows where natural (native) and cultivated beds were at that time, as well as where introduced oysters were planted. If shrimp had been present, these areas would not have sustained even short-term storage of oysters. In comparing this map to current conditions it's easy to see that shrimp have expanded significantly into areas used for many years to farm oysters. Between 1849 and 1895 (46 years), oysters were gathered from native oyster beds and moved to these storage locations so they would grow larger and also be more accessible for loading onto boats for export. In 1895 legislation was passed with the goal of fostering shellfish farming where interested parties could apply to purchase marine lands they believed would sustain shellfish beds. These lands had become known over the many years prior to the passage of said legislation as areas that could be depended on to hold oyster crops. From 1895 until approximately 1935 interested parties could apply to purchase these tidelands from the State. If these lands had not been successfully able to sustain oyster crops for any reason, including shrimp infestation, then they would not have been purchased. Because they had been using these lands for 86 years at that point in time, it was well understood where stable lands were that could be depended on to produce an oyster crop. It was not until approximately 1947 when shellfish farmers began to notice their crops were disappearing. Prior to that, these lands had been under cultivation for almost 100 years with no history of shrimp infestation causing crop loss. This overview of shrimp population expansion is important to understand because while these shrimp are a native species, something has occurred to allow them to expand vastly out of their historic population areas. The SEIS should acknowledge this expansion history. Like many agricultural pests that are also native species, these shrimp species have also expanded out of their natural habitat areas and are acting to destroy long existing historic shellfish farm lands. Like any farming sector, no matter if its marine or terrestrial, shellfish farmers must have pest management tools to control pests no matter if they are native or invasive pests.

The question of why shrimp have expanded their habitat range is touched on in the SEIS. Unfortunately, the reasoning provided is not aligned in any way with history or the real-world facts. There are inferences that native oyster harvesting, shellfish grower actions, etc. have somehow contributed to the imbalance of shrimp in Willapa Bay and Grays Harbor. I have been involved in shellfish farming for the better part of my life (over 50 years), and these claims are frankly nonsense and without merit. While there are multiple hypothesis about why shrimp have acted to expand their habitat, one seems more likely to be a basic cause. In its natural state the Columbia River plume would seasonally fill the Willapa and Grays Harbor with fresh water thereby lowering the salinity in the bay to levels that acted to naturally control new juvenile shrimp recruits. These recruits flush into the estuary and settle out into the upper sediments of the tidelands. When salinity levels would reduce due to the annual freshets, juvenile shrimp would be naturally controlled. With the heavy damming of the river, these freshets have been about eliminated. While there are other natural contributors to controlling shrimp populations, it seems likely that the general salinity reduction that occurred all over the bay had the largest impact in regard to naturally controlling shrimp. We appreciate that the SEIS touched on reasons why shrimp populations have expanded in Willapa Bay, but the reasons listed are so unlikely that they are never referenced in any of the many groups we have worked with on this matter. In fact, we have never heard anyone mention most of the causes noted in the SEIS. If the SEIS is going to include reference to possible causes of the imbalance in shrimp populations, it should include only those that have a realistic possibility to affect shrimp population dynamics. The one thing we believe all will agree on is that whatever has caused this problem, it's based on human interference in the system of one form or another.

We request that the SEIS add additional information in regard to the negative consequences of the no action alternative #1. The amount of information on the negative impacts shrimp infestation have on native Eel grass, crabs, fish, diatom production, shellfish beds, etc. is well documented, and yet we see almost no mention of these negative impacts that will result if the no action alternative is selected. This is a disservice to the reader of the SEIS as it implies that the impact of no action is neutral. The SEIS must include a balanced review of these impacts.

We are concerned that the discussion around the impacts to crab leaves the reader to believe that there is an overall negative impact to crab populations. This is in direct conflict with what actual field research has demonstrated, with historic crab harvest information, and with a vast amount of institutional knowledge. The fact is that by protecting shellfish beds crabs are provided a refuge where they can live and grow into adulthood. On the other hand, if shrimp infest an area, the habitat for crab, Eel grass, etc. is essentially eliminated. The species density and abundance plummets as shrimp infest. This fact needs to be clarified in the SEIS so the reader has a clearer understanding of the actual impact and can appreciate that controlling shrimp is a benefit to many other species, including commercial species such as Dungeness crab.

In regard to mechanical control, over the past 20 years we have tried many mechanical methods to control burrowing shrimp. While we will continue to participate in an Integrated Pest Management (IPM) program, at this time we have not found any mechanical methods that provide an adequate level of control. Our findings are that even if a method disturbs the shrimp, they simply return to the bed and burrow into the sediments.

There is an inference in the SEIS that off bottom culture methods can be implemented to try to "farm around" shrimp infestations. We've met with many growers who have and are trying to develop alternative culture methods that allow shrimp infested areas to be farmed, and to date not one farm has said that off bottom techniques can be used as a solution. In fact, almost all successful off bottom projects have been treated for shrimp in order to be sustainable. At the current time we are seeing most if not all of these off-bottom projects being heavily damaged by shrimp infestations. While there are experimental trials looking at new methods as part of our IPM program, at this time there simply is no off bottom or any other culture methods that can be sustained without effective shrimp population management.

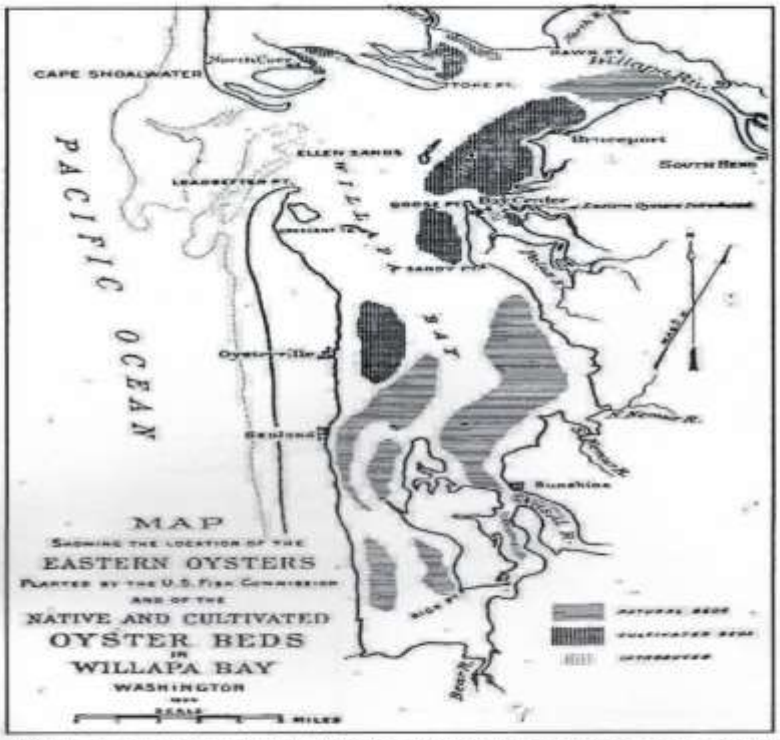
Another point of confusion contained in the SEIS is in regard to why off bottom culture techniques have been developed. There are two long-term primary reasons for implementing off bottom culture techniques. The first is to utilize ground that is considered marginal as far as growing conditions so that a suitable oyster for a particular market can be produced. Another reason to implement off bottom culture is to allow ground that may have high currents or expose to sever weather to hold an oyster crop. Bottom culture for this type ground isn't possible because high currents of weather exposure make the risk of losing the crop too high. It's important to clarify that off bottom culture methods were not developed to try to farm around shrimp infestations, and at this time all off bottom techniques require shrimp control to be sustained. Of course, where shrimp don't naturally occur there may be opportunity to farm off bottom.

Again, we appreciate the opportunity to provide comments on this critical pest management issue. Our farm is being heavily impacted by these invading shrimp, and after 4 generations of farming we face the real possibility of losing our farm if we cannot get an effective management tool in place. For over 60 years shellfish growers have been working on IPM tools to address this and other pest issues, and this process will continue. I am aware of the controversy around using pesticides in general, but we must allow the science to prevail. In this case, the science clearly tells us that controlling burrowing shrimp is not only a benefit in regard to protecting our farm lands, but to the general health of the estuary.

Sincerely,

Brian & Marilyn Sheldon

1894 U.S. Fish Commission map of Willapa Bay (Pacific County Historical Museum)



1894 U. S. Fish Commission map of Willapa Bay. The natural native oyster beds at the south end of the bay (first by informal agreement, then by law), were set aside as reserves to help restock the cultivated beds. (PCHS image.)

Commenter: Vicki Wilson - Comment O-22-1

(Email Submission)

Please see attached comments on the Draft SEIS for Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor.

Farmed Geoduck Clams
ARCADIA POINT SEAFOOD
On Totten Inlet, Puget Sound, Washington

October 31, 2017

Email: burrowingshrimp@ecy.wa.gov
Derek Rockett, Water Quality Program
Washington State Department of Ecology
Southwest Regional Office
PO Box 47775
Olympia, WA 98504

Re: Draft SEIS for Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor

Thank you for this opportunity to provide comments on the draft SEIS. Our family operates a small shellfish company in South Puget Sound. Although burrowing shrimp are not as large a problem on our farms as they are in the Willapa Bay and Grays Harbor areas, we have seen first hand the negative impacts they can have on the ecology and productivity of tidelands.

We recognize that Ecology is in the pre-decisional phase of the process and the current focus is on the draft SEIS. However, before turning to the SEIS we want to make it clear that we support issuance of this NPDES permit as soon as is reasonable, with of course appropriate conditions and monitoring requirements that are (1) operationally realistic, (2) aligned with best available science/information, and (3) allow for adaptive management as experience dictates.

Although we do not have the qualifications to provide a useful critique of the draft SEIS, we have some general observations to share. We base these comments on our understanding that the applicants favor the option of reduced acreage (500 acres per year) with ground-based application, as part of an Integrated Pest Management program.

1. In 2015, Ecology issued a permit for use of Imidacloprid on 2,000 acres using helicopter aerial spraying. Ecology included conditions and monitoring requirements that it believed were sufficient to mitigate any potential significant unavoidable adverse impacts and thus meet clean water requirements. There was nothing in the updated SEIS research and literature reviews to indicate that the same could not be true for the current "reduced acreage-ground based application" option. Similar to 2015, we believe appropriate conditions, monitoring requirements, and experiential-based adaptive management can address any new findings/concerns.

2. It was interesting to note how often the SEIS analysis indicated no significant unavoidable adverse impacts, and in the few instances (e.g., sediments and animals) where potential impacts existed, they were localized and short-term with fairly rapid recovery. Thus, supporting our comments in point 1.

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3. Public concerns about impacts to pollinators and crab are worth noting. Honey bees, generally considered the most important pollinator, as well as other pollinators such as wasps, flies, butterflies and even hummingbirds rarely frequent marine tidelands. With the elimination of helicopter spraying, any perceived impacts on pollinators due to wind-drift are virtually non-existent. Regarding impacts to juvenile and planktonic forms of Dungeness crab, the Coalition of Coastal Fisheries, which includes several WA crab fisher organizations, has written in support of permit issuance—it is hard to believe it would do so if the crabbers felt this permit threatened their resource. From personal communication, it is our understanding that the magnitude of any impact to the crab population is small given the abundance levels at the life stages discussed in the SEIS (especially when compared to impact on adult crab of habitat lost due to shrimp).

4. One of the areas of uncertainty mentioned was not enough scientific information and field studies in marine environments. We agree there are unanswered questions and believe that this smaller-acreage proposal offers an ideal opportunity for empirical research and observation to help answer these questions and to do so on a small, but still commercially viable, level.

5. Although burrowing shrimp are native and serve a role in the ecosystem, there is truth to the saying of "too much of a good thing". Their overabundance is negatively affecting the estuary as whole, turning bio-diverse tidelands into vast quicksand deserts. Some may see only the "self-serving" aspect of commercial growers wanting to save their once productive beds, we choose to see an opportunity to use commercial growers (at their expense) to help protect the estuary. Small investments can have large returns. For example, it is possible to protect 100 acres of habitat from adult shrimp in-migration by treating only the outside perimeter, say 5-10 acres, of the area.

The growers of Willapa Bay and Grays Harbor have worked tirelessly to have an effective Integrated Pest Management program that balances environmental, economic, and cultural goals. There is every reason to believe this same dedication will continue in the future under a permit for burrowing shrimp control using Imidacloprid.

Sincerely,

Vicki Wilson

Vicki and Steve Wilson

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Commenter: Mary McAleer - Comment O-18-1

(Email Submission)

Attached please find Association of Washington Business's comment on the imidacloprid NPDES permit DSEIS.

Please don't hesitate to contact me with any questions.

November 1, 2017

Derek Rockett
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Re: Draft Supplemental Environmental Impact Statement: Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

Dear Mr. Rockett,

Thank you for considering the Association of Washington Business's (AWB) comments on the Draft Supplemental Environmental Impact Statement for the Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor. AWB is Washington's oldest and largest statewide business association, and includes nearly 7,000 members representing 700,000 employees. AWB serves as both the state's chamber of commerce and the manufacturing and technology association.

AWB has been a proponent of the use of imidacloprid for control of *Neotrypaea californiensis* and *Upogebia pugettensis* since the proposal's inception. AWB members appreciate the opportunity to again support the Department of Ecology's permitting of this critical tool to protect the state's vital shellfish industry. The permitted use of imidacloprid is an essential tool both for Washington state's economic and ecological health.

Ecological Factors

Washington State Department of Ecology's approval of Alternative 4 use of imidacloprid will provide multiple environmental and economic benefits by preserving the aquaculture industry. In chapter three of the April 2015 Final Environmental Impact Statement for imidacloprid use, Ecology lists ecosystem services provided by oyster beds including "water filtration, resulting in decreased suspended solids, turbidity, and increased denitrification; habitat for epibenthic invertebrates such as crabs; carbon sequestration; and stabilization of adjacent habitats" (Rockett, Grabowski and Peterson, 2007). Washington state's oyster population should be carefully preserved in Grays Harbor and

Willapa Bay. Oysters and clams as foundation species ameliorate conditions for other organisms important to estuarine trophic preservation including zooplankton, and boost marine biodiversity by providing clean habitat to other environmental stewards such as algae and barnacles.

Alternative 4's permit conditions and associated mitigation measures would be protective of Washington state surface water quality standards—some of the most stringent in the nation— and of ESA-listed salmonids and green sturgeon.

The DSEIS is complete with several field trials not modeling, but demonstrating the proposed imidacloprid NPDES permit's protection of ecological features in Grays Harbor and Willapa Bay. Imidacloprid has routinely and thoroughly been tested as a safe choice for restricting burrowing ghost shrimp populations. It boasts an impressive safety profile including a 5000 mg/kg bodyweight dermal LD50, a hydrolysis/photolysis half-life of mere hours, and few hazardous decomposition products (Guadalupe et. al. 2004, Ramirez et. al. 2004, Makhteshim Agan MSDS). Most importantly, the NPDES permit and its adaptive management options were the only choice considered with species-specific efficacy toward controlling burrowing shrimp at manageable populations of less than ten burrows per square meter.

Economic Factors

Of all global estuarine habitats, 85% of oyster reef habitat has been lost globally over the past 130 years (Lotze et al. 2006, Beck et al. 2011). Meanwhile, Grays Harbor and Pacific Counties struggle to compete with other economic regions of Washington state with the second- and thirdhighest unemployment percentages statewide. Supplying 25% of the nation's oyster market, the area's family-wage jobs—and the infrastructure, services and economic activity they support—are well-documented in the DSEIS. In the 2013 Northern Economics assessment, aquaculture promoted an impressive $1.82 economic multiplier effect for every dollar spent by oyster growers, and generated nearly 3,000 jobs. The replacement cost analysis demonstrates that shellfish aquaculture can provide up to $884,400 in ecosystem benefits in Oakland Bay which would otherwise be afforded by taxpayers or foregone altogether. At a time when Washington state is feeling more diaspora between the living and working conditions of rural versus urban areas, rural natural resource development sectors—some of the only

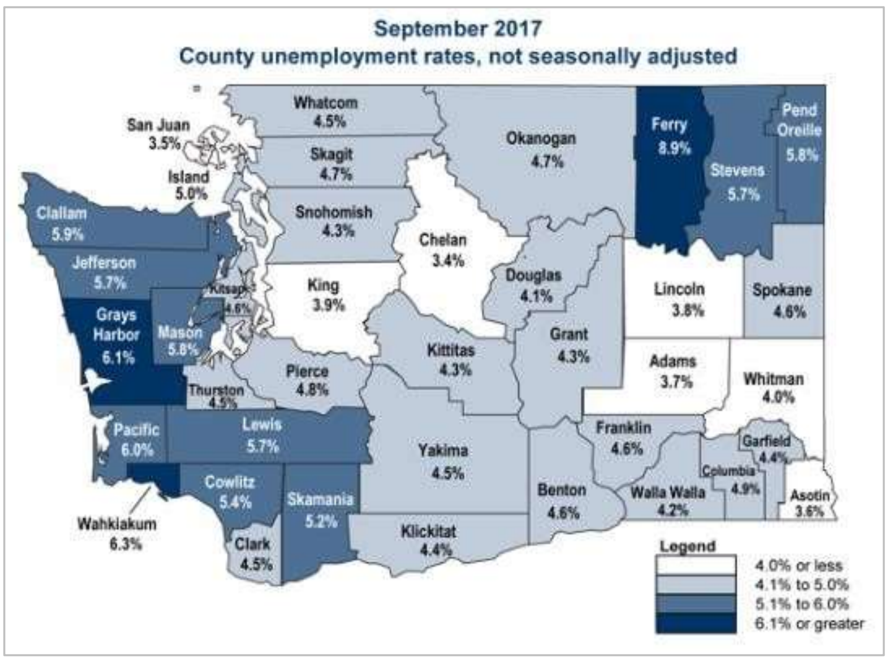

Figure 1: Grays Harbor County and Pacific County suffer some of Washington state's highest unemployment figures. Source: Washington Employment Security Dept.

propagators of original wealth in the private sector— should be protected. In the last decade, the majority of jobs lost nationally and in Washington state where in rural natural resource extraction (Economic and Revenue Forecast Council 2017). Those remaining employment opportunities are defended by opportunities like an imidacloprid NPDES permit for shellfish growers.

Thank you for considering AWB's comments on the Draft SEIS for the use of imidacloprid to control burrowing shrimp in Grays Harbor and Willapa Bay. We encourage the Ecology Water Quality Program to continue its support of oyster and clam growers, harvesters and communities in Grays Harbor and Willapa Bay by following the findings of the Draft SEIS and issuing a Draft NPDES Permit. We look forward to future dialogue and remain committed to preserving Washington state's vital aquaculture industry.

Sincerely,

Gary Chandler

Vice President, Government Affairs
Association of Washington Business

Commenter: Trina Bayard - Comment O-7-1

Please see attached file for Audubon WA comments

Audubon WASHINGTON

November 1, 2017

Washington State Department of Ecology

Water Quality Program
ATTN: Derek Rockett
derek.rockett@ecy.wa.go
v

Southwest Regional Office

PO Box 47775

Olympia, WA 98504

RE: Draft Supplemental Environmental Impact Statement – Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

Dear Mr. Rockett,

This letter concerns the draft *Supplemental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington* (SEIS)[1] and associated *Final Environmental Impact Statement Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington* (FEIS; Washington State
Department of Ecology; April 9, 2015).[2] These materials are associated with the application by the Willapa-

Grays Harbor Oyster Growers Association (WGHOGA) to the Washington State Department of Ecology (Ecology) for a permit under the National Pollutant Discharge Eliminations System (NPDES) for Willapa Bay and Grays Harbor, and Sediment Impact Zone (SIZ) authorizations for Willapa Bay and Grays Harbor. The applicants are requesting authorization to use the neonicotinoid pesticide imidacloprid to treat up to 500 acres annually of commercial shellfish beds: 485 acres in Willapa Bay and 15 acres in Grays Harbor to control native burrowing shrimp (ghost shrimp, *Neotrypaea californiensis* and mud shrimp, *Upogebia pugettensis*).

Audubon Washington is an organization dedicated to the protection of birds and their habitats. We have 25 active chapters here in Washington, representing over 34,000 members. We also have three science and nature centers located in Seattle, Sequim and Tacoma that serve over 35,000 people each year.

Audubon appreciates the long-time presence of the oyster industry in Southwest Washington, its role in providing jobs and revenue to the region, and the industry's production of seafood and contributions to environmental quality. We recognize the challenges that burrowing shrimp pose to the industry in Southwest Washington, and in particular to the family farms of Pacific and Grays Harbor counties. Considerable investment has occurred by growers large and small to limit these native shrimp whose natural burrowing behavior results in siltation and sediment changes that are harmful to oyster production.

Audubon has worked to understand the impacts of chemical pesticide use and the ecological role of burrowing shrimp in coastal estuaries since 2014. We have significant concerns about the use of chemicals to control burrowing shrimp in and around oyster operations, especially in the absence of a greater understanding of the conditions and factors that influence burrowing shrimp distribution and populations. **Audubon especially has strong reservations about this specific pesticide, imidacloprid, which is demonstrably harmful to aquatic invertebrates as well as to birds. As such, WE SUPPORT ADOPTION OF ALTERNATIVE 1, THE NO ACTION ALTERNATIVE.**

Recognizing that the applicants are faced with reduced oyster production while alternative approaches are explored, Audubon encourages consideration of a three-year permit constituting a phase-out period, after which further imidacloprid use will not be considered. As presented here, however, Audubon can only support the "no action" alternative. If a phase-out permitting pathway is possible, it would be critically important to immediately convene and implement a parallel process to bring scientific and technical expertise to the task of transitioning growers to culture methods that can withstand cyclic ghost shrimp population changes and to develop a research program to address key information gaps pertaining to ecosystem-based management in Willapa Bay and Grays Harbor.

Audubon's priorities are to encourage lasting solutions that will help the industry end its long-standing reliance on pesticides and create conditions amenable to ecologically sustainable and economically rewarding shellfish aquaculture. Audubon looks to the considerable scientific, technological and natural resource management expertise in the Pacific Northwest to invest in assessing, understanding and fairly resolving the complex set of issues facing Willapa Bay and Grays Harbor shellfish growers and other coastal stakeholders. We are actively working to secure financial and technical resources to help understand the root causes of ghost shrimp proliferation in shellfish beds and shed light on the ecological role of burrowing shrimp in coastal estuaries. We are eager to work together with shellfish growers and other coastal stakeholders who share an interest in healthy coastal estuaries.

In the sections below we highlight our primary areas of concern regarding the proposed use of pesticides in Willapa Bay and Grays Harbor, including:

- The lack of ecosystem perspective in addressing the role of burrowing shrimp in coastal estuary systems and appropriateness of a long-term chemical control program in the intertidal environment;
- insufficient evaluation of exposure pathways, both on and off-plot, to birds and other non-target species and direct and indirect effects associated with pesticide exposure and foraging habitat degradation;
- the need for a greater level of scientific rigor in field studies associated with burrowing shrimp management and control in Willapa Bay and Grays Harbor.

1.0 Ecosystem considerations

Citing MacGinitie (1934), Horning et al. (1989) note that the ghost shrimp "is one of the most abundant residents of marine sloughs or bay mudflats on the west coast of North America," and go on to conclude that "the ghost and blue mud shrimp appear to be integral part of the nearshore environments."[3] They are commonly found in intertidal areas from southeastern Alaska to Baja Mexico, and are known to occur at high densities in estuaries from Northern California to British Columbia, Canada.[4]

Burrowing shrimp have been described as ecosystem engineers because of how their burrowing activity affects nutrient and carbon fluxes and alters benthic communities. Numerous peer reviewed studies suggest that permeable sediments, such as those formed by inhabitation by ghost shrimp, enhance removal of nitrogenous nutrients and reduce coastal turbidity, thereby improving overall water quality and reestablish healthier intertidal benthic environments.[5,6,7] Burrowing shrimp also exert considerable influence on intertidal food webs; an unpublished estimate of *Neotrypaea* (ghost) shrimp biomass in Willapa Bay in 2006 was close to 20,000 tons (B. Dumbauld, unpublished data). Accordingly, mud and ghost shrimp may represent the largest single contributor to estuary secondary production (i.e., food for consumer organisms) in west coast estuaries.

Ghost shrimp are prey for large-bodied shorebirds like long-billed curlews and marbled godwits, and red knots may forage in association with shrimp burrows (See Appendix A). Burrowing shrimp are also prey for other species in the marine and estuarine ecosystem, particularly fish. ESA-listed green sturgeon, salmonids, Pacific staghorn sculpin, Dungeness crabs, sea-run cutthroat trout, and leopard sharks are all known to prey on them.[3] A recent study of green sturgeon foraging dynamics in Willapa Bay found that feeding pit density was strongly associated with high densities of ghost shrimp, an important prey item for sturgeon during the summer months.[8] Finally, recreational fishermen use burrowing shrimp as bait and in Washington, Oregon and California they sometimes are harvested commercially for this purpose.

Existing evidence suggests that cyclic changes in shrimp densities over time are to be expected. The SEIS (231) states that ghost shrimp recruitment spiked during 2010-2016, following a time of very low recruitment from the mid-1990's to the early 2000's. Unpublished data from Willapa Bay and Yaquina Bay, OR indicate that large fluctuations in ghost and mud shrimp density and recruitment have occurred since the late 1980's when data collection began (B. Dumbauld, unpublished data). Large fluctuations in density and recruitment are also corroborated by earlier accounts of dramatic changes in shrimp densities.[9] Today, mud shrimp are purportedly close to extirpation in Washington and California due to an introduced parasitic isopod that limits reproduction.

The recent uptick in ghost shrimp recruitment and the concurrent decline of mud shrimp have largely been considered through the lens of shellfish aquaculture. There is a pressing need to advance an objective, ecosystem-based evaluation of ghost and mud shrimp population dynamics in relation to both coastal ocean conditions and conditions within Willapa Bay and Grays Harbor. Although significant resources have been expended exploring control methods for burrowing shrimp, much less research and management attention has been given to investigating the role of burrowing shrimp in healthy functioning coastal estuaries. Because of this narrow focus, coastal stakeholders lack the information that would allow them to assess the ghost shrimp/aquaculture conflict from a broader perspective. For example:

- What are the root causes of the apparent burrowing shrimp irruption in Willapa Bay and Grays Harbor? When viewed in the context of past population fluctuations in these estuaries, is there evidence that current densities or spatial extent of occurrence are unusually high?
- Are the current densities of ghost shrimp populations in Willapa Bay and Grays Harbor anomalous compared to other west coast estuaries?
- How does avian and fish use of the estuary differ among shellfish beds, shrimp beds, and other habitat areas? What are the population-level consequences of a decades-long burrowing shrimp control program in Willapa Bay for ESA-listed species like green sturgeon?
- Do ghost shrimp reach high densities in certain sediment types in ways that are predicable? Are there possible alternative culture techniques that could be pursued in these areas during times of high recruitment?
- What are the factors associated with native mud shrimp persistence in remaining population strongholds in Oregon?

2.0 Imidacloprid exposure pathways and potential non-target impacts

In Audubon Washington's December 8, 2014 comments on the draft EIS on Control of Burrowing Shrimp using imidacloprid, we raised a number of general concerns about the potential effects of imidacloprid use on non-target organisms, Grays Harbor and Willapa Bay ecosystems, and about uncertainties surrounding the persistence of imidacloprid in the estuarine environment. In subsequent communications with the Department we have provided specific references and recommendations regarding these concerns, some of which we are pleased to see have been incorporated into the SEIS. Some of these concerns and recommendations are still relevant, however, and are included below.

According to the product label for the granular form of imidacloprid (0.5G), the product "is highly toxic to aquatic invertebrates" Label instructions for use in and around water read as follows: "Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark.

Do not contaminate water when disposing of equipment wash." The Environmental Protection Agency (EPA) made a notable exception to these guidelines when it granted permission to Washington state shellfish growers to use imidacloprid in intertidal mudflats. In addition, the EPA failed to fulfill their responsibility under the Endangered Species Act, which requires consultation with the US Fish and Wildlife Service regarding potential listed species impacts.

Given the EPA's failure to consider potential listed species impacts in granting this unique exception, and with few peer-reviewed studies in the marine environment to draw from, we urge Ecology to note the toxicity of imidacloprid acknowledged in its labeling and adopt a precautionary approach in assessing and managing the use of imidacloprid in Willapa Bay and Grays Harbor. This approach is described here in a 1998 consensus statement:

> …when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.[10]

The four main tenets of this precautionary approach are: 1) take preventive action in the face of uncertainty; 2) shift the burden of proof to the proponents of an activity; 3) explore a wide range of alternatives to possibly harmful actions; and 4) increase public participation in decision making.

2.1 *Persistence of imidacloprid in surface water*. The SEIS (citing CSI 2013) states that laboratory studies of the half-life of imidacloprid at a pH range of 5 – 7 can be greater than one year, while the half-life of imidacloprid at pH 9 is approximately one year (3-11). These studies likely underestimate the half-life of imidacloprid in natural aquatic systems. Main et al. (2014) documented high concentrations of neonicotinoids, including imidacloprid, in wetlands one year after treatment.[11] These wetlands were slightly alkaline, with a pH range (~8.0) similar to that of sea water. Also, contrary to the assumption of rapid photolysis, neonicotinoid concentrations in aquatic systems were not higher in wetlands with surficial plant cover or greater depth, both of which should reduce photolysis relative to shallow, clear wetlands.[12] Though rapid photolysis of imidacloprid occurs in ideal laboratory conditions, in natural environments, such as Willapa Bay and Grays Harbor, such factors as turbidity and low temperatures can lead to prolonged persistence, with measurable and ecotoxicologically relevant concentrations up to a year posttreatment.[13,14,15] Given the low temperatures, turbidity, and depth of the water, as well as frequent cloud cover in the Willapa Bay and Grays Harbor coastal environment, imidacloprid and its degradation products are likely to persist for up to a year and possibility longer in surface waters.

It is possible that imidacloprid and its degradation products are widely dispersed within Willapa Bay and adjacent coastal waters. This raises the possibility that impacts may occur over a much larger area than the site of application and in ecosystem types that differ from shallow, intertidal oyster beds, none of which are addressed in the SEIS. Potential on-plot impacts to surface waters are discounted because of the expectation that the pesticide would be diluted by incoming tides. However, the cumulative effects of repeated applications to Willapa Bay and the accumulation of imidacloprid in sediments and surface water must be evaluated. Additionally, the potential for dispersion over broad coastal areas increases the possible transport pathways by which imidacloprid and its degradation products could be transported to land ecosystems (and land-based pollinators).

2.2 *Imidacloprid solubility and distribution in sediments*. The SEIS provides reference to field and laboratory studies that indicate that imidacloprid persists longer in sediments that have high levels of organic carbon.[16] Long-term studies assessing imidacloprid persistence in different sediment types are not available, but it's possible that repeated pesticide application could lead to increasing concentrations and cumulative effects in places like the southern portion of the Bay where high amounts of organic carbon exist and tidal exchange is low. Field data on long-term pesticide persistence in a range of hydrologic and sediment conditions are needed.

2.3 *Impacts to non-target organisms*. The SEIS acknowledges that scientific studies to date, including comprehensive reviews by Health Canada[17] and the EPA[18] point to the high toxicity of imidacloprid to freshwater invertebrates, the wide range of toxicity documented for other organisms, and the potential for sub-lethal and indirect effects to animals. Under the preferred alternative (Alternative 4), the SEIS concludes that impacts to non-target organisms, including zooplankton, benthic invertebrates, forage fish and groundfish, birds, pollinators, and threatened and endangered species, would either not occur due to high toxicity thresholds (e.g., fish) or be short-term and localized to treated beds and areas immediately adjacent. The SEIS also acknowledges a high degree of variability and uncertainty regarding the persistence of imidacloprid in the sediment, the extent of potential off-plot and cumulative impacts, and toxicity thresholds for marine invertebrates. The natural variability inherent in the estuarine environment, wide range of biologically relevant toxicity levels to living organisms, and unknown cumulative impacts of intertidal pesticide use all point to a troubling lack of certainty regarding short and long-term impacts to non-target organisms.

2.3.1 *Epibenthic organisms*. The SEIS concludes that impacts to zooplankton and benthic invertebrates are expected to be short term because field studies indicate that benthic invertebrate populations recover within 14 to 28 days following treatment (3-28). The SEIS also acknowledges that invertebrate recovery may be slower in sediments with higher levels of organic carbon. It's important that the public understand how the department of Ecology defines "recovery". Using the Puget Sound Marine Criterion for Sediment Management Standards as a foundation, Ecology previously developed desired endpoints related to the abundance and taxonomic richness of crustaceans, polychaetes, and mollusks. For a treated site to be considered recovered, and thus meet the conditions of the NPDES permit and SIZ authorization, endpoints for these values in a treated site must be at least 50% of the endpoint value in a control or reference site.[2] By this standard, a treated site can be considered "recovered", despite a 50% difference in biotic richness and abundance. It's also notable that the variability in the benthic invertebrate 2014 field trials was high, resulting in low statistical power to detect differences between treated plots and reference sites. In short, we are left with a recovery criterion that is insufficiently protective of benthic life and impractical to apply given the variability in the system.

Zooplankton and ichthyoplankton are vital food sources for fish, including juvenile coho and Chinook salmon.[19] Decapods, including the burrowing shrimp, have much higher tolerances, by 1-2 orders of magnitude, to neonicotinoids, including imidacloprid, than do other crustaceans that contribute to the marine zooplankton and benthic invertebrate faunas, including isopods, amphipods, mysids, and podocopida.[15] Therefore, if imidacloprid is used at concentrations sufficient to kill burrowing shrimp, it is likely to have detrimental effects on the more sensitive marine zooplankton and benthic invertebrates. Together, these organisms constitute a critical food base for marine birds, including shorebirds, waterfowl, and seabirds.

2.3.2 *Pollinators and other insects*. Survival of bees depends on the functioning of complex behaviors within the colony in addition to the survival of individual bees. There is rich, scientific literature reporting that the sensitivity of colony function to pesticides is often orders of magnitude greater (i.e., at lower concentrations) than levels associated with traditional measures of individual survival (i.e., LD-50). For example, Urlacher et al. (2016) reports severe impacts on appetitive olfactory memories at concentrations of chlorpyrifos several orders of magnitude below reported LD-50s.[20] Numerous references in this recent publication point to similar impacts by neonicotinoids in general and imidacloprid specifically.

The proposed rate of application of 0.5 lb/acre is equivalent to 560 g/ha, which is more than 50 times over the lowest "maximum application rate" investigated by the European Food Safety Authority, which was found to produce a HQ value of 123, over double the trigger value indicating high risk to bees.[21] Moreover the U.S. Environmental Protection Agency's (EPA 2016) new imidacloprid risk assessment for bees identifies a risk level of 25 ppb (0.025 mg/kg), over 100 times lower than the proposed application concentration of 3.34 mg/kg.[22] Imidacloprid is highly toxic to bees at very low concentrations, with an LD50 contact of 0.081 µg/bee and an LD50 oral of 0.0037 µg/bee.[23] Consequently, applications at the rates proposed here are likely to be acutely toxic to any bees that come into contact with the insecticide. As honeybees regularly forage several kilometers from their nest, bees in colonies 0.5 miles from the shellfish beds are well within foraging range and may be exposed to imidacloprid, which is frequently transported by wind, soil water or waterways (up to 95% of active ingredients on treated seeds[24]) and could be taken up by nearby plants.

2.3.3 *Fish*. Though imidacloprid's direct toxicity to fish is limited, it has been shown to have sub-lethal effects on fish at environmentally relevant concentrations, including physiological stress, damage to DNA, and reduced growth rates.[25,26] Toxicity to ichthyoplankton should be addressed.

2.3.4 *Birds*. The SEIS concludes that on-plot impacts to birds are expected to be minor due to the expected short-term reductions in prey species, limited pathways for direct consumption, limited toxicity to birds and the relatively small amount of the Bay/Harbor that would be subject to impacts.

Imidacloprid is toxic to birds in acute doses with concentrations as low as 13.9 mg/kg.[15] Furthermore, sublethal (chronic) effects on reproduction (testicular anomalies and reduced embryo length) and genetic material (increased breakage of DNA) have been observed in Japanese Quail at concentrations as low as 1 mg/kg, one-third of the proposed application levels.[27] House Sparrows experience loss of coordination and inability to fly at concentrations as low as 6 mg/kg.[28] Indeed, Gibbons et al. (2015) reports the results of numerous studies showing direct harm to birds.[26] The Gibbons study also cites one instance where young robins appear to have been poisoned by grubs emerging from a lawn treatment.

The SEIS minimizes the likelihood of shorebirds consuming granular insecticides or pesticide-laden prey. Shorebirds often quickly return to foraging sites immediately after human disturbance has ceased. Hence, shorebirds could easily come into contact with and consume insecticide granules that remain along the shoreline or in shallow waters prior to hydrolysis. Birds often consume small pebbles and it is not unusual for seeds to be recorded among the gut contents of feeding shorebirds,[29] so it is not unreasonable to assume that they could consume these clay and insecticide pellets. In addition, anecdotal references in the SEIS and other imidacloprid field study reports describe direct consumption of imidacloprid-laden prey by birds. Supplemental information on the avifauna of Willapa Bay and Grays Harbor and their foraging dynamics is included in Appendix A.

The SEIS has focused overwhelmingly on direct acute toxicity (i.e., mortality) to birds (3-24 – 3-25). The possibility for sub-lethal and chronic effects is mentioned in the final paragraph on potential impacts to birds, but never fully addressed. Even if pesticides don't directly and immediately kill birds, they can have population-level effects by reducing survival and reproductive success. For species like the red knot, which has a significant proportion of its Pacific population stopping over in Willapa Bay and Grays Harbor during spring migration,[30] this could have population-level effects.

2.3.5 *Mammals.* Though imidacloprid's direct toxicity to mammals is low, as with fish and birds, sub-lethal effects to reproduction, immune response, growth, and plasma biochemistry occur at concentrations as low as 0.21-5 mg/kg in a variety of mammal species including cows, mice, and rats (numerous studies reviewed in Gibbons et al. 2015).[26]

2.3.6 *Indirect effects.* The SEIS review of potential effects on threatened, endangered and protected species focuses on direct toxicity, ignoring the sub-lethal and chronic effects discussed above. Indeed, salmonids may come into direct contact with imidacloprid, including potential consumption, during application. Similarly, the proposed application rate produces concentrations over three times that known to cause detrimental sub-lethal effects to birds, as cited above. Birds such as the federally threatened/state endangered Pacific coast population of snowy plovers could face reproductive, genetic, and physiological harm if they consume imidacloprid, particularly in the granular form.

3.0 Issues and recommendations related to 2014 experimental trials for imidacloprid use in Willapa Bay

We noted a number of issues upon review of the 2014 experimental field trials that compromise the validity of the results. These issues fall into four categories:

- Sampling design and statistical issues
- Timing of sampling
- Metrics assessed
- Adherence to sampling framework

Should additional monitoring be conducted, we raise the following concerns and recommendations for consideration.

3.1 Sampling design and statistical issues

- The use of three or more treatment sites for different measures complicates interpretation of the results. It was not clear why the Cedar River site was not used as the treatment site for all measures.
- The size of the control sites was not described.
- The lack of pre-treatment sediment samples from the treatment sites, and post-treatment samples from a control site, make comparisons problematic.
- T-tests are highly sensitive to violations of assumptions, such as that the data are normally distributed and that the variances of the two groups (treatment and control) are similar (aka homogeneity of variances). Data such as these (particularly invertebrate abundance) rarely meet these assumptions and, therefore, t-tests are recommended only if used following a transformation that produces data that meet all assumptions. T-tests also fail to account for the fact that samples that are physically close to one another are more likely to have similar values (i.e., lack of independence).
- As it stands, given the violation of assumptions (independence, homogeneity, and normality) and the sensitivity of t-tests to these violations, the results of these statistical analyses are not

reliable. Although the authors used alternative techniques when their data violated one of the assumptions
(normality), there is no discussion of methods to evaluate or account for violations of the other, equally-important assumptions. Moreover non-parametric tests are conservative and thus less likely to detect differences between control and treatment sites.

***Recommendation*:** This experimental design is perfectly suited for a Before-After-Control-Impact (BACI) analysis, which would also account for potential pre-treatment differences between treatment and control site measures. Moreover random effects should be incorporated to account for the lack of independence among survey points. A BACI analysis in a general linear mixed modeling framework would resolve these issues, and would present results of a single, coherent analysis, avoiding the complex and confusing pathways used.

3.2 Timing of sampling

- It is problematic that the first invertebrate samples did not occur until two weeks post-treatment. Samples should have been conducted within one to two days to document immediate populationlevel effects. Such a delay likely minimizes the apparent effects of imidacloprid by allowing time for immigration of invertebrates to the site.

***Recommendations*:**

- We highly recommend conducting the first invertebrate sampling within one to two days of treatment.
- Due to the temporal variability in invertebrate abundance and richness, sampling frequency should also be increased to account for stochastic variation. A power analysis may be appropriate to determine what level of sampling is required to detect change.

3.3 Metrics sampled

- Biomass is an ecologically-relevant measure of invertebrate availability to predators such as shorebirds. This is especially relevant given that imidacloprid has been shown in studies to reduce growth rates in many organisms (see comments above).

***Recommendations*:** We recommend any future invertebrate studies include measurements of biomass and that thresholds for this metric are developed for under a new Sediment Impact Zone authorization if Alternative 4 is approved.

3.4 Adherence to sampling framework

Presumably, the sampling framework developed in collaboration between Ecology and industry representatives represents a compromise between the ideal study design and the realities of field work in a tidal system. However, the 2014 Field Study report and Ecology's own review of the field report indicates problematic deviations from the sampling framework that may bias the results.

***Recommendations*:**

- A process in which deviations from the sampling framework are communicated and approved by Ecology during the field season would be preferable to the current practice of after-the-fact reporting. In reviewing proposed deviations from the proposed sampling scheme, Ecology would need to consider whether the deviations would compromise the scientific validity of the results.
- The lead field investigator for the imidacloprid field trials is widely perceived to hold a bias towards the use of pesticides. To repair public trust in the Ecology permitting process, we recommend that a small peer-review panel of technical experts is convened to review and evaluate any further imidacloprid field testing scenarios. Panel members should be entirely independent of Ecology or the industry, but could include appropriately qualified individuals from other agencies, academic institutions, unrelated industries, etc.

Summary and recommendations

Despite the importance of Willapa Bay and Grays Harbor for migratory birds and fish, shellfish production, and other natural resource economies, Washington State has invested very little in the rigorous scientific assessment, management and stewardship of these vital places. The consequences of over half a century of pesticide use on nutrient and carbon fluxes, food web dynamics, intertidal sediments, vegetation, and secondary consumers, including shorebirds and waterfowl in Willapa Bay and Grays Harbor are almost entirely unknown. Coastal stakeholders lack information on ecosystem condition, species status, distribution and population dynamics, ecological relationships and management alternatives that are necessary to understand and make informed decisions about burrowing shrimp management.

The SEIS incorporates a number of new studies and describes a considerable range of potential direct and indirect impacts to living organisms that may result under Alternative 4, the preferred alternative. The best available science tells us that at a minimum, imidacloprid use will have immediate effects on the benthic invertebrate and zooplankton communities within the treated plots, with drastic reductions in invertebrate prey for consumers. "Recovery" of these biotic communities after treatment is set at an unacceptably low level; when treated areas have at least half the benthic invertebrate abundance and richness as untreated reference areas. There is considerable uncertainty regarding how long and to what extent imidacloprid will persist in the different types of sediment and hydrological conditions found throughout the Bay and Harbor, whether or not benthic communities are actually recovered at the 50% criteria, the nature of sublethal effects on bird and fish populations, and the potential indirect effects on birds and fish through degradation of foraging habitat.

Our priorities are to encourage lasting solutions that will help the industry end its long-standing reliance on pesticides and create conditions amenable to ecologically and economically sustainable shellfish aquaculture. Audubon looks to the considerable scientific, technological and natural resource management expertise in the Pacific Northwest to invest in assessing, understanding and fairly resolving the complex set of issues facing Willapa Bay and Grays Harbor shellfish growers and other coastal stakeholders. We are actively working to secure financial and technical resources to help understand the root causes of the apparent ghost shrimp proliferation in shellfish beds and shed light on the ecological role of burrowing shrimp in coastal estuaries. We are eager to work together with shellfish growers and other coastal stakeholders who share an interest in healthy coastal estuaries.

Thank you for considering our issues and concerns. Please don't hesitate to contact us with any questions or concerns.

Sincerely,

Trina Bayard, Ph.D.

Director of Bird Conservation

Sam Merrill, Conservation Chair
Black Hills Audubon Society

Diane Bachen, President Kitsap Audubon Society

Judy Hallisey, President
Kittitas Audubon Society

Jim Castle, President
Lower Columbia Basin Audubon Society

Pam Borso, President
North Cascades Audubon Society

Bob Phreaner, President
Olympic Peninsula Audubon Society

Cindy Easterson, President Pilchuck Audubon Society

Heather Gibson, President
Rainier Audubon Society

John Brosnan, Executive Director
Seattle Audubon Society

Timothy Manns,
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Skagit Audubon Society

Tom Light, President
Spokane Audubon Society

Julie Burman, President
Vashon-Maury Island Audubon Society

Sharon Gauthier, President
Whidbey Audubon Society

Larry Brandt, President
Willapa Hills Audubon Society

Appendix A: Avifauna of Willapa Bay and Grays Harbor

Willapa Bay and Grays Harbor are sites of regional and hemispheric importance for shorebirds and waterfowl, supporting ten Important Bird Areas (IBAs) and two Western Hemisphere Shorebird Reserve Network sites; one of hemispheric importance at Grays Harbor and one of international importance at Willapa Bay. As the fourth largest estuary on the U.S. West Coast, Grays Harbor supports a diverse array of birds and marine wildlife, including exceptional numbers of migratory shorebirds and waterfowl. Willapa Bay is one of ten major flyway stopover points on the West Coast, and is a vital wintering area for waterfowl and shorebirds and the last remaining breeding area for Western Snowy Plovers in Washington State.

1.1 Shorebird conservation status. Grays Harbor and Willapa Bay support around two dozen species of shorebirds (WHSRN.org). Of these, 19 species regularly occur (e.g., Dunlin), and for some species (e.g., Western Sandpipers) large proportions of their populations use the two estuaries.[31] Eleven species are considered species of national conservation concern[32] and all but two species are considered of moderate to high regional concern (Table 1): The Red Knot is a species of high conservation concern nationally, and virtually the entire Pacific population (*Calidris canutus roselaari*) stops in Willapa Bay or Grays Harbor during migration.[30] These estuaries are also highly important for Marbled Godwits, some of which are from the small Alaska Peninsula breeding population, ca. 2000 individuals. These godwits are recognized as a unique subspecies (*Limosa fedoa beringiae*) and migrate through or overwinter at the two estuaries.[33] Finally, Long-billed Curlew, which prey on burrowing shrimp, presently are found in relatively small numbers in Willapa Bay, though historical use of the estuary is unknown.

1.2 *Habitat use.* Shorebird use of estuarine habitats varies throughout the year in response to the underlying substrate and associated prey availability, tide status, weather, and behavioral interactions with predators and competitors. Some species defend feeding territories in the non-breeding season (e.g., plovers) while most others feed in flocks.[34] Shorebirds do not feed across all intertidal habitats, rather they aggregate in patches according to prey availability.[35] Prey availability in turn, is driven by physical factors such as sediment grain size, tidal action and salinity. Sediment plays a fundamental role in supporting aquatic food webs; sediment grain size influences the distribution of benthic fauna and vegetation, which in turn influences foraging opportunities for shorebirds, as well as salmon and other fish. Not surprisingly, fish and birds are known to cue in on different sediment sizes while foraging. For example, Dunlin favor substrates with higher mud content[36] and Chinook salmon favor sand flats.[37]

The tidally-driven and seasonal nature of shorebird distributions makes delineating and prioritizing discrete habitat areas for conservation or protection a challenge. In their 2014 study, Frazier et al. found that shorebird use of intertidal habitats in an Oregon estuary is greatest as the tide approaches and recedes and that areas of low marsh, including *Zostera japonica* beds, *Neotrypaea*/sand dominated tideflats, and *Upogebia*/mud dominated tideflats, had comparable densities of birds, whereas *Zostera marina* beds had significantly lower shorebird densities.[38] No comparable study has been conducted at Willapa Bay or Grays Harbor, though Buchanan observed Red Knots foraging for bivalves in a variety of habitat types, ranging from the mudflat-saltmarsh interface to open mudflats more than 150 m from shore.[39]

1.3 *Diet and foraging preferences.* Shorebirds are opportunists in their food habits, and their preferred prey vary by location, year, season, and substrate. Documented intertidal prey include amphipods, cumaceans, bivalves (especially *Macoma* sp.), insects and polychaetes. Nevertheless, species-specific bill morphology and foraging behaviors are adapted to specific prey types, which can constrain foraging choices.[40] Small species, such as Western Sandpipers, take a wide variety of invertebrate prey (e.g., Senner et al. 1989[41]), while the much larger Red Knots are specialists on bivalves, such as *Macoma balthica*. Recent studies have also documented the importance of biofilm, a diatom-dominated microorganism community that forms on the surface of intertidal flats as a food source for some *Calidris* species, such as Dunlin and Western Sandpipers.[42] Larger bodied species such as Long-billed Curlews are known to eat large prey, including ghost shrimp.[43] In fact, it has been proposed that this species' long, decurved beak has evolved specifically to prey on ghost shrimp. Marbled godwits also prey on ghost shrimp.[44] In addition, Red Knots have been observed to prey on the spat of bivalves which have a commensal relationship with ghost shrimp and their burrows.[39]

Table 1. Conservation status of shorebird species regularly occurring in Willapa Bay and Grays Harbor.[31] ESA – listed under the U.S. Endangered Species Act; IM – requires immediate conservation action, meets criteria for the Birds of Conservation Concern (BCC); MA – needs management attention, meets BCC criteria; WL – meets Watch List 2014 criteria as a global species, USA/Canada population, or a taxa below these levels; N. Pacific – regional scores from the N. Pacific Shorebird Plan[3]. Category codes: 5 = Highly imperiled, including species listed as threatened or endangered; 4 = High concern; 3 = Moderate concern; 2 = Low concern; 1 = No risk; WA ESA – listed under Washington State Endangered Species Act; SGCN – Washington Department of Fish and Wildlife Species of Greatest Conservation Need.[45]

Common name	**Scientific name**	**Conservation Status**						
		ESA	**IM**	**MA**	**WL**	**N. Pacific**	**WA ESA**	**WA SGCN**
Black-bellied Plover	*Pluvialis squatarola*					4		
Snowy Plover	*Charadrius nivosus*	X			X	5	X	
Semipalmated Plover	*Charadrius semipalmatus*					3		

Black Oystercatcher	*Haematopus bachmani*				X	4		X
Greater Yellowlegs	*Tringa melanoleuca*					4		
Lesser Yellowlegs	*Tringa flavipes*			X		2		
Whimbrel	*Numenius phaeopus*		X		X	4		
Long-billed Curlew	*Numenius americanus*			X	X	2		
Marbled Godwit	*Limosa fedoa*			X	X	4		X
Ruddy Turnstone	*Arenaria interpres*					4		
Black Turnstone	*Arenaria melancephala*				X	4		
Red Knot	*Calidris canutus*		X		X	4		X
Surfbird	*Calidris virgata*					4		
Sanderling	*Calidris alba*			X		4		
Dunlin	*Calidris alpina*				X	4		
Least Sandpiper	*Calidris minutilla*					3		
Western Sandpiper	*Calidris mauri*					4		
Short-billed Dowitcher	*Linmodromus griseus*				X	4		
Long-billed Dowitcher	*Limnodromus scolopaceus*					3		

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October 31, 2017

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Re: Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster

and Clam Beds in Willapa Bay and Grays Harbor, Washington

These comments on the draft Supplemental Environmental Impact Statement (SEIS) to Washington's Department of Ecology (Ecology) are submitted on behalf of our membership in the state of Washington. Beyond Pesticides is a grassroots membership organization that represents community-based organizations with members across the United States and worldwide –a range of people seeking to improve protections from pesticides and promote alternative pest management strategies that eliminate a reliance on toxic pesticides.

The draft SEIS is in response to the application from the Willapa-Grays Harbor Oyster Growers Association for a permit for annual application of the insecticide imidacloprid, to control ghost shrimp and mud shrimp (collectively known as burrowing shrimp) on 500 acres of shellfish beds within Willapa Bay and Grays Harbor, over a period of five years. A permit under the National Pollution Discharge Elimination System (NPDES) is needed to authorize such applications.

We oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology. Imidacloprid's use threatens to have long-term and possibly irreparable impact on aquatic communities, with cascading trophic impacts to both aquatic and terrestrial ecosystems.

Background

In 2015, Ecology approved a permit that would allow imidacloprid, to be sprayed in Willapa Bay and Grays Harbor to control burrowing shrimp on 2,000 acres of tidelands. Local residents feared that the use of imidacloprid would contaminate the oyster beds and the oysters the state was trying to protect. Consumers, environmental organizations, and prominent local chefs spoke out against the spraying. An environmental assessment conducted by Ecology found that, "The proposed use of imidacloprid to treat burrowing shrimp in shellfish beds located in Willapa Bay and Grays Harbor is expected to have little or no impact on the local estuarine and marine species….,"[1] and that imidacloprid was "safer" than the alternative; a carbamate insecticide, carbaryl. The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) also weighed in stating there are many unknowns regarding impact to other aquatic and terrestrial biota. NMFS finds that the native burrowing shrimp plays an important role in the natural ecosystem, and voiced concern for the green sturgeon – a "species of concern" under the Endangered Species Act (ESA), which could potentially be impacted via reduced food sources in its designated critical habitat. The shellfish industry eventually requested the permit withdrawn in response to strong public concerns.

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[1] Washington State Department of Ecology. 2013. Risk Assessment for Use of Imidacloprid to Control Burrowing Shrimp in Shellfish Beds of Willapa Bay and Grays Harbor, WA. http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid/docs/ImidaclopridRiskAssessment.pdf

Current Application

In 2016, oyster growers from the Willapa Grays Harbor Oyster Grower Association applied for a new pesticide permit for imidacloprid to control the burrowing shrimp. This time the permit was aimed at treating less acreage than the 2015 application: up to 485 acres in Willapa Bay and 15 acres for Grays Harbor, with application to be conducted from boats or ground equipment rather than aerial spraying.

To grant a NPDES permit certain factors must be considered in the SEIS, including impact to surface water, sediments, wildlife and human health. The identification of imidacloprid as a chemical option for control of burrowing shrimp began in the late 1990s as an alternative to the carbamate, carbaryl. Imidacloprid applications are proposed to be made using “adaptive management principles” to (1) preserve and maintain the viability of the commercial shellfish industry, (2) preserve and restore select commercial oyster and clam beds at risk from sediment destabilization.

Current Regulatory Oversight

Ecology has reviewed the recent imidacloprid aquatic assessment from U.S. Environmental Protection Agency (EPA) and Canada’s Pest Management Regulatory Agency (PMRA). These two assessments find that imidacloprid pose risks to aquatic organisms, especially aquatic invertebrates. Notably, PMRA states, “[I]t is not possible to accurately predict how much use reduction would be necessary to achieve acceptable levels of imidacloprid in the environment and, therefore, any use-reduction strategy would require extensive and comprehensive water monitoring information to confirm that risk reduction targets are being achieved.”[2] PMRA is correct that even mitigation strategies to reduce imidacloprid impact on the environment, like that being proposed in this new permit request, may not be realistic, and most likely not sustainable or achievable to protect sensitive organisms. This is one reason this agency proposed to phase out imidacloprid.

EPA identified aquatic insects as the most vulnerable to imidacloprid exposures, and specifically found that foliar spray and a combination of other application methods, including on-the-ground applications, have “the greatest potential risks for aquatic invertebrates. . .”
EPA also acknowledges that “the potential exists for indirect risks to fish and aquatic-phase amphibians through reduction in their invertebrate prey-base.”[3] We believe EPA’s assessment warrants a federal restriction on the use of imidacloprid, similar to PMRA’s proposal. Therefore, it would be counterintuitive for Ecology and the state of Washington to greenlight increased uses of this chemical.

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[2] PMRA. 2016. Proposed Re-evaluation Decision PRVD2016-20, Imidacloprid. Health Canada. Ottawa, Ontario.
[3] USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC
[4]Ibid

Concerns with Imidacloprid in Aquatic Environments

Neonicotinoids like imidacloprid, affect the nervous system of insects and other invertebrates by interfering with their nicotinic acetylcholine receptors (nAChRs).[4] This mechanism of action shows higher selective toxicity in invertebrates compared to vertebrates.[4] Neonicotinoids are known for their action on non-target terrestrial insects, like the honey bee, but their neurotoxic activity in aquatic invertebrates like aquatic insects, crustaceans and worms also occurs when these chemicals get into waterways where these organisms reside.

There is generally little data for marine aquatic organisms, however preliminary studies found increased mortality at higher concentrations of imidacloprid.[5] Studies investigating the impacts of neonicotinoids on aquatic organisms find that these pesticides can have devastating impacts of aquatic communities and on the higher trophic organisms that depend on these communities. Van Dijk et al.'s (2013) comprehensive look at the effects of imidacloprid in surface water reports a wide variety of aquatic invertebrates adversely harmed by imidacloprid residues in water.[6] Even at low, sublethal levels imidacloprid has the ability to reduce survival and growth in these organisms, and can affect molting and larval development. In crabs, imidacloprid is highly toxic to juvenile and post-larval crabs, with post-larval crabs the most sensitive life stage. [7]

The effects of imidacloprid on certain aquatic organisms are wide-ranging and include significant reduction in abundance, significant reduction in survival, reduced feeding, and behavioral changes.[9] Benthic organisms in particular are at risk. Studies find that benthic communities in general experience significant reductions in abundance.[8,9]

Sublethal effects in fish have also been observed. Growth and development in some species have been reported, which was attributed to a loss of the aquatic invertebrates juvenile fish rely on as a food source.[10] Further, others have reported decreased viability and hatching success, leading them to

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[4] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374

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conclude that imidacloprid is more toxic to fish in early developmental phases, even at low concentrations. [11]

The impacts of imidacloprid on Willapa Bay and Grays Harbor cannot be overstated. Native ghost shrimp (*Neotrypaea californiensis)* and mud shrimp (*Upogebia pugettensis)* have important function in this ecosystem, which shellfish growers blame for their declining industry. According to an analysis conducted by the Xerces Society, "The benefits from these species are likely to include ecosystem services such as substrate bioturbation, improving water quality and nutrient availability."[12] Other species like migratory birds that depend on shoreline aquatic invertebrates can also be significantly impacted. These trophic impacts are also extended to other aquatic predators in the Bay. These disruptions can have long-term cascading effects on food webs and habitats in or near aquatic environments.

The Draft SEIS

Imidacloprid is a broad-spectrum insecticide that will have direct and indirect impacts on non-target organisms in Willapa Bay and Grays Harbor. At treatment sites, it is expected that there will be high mortality for a wide range of aquatic invertebrates. Ecology reviewed the available scientific literature and identifies impacts to zooplankton, benthic invertebrates and crustaceans (Dungeness crab), as well as short-term and longer-term impacts to surface waters and sediments. Indirect impacts to fish species like the green sturgeon and birds, due to reduced invertebrate availability, have also been recognized.

The SEIS notes that imidacloprid concentrations as high as 1,600 ppb (4,200ppb in other studies) is expected at treated sites after application with flushing to "undetectable levels" within 2 to 3 tide cycles.[13] According to the assessment, 2014 field trials in Willapa Bay documented detectable concentrations of imidacloprid at up to 2,316 feet from the edge of sprayed plots. Ecology finds that due to tidal dilution there will be low to moderate potential to cause ecological impacts in non-target areas after successive tidal cycles.[14] In sediment, levels of imidacloprid that were high enough to pose risks that linger after 14 days, with slower dilution rates. Concentrations were still detected after 56 days. The environmental persistence of imidacloprid after initial application in these aquatic environments poses risks to non-target organisms. Studies report that chronic impacts on aquatic invertebrates occur at levels as low as 0.01 ppb, with current federal aquatic life benchmarks for chronic effects at 1.05 ppb.[15] Therefore, low residues of imidacloprid, that not only migrate from

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[12] The Xerces Society (December 2014). Letter to Derek Rockett, Washington State Department of Ecology Water Quality Program. Re: *Draft National Pollution Discharge Elimination System, Waste Discharge Permit No. WA0039781* (draft permit) and *Draft Environmental Impact Statement: Control of Burrowing Shrimp* [*U*]*sing Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington* (draft EIS).

[13] Washington State Department of Ecology. 2017. Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington – Draft. Water Quality Program. Olympia, Washington.

[14] Ibid

[15] Harriott, H and Shistar, T. 2017. Poisoned Waterways. Pesticides and You.

treatment sites but persist in water and sediment in Willapa Bay and Gray Harbor, will continue to pose systemic risks to non-target organisms.

Further, there are acknowledged “knowledge gaps” in Ecology’s SEIS. Ecology notes that its current scientific review contains data gaps, including “effects of imidacloprid to marine invertebrates from chronic exposure, the long-term persistence of imidacloprid in marine sediments, and indirect effects to species or food chains due to reductions in invertebrate numbers following imidacloprid exposure.” Therefore, Ecology must resolve these data gaps before it issues a permit for imidacloprid in this marine environment.

Known Impacts

The finding highlighted by the Washington State Department of Ecology that use of imidacloprid would result in “Immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides” is consistent with research on imidacloprid and other neonicotinoid insecticides. A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, and others, on the impacts of neonicotinoids in surface waters from 29 studies in nine countries finds that these chemicals adversely affect survival, growth, emergence, mobility, and behavior of many sensitive aquatic invertebrate taxa, even at low concentrations.[16]

Neonicotinoids were also recently evaluated by a large panel of international experts chartered under the International Union for the Conservation of Nature (IUCN), which found that these chemicals have “wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats.”[17]

Uncertainties Identified in the SEIS

The SEIS points out a number of issues that have not been adequately addressed by research. In some cases, the SEIS suggests that a research component might be incorporated into the permit. This is an inadequate approach, which essentially assumes that the impacts in question will not be substantial. The questions should be resolved before the permit is issued:

Efficacy of Imidacloprid

Crucially, the SEIS identifies uncertainties regarding the efficacy of imidacloprid for controlling burrowing shrimp. In discussing impacts of imidacloprid on other marine invertebrates, the SEIS states, “[I]mpacts to invertebrates from spraying imidacloprid have generally been limited in either extent or duration. For example, on-plot invertebrate measurements have generally not been more than 50 percent different than those on control plots after 14 or 28 days, although reaching appropriate statistical power has been difficult to achieve. In part, this may be due to high recolonization rates of invertebrates following treatment, survival of organisms on-plot despite treatment, or both.”

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[16] Morrissey, C, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. Environment International 74: 291–303.

[17] Van der Sluijs J.P., et al. 2014. Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environ Sci Pollut Res doi:10.1007/s11356014-3229-5

The SEIS said that impacts on invertebrates “would be expected within the boundaries of the treatment plots as imidacloprid is applied directly to the substrate or in shallow water. These on-plot impacts are generally expected to be short-term, as field trials have shown that benthic invertebrate populations recover (e.g., repopulate treated plots). For example, trials with imidacloprid have demonstrated invertebrate recovery within 14 days of chemical applications.” This does not support the use of imidacloprid as an effective control for burrowing shrimp.

Other uncertainties related to the need for imidacloprid and its efficacy that were raised by the SEIS include the following:

- “A well-defined method for determining the treatment threshold to ensure efficacy of the product on the target species of burrowing shrimp (Neotrypaea californiensis and Upogebia pugettensis) has not yet been formulated from the preliminary research data on imidacloprid.”
- “It is not yet known whether the target species of burrowing shrimp may become resistant to the effects of imidacloprid over time.”
- “Field research data are lacking regarding how burrowing shrimp affect clams, and the threshold for damage to clam beds.”
- “There is uncertainty whether imidacloprid treatments during periods of low water temperature will have successfully reduced burrowing shrimp populations.”

Direct and Indirect Impacts of Imidacloprid
The SEIS identified uncertainties related to the assessment of damage caused by imidacloprid, including the following:

- “The results of multi-year studies (> 2 years) are not yet available to affirm whether imidacloprid accumulates in sediments, and if so, the "worst-case" scenario of such accumulation.”
- “Due to the preliminary nature of research data available at the time of this writing, there is uncertainty regarding whether imidacloprid may have potential long-term sediment toxicity effects on benthic and free-swimming invertebrate communities, the species that utilize them as food sources, and the ability of the Willapa Bay and Grays Harbor estuary ecosystems to maintain homeostasis, as a whole.”
- “The effects of imidacloprid on zooplankton species are largely unstudied.” However, in reviewing studies showing impacts on crab megalopae (last planktonic stage), the SEIS dismisses this uncertainty, saying “[G]iven the abundance of zooplankton, effects are expected to be localized and temporary.” (See discussion of Dungeness crabs, below.)
- “Limited information in marine environments is available regarding the possible sublethal effects of imidacloprid on non-target aquatic organisms. Ultimately, burrowing shrimp are controlled through sub-lethal effects.”
- “Limited information is available regarding imidacloprid impacts to marine vegetation.” Although field studies showed that imidacloprid is taken up by eelgrass,

this is dismissed with "Imidacloprid is an acetylcholinase (sp) inhibitor and plants do not have a biochemical pathway involving acetylcholinase (sp). Therefore, it is unlikely that imidacloprid would adversely affect eelgrass or other marine vegetation." However, its impacts on organisms that feed on marine vegetation should be assessed.

- "Limited field verification data are available at the time of this writing regarding the toxicity and persistence of imidacloprid degradation products."
- "A limited number of field studies have been conducted in the estuarine environment to confirm the off-plot movement of imidacloprid following applications of the flowable and granular forms on commercial shellfish beds." Field data from both 2012 and 2014 trials in Willapa Bay "showed a strong pattern of high on-plot and low off-plot concentrations during the first rising tide. Imidacloprid was detected at considerable distances off-plot, but at highly variable concentrations (e.g., 0.55 ppb to 1300 ppb). These varying results suggest that site-specific differences in how tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot."
- "It is not possible to quantify the total acreage of commercial shellfish beds to be treated with imidacloprid over the five-year term of the NPDES permit."

These uncertainties with regard to imidacloprid's long-term toxicity must be resolved before a permit is approved.

Cumulative and Synergistic Effects

Cumulative Impacts

Another shortcoming is the lack of consideration of aggregated imidacloprid concentrations and exposures in the SEIS. It is known that agricultural runoff poses major challenges to water quality. These exposures, combined with applications proposed for this permit, would conceivably result in higher residues in Willapa Bay and Grays Harbor, and thus elevated and unassessed risks. Ecology must go back and take into conduct a cumulative/ aggregate impact assessment for imidacloprid. Additionally, the science shows that there can be additive and synergistic effects on non-target communities from imidacloprid exposures. Some pesticide combinations, for example, include certain fungicides combined with either pyrethroid or neonicotinoid insecticides that can increase toxicity synergistically.[18,19] Imidacloprid has been found to act synergistically with inert ingredient mixtures that result in reduced populations of aquatic species when compared to imidacloprid alone. [22]

Synergistic Chemical Impacts

Here there are again some known unknowns. The imidacloprid products consist primarily of so-called "inert" ingredients by volume. The granular products are 99.5% unspecified ingredients. One flowable

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[18] Wachendoorff-Neumann, U. et al. 2012. Synergistic mixture of trifloxystrobin and imidacloprid. Google patents United States Bayer CropScience AG.

[19] Andersch, W. et al. 2010. Synergistic insecticide mixtures. US Patent US 7,745,375 B2. Bayer CropScience AG

[22] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374.

formulation identifies propylene glycol as part of the 78% “inert” ingredients. Since “inert” ingredients are present to make the product more effective, it is imperative that the potential for additive or synergistic impacts of imidacloprid and “inert” ingredients be investigated.

The synergistic effects of imidacloprid and the herbicides imazamox, imazapyr, and glyphosate, which are used to control *Zostera japonica* and *Spartina*, is dismissed, based on factors such as limited overlap in exposure (imazapyr) and different modes of action (imazamox). These factors lead to assumptions of limited risk, not actual evaluations of the risk. Other toxic chemicals found in Willapa Bay and Grays Harbor should also be included in the risk analysis for synergistic effects.

Dungeness Crabs

New research on the impacts of imidacloprid on crabs is reviewed in the SEIS. This research supports the conclusion in the SEIS that “[S]ome Dungeness crab juveniles and planktonic forms are likely to be killed by the proposed application of imidacloprid on shellfish beds.” It does not support the conclusion, “[I]midacloprid effects are not expected to impact bay-wide populations of Dungeness crab in these estuaries.”

The California Department of Fish and Game finds, “There seems little doubt that [Dungeness] crab populations, with their extremely fecundities and vulnerable early larvae stages, are prone to large natural fluctuations in abundance.”[20] Variability in population size has long been understood to be a factor increasing the risk of extinction.[21] For example, drastic population fluctuations are believed to have increased the susceptibility of the passenger pigeon to human exploitation, leading to its extinction.[22] Dungeness crabs are susceptible to a number of threats, including changes in water chemistry and the presence of pollutants.[23] Recently, research has identified acidification due to climate change as a threat.[24] The synergistic impacts of imidacloprid with these other threats must be evaluated.

[20] California Department of Fish and Game, 2001. California’s Living Marine Resources: A Status Report. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34263&inline.

[21] Soulé, M.E. and Simberloff, D., 1986. What do genetics and ecology tell us about the design of nature reserves?.
Biological conservation, 35(1), pp.19-40.

[22] Hung, C.M., Shaner, P.J.L., Zink, R.M., Liu, W.C., Chu, T.C., Huang, W.S. and Li, S.H., 2014. Drastic population fluctuations explain the rapid extinction of the passenger pigeon. *Proceedings of the National Academy of Sciences*, *111*(29), pp.10636-10641. http://www.pnas.org/content/111/29/10636.full.

[23] Encyclopedia of Puget Sound. 3. Dungeness Crabs. https://www.eopugetsound.org/science-review/3-dungenesscrabs.

[24] Marshall, K.N., Kaplan, I.C., Hodgson, E.E., Hermann, A., Busch, D.S., McElhany, P., Essington, T.E., Harvey, C.J. and Fulton, E.A., 2017. Risks of ocean acidification in the California Current food web and fisheries: ecosystem model projections. *Global change biology*, *23*(4), pp.1525-1539. https://www.researchgate.net/publication/312279519_Risks_of_ocean_acidification_in_the_California_Current_f ood_web_and_fisheries_Ecosystem_model_projections.

Ecosystem-Mediated Impacts

The SEIS says, "[I]t is unlikely that imidacloprid would impact plants present on treated plots immediately after treatment since plants lack the nervous system pathway through which imidacloprid impacts some organisms." This statement ignores the fact that plants are the system for delivering neonicotinoids such as imidacloprid to insects in agriculture. The chemical is taken up by plants, distributed through plant tissues, and insects are poisoned –with sublethal to lethal effects— when they consume plant tissues or products such as pollen, nectar, and sap. Given this background, it is incumbent on Ecology to demonstrate that there will be no effect on non-target organisms feeding on plants contaminated with imidacloprid.

Habitat Restoration –An Alternative Not Considered.
Human activity has affected the Willapa Bay and Grays Harbor, throwing the ecosystem out of balance, leading to the loss of some native predators, an increase in invasive species, and slumping oyster productivity. In the mid-1800s, logging began to alter stream morphology and increase sediment load flowing into the bays. Effluent from pulp mills dumped into waterways, also impaired water quality and contributed to the decline of fish populations like salmon and sturgeon. Floodplains were cleared for agriculture and then later urbanized, leading to a loss of the natural riparian vegetation.[25] At the same time, the native Washington oyster, *Ostrea lurida*, began to decline due to over-harvesting and declining environmental quality. This led oystermen to import the Pacific oyster from Japan and to create artificial oyster beds to help boost productivity.

By the early 1920s, numbers of the native burrowing shrimp began growing. Some believe that changes in oystering practices led to the shrimp's success. The natural layer of shell deposits to which oysters attach is typically removed during harvest, exposing bare sediment, and allowing the shrimp to burrow.[26] This, coupled with the declining predatory fish populations in the bay, led to an explosion in shrimp populations. Early efforts to prevent shrimp from burrowing –graveling, shelling— were not effective, and soon gave way to chemical control options.

In addition, Spartina (*Spartina alterniflora*) and the non-native eelgrass (*Zostera japonica*) now grow on much of the tide flats in the bays.[27] Chemical treatment for these nonnative species has been performed for years, further endangering the long-term health of the bays' ecosystem.

Several efforts are underway to restore salmon species in the Pacific Northwest, including Willapa Bay. Stream enhancement and restoration improves habitat for fish, amphibians, and invertebrates. These species can help control bountiful populations of burrowing shrimp and aquatic plants.[28]

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[25] Hatchery Scientific Review Group. 2004. Willapa Bay. Hatchery Reform Recommendations. Puget Sound and Coastal Washington Hatchery Reform Project Hatchery Scientific Review Group.

[26] Feldman, K, Armstrong, D. et al. 2000. Oysters, Crabs, and Burrowing Shrimp: Review of an Environmental Conflict over Aquatic Resources and Pesticide Use in Washington State's (USA) Coastal Estuaries. Estuaries. 23(2):141-176.

[27] Washington State Department of Ecology. Spartina, http://www.ecy.wa.gov/programs/sea/coast/plants/spartina.html.

[28] A Snail's Odyssey: a journey through the research done on west-coast marine invertebrates –predators and defenses. http://www.asnailsodyssey.com/LEARNABOUT/SHRIMP/shriPred.php.

Unfortunately, chemicals have been employed to reduce “invasive” plants and the borrowing shrimp. The use of these chemicals only serves to further threaten the long-term health of the sensitive ecosystem by adversely affecting other non-target species, and potentially throwing other communities out of balance. It is essential that non-chemical options be explored, such as encouraging the revival of native fish and the development of natural oyster beds to suppress shrimp populations.

Conclusion

Imidacloprid has been identified as a replacement for the toxic carbamate, carbaryl, which has been used in the Bay. However, replacing one toxic chemical with another is not a viable option. Ecology must work with the applicant to explore other biological or cultural methods to adapt to the challenges of farming while respecting ecology of the native burrowing shrimp, which have their own ecological importance to the Willapa Bay and Grays Harbor. We are willing to work with Ecology and other stakeholders to find long-term sustainable and ecologically sound solutions for shellfish farmers in the state, which is important to the local economy.

It is undisputed that imidacloprid poses significant dangers to aquatic organisms, and by extension to other species that depend on them as a food source. Ecology’s SEIS does not support the use of imidacloprid in Willapa Bay and Grays Harbor. There are several data gaps that, without being resolved, preclude the agency from making a decision to grant a NDPES permit for imidacloprid. Imidacloprid is too toxic for the control of burrowing shrimp in such a sensitive tidal area, and the efficacy of such treatment has not been established. Simply attempting to monitor for ecological effects does not protect Willapa Bay and Grays Harbor from the long-term effect of a five-year long pesticide program. All parties would be better served by implementing an alternative plan to restore the ecology of Willapa Bay and Grays Harbor.

Respectfully,

Nichelle Harriott
Science and Regulatory Director

Commenter: Center for Food Safety - Comment O-8-1

Please find attached comments urging Ecology NOT to move forward with a spray permit for imidacloprid on shellfish beds in Willapa Bay/Grays Harbor, signed by 446 Center for Food Safety members.

CENTER FOR FOOD SAFETY

November 1, 2017

NO spraying of imidacloprid in Willapa Bay and Grays Harbor

Dear Washington Department of Ecology:

As a resident of the Pacific Northwest, our bays and marine waters and the wildlife they support are very important to me. That is why Ecology must not allow the spraying of dangerous neurotoxins into Willapa Bay and Grays Harbor.

The Pacific Northwest is home to many iconic species like salmon, commercially valuable species like Dungeness crab, and endangered species like green sturgeon. These and many more are threatened by the use of neurotoxins in Willapa Bay and Grays Harbor, which in addition to providing essential habitat are also home to two National Wildlife Refuges.

Imidacloprid has never before been approved for use in water and is nearly always labeled as “highly toxic to aquatic invertebrates,” including species like crabs. As experts have recognized, spraying this toxin into bays will not just kill the native burrowing shrimp, it will also kill or harm all aquatic invertebrates it touches, and indirectly impact species that rely on these food sources. Further, given the significant data gaps, this under-studied plan should not move forward.

Pesticides are not the only option to restore balance to Willapa Bay and Grays Harbor, but Ecology failed to evaluate any alternatives that are more environmentally protective than spraying imidacloprid. Simply put, the plan to spray imidacloprid is not adequately protective of wildlife, water quality, or public health. I urge Ecology not to move forward with a spray permit for imidacloprid on shellfish beds in Willapa Bay/Grays Harbor.

SIGNED (446 CFS members):

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Naomi	Bloom	Portland	OR	97201
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Virginia	Davis	Woodinville	WA	98072
Deborah	Schaefer	Hermiston	OR	97838
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Ryan	Rounkles	Portland	OR	97214
Linda	Graham	Ashland	OR	97520
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Phil	Goldsmith	Portland	OR	97210
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Janet	Meredith	Friday Harbor	WA	98250
William	Koopman	Olympia	WA	98513
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Michael	Kaibel	Merrill	OR	97633
Sandy	Bishop	Lopez Island	WA	98261
Brent	Rocks	Portland	OR	97201
Judy	Sanfilippo	Eugene	OR	97405
Carol	Else	Lakewood	WA	98498
Ann	Clifton	Olympia	WA	98512
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Arthur	Tetrault	Ashland	OR	97520
Jerry	Matsui			98122
John	Dobbins	Kennewick		99336
Brian	Rulifson	Seattle		98107
Tiffany	Welton	Kirkland	WA	98034
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Doug	Gibson	Gates	OR	97346
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Dorothy	Parshall	Langley	WA	98260
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Steve	Aydelott	Bend	OR	97701
C	Lenihan	Beaver	WA	98305
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Diane	Black	Salem	OR	97317
Shelly	Ackerman	Langley	WA	98260
Jeannine	Cook	Roseburg	OR	97471
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Nancy	Diskin	Eugene	OR	97405
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Jesse	Mallory	Kennewick	WA	99337
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Evonne	Laforge	Yelm	WA	98597

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Sada	Showell	Cheney	WA	99004
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Holly	Hughes	Indianola	WA	98342
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Baker	Smith	Burien		98168
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Craig	Feyk	Edmonds		98020
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Bob	Thomas	Myrtle Creek	OR	97457
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Joshua	Lifton	Portland	OR	97211
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Gwendolyn	Henry	Enumclaw	WA	98022
Pamela	Collord	Portland	OR	97267
Robert	Walling	Seattle	WA	98133
Cynthia	Shelton	Langley	WA	98260
Eileen	Gribble	Bellingham	WA	98225
Irene	Saikevych	Central Point	OR	97502
Nina	Svasabd	Seattle	WA	98177
Melissa	Hathaway	Gresham	OR	97030
Howard	Clark	Olalla	WA	98359
Hank	Stevens	Gresham	OR	97030
Cynthia	Woscek	Saint Augustine	FL	32080
Kim	Wick	Buxton	OR	97109
Kerry	Knight	Monroe	WA	98272

James	Murphy	Seattle	WA	98122
Jana	Doak	Renton		98059
Bruce	Dobson	Langley		98260
Wendy	Simmons	Eugene	OR	97405
Doris	Wilson	Kirkland		98034
Betsy	Czinger	Spokane		99208
David	Cason	Sequim		98382

Denise	Bolzle	Beaverton	OR	97078
Mary Fay	Helmon	Issaquah	WA	98029
Lynne	Lesson	Langley	WA	98260
Patricia	Miksa	Portland	OR	97202
Fayette	Krause	Port Townsend	WA	98368
Mary	Shields	Bellingham	WA	98226
Wendy	Holland	Coos Bay	OR	97420
Ann	Breese	Bellevue	WA	98005
Nina	French	Seattle	WA	98178
Erik	Larue	Burlington	WA	98233
Cynthia	Marrs	Junction City	OR	97448
Sue	Stoeckel	Everett	WA	98203
Gerald	Smith	McMinnville	OR	97128
Martha	Shelley	Portland	OR	97203
Linda	McBride	Wakefield	RI	2879
Heidi	Castaneda	Coupeville	WA	98239
Michelle	Trosper	Battle Ground	WA	98604

Jack	Stansfield	Stanwood	WA	98292
Ronna	Wareh	Aloha	OR	97078
Jack	Huisinga	Bainbridge Island	WA	98110
Maurine	Canarsky	Portland	OR	97214
Sarah	Ross	Eugene	OR	97405
Phyllis	Lewis	Sisters	OR	97759
Glen	Bovenkamp	Normandy Park	WA	98166
Rita	Ryder	Lake Tapps	WA	98391
Scott	Baker	Poulsbo	WA	98370
Matthew	Waldron	Hillsboro	OR	97123
Mary	Repar	Stevenson	WA	98648
Catherine	Hillerman	Oregon City	OR	97045
Tara	Iacolucci	Kent	WA	98031
Daniel	McCollum	Cottage Grove	OR	97424
Karelina	Resnick	Eatonville	WA	98328
John	Atkinson	Seattle	WA	98133
Brian	Ferguson	Seattle	WA	98103
Svitlana	Dyeryabina	Bothell		98021
Linda	Duer	Duvall		98019
Bobby	Morrison	Olympia	WA	98502
Sandra	Quam	Vashon		98070
Kris	Alhassan	Airway Heights		99001
Domingo	Hermosillo	Seattle		98117
Annika	Bowden	Seattle		98116

Jean	Saunders	Dallas	OR	97338
Susan	Dumont	Belfair	WA	98528
Eric	Archambault	Paris	TX	75460
Julie	Hahn	Seattle	WA	98107
Lawrence	Magliola	Sequim	WA	98382
Joan	Gouge	Lopez Island	WA	98261
Jennifer	Gibbs	Ashland	OR	97520
Mary	Pritchard	Eugene	OR	97401
Jeffry	Sarantopulos	Friday Harbor	WA	98250
Jim	Popper	Gold Bar	WA	98251
Berklee	Robins	Lake Oswego	OR	97035
Joan	Wilder	Bend	OR	97703
Virginia	Ciszek	Vashon	WA	98070
Rebecca	Weiss	Seattle	WA	98118
Gwen	Purdy	Poulsbo	WA	98370
Susan	Berta	Freeland	WA	98249
Molly	McEnerney	Lafayette	CA	94549
James R.	Whitefield	Anacortes	WA	98221
Pat	Pearson	Port Ludlow	WA	98365
Tom	Lang	Blaine	WA	98230
Alline	Thurlow	Seattle	WA	98122
Camille	Hall	Corvallis	OR	97330
Dianne	Ensign	Portland	OR	97219
Marguerite	Winkel	Spokane	WA	99201
Ralph	Sanders	Black Diamond	WA	98010

Rebecca	Crowder	Eugene	OR	97405
Patty	Bonney	Portland	OR	97223
Autumn	Summers	Sebastopol	CA	95473
Darlene	Sievert	Seattle	WA	98103
James	Morgante	Seattle	WA	98104
Jared	Widman	Port Orchard	WA	98366
Brian	Hildebrandt	Mercer Island	WA	98040
Judith	Hance	Seattle	WA	98115
Kathleen	Beavin	Bothell		98021
Cathy	Harris	Vancouver		98683
Carol	Wagner	Canby	OR	97013
Kimberlee	Ireton	Edmonds		98026
Gail	Ferber	Edmonds		98020
Barbara	Gregory	Seattle		98115

Kirstin	Clauson	Freeland		98249
Sammy	Low	Stanwood	WA	98292
Michael	Framson	Medford	OR	97504
Craig	Weakley	Anacortes	WA	98221
Darlene	Schanfald	Sequim	WA	98382
Annapoorne	Colangelo	Clinton	WA	98236
Stephen	Condit	Seattle	WA	98133
Marlene	Lambert	Sequim	WA	98382
Marietta	Bobba	Seattle	WA	98178
Deva	Vance	Portland	OR	97219
Jessica	Kopicki	Bellingham	WA	98229
Dorinda	Kelley	Portland	OR	97213
Mary	Schroff	Poulsbo	WA	98370
Randall	Esperas	Bend	OR	97707
Ginny	Barry	Beaverton	OR	97007
Katherine	Showalter	Portland	OR	97202
Patricia	Coffey	Langley	WA	98260
Bonnie	Hildebrand	North Plains	OR	97133
Steven	Tichenor	Grants Pass	OR	97527
John	Goldthwait	Redmond	WA	98053
Dwight	Long	Klamath Falls	OR	97603
Barbara	Comnes	Ashland	OR	97520
Jen	Dimarco	Friday Harbor	WA	98250
Kelly	McConnell	Portland	OR	97223

Kathy	Peterson	Olympia	WA	98516
Richard	Crerie	Sedro Woolley	WA	98284
Richard	Knablin	North Bend	OR	97459
Danny	Dyche	Hillsboro	OR	97123
Mike	McCormick	Seattle	WA	98115
Nancy	Sosnove	Everett	WA	98201
Michael	MacDougall	Nine Mile Falls	WA	99026
Nancy	Brown	Stanwood	WA	98292
Douglas	Demers	Tahuya	WA	98588
Angela	Smith	Seattle	WA	98166
Laura	Hanks	Portland	OR	97222
Sharon	Fetter	Puyallup	WA	98371
Gay And David	Santerre	Buckley	WA	98321
Craig	Mackie	Nehalem	OR	97131
Roni	Britton	Redmond	WA	98052
Janna	Piper	Portland	OR	97293
F	H	Orting		98360
Howard	Cherrington	Twisp	WA	98856
Michael	Arveson	Bonney Lake	WA	98391
Tracy	Ouellette	Bow	WA	98232
Lauren	Turner	Sequim	WA	98382
Per	Fagereng	Portland	OR	97202
Sue	Moon	Seattle	WA	98144
Sherry	Bupp	Redmond	WA	98052

Pamela	Wunderich	Heppner	OR	97836
David	Hermanns	Portland	OR	97203
Robert	Mueller	Kenmore	WA	98028
Karen	Horn	Ashland	OR	97520
Ellen	Saunders	Manning	OR	97125
Bonnie	Mauck	Portland	OR	97219
Elena	Rumiantseva	Seattle	WA	98115
Marion	Moat	Bothell	WA	98021
Wendy	James	Bellingham	WA	98229
Mary	Higgins	Mountlake Terrace	WA	98043
Karen	Young	Eugene	OR	97401
Sandi	Cornez	Portland	OR	97219
Taylor	Barker	Redmond	WA	98052
James	Mann	Elk	WA	99009
Michael	Stathatos	Washougal	WA	98671
Joe	Wiederhold	Bellingham	WA	98229
Jan And Larry	Slobin	Portland	OR	97229
Shane	Hoefsloot	Edmonds	WA	98020
Judith	Rice-Jones	Colorado Springs	CO	80907
Robert	Jensen	Olympia	WA	98513
Chris	Chenoweth	Lake Oswego	OR	97035
Richard	Kunz	Poulsbo	WA	98370
George	Fairfax Md	Oak Harbor	WA	98277
Kathy	Wilmering	Seattle	WA	98103
Janice	Olson	Centralia	WA	98531

Sandra	Maloff	Vancouver	WA	98683
Hm	Mm		OR	
Rosemary	Miller	Seattle	WA	
Mary	Delay	Woodinville	WA	98072
Valerie	Guinan	Bend	OR	97707
John	Browne	Ocean Park	WA	98640
Jodi	Thomas	Mount Vernon	WA	98274
Luminara	Serdar	Eugene	OR	97401
Heather	Bradley		WA	
Jason	Knopp	Vancouver	WA	98665
Patricia	Dunning		OR	
Charlene	Street	Lacey	WA	98503
Cathleen	Gosho	Seattle	WA	98133
A	R		WA	
James And Louise	Key	Camano Island	WA	98282
Ruchi	Stair	Seattle	WA	98133
Phyllis	Villeneuve	Olympia	WA	98512
P	Walchenbach	Sequim	WA	98382
H	Goldblatt	Bainbridge Island	WA	98110
Jaz	Klinski	Olympia	WA	98506
Craig	Geiger	Olympia	WA	98501
D	Robinson	Curlew	WA	99118
Margaret Ann	Farmer	Yelm	WA	98597
Jackie	Albert	Poulsbo	WA	98370

Louise	Siewert	Tualatin	OR	97062
Kevin Gershom	Sicard	Independence	OR	97351
Linda	Frank	Tacoma	WA	98445
Jane	Haugen	Edmonds	WA	98020
Athena	Fitch	Belfair	WA	98528
Ruth W.	Shearer	Lacey	WA	98503
Jane	Sherman		WA	
Mary	Carter	Olympia	WA	98512
Ea	Wo		WA	
Jay	Zhang	Renton	WA	98058
Zoi	Encinas	Everett	WA	98201
Vickie	Waldier	Ilwaco	WA	98624
Robyn	Pipkin	Mount Vernon	WA	98274
A	Harting	Morton	WA	98356-9422
C	Beatley	Portland	OR	97212
Lisa	Ferraris		OR	
Ben	Goe		WA	
Paul	Decourcey	Gresham	OR	97080
El	Frazier	Olympia	WA	98502
Monika	Hinse	Orinda	CA	94563
R	B	Ashland	OR	97520
Dr. Shelley	Sovola	Brookings	OR	97415
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Kathleen	Bauer	Portland	OR	97212

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Commenter: Amy van Saun - Comment O-12-1

Please see attached comments from Center for Food Safety, Center for Biological Diversity, and Western Environmental Law Center.

CENTER FOR FOOD SAFETY

November 1, 2017

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Washington State Department of Ecology
Southwest Regional Office
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Re: Comments on Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

Introduction

Thank you for the opportunity to comment on the Washington Department of Ecology (Ecology)'s Supplemental Environmental Impact Statement (SEIS) for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington. These comments are submitted on behalf of Center for Food Safety, Center for Biological Diversity, and the Western Environmental Law Center.

Center for Food Safety (CFS) is a national non-profit organization representing over 900,000 members nationwide and tens of thousands in Washington State. CFS uses education, policy and legislation, and impact litigation to address the negative effects to public health and the environment from harmful food production technologies, and supports ecological food production, like organic and beyond. CFS operates in the Pacific Northwest and is particularly concerned with the increasingly industrial aquaculture and in particular the use of pesticides in shellfish aquaculture.

Center for Biological Diversity is a national non-profit organization with offices in the Northwest and throughout the country, dedicated to the protection of diverse native species and their habitats through science, policy, education, and law. The Center has over 1.3 million members and online activists throughout the United States, including many in Washington State.

The Western Environmental Law Center uses the power of the law to safeguard the public lands, wildlife, and communities of the American West in the face of a changing climate. We envision a thriving, resilient West, abundant with protected public lands and wildlife, powered by clean energy, and defended by communities rooted in an ethic of conservation. As a public interest

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law firm, WELC integrates national policies and regional perspective in partnership with our clients to implement smart and appropriate place-based solutions.

While we applaud Ecology for drafting the SEIS to evaluate the science that has evolved since the Final EIS for imidacloprid use in Willapa Bay and Grays Harbor, we believe the draft SEIS fails to adequately assess all new information and a reasonable range of alternatives, and accordingly Ecology should **not** move forward with a Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit or Sediment Impact Zones for imidacloprid use in Washington waters. The SEIS identifies significant unknowns and data gaps, and what we do know about neonicotinoids is extremely disturbing. Imidacloprid is the oldest and most toxic of the neonicotinoid insecticides. Regulators around the world are finally waking up to the pollution of our soils and waterways with this class of insecticides and the extremely harmful consequences —a[1] second Silent Spring according to some experts.[2] Pesticides, more accurately described as "biocides" because they rarely only kill "pests," are designed to kill living things and as such their use in marine and estuarine environments will have negative unintended effects. To continue the toxic legacy of carbaryl with another pesticide will only continue the pesticide treadmill. Not only is imidacloprid not the only option for restoring balance to the Bay, it is unlikely to be effective in achieving longterm ecological balance. More than 50 years of carbaryl use (a likely carcinogen) has not solved the shrimp problem identified by some shellfish growers, and there is no indication that imidacloprid will be any different. Indeed, the efficacy shown through field trials indicates that this plan is readymade to breed resistant burrowing shrimp. While the poisoning of public waters may provide some limited short-term relief, it is not a long-term solution.

The SEIS, although acknowledging some likely harms and many unknowns, still concludes that there will be no significant unavoidable adverse effects of spraying imidacloprid into the Bay, or that any impacts will be localized and short-term. This conclusion is not supported by the science, and reliance on the unpublished research of Kim Patten is inappropriate, given his ethical violations

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[1] In response to alarming levels of aquatic contamination and impacts to pollinators, Canada's Pesticide Management Regulatory Agency (PMRA) is currently considering a ban on imidacloprid, https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pestmanagement/public/consultations/proposed-re-evaluation-decisions/2016/imidacloprid /document.html, (*see also* CFS Comments to Health Canada PMRA on Proposed Re-evalution Decision PRVD2016-20, Imidacloprid, attached as Exhibit A). In Europe, a temporary ban on major neonicotinoids is poised to become a permanent ban. Damian Carrington, *Europe poised for total ban on bee-harming pesticides*, The Guardian (Mar. 23, 2017). France has already imposed a full ban on neonicotinoids. *France says ban on neonicotinoids will go ahead in 2018*, Farming UK (June 28, 2017).

[2] *Silent Spring*, a book by Rachel Carson published in 1962, detailed the detrimental effects of indiscriminate pesticide use—leading to the ban on DDT and inspiring the environmental movement and creation of the Environmental Protection Agency.

3 showing close ties to the shellfish growers that are the permit proponents. Further, Ecology cannot evaluate the shellfish growers' plan in a vacuum, or as compared only to the old, now abandoned, plan to spray even more acreage. Rather, Ecology must evaluate a range of reasonable alternatives, including more environmentally protective alternatives, to the proposed NPDES permit. Given the massive uncertainties and the known harmful impacts, it is simply not worth the risk to use a dangerous neurotoxin in public waters that provide essential habitat to so many species.

State Environmental Policy Act

The State Environmental Policy Act ("SEPA") is Washington's core environmental policy and review statute. Like its federal counterpart, the National Environmental Policy Act ("NEPA"), SEPA broadly serves two purposes: first, to ensure that government decision-makers are fully apprised of the environmental consequences of their actions and, second, to encourage public participation in the consideration of environmental impacts. *Norway Hill Preservation and Prot. Ass'n v. King Co*, 87 Wn.2d 267, 279 (1976). For decades, SEPA has served these purposes effectively, requiring full environmental reviews for projects with significant environmental impacts.

SEPA was enacted to "encourage productive and enjoyable harmony between humankind and the environment" and to "prevent or eliminate damage to the environment and biosphere." RCW 43.21C.010. Thus in adopting SEPA, the Washington legislature declared the protection of the environment to be a core state priority, "recognize[ing] that each person has a fundamental and inalienable right to a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment." RCW 43.21C.020(3). This policy statement, which is stronger than a similar statement in the federal counterpart of NEPA, "indicates in the strongest possible terms the basic importance of environmental concerns to the people of the state." *Leschi v. Highway Comm'n*, 84 Wn.2d 271, 279–80 (1974).

SEPA is more than a purely "procedural" statute that encourages informed and politically accountable decision-making. SEPA requires agencies to integrate environmental concerns into their decision making processes by studying and explaining environmental consequences before decisions are made. *See Stempel v. Dep't of Water Resources*, 82 Wn.2d 109, 117–18 (1973). In enacting SEPA, the state legislature gave decision-makers the affirmative authority to deny projects where environmental impacts are significant, cannot be mitigated, and collide with local rules or policies. SEPA provides substantive authority for government agencies to condition or even deny proposed actions—even where they meet all other requirements of the law—based on their environmental impacts. RCW 43.21C.060. As one treatise points out, when this premise was challenged by project proponents early in SEPA's history, "the courts consistently and emphatically responded that even if the action previously had been ministerial, it became *environmentally discretionary* with the enactment of SEPA."[4]

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Washington State Executive Ethics Board, Investigative Report and Board Determination of Reasonable Cause, No. 2017-012, Kim Patten, Director WSU Pacific County Ext. (July 20, 2017), attached as Exhibit B. 4

Richard Settle, *SEPA: A Legal and Policy Analysis*, §18.01[2] (2014) (emphasis added).

Discussion

I. Purpose and Objectives

Each EIS must "specify[] the purpose and need to which the proposal is responding . . .." WAC 197-11-440(4). Because the stated purpose and need for an action determines the range of alternatives, it is essential that the agency articulates the project's purpose and need from the agency's perspective rather than simply adopting the project proponent's objectives for the project as its own. As courts have cautioned, "[o]ne obvious way for an agency to slip past the structures of NEPA is to contrive a purpose so slender as to define competing 'reasonable alternatives' out of consideration (and even out of existence.)" *Davis v. Mineta*, 302 F.3d 1104, 1119 (10th Cir. 2002).

Here, Ecology has identified the objectives of the proposed action as "[p]reserve[ing] and maintain[ing] the viability of clams and oysters commercially grown in Willapa Bay and Grays Harbor by controlling populations of two species of burrowing shrimp on commercial shellfish beds," and "[p]reserve[ing] and restor[ing] selected commercial shellfish beds in Willapa Bay and Grays Harbor that are at risk of loss due to sediment destabilization caused by burrowing shrimp." SEIS at 2-1. By adopting the proponent's purpose and need statement for the proposed action, Ecology has unnecessarily limited the range of potential alternatives that could meet the true object—namely, ensuring the viability of clams and oysters commercially grown in Willapa Bay and Grays Harbor. While it is true that the impact of burrowing shrimp on the shellfish beds in the region are the focus of the proposed permit, limiting the scope of analysis to only solutions that will address that one piece of the puzzle is problematic. Indeed, as discussed below, to date, Ecology has failed to identify any "reasonable alternatives," WAC 197-11-440(b)(5), to the proposed action. This indicates that the purpose and need is too narrowly defined.

Ecology's stated purpose and need is myopically focused on "controlling" burrowing shrimp and to ease the impacts on beds "destabliz[ed]" by the shrimp. These limiting clauses swallow the larger goal of the action, protecting the shellfish harvest from these areas. That is, controlling (or extirpating) the native burrowing shrimp cannot, or at least should not be, Ecology's purpose here. Rather, finding a solution that will allow Willapa Bay and Gray Harbor to continue to support viable shellfish operations while maintaining their ecological integrity and vitality should be the goal of this proposal. The purpose and need as stated does not allow the consideration of viable alternatives that could allow this to happen, with less environmental impact than the proposed action.

II. Reasonable Alternatives

SEPA requires that an EIS contain a detailed discussion of alternatives to the proposed action. RCW 43.21C.030(c)(iii). SEPA's regulations provide that an EIS must consider as alternatives those "actions that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation." WAC § 197–11– 440(5)(b). The discussion of alternatives in an EIS need not be exhaustive, but the EIS must present sufficient information for a reasoned choice among alternatives. *Toandos Peninsula Ass'n v. Jefferson Cy.,* 32 Wash. App. 473, 483 (1982).

A. The Alternatives Considered are Not Reasonable Alternatives

Here, Ecology has failed to consider any "reasonable" alternatives. Instead, in addition to the "no action" alternative, Ecology has proposed a single, more environmentally harmful alternative. This, by definition, is not a reasonable alternative. As a result, Ecology has wholly failed to comply with SEPA.

Ecology has identified the proposed action as authorizing an individual NPDES permit to authorize chemical applications of imidacloprid on up 485 acres per year of commercial clam and oyster beds within Willapa Bay, and up to 15 acres per year within Grays Harbor. With this established as the proposal, Ecology must develop, consider and explain the impacts of reasonable alternatives.

Ostensibly, Ecology will claim to have offered four alternatives for consideration: the no action alterative, Alternative 2: Continue Historical Management Practices – Carbaryl Applications with Integrated Pest Management (IPM); Alternative 3: Imidacloprid Applications with IPM on up to 2,000 acres per year in Willapa Bay and Grays Harbor, with aerial applications by helicopter, and Alternative 4: Imidacloprid Applications with IPM on up to 500 acres per year in Willapa Bay and Grays Harbor, with no aerial applications by helicopter. In addition, Ecology summarily dismisses several other alternatives, which according to the agency were considered but eliminated from detailed evaluation. However, Ecology notes that it is no longer considering Alternative 2. This leaves only the "no action" alternative and Alternative 3, against which the environmental impacts of Alternative 4, the proposed action, can be judged. It is unclear why Ecology is still considering Alternative 3, given that the current proposal by the WGHOGA is Alternative 4.

"The Washington Supreme Court has emphasized that the focus of SEPA is environmental impacts, explaining that a reasonable alternative is one that could feasibly attain or approximate a proposal's objectives *at a lower cost to the environment*." *Pub. Util. Dist. No. 1 of Clark Cty. v. Pollution Control Hearings Bd.*, 137 Wash. App. 150, 161–62, 151 P.3d 1067, 1072 (2007) (citing *King County v. Cent. Puget Sound Bd.*, 138 Wash.2d 161, 184–85, 979 P.2d 374 (1999)). Indeed, "[t]he required discussion of alternatives to a proposed project is of major importance, because it provides a basis for a reasoned decision among alternatives having differing environmental impacts." *Weyerhaeuser v. Pierce Cty.*, 124 Wash. 2d 26, 38, 873 P.2d 498, 504 (1994). To ensure this analysis is robust, "[t]here must be a reasonably detailed analysis of a reasonable number and range of alternatives." *Id.*, 124 Wash. 2d at 41 (citing Settle, The Washington State Environmental Policy Act: A Legal and Policy Analysis § 14(b)(ii) (4th ed. 1993)).

Unfortunately, here Ecology has not offered any "reasonable alternatives" for comparison.[29] First, according to Ecology, the "no action" alternative is not a viable alternative. Ecology concludes that under Alternative 1, "it was expected that most productive commercial clam and oyster grounds would decline over the subsequent 4- to 6-year period if no permit was issued to authorize pesticide applications to treat burrowing shrimp populations." SEIS at 2-12. As a result, if

6 this is true,

the no action alternative will not "attain or approximate the proposal's objectives," and thus is not a "reasonable alternative" by definition. Indeed, if this statement is accurate, then Alternative 4 will also fail to meet the purpose and need: if treatment will only take place on 500 acres per year, or a total of 2,500 acres during the life of the permit, then "most" commercial shellfish acreage in Willapa Bay and Grays Harbor will go untreated, as the amount of acreage

7 authorized

for shellfish aquaculture in these areas is more than ten times larger. If it is true that "most productive commercial clam and oyster grounds" are subject to decline (on the "order of 60 to 80 percent or more") then even the Alternative 4 proposal will not save the vast majority of oyster and clam grounds in Willapa Bay/Grays Harbor. Ecology should not overstate the nature of the problem here.

Second, according to Ecology, Alternative 3 is *not* less environmentally harmful alternative to the proposed action. In almost every instance, Ecology concludes that the environmental impacts of Alternative 3 will be "[s]imilar to Alternative 4" with respect to various environmental parameters considered, *see* SEIS 1-10–1-33, or worse because it included more acreage and aerial spraying. *See e.g.* SEIS at 2-13 (describing Alternative 4 as a "reduced-impact alternative compared to FEIS Alternative 3 in

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[29] With respect to Alternative 2, Ecology simply states that the "[u]se of carbaryl for the control of burrowing shrimp populations on Willapa Bay and Grays Harbor commercial shellfish beds is no longer considered by Ecology and other agencies to be a viable alternative," and therefore it will not be considered. SEIS at 2-12. As such, Alternative 2 does not serve as a "reasonable alternative" here.

that the acreage that may be treated under the currently requested permit is approximately two-thirds less"); 2-24 (the "substantive difference" between Alternatives 3 and 4 is the number of acres and the lack of aerial spraying in the currently proposed alternative). As a result, Ecology has failed to demonstrate how Alternative 3 would "attain or approximate a proposal's objectives *at a lower cost to the environment*."

As Alternative 3 was the only "viable" alternative Ecology has presented, it has failed to comply with SEPA. Again, SEPA requires the agency to develop, consider and compare "reasonable alternatives." WAC § 197–11–440(5)(b). Those alternative "*shall include* actions that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation." *Id*. (emphasis added). Here, this requirement has not been met, and the SEIS is insufficient as a matter of law.

Ecology cannot point to the other alternatives "eliminated from detailed evaluation" to save the SEIS. Although Ecology certainly is permitted to "indicate the main reasons for eliminating alternatives from detailed study," it must nonetheless, "[p]resent a comparison of the environmental impacts of the reasonable alternatives, and include the no action alternative." WAC §§ 197–11– 440(5)(b)(v) and (vi). Here, by not providing a more detailed analysis of the other alternatives Ecology has failed to include the required analysis of "reasonable alternative."

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[6] This claim is made with no citation or corroboration and thus its veracity is seriously questionable.

[7] *See* National Marine Fisheries Service, Endangered Species Act Section 7 Formal Biological Programmatic Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Shellfish Aquaculture Activities in Washington State, 8 (Sept. 2016) (table showing total continuing active and fallow acres of ground-based shellfish activity in Willapa Bay to be 25,965 acres and in Grays Harbor 3,065 acres, based on U.S. Army Corps of Engineers numbers).

If Ecology cannot envision a less environmentally harmful alternative for consideration and analysis, not complying with SEPA is not the correct action. Instead, as discussed above, Ecology likely needs to reevaluate the purpose and object of the proposed action, and broaden the definition to allow the consideration of additional, reasonable measures that could meet the newly defined purpose. Alternatively, Ecology could return the question to the project proponent for them to develop the information necessary for the agency to consider truly reasonable alternatives, which are both viable and cause less environmental harm. Absent taking such a step, Ecology has no choice but to deny the proposed action because it cannot comply with SEPA. RCW 43.21C.060.

B. Reasonable Alternatives Not Considered

Ecology eliminated non-chemical control methods for burrowing shrimp, including mechanical and alternative culture methods, based on unpublished research by Dr. Kim Patten. SEIS at 2-20–2-22. Apparently these methods of shrimp control (which appear variously more and less environmentally destructive, but without more detail it is impossible to know) were eliminated from consideration because they "failed to permanently reduce shrimp populations below the economic threshold (10 burrows/m²)." SEIS at 2-22. However, given the efficacy of imidacloprid ranging widely from 0% to 97%, (SEIS at A-10, Hart Crowser 2016 at 25), it is unclear why lower efficacy percentages are acceptable as a reasonable alternative when it is imidacloprid, but not when it is a mechanical method.

As explained above, Ecology failed to identify and evaluate a reasonable alternative that is less environmentally harmful, and part of this failure was the unreasonably narrow purpose and need. Stepping back, Ecology must look critically at the *causes* of increased shrimp populations and/or the imbalance of these native invertebrates, before it will find a viable long-term solution. Instead of focusing only on how to kill the shrimp, Ecology should be looking at how to encourage the other elements in the Bay's complex ecology that would bring shrimp into balance.

First, if a loss of predators is part of the problem, than a solution that focuses on restoration of those species' habitat would go a long way to bringing back these needed pieces of the puzzle. Just as in gardening, if aphids are attacking you can spray the whole thing with biocides that will kill off most insects, or you can encourage beneficial insects, like ladybugs, to eat the aphids. The former may seem like a quick and easy solution, but it does not stop pests in the long term. This is the lesson from terrestrial agriculture: industrial farming has been relying on chemical pest control for decades but still has major pest problems, whereas more and more evidence indicates that [8] encouraging a diverse array of insects, many of which are beneficial, will keep pests in check. Thus,

[8] *See e.g.* David W. Crowder et al., *Organic Agriculture Promotes Evenness and Natural Pest Control*, 466 Nature 109 (2010) http://www.nature.com.lawpx.lclark.edu/nature/journal/v466/n7302/

full/ nature09183.html; Matthew J.W. Cock et al., *Trends in the Classical Biological Control of Insect Pests by Insects: An Update of the BIOCAT Database*, 61 BioControl 349 (2016), https://link.springer.com / article/10.1007%2Fs10526-016-9726-3; Matthias Tschumi et al., *Tailored Flower Strips Promote Natural Enemy Biodiversity and Pest Control in Potato Crops*, 53 J. Applied Ecology 1169 (2016). doi:10.1111/1365-2664.12653; Robin Drieu & Adrien Rusch, *Conserving Species-Rich Predator Assemblages Strengthens Natural Pest Control in a Climate Warming Context*, 19 Ag. Forest Entomology 52 (2016) 10.1111/afe.12180.

an alternative that involves restoration of crucial shrimp-predator habitat could be both viable to control shrimp populations in the long-term and be more environmentally beneficial. It cannot be forgotten that the burrowing shrimp play an important role in the ecology of the Bay.

Second, Ecology failed to examine the interplay between eelgrass and shrimp in the SEIS, beyond noting that burrowing shrimp can inhibit eelgrass growth and density. *See e.g.* SEIS at 1-18. But this relationship runs both ways, as Ecology itself noted in its FEIS for the use of imazamox on Japanese eelgrass: research shows that "eelgrasses can reduce numbers of burrowing shrimp (ghost shrimp and mud shrimp) that are also problem species for shellfish growers. (Feldman et al. 2000;

9 and Harrison 1987 as cited in Fisher Bradley and Patten 2011)." This includes native *z. marina* and

z. japonica eelgrasses, whose roots impede shrimp burrowing. So this begs the question of whether the loss of eelgrass is contributing to increased shrimp numbers, and whether the intentional killing of eelgrass through chemical means is contributing. Ecology did not evaluate this interplay, but the same shellfish growers who now seek to use imidacloprid to kill shrimp have for years used imazamox to kill eelgrass, under the guise of the Japanese eelgrass being non-native and harmful to clam production. But Japanese eelgrass deters shrimp as well as native eelgrass. Is it possible that killing off eelgrass has allowed the shrimp to flourish? Growers used chemicals to kill off shrimp (carbaryl), possibly allowing Japanese eelgrass to flourish in their place, then growers got a permit to kill the eelgrass through chemical means, and now shrimp numbers are increased, so the growers are back asking to spray different chemicals to kill off the shrimp. It is a never-ending pesticide treadmill, and because some shellfish growers have identified both eelgrass and burrowing shrimp as pests, they seek to use the easiest and cheapest solution to killing them both. But this is not how nature works—you cannot simply remove one element and assume that balance will be restored. Ecology needs to thoroughly evaluate how the removal of eelgrass may have contributed to an increase in shrimp, along with other causes of shrimp increase, before it can identify reasonable solutions. This may include comparing shrimp recruitment and eelgrass removal in the last few years (i.e. is there an overlap of acreage where eelgrass was sprayed and increased shrimp recruitment?).

Once the causes of shrimp imbalance are better understood, a solution that will actually be effective may be found. Several less environmentally harmful alternatives to the current proposal are also immediately identifiable, and were not considered in the SEIS. These include (or some combination of) the following:

- **Mechanical means (w/o pesticides)**: harrowing to expose shrimp and allow predators to consume them, *see* Comments of Erika Buck, FMO Aquaculture.
- **Alternative culture (w/o pesticides)**: use of techniques that protect oysters from sinking into surface of substrate, while evaluating environmental impacts of these techniques (i.e. sediment retention, plastic introduction, etc).
- **Bay restoration**: would be useful in conjunction with all alternatives, focus on habitat for predators of burrowing shrimp and other wildlife or plants that keep shrimp in check. **Imidacloprid w/ increased protections**, such as:
  - **No spraying in areas with higher organic carbon material in sediments**, based on increased persistence of imidacloprid in these sediment types (SEIS at 1-22, 1-35,

[9] Ecology, Final Environmental Impact Statement: Management of Zostera japonica on Commercial Clam Beds in Willapa Bay, Washington, 77-78 (2014).

2-24, 2-25). South Willapa Bay was originally excluded from the Sediment Impact Zone (SIZ) in 2015 because studies showed that imidacloprid would bind more readily to sediments with higher organic carbon. *Id.* at 2-6. Ecology provides no good reason why this been changed in the 2016 proposal when nothing in the intervening years indicates that the persistence is less of a concern; indeed the 2014 field studies did not include areas with higher organic carbon sediments, so are useless in refuting this increased persistence concern. Only one field trial was conducted in an area with high organic carbon (2011, Cedar River) and these results showed greater persistence in sediments and greater impacts to benthic organisms. *Id.* at 3-4. ○ **Integrated Pest Management that is actually outlined and evaluated**. As noted in the SEIS, the proposed IPM plan that was supposed to be submitted and approved by Ecology in 2001 was never submitted, nor in conjunction with the 2016 WGHOGA plan. Thus, Ecology and the public have no idea what IPM measures will be taken, and how this may contribute to the efficacy of pesticide use, development of shrimp resistance, and impacts to non-target organisms. The purpose of IPM is to use pesticides as a last resort, with the understanding that they are not a panacea. Without knowing even the basics of the IPM plan that would accompany an imidacloprid NPDES permit, it is unclear how environmentally protective any alternative actually is. An IPM plan for instance might require a certain set of circumstances to be in place before chemicals are used, after attempting other non-chemical methods of control.

○ Lower acreage

  - **Requirement not to treat many small plots in a checkerboard pattern or close together** (which would have greater off-plot impacts, SEIS at 2-14), or a requirement to maintain a certain distance between treated plots each year. ○ **Work window restrictions**. For salmon, bull trout, and forage fish, U.S. Army Corps approved work windows for Willapa Bay run from **July 16-Oct. 14**. However, the proposed plan would allow spraying from April 15 to December 15, which could [10] allow spraying outside the windows for salmon, bull trout, and Pacific Sand Lance. Ecology acknowledges the overlap with juvenile salmon out-migration, but summarily concludes that "application methods would minimize potential for direct exposure" (SEIS at 3-30) with no details as to *how* this will happen, or evaluation of whether there is potential for exposure after application, through ingestion of contaminated food, or indirect effects from a reduction in food sources.

- **Buffers**. The only buffer offered in the SEIS for any subsequent permit is a 25-foot buffer for shellfish to be harvested within 30 days. This is wholly inadequate to prevent contact between soon-to-be harvested oysters and clams and imidacloprid drift, given the distances at which imidacloprid was detected in the field trials (at 1,640 and 2,400 feet). This chemical will disperse in water, (that is exactly what the proponents rely on to claim impacts will be limited), and any spraying adjacent to oysters will result in their exposure and filtration of that same water. To allow spraying within 25 feet of oysters that might be harvested the *next day* will ensure contamination. Not only are greater buffers needed to prevent contamination of food, they should be imposed to protect adjacent tide beds. These buffers should be based on field research and be sufficient to prevent harmful levels of imidacloprid to drift off of plots being sprayed.

[10] USACE, Approved Work Windows for Fish Protection for All Marine/Estuarine Areas (Aug. 14, 2012).

III. Scope and Adequacy of Environmental Review

SEPA requires an EIS for any action that has a "probable significant, adverse environmental impact." RCW 43.21C.031(1). Significance means a reasonable likelihood of more than a moderate adverse impact on environmental quality." WAC 197-11-794.

"A proposal's effects include direct and indirect impacts caused by the proposal. Impacts include . . . the likelihood that the present proposal will serve as precedent for future actions." WAC

197-11-060(4)(d). The scope of impacts includes direct, indirect, and cumulative impacts. WAC 197-11-792. "The range of impacts to be analyzed in an EIS (direct, indirect, and cumulative impacts, WAC 197-11-792) may be wider than the impacts for which mitigation measures are required of applicants." WAC 197-11-060(4)(e). It is implicit in SEPA that an "agency cannot close its eyes to the ultimate probable environmental consequences of its current action." *Cheney v. City of Mountlake Terrace*, 87 Wn.2d 338, 344 (1976).

An EIS must evaluate the likely impacts related to the project. WAC 197-11-060(4).

Decision makers must provide a "detailed statement" of environmental impacts. RCW 43.21C.030(2)(c). SEPA requires full disclosure and "detailed" consideration of all affected environmental values. At its heart, SEPA is an "environmental full disclosure law." *Norway Hill Preservation and Protection Association v. King Cnty. Council*, 87 Wn.2d 267 (1976). The *Norway Hill* court also highlighted the legislature's intent that "environmental values be given full consideration in government decision making," and its decision to implement this policy through the procedural provisions of SEPA which "specify the nature and extent of the information that must be provided, and which require its consideration, before a decision is made." *Id.* at 277–78.

Environmental reviews under SEPA must identify significant impacts on the natural and built environment. WAC 197-11-440(6)(e). Such reviews must use sufficient information and disclose areas where information is speculative or unknown. WAC 197-11-080(1), (2). Where there is scientific uncertainty, Washington courts have required agencies to disclose responsible opposing views and resolve differences. These requirements feed into the ultimate standard of review for EISs: adequacy is based on a rule of reason. *Cheney v. Mountlake Terrace,* 87 Wn.2d 338, 344 (1976). Courts require reasonably thorough information disclosure and discussion, good data and analysis to support conclusions, and sufficient information to make a reasoned decision. *Klickitat County Citizens Against Imported Waste v. Klickitat County,* 122 Wn.2d 619, 633 (1993). Sufficiency of the data is also assessed under the "rule of reason," which requires a "'reasonably thorough discussion of the significant aspects of the probable environmental consequences' of the agency's decision." *Weyerhaeuser v. Pierce Cnty.,* 124 Wn.2d 26, 38 (1994) (citations omitted).

In making the similar assessment under NEPA, federal courts require agencies to take a "hard look" at environmental impacts. More specifically, for review of the NEPA claims, the Court must "ensure that an agency has taken the requisite hard look at the environmental consequences of its proposed action, carefully reviewing the record to ascertain whether the agency decision is founded on a reasoned evaluation of the relevant factors." *Te-Moak Tribe v. Interior*, 608 F.3d 592, 599 (9th Cir. 2010) (quoting *Greenpeace Action v. Franklin*, 14 F.3d 1324, 1332 (9th Cir. 1992) (internal quotation marks and citations omitted)). This review must be "searching and careful." *Ocean Advocates v. U.S. Army Corps of Engineers*, 402 F.3d 846, 858 (9th Cir. 2005).

Washington Courts have employed the "hard look" doctrine directly or in other cases have required full disclosure and consideration of environmental values. *See Pub. Util. Dist. No. 1 of Clark Cnty. v. Pollution Control Hearings Bd.*, 137 Wash. App. 150, 158, 151 P.3d 1067, 1070 (2007); *Toward*

Responsible Dev. v. City of Black Diamond, 179 Wash. App. 1012 review denied, 180 Wash. 2d 1017, 327 P.3d 54 (2014) (unpublished opinion) ("Courts review an EIS as a whole and examine all of the various components of [the] agency's environmental analysis ... to determine, on the whole, whether the agency has conducted the required 'hard look.'"); *see also Coalition for a Sustainable 520 v. U.S. Department of Transportation*, 881 F. Supp. 2d 1243, 1259 (W.D. Wash. 2012) (holding implicitly that "hard look" under NEPA sufficient for SEPA review). Where "hard look" is not discussed or employed directly, courts have required a "reasonably thorough discussion" of environmental impacts. *See Toward Responsible Dev. v. City of Black Diamond*, 179 Wash. App. (2014); *PT Air Watchers v. State, Dep't of Ecology*, 179 Wash. 2d 919, 927, 319 P.3d 23, 27 (2014) (citing *Norway Hill*, 87 Wn.2d at 275) (requiring "full disclosure and consideration of environmental values").

A. Unknown Impacts/Knowledge Gaps

Ecology acknowledges some of the (significant) areas of uncertainty and data gaps. SEIS 133–1-38. Some very concerning data gaps exist, and should be filled before Ecology moves forward with a permit. Among these are the lack of research on impacts to marine species, the lack of multiyear studies on the accumulation of imidacloprid in sediments (particularly high organic carbon sediments that are also proposed for spraying), long-term toxicity to benthic and free-swimming invertebrates, and the species that use them as food sources, a method for determining the treatment threshold to ensure efficacy, the possibility of resistance by burrowing shrimp, and whether changes in season will affect impacts and efficacy (as field trials were limited in time and treatment is proposed for April through December), and the effects of imidacloprid degradation products. These uncertainties alone indicate that more research must be completed; otherwise the impacts of this plan will not be known until it is too late.

As to efficacy and the development of resistance, if Ecology allows imidacloprid to be used on oyster and clam beds, this chemical will be sprayed at levels that will kill anywhere from 30 (or lower) to 90 percent of mud shrimp in any given plot. SEIS at 2-23. Not only does this extreme variability call into question whether this proposal will even work for everyone who wants to use it, but it is very troubling from the point of view of invertebrate resistance. Pesticide resistance in land-based agriculture is common and widespread, even with respect to neonicotinoids.[11] It occurs when

[11] Bass, C., I. Denholm, M.S. Williamson, and R. Nauen. 2015. The global status of insect resistance to neonicotinoid insecticides. *Pesticide Biochemistry and Physiology, 121*, pp. 78-87; Elzaki, M.E.A., J. Pu, Y. Zhu, W.

Zhang, H. Sun, M. Wu, and Z. Han. 2017. Cross-resistance among common insecticides and its possible mechanism in Laodelphax striatellus Fallén (Hemiptera: Delphacidae). Oriental Insects, pp. 1-14; Perry, T., P. Batterham, and P.J. Daborn. 2011. The biology of insecticidal activity and resistance. Insect Biochemistry and Molecular Biology, 41(7), 411-422; Voudouris, C.C., M.S. Williamson, P.J. Skouras, A.N. Kati, A. J. Sahinoglou, and J.T. Margaritopoulos. 2017. Evolution of imidacloprid resistance in Myzus persicae in Greece and susceptibility data for spirotetramat. Pest Management Science, 73(9), pp. 1804-1812.

plants or insects evolve in response to a chemical stimulus, such that the chemical no longer kills or harms the species that is targeted. If a chemical is highly effective at killing the target species, then resistance develops slowly, as there is less of a chance for resistant populations to develop. However, when a chemical is used at a concentration that will have a moderate effect on the target species' survival, like the proposed use, then resistance can happen very quickly. Given this uncertainty, we not only question whether the proposed use of imidacloprid is safe, but whether the demonstrated efficacy even justifies its use in the first place. These values are highly variable and it is very likely that, if this proposal is granted, some users will not get any benefit at all. This level of efficacy also lends itself to the quick development of resistance in shrimp, which will further decrease efficacy over the five years of the proposed permit. As discussed elsewhere, however, increasing the concentration, application rates, and/or the geographic scope of the applications brings addition *known and unacceptable* environmental risk. Thus, any "benefits" gained in terms of efficacy will be significantly outweighed by the larger harms caused.

As to imidacloprid degradation products, only imidacloprid is analyzed in this study and all of the field trials submitted so far. Ecology states: "Studies have shown that imidacloprid has eight degradation products as a result of hydrolysis, photolysis, and soil and microbial degradation. These degradation products include: imidacloprid-olefin, 5-hydroxy- imidacloprid, imidaclopridnitrosimine, imidacloprid-guanidine, imidacloprid-urea, 6-chloronicotinic acid, imidaclopridguanidine-olefin, and acyclic derivative. The toxicity levels of all the degradation products are equal to or lower than the toxicity of the parent compound (SERA 2005)." SEIS at 3-11. These degradation products are not inert or somehow non-toxic. In fact some of their toxicities may be as high as the parent compound itself. Therefore, if the parent compound can no longer be detected, this should not be taken as any indication that there are not degradation products that are still having toxicities to aquatic invertebrates.

Field Study Flaws and Gaps.

The 2014 field studies in Willipa Bay[30] provide the most recent and extensive analysis of the effects of imidacloprid on marine communities in these tidelands. Unfortunately, we have identified many weaknesses in these field trials, some of which could benefit from a new analysis by Ecology and

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Hart-Crowser. 2014 Field Investigations. Experimental Trials for Imidacloprid Use in Willapa Bay. Willapa Bay, Washington. January 8, 2016. (hereafter 2014 field study) some of which render the analysis relatively uninformative. We have focused our critique to the analysis of imidacloprid concentrations in surface water, sediment and sediment porewater. The surveys of the effects on benthic and epibenthic invertebrates, unfortunately, are highly subjective due to the extreme variability in these regions and should not be used in decision making.

The screening values used in the 2104 field studies are **not protective** of saltwater invertebrates. Therefore, these studies can tell you when unsafe concentrations were present but cannot tell you when safe conditions existed. The screening values used were 3.7 μg/L for surface water, 6.7 μg/L for sediment and 0.6 μg/L for sediment porewater.

1. Surface water

For the surface water we believe the authors underestimated the potential for imidacloprid residues to seep from the sediment back into surface water during sequential tides. While the highest concentrations would certainly be immediately after application, there would likely be some amount of imidacloprid moving from the sediment back into tidewater that subsequently comes back into the bay on a regular basis. Since surface water was not measured after 2 hrs post-application,[31] that remains a significant uncertainty in the field trials.

We also disagree with the authors' decision to use the LC_{50} of the mysid shrimp as the acute toxicity criterion. This value was identified in 2012 and ignores the analyses that have been completed since then.[14] It is also extremely troubling that the authors would pick and choose the surrogate species they feel is most relevant (in this case using the mysid shrimp as the most "relevant invertebrate"). There are very few studies done on species that exist in Willapa bay and choosing the one surrogate species that resides in these waters and coming to the conclusion that this accurately represents all invertebrates in the bay in scientifically indefensible.

As an alternative to using the LC_{50} of a single species to identify a safety threshold for acute toxicity, we recommend using one tenth of EPA's acute toxicity criterion for freshwater invertebrates, which is based on a wide variety of species and would be adequately protective of all species in the bay. This value would come to 0.077 μg/L instead of the current 3.7 μg/L. Alternatively, one tenth of the HC_{05} value from the PMRA analysis could be utilized. This value would be 0.137 μg/L instead of the current 3.7 μg/L. The practical quantitation limit for dissolved imidacloprid in water in this field study is below

[31] 2014 field study at 9.
[14] *Id.* [15] *Id.* at 10. [16] *Id.* at 12.

both of these values (0.04 μg/L);[15] therefore, Ecology can take the data from the 2014 field studies and analyze through the lens of a new screening value.

2. Sediment and Sediment Porewater

The screening value for imidacloprid in sediment is the same as the practical quantitation limit. Therefore, this screening value does not identify a safe level of exposure; it is simply a result of the limits of the detection equipment used. That should be more clearly outlined in the draft SEIS, perhaps with the statement: "Undetected imidacloprid in sediment is not an indication that the levels are safe for invertebrates, therefore the sediment data can only be used to identify when levels of imidacloprid are harmful, not when they are safe."

The authors have decided to use a screening value of 0.6 μg/L for sediment porewater based on cherry-picking No Observed Effect Concentrations (NOECs) from species that live in sediments and choosing the lowest one. There was no discussion on what benthic species were used as suitable surrogates and whether these were saltwater or freshwater species, just that "a NOEC screening concentration up to 6 μg/L could be supported."[16] Ecology states: "EPA (2017) includes only two chronic studies of imidacloprid effects on saltwater invertebrates. If a larger database had been available, it seems likely lower values for chronic toxicity would have been noted for one or more invertebrate types, especially given the consistent pattern of wide variation in imidacloprid toxicity among species."[32] Since there were only two chronic studies of effects to saltwater invertebrates (one of which was the mysid shrimp, which the authors elected not to use), this suggests to us that the authors used freshwater benthic species as surrogates to identify the screening value of 0.6 μg/L. We are puzzled on why it would be suitable to use a freshwater invertebrate as a surrogate in this instance but nowhere else in the study.

Again we must stress how problematic it is to cherry-pick toxicity data from one or two species to identify screening values for all invertebrates in an entire ecosystem. We understand the desire to only analyze toxicity to creatures that live in the sediments and will be directly exposed to porewater, however many epibenthic species, like mysid shrimp, eat benthic organisms and will likely be exposed to imidacloprid seeping off the sediment and into surface water at the epibenthic zone. Furthermore, just because some invertebrates don't live in sediment does not mean that they should be taken out of the analysis. There are no data whatsoever to indicate that benthic organisms are somehow intrinsically different in their sensitivity to imidacloprid than other invertebrates. Therefore, in the interest of analyzing species with a variety of sensitivities to imidacloprid, the NOEC that EPA has identified for

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[32] *Id.* at A-
5. [18]
EPA. Imidacloprid: Human Health Draft Risk Assessment for Registration Review. June 22, 2017, https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0844-1235.

saltwater invertebrates (based on the mysid shrimp) would be the better choice. One tenth of that value would be 0.016 μg/L. This level is below the practical quantitation limit of the study.

Imidacloprid does not volatilize, is highly water soluble, and does not hydrolyze readily. However, it is photosensitive.[18] In the methodology section of the 2014 field study there was no mention of protecting sediment or sediment porewater samples from light. Imidacloprid buried under a layer of sediment would be protected from photolysis and would be expected to be relatively stable and have a much longer half-life. However, once a sample is collected, the chemical may now be exposed to light and begin to photolyse during sample collection and processing. This could ultimately underestimate the amount of chemical that exists in sediment and sediment porewater.

Further, the 2014 field trial failed to collect pre-and post-treatment sediment and porewater samples for control sites (Taylor and Coast treatment areas) or pre-treatment samples at the actual test sites. The study could be missing additive effects if there is any imidacloprid residues already in the water (from upload sources), and at base, without control data the impacts of imidacloprid are presented in a vacuum. The study further indicated that efficacy numbers were not reliable. *Id.* at 12. The study also stated that while benthic and epibenthic invertebrate samples were collected 1 day before treatment, and 14, 28, and 56 days after treatment, the 56 day sample was not processed, but provides no indication as to why, and what data is now missing because of this. *Id.* at 13-14. The field study also failed to include any areas with high organic carbon, despite the higher persistence of imidacloprid in these sediments. *Id.* at 23. Finally, surveys for dead crabs were conducted only along the borders of the spray area, and so are not necessarily indicative of the full amount of injured and dead crabs on the whole treated plot. *Id.* at 24-25.

B. Direct, Indirect, and Cumulative Impacts

Because the screening values used in the field studies and SEIS are not supported by sound science, the conclusions as to direct impacts to wildlife (invertebrates and vertebrates) are highly questionable. For the reasons described above, the 2014 field studies are of limited utility. As described below, the toxicity values used as the basis of the SEIS analysis are also flawed. Ecology must go back to evaluate impacts based on scientifically defensible levels.

To provide some context, imidacloprid products are not approved for use in water in *any other context*, and to the contrary, labels on most neonicotinoid products strictly prohibit use in water or in places that could drift into water, noting the high toxicity to aquatic invertebrates. Accordingly, most aquatic studies are looking at concentrations that have drifted/run off from terrestrial sources of neonic-use, like in coated crop seeds or liquid drenches of ornamental plants, and not direct use in water. The plan proposes not just to spray imidacloprid in water, but to do so at a rate of 0.5 lb

a.i./acre, the highest application rate allowed for imidacloprid on any agriculture crop in the U.S. In fact, this application rate for oyster beds in the state of WA is higher than any other agricultural commodity in this country for application methods other than chemigation.[19] Simply put, this will result in some of the highest concentrations of imidacloprid allowed on *land* in the U.S., but in water (where all other uses are prohibited).

1. Acute toxicity value

Clearly the lack of toxicity studies of imidacloprid's effect on saltwater invertebrates is an enormous uncertainty when trying to estimate ecosystem-wide effects of pesticide spraying in these estuaries. Unfortunately, Ecology has opted to use the EPA's acute toxicity criterion for saltwater invertebrates, which is 16.5 μg a.i./L.[20] This is not a protective threshold value and should be discarded for the following reason:

The 16.5 μg a.i./L value is based off of EPA's antiquated Risk Quotient (RQ) and Level of Concern (LOC) approach for analyzing risk. The National Academies of Sciences issued a scathing indictment of this methodology in the context of endangered species risk assessment in 2013.[21] In this report, the authors state:

- The EPAs "concentration-ratio approach" for its ecological risk assessments "is ad hoc (although commonly used) and has unpredictable performance outcomes."[22]

19 EPA. Imidacloprid: Human Health Draft Risk Assessment for Registration Review. June 22, 2017. Appendix D. Table D.3. Available here: https://www.regulations.gov/document?D=EPA-HQOPP-2008-0844-1235.

20 SEIS at 3-20.

21 National Academy of Sciences. 2013. *Assessing Risks to Endangered and Threatened Species from Pesticides*, Committee on Ecological Risk Assessment under FIFRA and ESA Board on Environmental

Studies and Toxicology Division on Earth and Life Studies National Research Council (April 30, 2013). (hereafter NAS Report). 22 *Id*. at 149.

- "RQs are not scientifically defensible for assessing the risks to listed species posed by pesticides or indeed for any application in which the desire is to base a decision on the probabilities of various possible outcomes."[23]
- "The RQ approach does not estimate risk…but rather relies on there being a large margin between a point estimate that is derived to maximize a pesticide's environmental concentration and a point estimate that is derived to minimize the concentration at which a specified adverse effect is not expected."[24]

This critique should not be brushed off as being "endangered species specific." One reason it is hard to estimate risk to endangered species is due to unsuitable, or lack of available, surrogate species. Ecology is grappling with the exact same problem here. There are simply not enough studies that have been done on saltwater invertebrates. Ecology states: "For saltwater invertebrates, EPA (2017) found only a limited number of studies covering seven estuarine or marine species, five of which were crustaceans."[25] This is simply not sufficient. Ecology also states that "Within groups (e.g., among aquatic insects), the range of toxicity could vary over four orders of magnitude or more (i.e., the difference between a value of 1 and a value of 10,000)…"[26] With that amount of variability in toxicity, a toxicity threshold based off of studies on seven species is completely meaningless. There is a reason that EPA's acute toxicity criterion is so much higher than PMRA's or any of the other independent analyses that have been done. The RQ/LOC analysis is designed to be used when there is an abundant dataset with a wide variety of species that have been studied. That is not the case here and this methodology should simply not be used to estimate risk to marine invertebrates. There are two ways Ecology could move forward to identify a scientifically defensible acute toxicity criterion. The first would be to use EPA's acute toxicity criterion for freshwater invertebrates and an LOC of 0.5. Unlike saltwater species, there is an abundance of data on freshwater invertebrates representing multitudes of species and this data set could be reasonably assumed to be protective of the many invertebrates in Willapa Bay and Grays Harbor. This would identify a value of 0.39 μg a.i./L. The second would be to use a Species Sensitivity Distribution (SSD) to develop a 5th percentile Hazard Concentration (HC_{05}) value instead of simply using the lowest EC_{50} value. The National Academies of Sciences recommends this approach as a better alternative to using a single species or low number of surrogate species to estimate toxicity.[27] Canada's Pesticide Management Regulatory Agency (PMRA) did do this analysis for estuarine/marine invertebrates and identified an acute toxicity value of 1.37 μg a.i./L. This approach was also used in Morrissey et al. for freshwater invertebrates.[28]

[23] *Id*. at 15. [24] *Id*. at 14. [25] *Id*.
[26] Ecology draft SEIS. Pg A-4
[27] NAS report. Pgs 128-131.
[28] Morrissey, C. A., P. Mineau, J. H. Devries, F. Sanchez-Bayo, M. Liess, M.C. Cavallaro, and K. Liber. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: a review. Environment International 74:291-303.

2. Other Impact Issues

Further, several additional studies exist that it does not appear Ecology used in the SEIS. These relate to aquatic impacts of imidacloprid on non-target species, and resistance to neonicotinoids,[29] and are listed in **Appendix A** and will be submitted along with these comments.

Overall, Ecology should not gloss over potential direct, sub-lethal impacts to vertebrate species, given that in the range of toxicity values, some sub-lethal impacts are possible at levels far below[30] what will be on- and off-plot if this plan goes forward. The same goes for indirect impacts to fish and bird species from loss of prey. Ecology repeatedly assumes that because the treatment acreage is smaller in Alternative 4, it will not cause Bay-wide or population wide impacts to these species, but fails to recognize that these impacts will exist in combination with others, and may have cumulative impacts.

SEPA requires consideration of cumulative effects. WAC 197-110060(4)(e); WAC 197-11330(3)(c) ("Several marginal impacts when considered together may result in a significant adverse impact."); *White v. Kitsap Cnty.*, SHB No. 09-019 at 17 (2009) (cumulative impacts of a proposed action together with the impacts of pending and future actions should be considered when making a threshold determination). While the SEIS contains sections discussing the mitigation measures that might reduce impacts, including the cumulative impact, these sections say essentially nothing about what the actual mitigation measures will be, or how they will reduce or eliminate impacts from imidacloprid spraying. The SEIS cumulative impacts section admits that it is unknown was the cumulative impact on sediments will be, but determines that this can be derived from monitoring once the permit is granted. SEIS at 2-28. This fails to evaluate what the potential cumulative impact on the Bay's resources will be from sediments containing imidacloprid residues for significant amounts of time. As to water quality, reliance on dilution and degradation is not sufficient in place of a cumulative impacts analysis. How will adding imidacloprid to waters already containing other pollutants (i.e. imazamox sprayed onto eelgrass, run-off from terrestrial sources, etc) impact water quality and the organisms that rely on clean water? What about invertebrates? If, as Ecology claims, populations of invertebrates return to sprayed plots within 2 or 4 weeks, then why wouldn't shrimp return just as quickly? SEIS at 2-29. If imidacloprid's impacts are really so limited, then how can it be claimed to be an effective solution to restore balance to burrowing shrimp?

Further, Ecology has failed to adequately evaluate impacts to threatened and endangered speices, somehow concluding that impacts to these species will be minimal or nonexistent. However, Frew (2015) reported an imidacloprid No Effect level for white sturgeon of 700 ppb (as a proxy for green sturgeon). This is lower than on-plot concentrations reported in field trials, so how can Ecology dismiss direct, sub-lethal and/or chronic impacts to green sturgeon? Using the LC50, (meaning a 50% chance of causing death, or "take" in this situation), is unacceptable. Ecology should not be using LC50 as appropriate exposure threshold for threatened and endangered species, whose very survival is already in jeopardy and any additional stress can be magnified in an extinction vortex (i.e. even if something else caused the species' initial decline, like habitat destruction, the final

[29] CFS has also submitted comments on EPA's Preliminary Aquatic Risk Assessment in Support of the Registration Review of Imidacloprid, and previously provided these to Ecology. They are also attached here as Exhibit A.

[30] Gibbons et al. 2015, SEIS at 3-23, 3-25, A-12.

descent to extinction is often driven by synergistic processes disconnected from the original cause of decline, including pesticide impacts or a reduction in food sources.[31]

Ecology fails to address additive or synergistic impacts on wildlife from imidacloprid in conjunction with other pesticides or other compounds already found in the water.

Conclusion

Given the significant unknowns, and lack of data, Ecology should not move forward with a permit to spray imidacloprid. The negative impacts are likely higher than Ecology reports in the SEIS, because one of the basic elements of this analysis, the screening levels for toxicity to invertebrates, is flawed. The evidence suggests not only a higher negative impact, but that the imidacloprid spray plan may not be effective in the long term. Ecology failed to assess a reasonable range of alternatives that would address the true purpose, to preserve commercial shellfish harvest while maintaining the health of Willapa Bay and Grays Harbor. As such, Ecology must draft a SEIS that complies with SEPA prior to moving forward with any NPDES permit. Knowing what we now know about neonicotinoids, it is best to end consideration of any imidacloprid spraying into marine or estuarine waters, and instead to focus on habitat restoration, including eelgrass, and sustainable methods of restoring balance to the Bay.

Respectfully submitted,

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31 *See* Brook, B. W., N.S. Sodhi, and C.J. Bradshaw, *Synergies among extinction drivers under global change*, Trends in Ecology and Evolution 23:453-460 (2008).

APPENDIX A

Aquatic

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Exhibit A

CFS Comments on Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds
in Willapa Bay and Grays Harbor, Washington

Catalogue number: H113-27/2016-20E-PDF

Pest Management Regulatory Agency (PMRA)
Health Canada
2720 Riverside Drive
Ottawa, Ontario

March 22, 2017

Comments to Health Canada Pest Management Regulatory Agency on Proposed Re-evaluation Decision PRVD2016-20, Imidacloprid

The Center for Food Safety (CFS)[1] in conjunction with the Save the Oak Ridges Moraine Coalition (STORM)[2] and Avaaz[3] submit the following comment in support of Health Canada Pest Management Regulatory Agency's (PMRA) proposal to prohibit the use of imidacloprid and further encourages PMRA to expedite the proposed phase out process.

We are writing on behalf of over 4.4 million people worldwide, including 200,474 Canadians, who have signed an Avaaz petition urging Canada and others to "immediately ban the use of neonicotinoid pesticides" particularly imidacloprid. Additionally CFS has 5,275 Canadian members who are increasingly concerned about the impacts that pesticides, especially neonicotinoids, are having on pollinators and our environment. Given the weight of evidence showing detrimental impacts of imidacloprid to aquatic ecosystems and the comprehensive evaluation of possible mitigation strategies, we encourage PMRA to accelerate its proposed phase out of this agent for agricultural and outdoors uses.

The Pest Control Products Act makes clear that Health Canada is responsible for regulating the use of pesticides "to protect human health and safety and the environment." Thousands of Canadians have also submitted comments to this consultation, through Avaaz, reaffirming their expectation that PMRA fulfill this responsibility by acting swiftly to prohibit the use of imidacloprid.

1 CFS is a nonprofit, membership organization with a mission to empower people, support farmers, and protect the earth from the harmful impacts of industrial agriculture. Through groundbreaking legal, scientific, and grassroots action, CFS protects and promotes the public's right to safe food and the environment. CFS has more than 830,000 consumer and farmer supporters—including 5,275 Canadian members.

2 The STORM Coalition is focused on protecting the ecological integrity of the Oak Ridges Moraine. Since 1989, STORM has been working to ensure that local and regional governments' planning decisions respect the environmental significance of the moraine and take into account its ecological and hydrological functions.

3 Avaaz is a 44-million-person global campaign network that works to ensure that the views and values of the world's people shape global decision-making. "Avaaz" means "voice" or "song" in many languages. Avaaz members live in every nation of the world.

Sonya V. Thursby of Toronto, an Avaaz member, wrote:

Demonstrate leadership by banning Imidacloprid! We know how critical a balanced ecosystem is to sustain life—the harm this chemical causes to aquatic insects throws off this significant balance. The phase out period needs to be shortened to now—the time to act is now because we have the knowledge to understand how harmful this chemical is to our ecosystems and biodiversity. What state will our ecosystem be in when my 13 and 17 year old children reach adulthood if leaders like you act now.

This submission asserts that:

a. The proposed three - five year phase out period is unnecessarily long, given the data presented by PMRA, and the weight of scientific evidence demonstrating imidacloprid's harm to wildlife, including aquatic insects, terrestrial organisms, birds and pollinators.
b. Neither alternative use reduction plans, nor precautionary label statements will adequately or reliably reduce the risks posed to the environment by imidacloprid.
c. PMRA must also act to review and phase out other neonicotinoids to ensure that the environmental benefits of imidacloprid's prohibition are not offset by increases in the use of other similarly harmful agents.

Expedite the Phase Out: Imdacloprid is Found at Unsafe Levels Known to Cause Harm To a Variety of Species

A growing number of studies show that Canadian waters are in jeopardy from continued contamination by neonicotinoid insecticides used widely for agricultural and outdoor uses. In fact a three-year investigation of neonicotinoid insecticide contamination in surface water sites across southern Ontario revealed three of the five neonicotinoids tested (imidacloprid, clothianidin, thiamethoxam), had more than 90 percent detection rates in over half of the sites.[i] The Canadian government's threshold for imidacloprid residues in freshwater is .23 ppb, which was exceeded in 75 percent of the samples collected in two sampling sites.[ii] The data from the three-year investigation show a strong correlation between pesticide detection, precipitation, and stream discharge. Other studies of Canadian monitoring data by government and independent researchers revealed 98.7 percent detection frequency of thiamethoxam and 100 percent detection frequency of clothianidin in Southwestern Ontario water samples from corn-producing counties[iii], and 91 percent neonicotinoid detection (imidacloprid, thiamethoxam, clothianidin, acetamiprid) in wetlands sampled across the Prairie Pothole region.[iv] Health Canada reported imidacloprid at concentrations as high as 290 times greater than the level of acceptable risk.[v] Across all studies, researchers noted neonicotinoids long- term persistence and highlighted specific concerns for wetlands in colder climates where the chemicals persist in soil and transport via snowmelt to nearby surface water.[vi]

A prohibition will only be implemented after the publication of the government's final re-evaluation decision. If PMRA's suggested three - five year phase-out period is adopted then imidacloprid will continue to be used until 2020 or 2022, depending on the re-evaluation decision's final publication date. This is particularly troubling given the above noted findings, imidacloprid's half-life of up to 229 days in soils,[vii] and PMRA's own conclusion that "under current conditions of use, the environmental risks for most products containing imidacloprid do not meet current safety standards." France has committed to prohibit all neonicotinoid chemicals as early as 2018 and we strongly encourage the Canadian government to match these target dates.

Imidacloprid Impacts More Than Just Aquatic Insects

PMRA correctly identifies that imidacloprid places aquatic insects at risk; however, as the agency progresses with its final re-evaluation, it must also thoroughly assess risks to other species, including pollinators, birds, and beneficial insects (such as earthworms).

For earthworms, Wang et al. 2015 note a LC_{50} of 3.05 mg/kg of imidacloprid and that a sub-lethal dose of 2.0 mg/kg, caused an 84 percent decrease in fecundity.[viii] Because earthworms are critical to soil health, we feel it is imperative that harms to these beneficial insects are thoroughly evaluated in current and future risk assessments.

Hallman et al. 2014 determined that commonly-found levels of imidacloprid in Holland's surface water correlates to a 3.5 percent annual decline in bird populations.[ix] Gibbons et al. 2015 found, in a comprehensive review of 150 studies, that ingestion of even a few neonicotinoid-coated seeds could cause mortality or reproductive impairment to sensitive bird species.[x] While, PMRA acknowledges that coated seeds may be harmful for birds, it's suggested mitigation strategies (including label cautions and removing coated seeds from field surfaces) are inadequate when considering the minimal exposure required to cause harm.

Other Jurisdictions

The U.S. Environmental Protection Agency (EPA) made similar findings about aquatic ecosystems in the 2017 *Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid*. The comprehensive report incorporated data from PMRA as well as the European Food Safety Authority. Based on the evidence compiled, the EPA underlined the threat of imidacloprid to aquatic communities concluding, "It is evident ...that concentrations of imidacloprid detected in streams, rivers, lakes and drainage canals routinely exceed acute and chronic toxicity endpoints derived for freshwater invertebrates." and explained that acute and chronic risks were identified with a majority of registered uses of imidacloprid.[xi] Because the farming practices and water bodies in the nations are comparable, these conclusions bolster those of PMRA and further emphasize the need for strong regulatory action.

Alternative Use Reduction Plans and Precautionary Labels Will Not Sufficiently Reduce Risks

We also want to support and reiterate PMRA's caution against an alternative use reduction plan. As outlined in the assessment, any possible mitigation plans are hindered by an inability to accurately predict the degree of reduction necessary to meet acceptable imidacloprid levels without extensive and costly water monitoring information. Further any plans are limited by difficulties in specifying the uses causing high concentration levels and finding means of ensuring that approved imidacloprid use does not increase in areas in which it is not used extensively now. Finally, PMRA has identified immediate contamination concerns and there is no way to gauge how long an effective reduction plan would take.

The PMRA's Proposed Re-Evaluation Decision explains that water based imidacloprid is found at unsafe levels at agricultural sites, even though imidacloprid products have precautionary labels designed specifically to minimize this risk. For this reason, we again urge the agency to move forward with an expedited phase-out of imidacloprid, as current best management practices and pesticide product labels are insufficient for protecting aquatic species, birds, pollinators, and other beneficial insects.

Strong Actions Are Also Needed For Clothianidin and Thiamethoxam

While imidacloprid poses a significant threat to the environment, so to, do other neonicotinoid insecticides, such as clothianidin and thiamethoxam. We strongly encourage PMRA to take immediate action to curtail the use of all neonicotinoids, so as to ensure that the environmental benefits associated with an imidacloprid phase out are not suppressed by the increased use of similarly detrimental alternatives.

A 2017 report from Chretien et al. of Agriculture and Agri-Food Canada, as well as Quebec Ministry of Sustainable Development, raises concerns about contamination from surface runoff and subsurface tile drain losses with a particular focus on the contamination by clothianidin and thiamethoxam. The report documents a two year study in which 14 surface runoff and tile drain discharge events were monitored. The researchers reported, "detection frequencies close to 100 percent in edge-of-field, surface runoff and tile drain water samples...for thiamethoxam and clothianidin even though only thiamethoxam had been applied in the first year."[xii] These findings highlight the persistent nature of these chemicals in certain climates and soil conditions as well as the potential harm of their degradates. The insecticides were reported at median concentrations of .46 ppb and .16 ppb and many concentrations exceeded the .0083 ppb chronic threshold for effect on aquatic life recommended by Government of Quebec.[xiii] The authors of the report echoed the proposal established in the Quebec Pesticide Strategy 2015-2018, and explained that any plans for reduced use or mitigation to control dust and surface runoff would not be sufficient.

Despite these findings, with a majority of environmental monitoring programs and toxicity testing dedicated to imidacloprid use, "no ecological thresholds exist for thiamethoxam and clothianidin."[xiv] This major shortcoming is particularly an issue in Quebec where nearly 100 percent of corn and 50 percent of soybean seeds are planted with neonicotinoid seed coatings—covering nearly 500,000 ha.[xv] Giroux et al. found detection frequencies of thiamethoxam and clothianidin ranging from 93 percent to 98 percent from 2012 to 2014 in four Quebec watersheds.[xvi] Canada's increasing documentation of this contamination supports PMRA's analysis and is an indication of the critical need for setting stronger regulatory protections for the environment, including the proposed prohibition of imidacloprid, as well as other neonicotinoid insecticides.

Conclusions and Recommendations

Perhaps the most important point in PMRA's own conclusion was the realization that imidacloprid is indeed causing harm to aquatic environments and current uses are "not sustainable"[xvii]. CFS, Avaaz, and STORM fully agree with PMRA's strong conclusion - it is evident that a complete phase out is a necessary action to protect aquatic ecosystems from imidacloprid contamination. Furthermore, we support PMRA's call for similar evaluations to be conducted for additional neonicotinoid insecticides, particularly thiamethoxam and clothianidin. We commend PMRA for its decision to move forward with strong regulations based on the chemical's water solubility, persistence, and propensity for unintended contamination of critical waterbodies.

We would further like to highlight the analysis and recommendations in the two attached CFS reports, which are incorporated into this comment by reference: *2017 Updates to Water Hazard: Aquatic Contamination by Neonicotinoid Insecticides in the United States* and *Water Hazard: Aquatic Contamination by Neonicotinoid Insecticides in the United States.* Also incorporated are the attached testimonies of Avaaz members across Canada concerned with the continued use of neonicotinoid insecticides.

> Joe Thauberger of Canada, an Avaaz member, wrote:
>
> *To the PMRA, I am a retired farmer from Saskatchewan. I have seen with my own eyes the devastating affects on our wildlife. Insecticides of all kinds should be banned and used only under very special situations.*

Due to the reasons above, CFS, Avaaz, and STORM urge Health Canada to implement the proposed phase out of imidacloprid for agricultural and outdoor uses and to conduct similar evaluations of other neonicotinoid insecticides in order to put an end to the widespread contamination, the increasing concentration rates, and the observed decline in vital aquatic species. Finally, we urge you to consider shortening the phase out period to the shortest time feasible in view of the imminent hazards posed.

Thank you for your thoughtful consideration of this important matter.

Sincerely,
Center for Food Safety
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CENTER FOR FOOD SAFETY

July 24, 2017

Comments from Center for Food Safety on the EPA's Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid, dated December 22, 2016

Imidacloprid Docket ID: EPA-HQ-OPP-2008-0844
Imidacloprid Document ID: EPA-HQ-OPP-2008-0844-1086

The Center for Food Safety (CFS) is a nonprofit, membership organization with a mission to empower people, support farmers, and protect the earth from the harmful impacts of industrial agriculture. Through groundbreaking legal, scientific, and grassroots action, CFS protects and promotes the public's right to safe food and the environment. CFS has more than 900,000 consumer and farmer supporters across the United States**.** We are pleased to submit these comments on the Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid (PARA).

Unacceptable Delays in the Registration Review Process

Imidacloprid's Registration Review process is far behind the schedule to which the agency formally committed. The "Preliminary Work Plan" for this Registration Review, issued in 2008, had a "*2014–JulSep"* completion date.[1] It also had this statement (emphasis added): "*After reviewing and responding to comments and data received in the docket during this initial comment period, the Agency will develop and **commit** to a final work plan and schedule for the registration review of imidacloprid*." The current "Final
Work Plan" was issued in 2010.[2] It has this statement in the schedule: "*Final Decision and Begin PostDecision Follow-up* ***- 2016– Jan-Mar***." The agency has failed to comply with its own commitment, with a likely completion date now at least two years later than scheduled. EPA must expedite completion of this process.

Noncompliance with the Endangered Species Act

EPA acknowledges the lack of Endangered Species Act (ESA) analysis or compliance stating (p. 119):

> "Given that the agencies are continuing to develop and work toward implementation of the Interim Approaches to assess the potential risks of pesticides to listed species and their designated critical habitat, this ecological problem formulation supporting the Preliminary Work Plan for imidacloprid does not describe the specific ESA analysis, including effects determinations for specific listed species or designated critical habitat, to be conducted during registration review."

1 https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0844-0003.

2 July 23, 2010. Imidacloprid Amended Final Work Plan; https://www.regulations.gov/document?D=EPA-HQ-OPP-20080844-0121.

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However, EPA's PARA, taken together with an extensive amount of independent science, underscores that the ongoing contamination of aquatic ecosystems with imidacloprid run-off is adversely affecting a large variety of aquatic species – which includes ESA-listed aquatic species. Illustrative examples of ESA-listed aquatic species known to be vulnerable to these harmful effects include, but are not limited to (indeed there are scores of others): Hines emerald dragonfly (*Somatochlora hineana*); Nashville crayfish (*Orconectes shoupi*); Salt Creek tiger beetle (*Cicindela nevadica lincolniana*); and San Diego fairy shrimp (*Branchinecta sandiegonensis*).

It is essential that EPA act contemporaneously in this Registration Review risk analysis process to also include thorough analyses of foreseeable effects to ESA-listed aquatic species now. Under the ESA implementing regulation, 50 C.F.R. § 402.14(a), agencies must review their actions at the "earliest possible time." EPA must not delay this ESA-mandated review or else it will be in violation of the law.[33] Referencing alleged changes in the Interim Approaches document is not an excuse for non-compliance or for the extensive delays that have already occurred.

Harm to Aquatic Ecosystems and the Broader Environment

A growing number of studies show that North American waters are in jeopardy from continued contamination by neonicotinoid insecticides used widely for agricultural and outdoor uses. A 2016 U.S. Geological Survey (USGS) review of pesticide detections in streams across the Midwest found high concentrations of imidacloprid in 98% of the sites sampled.[i] Of all the insecticides tested, imidacloprid was detected at the highest concentrations, with numerous detections exceeding levels known to cause harm to aquatic invertebrates.[ii] This USGS review is part of a growing body of research that highlights the alarming levels of contamination exposed in national and regional monitoring data,[iii] and builds on other reported detection frequencies such as: the 76% detection rate of one or more neonicotinoids in streams across the Midwest in 2013,[iv] the 70% detection frequency of downstream samples in the southern Appalachians in 2012 and 2013,[v] and an overall 63% detection rate in streams sampled across the United States.[vi] EPA recognizes this research in the PARA and yet did not conclude that such vast contamination warranted immediate action to restrict uses. This clear failure to take immediate action is particularly concerning given that numerous analyses of peer-reviewed research have shown severe risk to aquatic

33 The scope of agency actions triggering Section 7 duties is broad, including all activities or programs of any kind authorized, licensed, funded, or carried out by federal agencies, including activities directly or indirectly causing modifications to land, water, or air. 50 C.F.R. § 402.02 (definition of "action"). The potential "effects" of an action that an agency must consider are similarly broad, and include both "direct" and "indirect" effects of the action and all activities "interrelated or interdependent" with that action. Id.

ecosystems—most notably Sanchez-Bayo et al. 2016, which alarmingly concluded, "Negative impacts of neonicotinoids in aquatic environments are a reality" and continues, "Solutions must be found soon if we are to save the biodiversity not only of aquatic ecosystems, but all other ecosystems linked by the food web."[vii]

Potential Impacts to Human Health

Furthermore, new research is emerging about the potential public health risks that imidacloprid and other persistent neonicotinoid pesticides pose. A 2017 study from USGS and the University of Iowa, *Occurrence of Neonicotinoid Insecticides in Finished Drink Water and Fate During Drinking Water Treatment*, found imidacloprid, clothianidin, and thiamethoxam in 100% of samples taken from University of Iowa tap water.[viii] The concentrations detected range from 0.00024 ppb to 0.0573 ppb. The report is the first peer reviewed study to examine neonicotinoid concentrations in finished drinking water. Although the study is limited to a small sampling area, the authors of the report conclude, "because of their pervasiveness in source waters, and persistence through treatment systems, neonicotinoids are likely present in other drinking water systems across the United States." While this study is preliminary and did not expose any concentrations known to have direct impact on humans, a 2015 publication by National Institute of Health called for further research on the chronic human health impacts of neonicotinoids.[ix] Since there are currently no standards for neonicotinoids in drinking water in the United States, CFS encourages EPA to consider this route of exposure as a potential threat to human health and immediately conduct a full array of safety testing. Then, appropriate health-based restrictions on them may be needed.

Proposed Action to Phase-Out Uses of Imidacloprid in Canada

In deciding the fate of the continued use of imidacloprid and other neonicotinoid insecticides, EPA should also consider the actions proposed by Health Canada's Pest Management Regulatory Agency (PMRA). PMRA's 2016 re-evaluation of imidacloprid includes a wealth of data from both government and peerreviewed research and concludes (emphasis added):

> *"The environmental assessment showed that, in aquatic environments in Canada,* ***imidacloprid is being measured at levels that are harmful to aquatic insects****. These insects are an important part of the ecosystem, including as a food source for fish, birds and other animals. Based on currently available information,* ***the continued high volume use of imidacloprid in agricultural areas is not sustainable."***[x]

Based on the documented exceedance of water quality thresholds and aquatic life benchmarks in monitoring data, PMRA proposed action necessary to protect aquatic ecosystems from imidacloprid and called for similar evaluations for other neonicotinoid insecticides. Specifically, PMRA proposed to *"phase-out all the agricultural and a majority of other outdoor uses of imidacloprid over three to five years."*[xi] EPA relied on data from the PMRA analysis in its PARA, yet no similar proposals were made to phase-out or even restrict uses of imidacloprid in the U.S. Given that EPA, PMRA, and California Department of Pesticide Regulation have been working together on the neonicotinoid registration reviews, CFS strongly urges EPA to propose similar actions to prevent continued damages to vulnerable ecosystems.

The following points address additional shortcomings in EPA's PARA. CFS encourages EPA to consider these shortcomings in its final review of imidacloprid:

1. **Gross Underestimation of Seed Treatment Contamination and Risk** EPA's PARA analysis proposes the unrealistic assumption that neonicotinoid chemicals applied as coatings on seeds planted below two centimeters do not move into surface waters and therefore are low risk.[xii] It is unacceptable that EPA's models do not account for lateral movement of these chemicals in soil and run-off. It is well documented that these chemicals move down into ground water—to assume they don't move laterally through surface soil (especially surface soil broken up by tillage) with precipitation is indefensible in view of numerous published reports showing that they do so.[xiii]

   Roughly 1,116,000 pounds of imidacloprid were used on crops in the United States between 2004 and 2013. Fifty-six percent of this usage was as seed coatings—and more specifically 36% was as a coating on soybeans.[xiv] Ninety-four percent of agricultural use scenarios modeled (29 of 31) in the PARA identified acute risks to freshwater species. A majority of use scenarios were seed-coating applications—pointing to the considerable risk from this route of exposure.

   The following graphic from the EPA PARA depicts the surface water contamination across the United States in relation to thresholds established for specific freshwater invertebrate species.[xv] As shown, concentration levels of imidacloprid detected in various water bodies are routinely exceeding benchmarks known to cause harm to critical aquatic species (with some storm event models showing nearly 100% exceedance). **EPA in the final ecological assessment should more accurately portray the harms caused by imidacloprid seedcoatings.[34]**

2. **New Endpoints but No Mandates to Ensure High Water Quality**
   After analyzing aquatic toxicity research, international benchmarks, and available monitoring data, and conducting acute lab testing, EPA's PARA proposed new acute and chronic endpoints for imidacloprid for freshwater invertebrates. Prior to the Assessment, EPA's endpoints were exponentially higher than other regulatory and non-regulatory benchmarks from around the world.[xvi] The new proposed endpoints of 0.39 ppb (acute) and 0.01 ppb (chronic) are not only more in line with the conclusions of PMRA, but they also are more consistent with the thresholds proposed by Morrissey et al., and discussed in CFS's 2015 *Water Hazard* Report. Yet, these endpoints have not been updated on EPA's Aquatic Life Benchmarks for Pesticide Registration website.[35] Moreover, there is no mandate by which toxicity benchmarks are enforced. According to its website, EPA's Office of Water may use the "aquatic toxicity data to develop ambient water quality criteria that can be adopted by states and tribes to establish water quality standards under the Clean Water Act,"[xvii] however there are no mandates to establish such standards. Given that current monitoring data shows exceedances of the proposed thresholds across the United States in various surface water bodies, **EPA should formally update proposed water quality standards.**

3. **No Mention of Pesticide Synergies** EPA's PARA contains almost no mention of pesticide synergies and the particular threat of chemical combinations to aquatic ecosystems unable to escape continued exposure to multiple pesticide stressors. According to Morrissey et al. 2015, "neonicotinoids are known to be additively or synergistically toxic when they occur together or

[34] Imidacloprid, Clothianidin, Thiamethoxam, Dinotefuran, Acetamiprid

[35] Not updated as of July 11, 2017 https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarkspesticide-registration

when combined with certain fungicides..."[xviii] These combined "tank mixes" of pesticide formulations are patented and even encouraged by agrichemical companies for their increased toxicity. In fact, a 2016 Center for Biological Diversity analysis of recently approved products from major pesticide companies found that 69% of patent applications claimed or demonstrated synergistic action.[xix] Additionally, when neonicotinoids were tested together for impacts on *Daphnia magna* species, a species known to be highly ***tolerant*** to neonicotinoid toxicity, the effects included notable impacts on reproduction, growth, and survival, in correlation to chemical synergism.[xx] Due to the tendency for aquatic ecosystems to be contaminated by several neonicotinoid chemicals from a range of application sites as well as other chemicals present in surface water bodies, **EPA's final risk assessment should include the threat from combined exposure and synergistic effects of multiple pesticides.**

4. Limited Field Realistic Conditions and Lack of Evaluation of Sub-lethal Impacts to Ecosystem Functioning and Food Chains

The PARA addresses the lack of higher-tier data stating that the final risk assessment will include "*an independent review of mesocosm data,*" however this delay in analysis poses a significant risk to aquatic ecosystems. EPA, in its assessment of impacts to fish and aquatic phase amphibians notes:

> *"While the risk of direct effects of imidacloprid to fish and amphibians is considered low, the potential exists for indirect risks to fish and aquatic-phase amphibians through reduction in their invertebrate prey base."*

A more thorough analysis of available peer-reviewed research will show that the indirect risks to fish and aquatic-phase amphibians are a reality and that the continued use of imidacloprid and other persistent neonicotinoid chemicals weakens the base of the food-web and is detrimental to entire watershed ecosystems—including birds**. If EPA continues to disregard the indirect but significant impacts, then the repercussions will extend far beyond the aquatic invertebrate prey base.**

5. Ignores Risks to Non-aquatic Species

Initially intended to be a complete ecological risk assessment of imidacloprid, EPA justified its decision to only include aquatic risks, stating:

> *"… a substantial body of aquatic monitoring and toxicity data have been generated for imidacloprid since the Agency's last comprehensive risk assessment was conducted. In contrast, very little new data have been generated on the toxicity of imidacloprid to birds and mammals since the Agency's most recent ecological risk assessments."*

This is an underestimation of the research that has emerged showing risks to non-aquatic species—particularly birds, which are impacted by the use of neonicotinoid chemicals as shown in the findings of the comprehensive Palmer and Mineau report, *The Impact of the Nation's Most Widely Used Insecticides on Birds,* as well as substantial other journalpublished bird research. It also is a setback in finalizing the registration review and initiating regulatory action on these environmental contaminants. [xxi] **Rather than wait on the full ecological risk assessment, EPA should recognize the risks to aquatic species as well as the interconnection of aquatic and terrestrial environments and immediately restrict uses of imidacloprid to prevent these harms.**

6. **Strong Evidence of Risk, Yet No Regulatory Action** EPA concluded in its PARA (emphasis added):

   > "*It is evident, however that* ***concentrations of imidacloprid*** *detected in streams, rivers, lakes and drainage canals* ***routinely exceed acute and chronic toxicity endpoints*** *derived for freshwater invertebrates."*

   Again, based on the substantial impacts to aquatic invertebrates, including ESA-protected species, happening on a wide-scale by registered uses, it is clear that EPA needs to take immediate action to restrict uses of imidacloprid and other neonicotinoid insecticides to prevent further damage to ecosystem services.

   Furthermore, EPA identifies that:

   > *"...the risk findings summarized in this assessment are in general agreement with recent findings published by Canada's Pest Management Regulatory Agency and the European Food Safety Authority."*

   EPA should follow PMRA's example in proposing a prompt full phase-out of imidacloprid for agricultural and outdoor uses. PMRA recognizes that due to imidacloprid's persistence and water solubility, regional restrictions will not be sufficient in mitigating risks. **EPA needs to enforce strong action now to prevent continued, potentially irreparable, damages to vulnerable species and ecosystems.**

Due to the reasons above, as well as those outlined in detail in the attached two reports, which are incorporated into this comment by reference, *Water Hazard 2.0: Continued Aquatic Contamination by Neonicotinoid Insecticides in the United States (2017)* and *Water Hazard: Aquatic Contamination by Neonicotinoid Insecticides in the United States (2015),* CFS urges EPA to take action to immediately restrict uses of imidacloprid to prevent further adverse impacts to aquatic ecosystems, pollinators, other vulnerable species, and the broader environment.

Recommendations to EPA

The agency should:

1. **Expedite completion of the final risk assessment and the overall Registration Review for Imidacloprid, which is now at least two and likely three years behind the schedule to which EPA had committed.**

2. **Conduct full ESA Sec. 7 compliance now, contemporaneous with the risk assessments in the Registration Review process, rather than afterwards, which would violate the ESA.**

3. **In the final risk assessment, more accurately portray the risk posed by seed-coatings and include a thorough field-realistic analysis of imidacloprid seed-coatings to aquatic systems.**

4. **Update its water quality benchmarks for imidacloprid using the newly proposed thresholds referenced in this comment.**

5. **In the final risk assessment, include a comprehensive examination of the threats from additive and synergistic effects of combined exposure of imidacloprid and multiple other pesticides, fungicides, inerts and other compounds.**

6. **Include higher-tier and mesocosm analyses to fully determine the risk to fish, amphibian, and bird species.**

7. **Immediately enforce strong action to restrict uses of imidacloprid and other neonicotinoid insecticides to prevent continued, potentially irreparable, damages to vulnerable aquatic ecosystems.**

CC: California Department of Pesticide Regulation

Attachments –Water Hazard 2.0: Continued Aquatic Contamination by Neonicotinoid Insecticides in the United States (2017); Water Hazard: Aquatic Contamination by Neonicotinoid Insecticides in the United States (2015)

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Exhibit B

CFS Comments on Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

Washington State Executive Ethics Board

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INVESTIGATIVE REPORT AND BOARD DETERMINATION OF REASONABLE CAUSE

CASE NUMBER:	2017-012
DATE:	July 20, 2017
RESPONDENT:	Kim Patten, Director WSU Pacific County Extension
EMPLOYING AGENCY:	Washington State University

I. INVESTIGATION

A. Background and Summary of Complaint

On January 12, 2017, the Executive Ethics Board (Board) received a complaint alleging that Kim Patten (Mr. Patten), Director of the Washington State University (WSU) Pacific County Extension Office, may have violated the Ethics in Public Service Act. The complaint alleges that Mr. Patten used state resources to conduct research for his personal benefit and that his personal involvement with the commercial shellfish industry is in conflict with his official duties.

B. Scope of Investigation and Relevant Facts

Board staff reviewed the complaint and all supporting documents, interviewed Mr. Patten, reviewed email records from Mr. Patten's WSU.edu and WSU Gmail accounts, and reviewed Mr. Patten's state owned computer hard drive.

Based upon the investigation, staff determined the following:

1. Mr. Patten has been employed with the WSU Research and Extension Unit located in Long Beach since 1990. In 2004, Mr. Patten became the Extension Professor, and in 2012, he became the Director of the Long Beach Extension Unit.

2. As Director of the Long Beach Extension Unit, Mr. Patten's primary duties are to conduct research and provide education in all aspects of the cranberry, shellfish and other local agriculture in the Pacific County community. Mr. Patten's stakeholders are cranberry and oyster growers, both private and commercial, along with state and federal agriculture and natural resources managers and their related agencies.

3. Mr. Patten uses two different email accounts in his position as the WSU Extension Unit Director. Pattenk@wsu.edu is the official email account used by employees of WSU and is maintained by WSU. Pattenk.wsu@gmail.com is an authorized email account used by WSU employees who work in remote areas where access to the official email account is not readily accessible, but is not maintained by WSU. Mr. Patten uses the pattenk.wsu@gmail.com account to conduct both WSU official and personal business.

4. Mr. Patten indicated in his response to Board staff that he considers the shellfish industry a very important "client" in that they are the major employer and economic engine for the region. Mr. Patten further indicated that he was officially assigned to work on the shellfish pest issue by deans and directors at WSU.

5. Mr. Patten indicated in his response to Board staff that he has the exact same relationship with the shellfish industry as he has with other agriculture industries within the Long Beach area. The cranberry industry provides the WSU Extension Unit office, lab, and utilities with no cost to WSU. The shellfish industry rents office space at the WSU Extension Office from the cranberry industry but the office space is not currently being used.

6. WSU Extension Unit Strategic Goals:

Enhance Natural Resources and Environmental Stewardship:

- Improved economy and quality of life.
- Resolve natural resource conflicts.
- Improve ecosystem management.
- Solve complex issues of water and fisheries management.
- Control spread of non-native invasive species.

Enhance Economic Opportunities for Agricultural Enterprises while Protecting Washington's Resources:

- Increase profitability and competiveness of agriculture and food enterprises.
- Reduce market risk to agricultural producers.
- Increase application of alternative agricultural systems.
- Increase application of integrated pest management and conservation strategies.

7. Mr. Patten indicted in his response to Board staff that he would attend some local, state, and regional shellfish grower meetings. At these meetings, he would speak on different topics and obtain feedback on issues affecting the industry. Mr. Patten further indicated that he would do the same thing for the cranberry industry.

8. Brian Sheldon (Mr. Sheldon) is an owner of the Northern Oyster Company and a Board member of the Willapa-Grays Harbor Oyster Growers Association (WGHOGA), a non-profit organization made up of privately owned oyster growers from the Willapa Bay and Grays Harbor area.

9. On October 20, 2010, the Washington State Noxious Weed Control Board (Weed Control Board) received a letter from the Northern Oyster Company regarding a request by Pacific County to list *Zostera japonica* (Zj), a non-native eelgrass, as a Class C noxious weed. The letter indicated that Zj was invading shellfish beds, altering the ground so that it was becoming "un-farmable" and having an impact on the Northern Oyster Company's ability to

continue farming oysters. The Weed Control Board did not list Zj as a Class C noxious weed in 2010.

10. On April 25, 2011, the Weed Control Board received another letter from the Northern Oyster Company requesting Zj be added to the Class C noxious weed list.

11. In August 2011, the Washington Department of Ecology (Ecology) received a letter from the WGHOGA requesting it begin the process of developing a new National Pollutant Discharge Elimination System (NPDES) permit allowing shellfish growers to control Zj with Imazamox, an aquatic herbicide. In response to the WGHOGA's request, Ecology's Water Quality Program (WQ) made a tentative decision to issue a new NPDES permit for controlling Zj with Imazamox.

12. On September 6, 2011, the Weed Control Board approved adding Zj to the 2012 Class C noxious weed list. On December 15, 2011, the Weed Control Board voted to add Zj as a Class C noxious weed for commercially managed shellfish beds only.

13. As part of the NPDES permit development process, WQ issued a public notice on February 1, 2012. After the initial public comment period, Ecology decided to reduce the scope of the permit and require an Environmental Impact Statement (EIS). The public comment period ended on March 9, 2012 at 5:00 pm

14. On March 7, 2012, Mr. Patten submitted a comment on the proposal as a private tideland owner from his pattenk@wsu.edu email account.

From: Kim Patten
To: Hamel, Kathy (ECY)
Subject: Public comment - NPDES eelgrass.
Date: Wednesday, March 07, 2012 3:43:56 PM

I am submitting a public comment on the NPDES for Japanese Eelgrass Management on Commercial Shellfish Beds General Permit.

I strongly encourage Ecology to issue this permit. As a private tideland owner in Willapa Bay for the past 22 years I've seen Japanese eelgrass change my recreational calm bed from a sandy easy- to -access productive bed to an unproductive muddy mess. I've been at a loss on how to recondition the bed into something useful. I've worn out rakes trying to clean the Japanese eelgrass out of my bed, all to no avail. Since private tideland owners are not covered by this permit, I would consider converting my bed to a commercial bed just to be covered by this permit and be able to remove the japonica.

Thank You

--
Kim and Andrea Patten
Tideland owner
Withheld
[redacted]

15. In 2012, the Washington Department of Fish and Wildlife (WDFW) and the Wildlife and Willapa Oyster Committee funded a grant for the research on estuary use of Imazamox.

16. On March 8, 2012, Mr. Patten submitted an application for an Experimental Use Permit (EUP) to apply the herbicide Imazamox on aquatic sites with the Washington State Department of Agriculture (WSDA) in connection with this grant and research.

17. The WSDA application identified property owners of four sites to be used in the experimental application of Imazamox:

- Brian Sheldon
- Taylor Shellfish
- Eric Hall
- Kim Patten

18. Each test site consisted of approximately ¼ of an acre of clam beds for each location for a total area of .98 acres.

19. The application identified the following individuals would be applying the herbicide to the site:

- Kim Patten
- Chade Metzger
- Nick Halderman
- All WSU employees.

20. The EUP application indicated that the ending date for the research was October 31, 2012.

21. In July of 2012, Mr. Patten submitted the final report on the impact of Zj and Imazamox to WDFW and the Wildlife and Willapa Oyster Committee.

22. On March 8, 2013, Mr. Patten again submitted an application to the WSDA for the EUP of Imazamox at the same four sites and the same three individuals as listed in in the 2012 EUP application. The ending date for the research was October 31, 2013.

23. Mr. Patten indicated in a response to Board staff that a EUP is only good for one year. In 2013, the main objective of his research was to conduct additional efficacy studies on Zj seedling control. Mr. Patten further indicated that he was trying to refine all gaps in efficacy he had in order to be sure everything was in order for the 2014 NPDES permit.

24. Mr. Patten indicated in a response to Board staff that when he applies for a EUP he adds all sites available for him to use at the time of the EUP application knowing he might not use some of those sites because if sites are not listed, he cannot use them. He further

indicated that he has dozens of projects going each year and he would rarely accomplish all of them but if he didn't include them on the EUP he would not be able to undertake those projects.

25. Mr. Patten also indicated in a response to Board staff that finding test sites for his research is one of his biggest challenges. The work tends to be destructive and growers need to be comfortable with that. They would crush shellfish accessing the site, they would harvest most of the crop on the test plots for destructive sampling purposes, and growers would have to agree to not harvest until the tests are completed.

26. Mr. Patten indicated in response to Board staff that for this particular research project the studies would be sited near the Nahcotta shellfish growing region on the Long Beach Peninsula, where Zj has formed large "meadows." Those sites were identified using the following criteria:

- They needed to be easily accessible (less than one hour boating or walking);
- needed to have gravel, clams and Zj;
- needed to have property owner's permission to treat and harvest from their site;
- sites could not be harvested until after the research had concluded; and
- the sites must be different enough locations across the bay to reflect the variation of effects that might occur.

27. Mr. Patten indicated that he chose the sites used in the research based on the above criteria. Mr. Patten further indicated that his site was actually a poor site and his last choice but he could not find anything further south down the bay.

28. Mr. Patten also indicated in a response to Board staff that he used about ½-acre of his clam farm. He put out 12 replicated plots within that ½-acre area. Each plot was 8 feet by 10 feet. There were six treated and six untreated control plots. The total area sprayed was about 480 square feet. These plots were destructively harvested to obtain number of clams, size and meat weight.

29. On September 26, 2013, the Weed Control Board announced a public hearing to consider changes to the 2014 noxious weed list. The hearing was scheduled for November 5, 2013 in Wenatchee, Washington. The announcement indicated that the Weed Control Board had several proposed changes for 2014. One of the proposed changes was reinstating the original 2012 listing of Zj as a noxious weed on commercially managed shellfish beds only. In 2013, the Weed Control Board had removed the modification of Zj and listed it as a noxious weed on all shellfish beds, commercial and private.

30. On September 27, 2013, Mr. Patten responded in opposition to the proposed changes from his pattenk@wsu.edu email account. In Mr. Patten's response to the Weed Control Board, he indicates that he is responding as a private landowner and as a scientist.

- **Private Landowner**: "As an owner of 2 acres of noncommercial clam ground in Willapa Bay, I find it unacceptable to learn that I will be unable to control

Japanese eelgrass on my own property…. going back to the 2012 listing I no longer have any options."

- **Scientist**: "By restricting this listing to the 2012 wording, you are essentially preventing the management of this invasive weed for the purpose of maintaining or restoring critical habitat for an ESA (Endangered Species Act) - listed species. You will no doubt hear testimony that *Z. japonica* provides valuable forage habitat for waterfowl along the Pacific Flyway. This is not a reason to justify going back to the 2012 weed listing…"

Mr. Patten's response consisted of three pages of text including two graphs and two attachments. The document was created on September 27, 2013 at 10:45 am and was last saved on September 27, 2013 at 12:03 pm. Total edit time was 53 minutes.

31. Mr. Patten told Board staff that he used his personal farm as an example of the effect of going back to the 2012 Weed Control Board modification of Zj as a noxious weed for all of the small private non-commercial shellfish farms in Willapa Bay.

32. After deliberation on the oral and written testimony received from the public comment period, on November 7, 2013, the Weed Control Board decided to leave Zj as classified rather than reverting back to a Class C noxious weed on commercially managed shellfish beds only.

33. On November 28, 2013, Mr. Patten received an email on his WSU Gmail account from Mr. Sheldon regarding Mr. Patten leasing his clam farm to Mr. Sheldon to harvest clams. By entering in to the agreement, Mr. Patten was converting his clam farm to a commercial clam farm.

Brian Sheldon <oysters@willapabay.org> Thu, Nov 28, 2013 at 10:35 AM
To: Kim Patten <pattenk.wsu@gmail.com>

Hi Kim,

Happy Thanksgiving.

I drafted up a simple lease agreement for your tideland, see attached. Take a look and modify as you want. If it looks ok we can sign and I can get the harvest site application sent in to DOH. I'll get you a copy of the Harvest site application so you'll have it for your records.

If you can get me a property description I'll shoot the north and south lines in from the survey corners so we can get some more permanent lines set.

Thanks,
Brian

11-28-13 Lease Agreement.docx
18K

34. On Saturday, November 30, 2013, Mr. Patten responded from his pattenk.wsu@gmail.com account

Kim Patten <pattenk.wsu@gmail.com> Sat, Nov 30, 2013 at 9:37 PM
To: Brian Sheldon <oysters@willapabay.org>

Looks fine.
I need to get the property information from my safe deposit box on Monday. I'll get it to you then.

WSU Extension programs are available to all with out discrimination.

[Quoted text hidden]

35. On December 1, 2013, Mr. Sheldon responded:

Brian Sheldon <oysters@willapabay.org> Sun, Dec 1, 2013 at 9:54 AM
To: Kim Patten <pattenk.wsu@gmail.com>

I'll be out of town at the Conservation District meetings in Cle Elum until late Wednesday. We can meet when I get back to sign and move ahead. I'd like to get the lines set before I put the crew there so we're harvesting up to the north and south lines. If you get the prop description and can e-mail it to me I'll convert it so we can shoot the lines in and set some more permanent markers on your north and south lines.

Today is Basketball so I'll be in Kelso. Go Ilwaco!!!

Thanks,
Brian

From: Kim Patten

36. On Wednesday December 4, 2013, Mr. Patten responded using the pattenk.wsu@gmail.com account with the property description. On December 5, 2013, Mr. Sheldon responded to Mr. Patten.

Brian Sheldon <oysters@willapabay.org> Thu, Dec 5, 2013 at 9:03 AM
To: Kim Patten <pattenk.wsu@gmail.com>

Hi Kim,

Just got back into town. I've got meetings today, but will try to get back on this tomorrow. I'll try to get with you and get the lease signed. After that I can submit the harvest site app to DOH.

Also, Nate at DOE has asked for a meet on December 13th down here. He said they want to discuss some changes they want to make to the draft NPDES permit. If you're available I may be asking you to attend. I asked Nate to send me something on what they are looking at changing. I'll let you know what I find out.

Thanks,
Brian

37. On January 2, 2014, Ecology posted a draft EIS to tribes, agencies, organization, and individuals with an interest in the Ecology proposal to issue a NPDES general permit for the use of the Imazamox on commercial clam beds (excluding geoducks) in Willapa Bay. The public comment period ended on February 15, 2014.

38. At 1:16 pm, on January 17, 2014, Mr. Patten commented on the draft permit from his pattenk@wsu.edu email account. Mr. Patten's comments were specific to Section 4(B) of the draft permit, requiring a 10 mm buffer zone. In his comments, he used his farm as an example of an economic hardship that would be caused by the proposed 10 mm buffer.

> "***My farm***: *As a commercial clam grower with a small parcel of ground thickly covered by Z japonica, this buffer will prevent most of my ground from being farmed. I have a 160' by 200' parcel that is farmable (32,000 ft²). This buffer removes 16,800 ft². My ground produces ~ 0.5 lbs/ft² every 4-5 years. I get paid $0.75/ lb. On ground with japonica my yields have been about half. This totals approximately $5,000 to $6,000 in crop loss. I think this is an unreasonable economic impact. The ground does not have drainage swales and there is little chance of "chemical trespassing.*"

> "***All farms***: *Not being able to treat up to the buffer zone constitutes a taking of private revenue and right to farm. For every 1 foot of property line on a clam farm, a grower can lose ~ $10 of net revenue (assumes an average yield of 1 lbs/ft² of clams every 3 years, with the grower netting $1/ lbs and a 30% reduction in yield with Z. japonica). Using an example of a small 3.5 acre clam farm (1000' by 160') a grower would lose $23,000 (2320 ft of property line x $10/ft) every three years having to accommodate this buffer. This buffer would cost a small grower over $7,000 a year in lost revenue. This constitutes a very significant economic impac*t."

39. On April 2, 2014, the NPDES general permit was issued by Ecology for the use of the Imazamox on commercial clam beds (excluding geoducks) in Willapa Bay. After consideration of the public comments made by Mr. Patten and others, Ecology did not remove the 10 mm buffer zone in the application process.

40. The effective date of the permit was May 2, 2014, with an expiration date of May 2, 2019.

41. On March 27, 2014, Mr. Patten again applied to the WSDA for a EUP to spray Imazamox in the Willapa Bay. Mr. Patten indicated in a response to Board staff that this application was to conduct some early timing studies to look at when Zj seedlings would emerge in an effort to determine the best time to use Imazamox to affect the germinating Zj seedlings. For this experiment, he needed to conduct several small timing studies.

42. The 2014 EUP only identified one site location owned by Taylor Shellfish Company, removing his site and the two sites owned by Brian Sheldon.

43. Mr. Patten indicated in his response to Board staff that the NPDES was issued in May 2014 and he no longer needed the EUP. The 2014 EUP was only used on .1 acres owned by Taylor Shellfish Company to conduct seedling-timing studies as indicated above.

44. Mr. Patten further indicated that after the NPDES was issued in April 2014 he treated his entire ½-acre clam farm.

45. Mr. Sheldon's company, the Northern Oyster Company, commercially harvested clams from Mr. Patten's 1/2 acre clam farm in 2014. According to the lease agreement, Mr. Patten was paid $0.70 per pound of clams. Pounds of clams were based on washed clams as prepared for shipping.

46. Mr. Patten indicated in a response to Board staff that at that time the average price was about $0.60 to $0.70 per pound depending on the size and quality. He recalled that he was paid $0.60 per pound.

David Killeen, Senior Investigator

II. APPLICABLE LAW

The complaint alleges violations of the following sections of the Ethics in Public Service Act:

RCW 42.52.020 – Activities incompatible with public duties states:

> No state officer or state employee may have an interest, financial or otherwise, direct or indirect, or engage in a business or transaction or professional activity, or incur an obligation of any nature, that is in conflict with the proper discharge of the state officer's or state employee's official duties.

RCW 42.52.160(1) – Use of persons, money, or property for private gain, states:

> No state officer or state employee may employ or use any person, money, or property under the officer's or employee's official control or direction, or in his or her official custody, for the private benefit or gain of the officer, employee, or another.

WAC 292-110-010 Use of state resources, prior to April 2016, states, in part:

.....

(2) **The following are permitted uses:**

(a) Use of state resources that is reasonably related to the conduct of official state duties, or which is otherwise allowed by statute.

(b) An agency head or designee may authorize a use of state resources that is related to an official state purpose, but not directly related to an individual employee's official duty.

(c) An agency may authorize a specific use that promotes organizational effectiveness or enhances the job-related skills of a state officer or state employee.
(d) A state officer or employee may make an occasional but limited personal use of state resources only if each of the following conditions are met:

(i) There is little or no cost to the state;

(ii) Any use is brief;

(iii) Any use occurs infrequently;

(iv) The use does not interfere with the performance of any officer's or employee's official duties; and

(v) The use does not compromise the security or integrity of state property, information, or software.

K. Reynolds

Kate Reynolds, Executive Director
Executive Ethics Board

III. BOARD REASONABLE CAUSE DETERMINATION AND ORDER

Based upon the investigative report, we, the Washington State Executive Ethics Board determine the following:

Dismissal
Pursuant to RCW 42.52.425, IT IS HEREBY ORDERED that the complaint is DISMISSED for the following reason:

____ Any violation that may have occurred is not within the jurisdiction of the board

____ The complaint is obviously unfounded or frivolous

____ Any violation that may have occurred does not constitute a material violation because it was inadvertent and minor, or has been cured, and, after consideration of all of the circumstances, further proceedings would not serve the purposes of this chapter.

Reasonable Cause
Pursuant to RCW 42.52.420, IT IS HEREBY ORDERED

_✓_ There IS reasonable cause to believe that violation(s) of RCW 42.52 have been or are being committed and the penalty may be:

- ☐ GREATER THAN $500
- ☑ $500 OR LESS
- ☐ NONMONETARY

______ There IS NOT reasonable cause to believe that violation(s) of RCW 42.52 have been or are being committed and the complaint is CLOSED.

DATED this 8th day of September, 2017

Anna Dudek Ross, Chair

Samantha Simmons, Vice-Chair

John Ladenburg, Member

Lisa Marsh, Member

Shirley Battan, Member

Commenter: Anne Shaffer - Comment O-3-1

Coastal Watershed Institute (CWI)

www.coastalwatershedinstitute.org

Our mission: "To protect and restore marine and terrestrial ecosystems through scientific research and local community, place based partnerships.."

24 October 2017

Please accept these comments on the DoE draft Supplemental Environmental Impact Statement for the continued effort by the shellfish industry to use Imidacloprid to control burrowing shrimp in Willapa Bay (http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid/). The Willapa Grays Harbor Oyster Growers Association (WHGOGA), which grows (non-native) clams and oysters, want to control (native) burrowing shrimp by applying Imidacloprid (a neonicotinoid insecticide).

Imidacloprid was previously reported to enhance adipogenesis and resulted in insulin resistance in cell culture models (Sun et al 2016, 2017). Therefore, this insecticide of strong concern for human health. Equally alarming, insecticides, including Imidacloprid, are of very high concern for damaging and killing, thru indirect or direct pathways, critical wild fish species of salmon and smelt, including the marine invertebrates that are critical food source for juvenile salmon and forage fish (Westin et al 2014, 2015). Macneale et al 2014 and Gibbons et al 2015 provide a review of some of these concerns, along with studies cited in previous permit review. DoE has received exhaustive comments on the previous application to use Imidacloprid to kill burrowing shrimp populations on up to 2,000 acres per year (total) of commercial clam and oyster beds in Willapa Bay and Grays Harbor. Proposed application methods included aerial spraying from helicopters. Ecology issued a 5-year NPDES Individual Permit (WA0039781) on April 16, 2015, following a SEPA environmental review process. However, ****On May 3, 2015, WGHOGA asked Ecology to withdraw the permit in response to strong public concerns***.* Ecology agreed and cancelled the permit on May 4, 2015, prior to the close of the appeal period and before the permit was active.

The new Supplemental EIS (SEIS) of the 'WGHOGA 2 is 016 NPDES permit application to Ecology' is for a 'revised' application. The revised proposal for the use of Imidacloprid to treat commercial clam and oyster beds on up to 500 acres per year (total) in Willlapa Bay and Grays Harbor. The 2016 application also stipulates spray and granular applications from boats and/or ground equipment rather than aerial applications from helicopters. The synopsis of the supplemental EIS states that this action will result in:

□ Immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish to the areas

treated with Imidacloprid and the nearby areas covered by incoming tides.
□ Significant uncertainty about the cumulative environmental impacts and other unknown advserse

impacts to other marine invertebrates and life cycles.

□ Potential indirect impacts to fish and birds if food sources are disrupted.
□ There are still knowledge gaps about Imidacloprid. Further research is needed,

In addition, DoE finds that, quote:' *There is also a growing public concern about Imidacloprid, which is a neonicitinoid pesticide*.'

The upshot: despite the significant literature documenting human health and ecosystem concerns/ risks surrounding its use, this insecticide is proposed (again) to be applied along shellfish beds and

shallow coastal areas of Willapa Bay, exactly where juvenile salmon and forage fish feed, rest, and migrate.

Clearly, regardless of the size of coverage, Imidacloprid applied to coastal areas will impact critical marine and nearshore ecosystems, and is a human health concern. It still includes the application of a highly toxic insecticide along shorelines used by numerous salmon and forage fish species, including Chinook and coho from as far away as Snake and Columbia River systems (Shaffer et al 2012). This insecticide will exactly impact prey species for these fish. Further, marine mammals, including killer whales *Orcinus orca*, that are critically endangered due to pollution and lack of food. These killer whales? Depend on Chinook salmon. This insecticide will therefore have a cascading impact that is exactly contraindicated to preserving and restoring our coastal ecosystem. Further, method of spray does not mitigate toxicity to fish, invertebrates, and coastal systems (or humans for that matter).

The substance and context of the comments pointing out the myriad of negative environmental impacts provided on the last EIS and permit are still exactly applicable on this 'revised EIS' (see:

http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid/commentsFeb2014.html). All previous comments detailing the negative and dangerous effects of use of this insecticide and it's impacts to fragile coastal ecosystems should also therefore be brought forward to this consideration.

And finally, from a management perspective, the public is not well served by this 'withdraw, wait, and resubmit' permit strategy by the aquaculture industry. The public should not have to keep reiterating these points and resubmitting reviews to insist that public agencies properly and wisely manage our critical ecosystems and coastal resources.

The bottom line? People don't want to eat pesticide laced shellfish-and have said so loud and clear. Washington's coastal ecosystems are complex, and critical to our region. Citizens of Washington have also stated clearly: our coastal ecosystems must be preserved. They must not be turned into industrial (non-native) shellfish feed lots. To that end, toxic insecticides, including Imidacloprid, should not be allowed to be applied on coastal ecosystems to wipe out native species to enhance nonnative shellfish species for commercial use. The state and federal resource agencies are legally mandated to preserve Washington States' wild species and their ecosystems, and to ensure that industrial aquaculture practices are limited to those that protect-and not destroy- wild intact ecosystems. Insecticide application in coastal zones, including Imidacloprid, are contraindicated to this mandate and should not be permitted.

Respectfully,

Anne Shaffer, PhD

Coastal Watershed Institute

P.O.Box 2263

Port Angeles, Washington 98362

anne.shaffer@coastalwatershedinstitute.org

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CWI is a 501c3 and Washington state non-profit corporation P.O. Box 2263

UBI number 601-708-612 Port Angeles, WA 98362

360.461.0799 www.coastalwatershedinstitute.org

Commenter: Brian Kingzett - Comment O-19-1

(Email Submission)

Please find attached a submission on behalf of Nisbet Oyster Co in support of the Draft Supplemental Environmental Impact Statement (Draft SEIS) for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington issued by the Washington Department of Ecology for public comment on September 15, 2017. We support the of issuance of a National Pollution Discharge Elimination Permit ("NPDES") as analyzed in the preferred alternative of the Draft SEIS and offer these comments in addition to those submitted through the Willapa Grays Harbor Oyster Growers Association.

Please do not hesitate to contact me directly should you have questions regarding this submission. Thank-you for the opportunity to comment and if possible could you please acknowledge receipt.

NISBET OYSTER CO., INC.
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October 30, 2017

Derek Rockett
Ecology Water Quality Program
P.O. Box 47775
Olympia, WA 98504-7775
Via email: burrowingshrimp@ecy.wa.gov

Dear Derek,

Re: Support for Draft Supplemental Environmental Impact Statement (Draft SEIS) for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor "

On behalf of Nisbet Oyster Co., Inc., I am pleased to submit comments in support of the Draft Supplemental Environmental Impact Statement (Draft SEIS) for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington issued by the Washington Department of Ecology for public comment on September 15, 2017. We support the of issuance of a National Pollution Discharge Elimination Permit ("NPDES") as analyzed in the preferred alternative of the Draft SEIS and offer these comments in addition to those submitted through the Willapa Grays Harbor Oyster Growers Association.

Nisbet Oyster Co. is a family run oyster farm based out of Willapa Bay WA since 1975. We farm on approximately 1900 acres of privately owned Bush-Callow Act oyster tidelands that have been in production since the 1800's, using extensive, natural and traditional low impact, bottom culture techniques. We also process farmed products for nine other farming companies in the Bay. We are very proud of the products that we produce and the ecological quality of the estuary that we operate in.

During the decades that we have been operating day in and day out in the bay, we have witnessed first hand the infestation of burrowing shrimp and the significant ecological changes that these species effect in the estuary beyond just the loss of our crops. We have been a participating member of WGHOGA, prior carbaryl control programs, and have supported scientific research to assess the effectiveness of pest control and our continuing search for alternatives. We have successfully restored previously abandoned tidelands where high densities of shrimp had created muddy barrens of low diversity into productive eelgrass beds that support the bottom culture of oysters and associated marine invertebrates, fish and waterfowl that use the bay.

We are very proud to be creating high quality local food in partnership with nature. Our family farm is now entering its third generation of farmers making us one of the "younger" farms in the bay. Our operations now directly support more than 100 employees and their families with family wage jobs as well as contributing to the health of our local coastal communities with secondary economic contributions.

We, with our fellow oyster farmers have had an active role in managing the bay from anthropogenic threats such as sewage pollution, excess run-off, invasive *Spartina* and burrowing shrimp. Willapa Bay has been anthropogenically changed through reductions in the Columbia River freshet and loss of predators which we believe kept burrowing shrimp in ecological balance, as well as decades of clear cut logging which resulted in increased sedimentation into the bay. Active participation in bay management and preservation has allowed our industry to be the largest employer in the county while maintaining a healthy environment. We do this against a backdrop of issues that we cannot control, such as anthropogenic climate change and ocean acidification. We are the stewards of our environment with respect to water quality and pollution and our oyster culture provides important environmental services.

During the last year, we have been forced to abandon more than 80 acres of our best growing areas due to extraordinarily high levels of shrimp recruitment which have resulted in the loss of stable eelgrass oyster complexes to soft mud barrens that are even dangerous for our crews to walk in. We are monitoring increases in shrimp on other previously healthy beds and are aware that continued progression left unchecked will result in loss of our crops, our business, our employees well being and ultimately the ecology of the bay.

We recognize that as stewards of the estuary and as providers of high quality food to our customers, that we have a responsibility to ensure that management of our beds is done in the most scientifically defensible and responsible manner that does not pass on any real or perception of risk to our customers, while ensuring that non-target impacts are within acceptable levels for the ecology of the bay. We are confident that the application of imidacloprid as outlined in the Draft SEIS will meet these objectives while we continue to further research the cause of the increased shrimp infestation and explore alternatives that will allow us to maintain our beds while continually minimizing impacts through the continual improvement framework of integrated pest management. The alternative of no treatment, will result in significant business and community hardships and disallow us from seeking out future alternatives.

The findings of the SEIS support the issuance of a draft permit for the use of Imidacloprid to control burrowing shrimp in Willapa Bay and Grays Harbor. There has been appropriate analysis and sufficient evidence to support the alternative (previously called "Alternative Four") within the SEIS, which allows IPM on up to 500 acres per year in Willapa Bay and Grays Harbor with no aerial applications by helicopter and no applications over oyster crops. This alternative, which is smaller in scope and different in method from the 2015 SEPA process, reflects best available science and a refined scope. The proposed mitigation measures and monitoring proposed will adequately offset the potential impacts and provide information for future refinements.

We encourage the Department of Ecology to support the alternative and continue with the process towards issuance of a draft permit. We appreciate the efforts that the Department of Ecology has made to engage coastal stakeholders and the review of the science that has guided this process. We will look forward to a mutually satisfactory path to a permit and working together to ensure that everyone's objectives are met and that the oyster industry in Willapa Bay and Grays Harbor will continue to be successful.

Sincerely,

David H. Nisbet
Owner

Commenter: Jennifer McDonald Carlson - Comment A-5-1

(Email Submission)

Please find the letter attached. This electronic copy is for your records and files.
Thank you.

UNITED STATES DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

NATIONAL MARINE FISHERIES SERVICE

West Coast Region

1201 NE Lloyd Boulevard, Suite 1100 Portland, OR 97232

November 1, 2017

Derek Rockett

Water Quality Program

Washington State Department of Ecology

Southwest Regional Office

PO Box 47775

Olympia, Washington 98504

Re: Comments on Draft Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

Dear Mr. Rockett:

Thank you for the opportunity to comment on Washington State Department of Ecology's

(Ecology) Draft Supplemental Environmental Impact Statement (DSEIS) provided September 18, 2017. The National Marine Fisheries Service (NMFS) recognizes the importance of the final decision Ecology must make regarding the use of the insecticide imidacloprid in Washington State's coastal estuaries. In providing our comments on the DSEIS, NMFS would like to emphasize aquaculture is an important component of our agency's efforts to maintain healthy and productive marine and coastal ecosystems, restore marine habitat, balance competing uses of the marine environment, create employment and business opportunities in coastal communities, and enable the production of safe and sustainable seafood. NMFS appreciates the continued open communication and sharing of information. In particular we appreciated the opportunity to meet with Ecology personnel on August 10, 2017, to discuss new research and analyses along with details of the new permit request prior to the issuance of the DSEIS.

NMFS is providing our comments based on our responsibilities under the Endangered Species Act (ESA) and the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as well as policies of the Department of Commerce and NOAA regarding aquaculture.

The National Pollutant Discharge and Elimination System (NPDES) permit request seeks allowance for the application of imidacloprid in limited areas of Willapa Bay and Grays Harbor to kill two endemic species of burrowing shrimp (*Neotrypaea calforniensis* and *Upogebia pugettensis*) on intertidal flats that are used for commercial shellfish operations. If granted, the request would require, for the first time for this purpose, "sediment impact zone" (SIZ) permits. The SIZ permits address the persisting effects to other benthic species in the intertidal habitat area.

NMFS would like to acknowledge changes that were made to the current DSEIS in response to comments we previously provided on December 8, 2014 to Ecology on a similar NPDES permit. In particular, the acreage proposed to be treated has been significantly decreased from 2,000 acres to 500 acres. Additionally, results of a number of new studies (including the efficacy and the benthic and water chemistry study results), have been made available to NMFS staff and are included in the DSEIS. However, NMFS still has concerns about the proposed action as described below.

Based on our review of the document, the DSEIS lacks a full assessment of the potential ecological ramifications of targeting these two species of burrowing shrimp. Burrowing shrimp provide a suite of ecological functions in West Coast estuaries. They rework intertidal and shallow subtidal bottom sediments during the normal course of their feeding, sheltering, and other activities. Burrowing and deposit-feeding by ghost shrimps affect the geochemical properties of the sediments, including grain size, nutrient exchange, and organic deposition. They create a unique habitat beneath the surface that supports more than a dozen different species. The DSEIS does not address the potential effects that burrowing shrimp control might have on these dependent species. The elimination of shrimp may ultimately eliminate the burrows that many other species rely on (e.g., *Nuttallia nuttallii, Neotrypaea californiensis,* *Crytomya californica, Tagelus californiansus*). In the effectively treated areas, these additional species may also be eliminated. The final SEIS Ecology releases should analyze this perturbation n of the ecosystem, and the significance of this potentially adverse ecosystem response by clearly defining the anticipated spatial and temporal scale of impacts.

Based on our review, the DSEIS' analysis does not fully support the need to control the burrowing mud shrimp (*Upogebia pugettensis*). During our meeting with you and other Ecology staff and managers on August 10, 2017, we discussed recent media reports

(http://www.opb.org/news/article/native-shrimp-once-killed-with-pesticides-now-at-risk-frominvasive-parasite/) and a study by Dumbauld et al. (2011) that *U. pugettensis* has all but disappeared from Willapa Bay and is close to complete extirpation from Washington's coastal estuaries. Ecology indicated they were aware of these reports suggesting *U. pugettensis* is likely being impacted by an invasive parasitic isopod. NMFS encourages Ecology to include in the final SEIS a discussion about the ramifications of targeting this species and more fully discuss the status of this species and whether there is a need to control them in the final SEIS.

Impacts to the untargeted benthic community is likely to be higher than described in the 2015 final EIS and the 2017 DSEIS. The 2014 Field investigations Experimental Trials for

Imidacloprid Use in Willapa Bay (Hart Crowser, 2016) described a sampling protocol we believe insufficient to accurately determine the magnitude of effects to benthic invertebrates. These experimental trials included megafauna sampling which focused on Dungeness crab. According to Hart Crowser (2016), "The average across all sites and treatments was 2 affected crab per acre." We believe this number does not accurately represent the total number of crabs affected because the study was not performed throughout the 90 acre sprayed test plot. Instead, observations were taken only on the inside and outside edge of a 7-meter perimeter along the spray zone. Within this smaller peripheral zone, 4 crabs were observed alive, 44 were observed experiencing tetany, and 93 crabs were found dead. It could be anticipated that there would have been much higher numbers if more timely and full systematic surveys were conducted throughout the test area. The DSEIS addressed this by estimating a high-end value of 18 crabs affected per acre sprayed. We are concerned with the degree of uncertainty surrounding these estimates.

The results of the megafauna survey are concerning because of the high ratio of affected to nonaffected crab (133:4) in the limited sample zone, and because it is anticipated that tetany and mortality observations would increase had observations been conducted within the entire 90 acre imidacloprid test plot. Extrapolation of affected crab per acre would have produced a more scientifically defensible number if a systematic survey was conducted and if there would not have been a 24-hour delay before megafauna (crab) counting began. Because observations began two full tidal cycles later, it is likely predation, tidal currents, and wind waves reduced the detection rates of affected crabs. Finally, the megafauna study excluded other important fauna in and on the benthos, as well as adverse effects to zooplankton (including early life stage planktonic forms of benthic mega-fauna) in the water column. The final SEIS should better describe the potential environmental impacts to sediments and surface waters, and extend the analysis to all the animals that depend on these different mediums.

In order to gauge the suitability of applying imidacloprid in the proposed areas, NMFS reviewed multiple EPA-registered labels for the active ingredient imidacloprid. This review found that both liquid and granular formulations had this prohibitive language:

> “Highly toxic to aquatic invertebrates. Do not apply directly to water, areas where surface water is present ***or to intertidal areas below the mean high water mark***.” (Emphasis added).

Based on our understanding of the label process, the U.S. Environmental Protection Agency

(EPA) approved just two labels without this prohibitive language: Protector 0.5G and Protector 2F. Both of these formulated products had the same percentage of the active ingredient as all other product labels reviewed. EPA conditionally registered these two labels and formulations to the oyster growers in Willapa Bay and Grays Harbor to apply in the water and below the mean high water mark. However, while EPA approved these labels, EPA’s ecological risk assessment does not evaluate this use, nor any use that allows direct application to aquatic habitats. The final SEIS should clarify why these products are acceptable to use in intertidal habitats when similar imidacloprid products are not.

The statement found on page 1-7 and on to page 1-8 of the DSEIS is concerning as it infers there is a reduced risk from imidacloprid in the marine environment:

> “The more limited studies of imidacloprid in marine environments, including the multiple field trials in Willapa Bay, document that imidacloprid is also toxic to marine invertebrates, but at higher concentrations or longer exposures compared to sensitive freshwater invertebrates.”

There are no citations to support this statement, and NMFS recommends it be removed from the final SEIS. Studies provided elsewhere in the DSEIS suggest imidacloprid toxicities to estuarine and marine invertebrates may be as high as in freshwater invertebrates. Osterberg et al. (2012) shows that several pesticides were tested on blue crab, a marine invertebrate. Of all tested active pesticide ingredients, imidacloprid was the second- most toxic to this species of crab. EPA's ECOTOX database indicates relatively few marine invertebrate species have been tested using reliable standardized toxicity test protocols and a substantial amount of variability in response is evident in both marine and freshwater species (https://cfpub.epa.gov/ecotox/). While field observations suggest impacts to crabs are likely, a large amount of uncertainty exists regarding the potential impacts to the marine invertebrate community, and to species that rely on them.

Since Ecology's Final Environmental Impact statement was issued in 2015 for the previous permit to use imidacloprid, the Health Canada Pesticide Management Regulatory Agency, following their own risk assessment, is currently considering an entire ban of this chemical. They found ambient concentrations of imidacloprid in aquatic environments at levels above that are harmful to aquatic insects. They also found, based on currently available information, the continued high-volume use of imidacloprid in agricultural areas is not sustainable. These concentrations are from drift and run-off pathways to the aquatic environment. Direct application to the aquatic habitat, as proposed by applicants for this permit, will result in much higher concentrations and consequently a greater likelihood of adverse ecological effects and ecosystem-level impacts. Ecology's final SEIS should better incorporate this information in the analyses on the use of imidacloprid on coastal estuaries.

Potential effects to Green sturgeon forage on burrowing shrimp and other benthic organisms are easily discerned in the treated areas (Hart Crowser 2016). However, the impacted area will extend beyond the area directly treated, as the pesticide will clearly be transported off site by water, as has been shown with limited water quality monitoring at Willapa Bay. Additionally, the crab studies, limited as they were, demonstrate effects beyond the perimeter of the treated area. The final SEIS should analyze the entire spatial extent of the area that may be impacted due to site application and by transport. The final SEIS should also calculate the concentrations likely to occur in the marine habitats due to direct application to these habitats.

The DSEIS does not adequately consider impacts of indirect effects such as the reduction in food availability to other species. It characterizes risk to fish, birds, and other organisms based almost exclusively on direct mortality, omitting indirect pathways of effect. Nor does the DEIS consider any sub-lethal effects on species. The final SEIS should address these additional effects.

Delayed, lingering, and latent effects resulting from imidacloprid's persistence in sediments are concerning (Hart Crowser 2016). Studies have found significant effects from persistent, low concentrations of imidacloprid (Van Dijk, et al. 2012). Van Dijk, et al. (2012) study showed that serious concern about the far-reaching consequences of the repeated use of imidacloprid (as proposed by this permit) to aquatic ecosystems is justified. The final SEIS should include an analysis of potential long-term ecosystem effects over the life of the proposed permit.

Direct in-water application of the granular formulation is also concerning. The DSEIS does not adequately describe fate and transport of this formulation. Instead, the draft states the product will be applied "during periods of shallow standing water." This implies applications would occur during a slack tide (see page 1-22) and that the product would stay in the area applied. Yet on this same page the DSEIS states imidacloprid would be applied in water during out-going tides. These statements are inconsistent. The final SEIS should better describe fate and transport along with persistence of the granular formulation.

With regard to the SIZ, and as mentioned previously to Ecology in our response letter to the

2014 draft NPDES permit, it appears the Puget Sound toxic site recovery standard used by Ecology to determine maximum biological effects is not sufficiently protective of aquatic resources and their habitats (Washington Department of Ecology 2013 - WAC 173-204). By this standard, when a site recovers up to 50% biotic richness and abundance, it meets the "recovered" standard. Applying this standard to the total acres treated and the off-site areas affected could represent a huge and continuing loss in biotic production for several other ecologically important and economically valuable species. The Puget Sound toxic site "clean-up" standard should not be used for this purpose because there is too much variability in sampling between treated sites and control sites to suggest that 50% can be equated with a viably functioning ecosystem. A better representation of recovery would be to use a higher value for return abundance and biotic richness. The value should indicate a trajectory that the site is indeed recovering. The final SEIS should include an analysis that explores the differences in biotic richness and biomass between the 50% standard proposed for a SIZ and a higher value alternative (e.g., 80%) measured on an impact scale that takes into consideration full acreage and offsite affects allowed over the 5-year permit.

NMFS agrees with the concerns raised by Ecology's Toxics Cleanup Program (TCP) in response to a previous draft of the SEIS (memo dated August 9, 2017) and finds that many of those concerns remain in the current draft SEIS. An example of an additional concern raised by the TCP, shared by NMFS, and not adequately addressed by the current draft SEIS is the potential for chronic effects on invertebrates. In numerous places, the draft SEIS describes potential adverse effects as being 'short-lived.' However, several lines of evidence demonstrate that effects may be more chronic. For example, field studies cited in the draft SEIS show that recovery from exposures in high dissolved organic content sediment is not complete even at 28 days. The DSEIS (page 1-17) states the half-life of imidacloprid as being greater than one year. Additionally, as reported in citations pointed out in the TCP memo, imidacloprid binds irreversibly to the receptor. This means that an individual's recovery is likely prolonged and any sublethal impacts may last well beyond 1 day (i.e. not 'short lived'). Animals may, therefore, not be observed dead or immobilized after 1 day, but nonetheless, be impaired in ways critical to their survival. Importantly, any sublethal effects could still be lingering when subsequent exposures occur.

In closing, while significant concerns remain about the unintended biological effects of controlling burrowing shrimp as described above, NMFS is also concerned about possible economic impacts the Willapa Bay Grays Harbor Oyster Growers Association (WGHOGA) is experiencing. In order to assist WGHOGA in investigating alternative types of oyster culture that would not require the control of burrowing shrimp, but could still maintain oyster production value, NMFS offers a number of funding opportunities. We recommend that WGHOGA work directly with the NMFS Office of Aquaculture staff and the West Coast Region Aquaculture Coordinator who can provide technical assistance to help develop proposals for such investigations. NMFS also encourages Ecology to seek state or other federal (e.g., EPA) funding sources that could help with alternative practices. Sources of funding we have identified include:

- **NMFS' Saltonstall-Kennedy Grant Program** - The Saltonstall-Kennedy Grant Program includes aquaculture as a priority to fund projects that encourage the development of environmentally and economically sound aquaculture as well as relieve fishing pressure and improve market availability of U.S. seafood products. http://www.nmfs.noaa.gov/mb/financial_services/skhome.htm
- **NOAA Sea Grant's Marine Aquaculture Grant Program** - Informally referred to as the "National Marine Aquaculture Initiative (NMAI)," this national competitive grant program encourages demonstration projects and research targeted to the development of sustainable marine aquaculture in the United States. The competition is designed to foster dynamic partnerships that channel resources toward the development of sustainable aquaculture technologies. Projects often involve partnerships among commercial companies, research institutions, universities, state governments, and coastal communities. http://www.nmfs.noaa.gov/aquaculture/funding/nmai.html
- **NOAA Small Business Innovation Research (SBIR) Program** - Investment in aquaculture research and development is supported by NOAA's SBIR program, which encourages small businesses to leverage federal funds to invest in innovative technologies and next-generation products and processes. http://techpartnerships.noaa.gov/SBIR.aspx
- **NMFS' Finance Program** - The Fisheries Finance Program provides long-term financing (up to 25 years) in the form of direct loans for up to 80 percent of the cost of construction, reconstruction, expansion, and purchase of aquaculture facilities. The program also may refinance existing loans. There are no early repayment penalties and the fees for a new loan are 0.5 percent. Aquaculture is considered a high priority in this program. http://www.nmfs.noaa.gov/mb/financial_services/ffp.htm

At this point, there has been no consultation under the ESA addressing aquatic application of imidacloprid, and there is no valid, current ESA coverage for the application of imidacloprid to control burrowing shrimp. To date, no federal action agency has requested consultation with NMFS to address the practice and its potential effects to ESA-listed species. Without a valid, current incidental take permit or statement addressing the effects of this practice on ESA-listed species, parties engaging in aquatic application of imidacloprid lack ESA coverage.

We look forward to continued dialogue with Ecology as the agency moves toward its final determination. We also look forward to a resolution that will allow continued shellfish culture in a manner consistent with the protection of other important resources.

If you have questions regarding funding opportunities described, please contact our Regional Aquaculture Coordinator, Laura Hoberecht by phone, 206-526-4453, or email, laura.hoberecht@noaa.gov. All other questions should be directed to Scott Anderson by phone, 360-753-5828, or email, scott.anderson@noaa.gov; or Thom Hooper by phone, 360-753-9453, or email, thomas.hooper@noaa.gov.

Sincerely,

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon – Washington Coastal Area Office

cc: Barry Rogowski
Rich Doenges
Leonard Machut
Cathy Tortorici

References:

Dumbauld, B.R., J.W. Chapman, M.E Torchin, A.M.Kuris. 2011. Is the Collapse of Mud Shrimp (Upogebia pugettensis) populations along the Pacific Coast of North America caused by outbreaks of a previously unknown bopyrid isopod parasite (Orthione griffensis)? Estuaries and Coasts. Volume 34, Issue 2, pp 336-350

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Osterberg, J.S., K.M. Darnell, T.M. Blickley, J.A. Romano, and D. Rittschof. 2012. Acute toxicity and sub-lethal effects of common pesticides in post-larval and juvenile blue crabs Callinectes sapidus. J. Exper. Marine Bio. And Ecolo. 424-425: 5-14

Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP (2013) Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5):e62374.

doi:10.1371/journal.pone.0062374

Washington Department of Ecology. 2013. Chapter 173-204 Washington Administrative Code. Sediment Management Standards. Olympia, WA.

Commenter: Megan Dunn - Comment O-6-1

Please see the attached comment letter.

NORTHWEST CENTER FOR ALTERNATIVES TO PESTICIDES

October 30, 2017

Derek Rockett, Permit Writer

Ecology, Water Quality Program

P.O. Box 47775 Olympia,
WA 98504-7775

e-mail: ECY RE WQ Burrowing Shrimp Permit burrowingshrimp@ECY.WA.GOV

Dear Mr. Rockett,

Thank you for the opportunity to provide comments on the Supplemental Environmental Impact Statement (SEIS) examining a new alternative for the use of imidacloprid to battle burrowing shrimp in Willapa Bay and Grays Harbor. These comments are being submitted jointly by the undersigned organizations representing thousands of Washington and Oregon residents and joining Northwest Center for Alternatives to Pesticides (NCAP) in expressing concerns about the proposed pesticide application. We have reviewed the SEIS as well as the Sediment Impact Zone Application (SIZ) that describe the proposed action and preliminary field trials.

SEIS Overview

The Washington Department of Ecology has issued an SEIS to re-examine allowing imidacloprid insecticide application to the waters of Willapa Bay and Grays Harbor. The use of imidacloprid is intended to control two native species of burrowing shrimp: ghost shrimp (*Neotrypaea californiensis*) and mud shrimp (*Upogebia pugettensis*). These shrimp impact the Pacific Coast commercial clam and oyster production by destroying the composition of intertidal soil, which causes oysters and clams to sink and suffocate. Ecology does not identify a preferred alternative, however the SEIS presents a reduced-scale alternative not previously considered - application of imidacloprid on up to 500 acres per year in the two bays, with application to occur from boats or ground equipment, rather than helicopter. The SEIS seems to hold out the possibility that subsurface injectors may be also used during the permit period. The total treatable area over the 5-year term of the permit could range up to 2,500 acres, rather than the previously approved 10,000 acres. While the total area to be treated is reduced, the rate of application is the same (0.5 lb a.i./A) as in the previously permitted alternative.

Members of the Willapa Grays Harbor Oyster Growers Association (WGHOGA) have claimed in the press that the redesigned proposal is now “extremely targeted.” One oyster grower describes the proposal as “a protective boundary.”

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Our Objections

We have identified numerous objections to the newly proposed alternative, as summarized below.

Toxicity to Non-Target Aquatic Invertebrates is Addressed in SEIS, but Evidence for Minimal Impact is Lacking or Contradictory in the SEIS

We cannot agree that the new alternative is “extremely targeted.” Nothing has changed about the active ingredient proposed. The pesticide imidacloprid is a broad-spectrum insecticide that kills, at very low concentrations, a very wide range of invertebrates. Imidacloprid labels clearly warn that the chemical is highly toxic to aquatic invertebrates.

Ecology acknowledges (p. 1-8) that high concentrations are expected during the first rising tide with concentrations of up to 1,600 ppb (even though concentrations of up to 4,200 ppb were apparently measured in field studies completed in 2012). Ecology also claims that flushing is expected to dilute dissolved imidacloprid to “undetectable levels” within 2-3 tidal cycles (page 1-8). However, one needs to dig deeper in the document (page 3-5) to find that data from the 2014 field trials show that on half of the sites treated experimentally, concentrations of imidacloprid in sediments or porewater ranged from 6.8-18 ppb fourteen days after the treatment.

The United State Environmental Protection Agency (EPA) in its 2017 preliminary aquatic risk assessment of imidacloprid, finds imidacloprid acutely toxic to aquatic invertebrates at levels ranging from <1 ppb to 85,200 ppb.[1] Seed shrimp (Ostracoda), a widely distributed group of aquatic invertebrates important to both saltwater and freshwater ecosystems, is tagged as the most sensitive group of crustaceans for which data is available, with acute EC50 values of 1–3 ppb, obviously a value thousands of times less than the initial expected concentrations if the 2012 field studies are to serve as a guide. Specific studies on saltwater species are less frequent but blue crab shows a 24-hr LC-50 of 10 ppb. Taken as a whole, the studies cited in the EPA risk assessment suggest that a wide variety of benthic and free-floating aquatic invertebrates will die at—and near— the treatment sites.

On page 1-7 of the document, we find the curious statement: *The more limited studies of imidacloprid in marine environments, including the multiple field trials in Willapa Bay, document that imidacloprid is also toxic to marine invertebrates, but at higher concentrations or longer exposures compared to sensitive freshwater invertebrates.* This seems like a sweeping overreach given that marine studies are rather lacking in number compared to freshwater studies.

Still, despite the limited number of marine studies and despite the information presented on ostracods which are important to saltwater ecosystems, Ecology has chosen (p. 3-20) to adopt the level of 16.5 ppb as its acute toxicity criterion. We believe this adopted level is short-sighted and too high.

[1] We cite this document several times in our letter but will only reference it once here. The risk assessment is: U.S. Environmental Protection Agency (USEPA). 2017. Preliminary aquatic risk assessment to support the registration review of imidacloprid. PC Code 129099. DP Barcode 429937. USEPA, Office of Chemical Safety and Pollution Prevention, Washington D.C. Prepared by USEPA Office of Pesticide Programs, Environmental Fate and Effects Division, Washington D.C. https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0844-1086

Chronic toxicity to freshwater aquatic invertebrates is also discussed in the EPA 2017 risk assessment, with values of 0.01 - 1,800 ppb presented (some are LOAEC values, but not the 0.01 value). Only two studies explore saltwater aquatic invertebrate chronic toxicity values, with the most sensitive value (NOAEC) attributed to mysid shrimp at 0.163 ppb. Mysid shrimp are not just laboratory animals. Mysids are found throughout the world in both shallow and deep marine waters where they can be benthic or pelagic, and they are also important in some freshwater and brackish ecosystems.[36] Mysid shrimp are also documented as occurring in Willapa Bay.[37]

What is not clear in the SEIS is how far lethal effects will extend away from the treatment site and whether concentrations of either imidacloprid, or any of its degradates, will result in longer-term chronic effects to aquatic invertebrates at the treatment site or elsewhere in the estuaries. Ecology claims that flushing is expected to dilute imidacloprid to "undetectable levels" at most a month or two beyond the application date. However, "detectable limits" appear to be the screening values of 6.7 and 0.6 ppb for whole sediment and sediment porewater, respectively and 3.7 ppb for surface water (SIZ application). According to the SIZ description of the methodology, when concentrations at 60m from the treated plots were lower than 3.7 ppb, samples collected at further distance were not analyzed. This methodology left important data gaps in the analysis, especially given that we know that both lethal and chronic impacts can affect aquatic invertebrates at concentrations less than 3.7

ppb.

We are disappointed that these "screening" or detectable levels were set unacceptably high in the field trials, considering other laboratories at this time were using technologies that allow detections at much lower concentrations. Levels of detection can vary widely between laboratories, but three examples show that it is more than feasible to detect dissolved imidacloprid down to the 0.02 ppb level.[38]

Ecology further characterizes impacts to benthic invertebrates as localized and short-term, claiming that field trials showed benthic invertebrate populations recovering quickly within 2-4 weeks after treatment. While the field trials were important precursors to the completion of the SEIS, we are skeptical that these results can be relied upon long-term when large portions of the bays will receive treatment - ten times the area exposed during experimental applications. Most systems can recover from short-term irregular perturbations. It is not so clear that a system like this can recover from a

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[36] Wikipedia. Mysidia. https://en.wikipedia.org/wiki/Mysida

[37] Graham, Eileen. 2010. Estuaries and Coasts 33:182-194. https://link.springer.com/article/10.1007/s12237-009-9235-z

[38] For example, Hladik and Kolpin (2015) reporting on US Geological Survey studies of imidacloprid, report their theoretical level of detection (LOD) for imidacloprid as 2 ng/L, while the method detection limits (MDL) ranged from 3.6 to 6.2 ng/L. To contrast, the Department of Environmental Quality laboratory in Hillsboro Oregon has minimum reporting limits of about 21.6 ng/L. The Washington State Department of Agriculture lists its imidacloprid reporting limit as 0.02 ug/L, about in line with the detection limit in Oregon.

series of perturbations such as would occur with annual imidacloprid applications across much larger geographic footprints than those tested during experimental field trials.

Whether the outcome can truly be characterized as localized or short-term is at the heart of our concern. The SEIS (page 1-37) claims that laboratory studies show that sub-lethal effects of imidacloprid are reversed once the chemical is removed. Since this statement is not cited, it is difficult to know which studies are the source of this statement. On the contrary, we are aware that some authors [5,6] note that since neonicotinoids bind virtually irreversibly to the nicotinicacetylcholine receptors in invertebrate nervous systems, the damage can accumulate, and therefore the toxic effects can be reinforced with chronic exposure—a phenomenon known as time-cumulative toxicity or delayed mortality. This is an important aspect of the property of neonicotinoids that should be taken into account when interpreting the standard tests and endpoints for aquatic invertebrates, since results likely underestimate the true toxic potential of these insecticides. Actual mortality at low concentrations may still be a result, but may occur at a longer time frame than that allowed in the standard laboratory study or those captured in the field trials.

Presence Of Data Gaps Undermines Ecology's Conclusion Of No Significant Adverse Effects

Ecology notes that its literature review notes "some scientific data gaps, including effects of imidacloprid to marine invertebrates from chronic exposure, the long-term persistence of imidacloprid in marine sediments, and indirect effects to species or food chains due to reductions in invertebrate numbers following imidacloprid exposure." These data gaps are mentioned as if they are of passing interest and seem to play no role in Ecology's ultimate conclusion of no significant adverse impacts. Risking these delicate and rare estuarine environments without understanding these critical effects is irresponsible.

Ecology's reasoning in concluding no significant adverse effects and that impacts would be both short-term and localized rests heavily on a few key assumptions:

a) That the area treated represents a small percentage of the overall bay area. This reasoning is significantly undermined by the admission that imidacloprid in the treated areas would soon disperse throughout the bays as a result of tidal action.
b) That tidal flushing will soon dilute dissolved imidacloprid to undetectable levels. While the field studies do show that dilution occurs, concentrations in sediments and sediment porewater appear to remain higher than levels known to be acutely or chronically toxic to aquatic invertebrates for as long as 56 days. Furthermore, limits of detection are not the same as toxicity endpoints.
c) That at the treated sites, concentrations will decline rapidly. It is reported in the SEIS that 2011-2012 field trials found sediment porewater concentration ranging from 8-20 ppb one

5 Rondeau, G., Sánchez-Bayo, F., Tennekes, H. A., Decourtye, A., Ramírez- Romero, R., and Desneux, N. (2014). Delayed and time-cumulative toxicity of imidacloprid in bees, ants and termites. *Sci. Rep.* 4:5566. doi: 10.1038/srep05566

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day after treatment. Yet it took another 55 days to get concentrations down to 0-0.5 ppb. At 0.5 ppb, we would still expect chronic impacts, based on the studies presented above. Moreover, the SEIS makes clear that sediments with higher levels of organic material seem to degrade imidacloprid more slowly.

d) That off-site impacts are discountable. In fact, the footprint of off-site impacts remain very poorly understood. Ecology reports that "detectable" levels were found as far as 2,316 feet away from experimental plots. This is approximately one half mile. This is a fairly large distance, and we really don't know if the methodology used missed detecting imidacloprid at environmentally relevant concentrations at points more distant. Detectable limits were set higher than levels known to result in impacts to some species, and there seems to not have been an attempt to measure imidacloprid levels at points throughout the bays. Thus, at a minimum, we might expect impacts to half-mile circles around each spray site. This dramatically increases the footprint of impact, but is never presented quantitatively or spatially in this way in the SEIS.

e) That typical atmospheric conditions are of no consequence in dispersing the chemical to much wider areas. Applicators could apply under any wind speed as long as speeds "average" 10 mph or less. No mention is made of gusts that could carry the spray. No quantitative analysis is presented of the distance that drift could carry the pesticide at wind speeds of 10 mph. We are instead presented with a list of drift mitigation measures and left to assume that the drift management mitigations will result in a negligible quantity of drift.

Field Trials Left Many Questions Unanswered

Despite field trials that determined detectable levels were located at a distance of 2,316 feet, Ecology concludes that imidacloprid in water is "expected to have a low to moderate impact to cause ecological impacts in non-target areas." (p. 1-17).

The field studies appear to have a number of deficiencies that make this conclusion—and the reassurance that recovery on treated sites would occur rapidly—questionable. The field studies, as summarized in the SIZ and in Appendix A of the SEIS, contain important information about methodology and results, that do not appear to be adequately taken into account in Ecology's conclusions. For instance,

a) In the 2011-2012, apparently megafauna mortality was only measured up to 150-164 feet away from the treatment site (2011-2012 studies). Had the study measured megafauna mortality more than 150 feet away, what would have been found? In the 2014 study, there appeared to be no attempt to measure megafauna mortality beyond the “edges” of the treatment area.

b) The 2011 study control and treatment plots differed markedly at the start of the experiment, making interpretation of results at the conclusion of the treatment difficult.

c) Ecology reports (p. 1-8) that field trials showed recovery by 28 days post-treatment but apparently the reality is not that simple. In fact, recovery was not seen by this time in the 2011 Cedar River site. In addition, a more detailed summary of the 2014 field trial (page A-22) notes that “However, as in previous years, variability in benthic abundance collections was high and statistical power was weak.”

d) Deep in the report on page A-25 is this curious statement:

Ecology determined that the “effects of imidacloprid cannot be discerned from seasonality and site variation or that relative recovery or recolonization is occurring within the 14-day period between the treatment date and first round of samples” (TCP April 17, 2015 memo). The 2014 benthic monitoring continued trends to date; all but one of the study monitoring locations have occurred in areas of low total organic carbon (less than 1% TOC) or high oceanic flushing. (emphasis added)

We understand that at least some areas with high organic carbon would be included in the treatment areas. Were the study sites selected to be representative of the areas to be sprayed?

This statement leaves us with much concern.

In summary, we have concerns over the methodology of the field trials and the use of the

conclusions to available evidence is simply not sufficient to conclude that the action would have no significant adverse effect on the ecology of the two bays.

Inadequate Analysis of the Effects to Threatened and Endangered Species

The analysis does a disservice to conservation by mostly limiting its analysis on listed species to an assessment of whether listed species would be directly impacted through toxic effects. Almost nothing is said about the impact to the prey base and ecological food web that supports these important and rare species.

The SEIS cites a study that showed that the green sturgeon diet may seasonally consist of up to 50% burrowing shrimp, but then fails to estimate the impact to its prey base.

No Recognition of Potential Impact to Two Nearby National Wildlife Refuges

Both water bodies host National Wildlife Refuges. The presence of these treasured and important federally-designated conservation sites is not even mentioned in the SEIS, nor is there any analysis of the potential impact to the ability of these Refuges to continue to fulfill their purposes.

Impacts to Dungeness Crab

The SEIS acknowledges that Dungeness crab and its planktonic forms will likely be killed in the areas sprayed, but discounts the likelihood that impacts would extend much beyond the sprayed areas. Dungeness crab is a treasured food resource to Washington residents, supporting both recreational and commercial harvest. According to Washington Department of Fish and Wildlife, Washington's coastal commercial crab grounds extend from the Columbia River to Cape Flattery near Neah Bay and include the estuary of the Columbia River, Grays Harbor, and Willapa Bay.[39] Would the State really risk commercial and recreational crabbing in these bays on the basis of the evidence presented so far?

Uncertainty Regarding Important Indirect Effects

The report acknowledges the uncertainty of whether treatment would result in resistance developing in the burrowing shrimp. The report makes no mention of whether Washington's citizens should be concerned about outbreaks of secondary pest/disease issues as a result of the treatment. Such secondary outbreaks are commonly associated with broad-spectrum pesticide use, and if they occurred, could create serious imbalances in the tidal ecology.

Ecology Understates Imidacloprid Properties (Environmental Fate) In Predicting Effects

Imidacloprid is water-soluble. The EPA's recent aquatic risk assessment cites solubility values ranging from 580-610 mg/L, a range classified as high by the widely used Pesticide Properties Database at U. Hertfordshire (although according to the US-based National Pesticide Information Center's system it would classify as moderately soluble). Across the country, imidacloprid is one of the most commonly detected pesticides in our water, detected in 13% of streams sampled by the US Geological Survey[40] — even though in most cases it's applied in terrestrial environments. Applying it directly to water that fluctuates twice daily according to the tides means that imidacloprid will dissolve readily after application and will then spread throughout the bays.

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[39] See Washington Department of Fish and Wildlife at http://wdfw.wa.gov/fishing/commercial/crab/coastal/

[40] EPA preliminary aquatic risk assessment, p. 9.

Imidacloprid's persistence is a concern. Ecology acknowledges that studies in the marine or estuarine environment are decidedly fewer than those in terrestrial environments. For example, the EPA risk assessment presents no studies that would help us truly understand the persistence of imidacloprid in the estuarine environment. Furthermore, the 2013 EPA registration that allows this use of imidacloprid in the estuarine environment is conditional, which means that studies to deem the application state are incomplete.

The EPA's preliminary aquatic risk assessment characterizes imidacloprid as "persistent in terrestrial and aquatic environments with the exception of conditions that favor aqueous photolysis." The SEIS claims that hydrolysis is one of the mechanisms that will result in breakdown of imidacloprid, but according to the EPA report, imidacloprid is stable to hydrolysis.

Ecology references field trials conducted in 2012 and 2014 that confirm imidacloprid persistence in sediment after application (Hart Crowser 2013 and 2016). The 2012 results documented detectable concentrations of imidacloprid at 56 days for two of five sampled locations, both of which were "below screening levels." As mentioned previously, we have no confidence in the screening levels selected, given studies referenced in EPA that show both lethal and chronic impacts to some aquatic invertebrates below these levels. Given that in some environments, imidacloprid is known to last for years, we do not believe that the window for time to measure environmentally relevant concentrations has been adequately explored.

Buffers to Protect Against Human Consumption are Inadequate

The buffers prohibiting harvest in proximity to treated areas—no harvest 25 feet from treated areas under Alt. 4—are framed as mitigations against the possibility of human consumption of imidacloprid. Once again, these are completely inadequate when we are talking about a highly soluble, persistent chemical that will readily disperse away from treated areas.

Monitoring Required Under The Permit is Inadequately Described

Ecology would (if the permit is issued) require that WGHOGA conduct long-term persistence monitoring of imidacloprid in sediments and monitor the effects of imidacloprid applications on invertebrates, including Dungeness crab. What kind of funding will be allocated to this? Will monitoring design capture all potential impacts?

Ecology Mission

We believe that approving the permit under Alternative 4 of the SEIS would be inconsistent with the mission of the Department of Ecology: "to protect, preserve and enhance Washington's land, air and water for current and future generations."

Our Recommendations

We recognize the importance of the oyster industry to Pacific County and to the state of Washington. Nonetheless, those involved need to go back to the drawing board. It is simply unacceptable to threaten the biological integrity of Washington's tidelands—which are critical to so many species of fish and birds—through the use of a highly toxic, highly soluble, and highly persistent pesticide.

Imidacloprid is on the table as an alternative to carbaryl, which was available in the past for the control of burrowing shrimp populations. We are pleased that reinstating carbaryl is not considered a viable option. Carbaryl is controversial in its own right due to its links to cancer and its risk to salmonids.

We support efforts to improve Integrated Pest Management (IPM) practices, research and demonstration. The SEIS states that commercial shellfish growers have been investigating mechanical means, alternative culture methods, various chemicals, and biocontrols for burrowing shrimp since the 1950s, and claims that only pesticide applications were found to be effective, reliable, and economical on a commercial scale.

The SEIS states that alternative culture techniques, such as long-line and bag culture, "would not support the shucked meat market that is the focus of most oyster culture in Willapa Bay, and would require large changes in the culture, harvest, processing, and marketing from these estuaries." All industries face challenges and constraints that they would prefer go away. While we do not advocate for disruption of any industry, we believe that the preferable position is for this industry to adapt, rather than expecting to contaminate estuaries critical to coastal and marine biodiversity home to numerous rare species, and a location for important fisheries including crabbing.

Timely efforts are needed to expand promising alternatives. Investments should be made in educational, technical, financial, policy, and market support to accelerate adoption of alternatives rather than continuing to rely on highly toxic pesticides. Research and demonstration are needed to determine and improve the most effective alternatives and their respective potential and feasibility for farms of different sizes, locations, shrimp population density, and access to equipment. The state should invest its resources in these efforts prior to and instead of allowing toxic contamination of state estuaries.

Department of Ecology must protect Washington's water, wildlife, public health, and local economies from the harmful impacts of toxic pesticides.

Thank you for the opportunity to comment.

Sincerely,

Kim Leval, Executive Director

Northwest Center for Alternatives to

Pesticides

Sharon Selvaggio, Program Director-Healthy

Wildlife and Water,

Northwest Center for Alternatives to

Megan Dunn, Program Director-Healthy
People and Communities,
Northwest Center for Alternatives to
Pesticides

Jeanie Murphy Ouellette
Public Education Program Specialist
City of Seattle, Parks and Recreation

Lisa Arkin, Executive Director
Beyond Toxics

Amy van Saun, Staff Attorney
Center for Food Safety

Edward P Kolodziej, Associate Professor
Center for Urban Waters

Roger Rocka, Co-facilitator
Columbia River Estuary Action Team
(CREATE)

Pesticides

Mimi Casteel, Co-Owner Bethel Heights
Vineyard
Proprietor, Hope Well Hopewell Wine

Steven G. Gilbert, PhD, DABT, Executive
Director
Institute of Neurotoxicology & Neurological

Disorders

Mark Sherwood, Executive Director

Native Fish Society

Glen Spain, Northwest Regional Director

Institute for Fisheries Resources

Lowell Ashbaugh, Vice President of

Conservation

Northern California Council of Fly Fishers

International

Stephanie Aubert, Gleaning Coordinator

Project Harvest

Todd Steiner, Executive Director

Turtle Island Restoration Network

Kurt Beardslee, Executive Director

Wild Fish Conservancy

Ricardo Small, Photographer

PCC Community Markets

Ken Peterson, Portland State University

Tim Coleman, Executive Director

Kettle Range Conservation Group

Glen Spain, Regional Director

Pacific Coast Federation of Fishermen

Commenter: Patricia Jones - Comment O-16-1

(Email Submission)

Please find attached our comment on the Permit for Imidacloprid Use in Willapa Bay and Grays Harbor.

Olympic Forest Coalition

Promoting the protection, conservation and restoration of natural forest ecosystems and their processes on the Olympic Peninsula, including fish and wildlife habitat, and surrounding ecosystems

November 1, 2017

Dr. Derek Rockett
Water Quality Program
Washington State Department of Ecology
Email:burrowingshrimp@ecy.wa.gov

Via Electronic Communication

Comment: Permit for Imidacloprid Use in Willapa Bay and Grays Harbor

Dear Dr. Rockett:

I'm writing on behalf of the Olympic Forest Coalition to urge you to reject the permit to allow the use of imidacloprid in Willapa Bay and Grays Harbor. The Olympic Forest Coalition is a membership organization based on the Olympic Peninsula working to protect the natural landscapes and waterscapes in Washington State, including marine waters associated to the Olympic Peninsula. Thank you for the opportunity to comment on this important environmental issue.

Imidacloprid is a dangerous pesticide that many scientific studies have found to cause significant harm to non-target species, including aquatic invertebrates. Young fish of many species including our native salmonids spend much of their early life cycle in estuaries where they adapt to living in a salt-water environment before out-migration. These chemicals are also linked to declines in pollinators and insects. The use of this pesticide in Willapa Bay and Grays Harbor should not be considered, given the global importance of the area for migrating shorebirds and other aquatic life.

The Grays Harbor National Wildlife Refuge, the "Bowerman Basin", is the spring migration of thousands of shorebirds and has been recognized as a Western Hemisphere Shorebird Reserve Network Site. Bowerman Basin and five other sites within the estuary have been designated as Washington State Important Bird Areas. According to the scientific journal Environmental Science and Pollution Research International:

> "*Imidacloprid and fipronil were found to be toxic to many birds and most fish, respectively. All three insecticides exert sub-lethal effects, ranging from genotoxic and cytotoxic effects, and impaired immune function, to reduced growth and reproductive success, often at concentrations well below those associated with mortality. Use of imidacloprid and clothianidin as seed treatments on some crops poses risks to small birds, and ingestion of even a few treated seeds could cause mortality or reproductive impairment to sensitive bird species*".

OFCO urges the Department of Ecology to work with industry to find reasonable alternatives to imidacloprid that will not threaten important ecosystems.

Thank you for your kind attention and consideration of these comments.

Sincerely,

Patricia Jones, PhD

Executive Director

PO Box 461 ● Quilcene, WA 98376-0461 ● (360) 710-7235 www.olympicforest.org ●
info@olympicforest.org

Commenter: Shari Tarantino - Comment O-4-1

Comments from Orca Conservancy are attached. -ST

October 29, 2017

Sent via electronic email to: droc461@ecy.wa.gov, burrowingshrimp@ECY.WA.GOV

Derek Rockett, Permit Writer

Washington State Department of Ecology

Water Quality Program

P.O. Box 47775

Olympia, Washington 98504-7775

RE: Imidacloprid Draft SEIS | WA0039781 | ECY RE WQ Burrowing Shrimp Permit | *Proposed Use of Imidacloprid for Burrowing Shrimp Control on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington*

Dear Derek Rockett,

On behalf of Orca Conservancy, we are providing comments on the Willapa-Grays Harbor Oyster Growers Association request for a permit to use the pesticide *imidacloprid* to control burrowing shrimp in Willapa Bay and Grays Harbor.

Orca Conservancy is an all-volunteer 501(c)(3) Washington State non-profit organization, established in 1996, with the mission of working on behalf of *Orcinus orca,* the killer whale, and protecting the wild places on which it depends. Orca Conservancy currently represents over 20,000+ members and supporters, and collaborates with some of the world's top research institutions and environmental groups to address the most critical issues now facing wild orcas. The organization's urgent attention is on the population of endangered Southern Resident killer whales (SRKW).

On November 18, 2005, after evaluating the five listing factors of the Endangered Species Act, 16 U.S.C. §§ 1531-1544, the National Marine Fisheries Service (NMFS) issued a final ruling listing the Southern Resident Killer Whales (SRKWs), as endangered under the Act. The southern resident population is comprised of three pods (identified as J-, K-, and L- pods) and is arguably the most familiar killer whale population to the general public. It

Orca Conservancy • PO Box 16628 • Seattle, WA 98116

occurs primarily in the Georgia Basin and Puget Sound from late spring to fall, when it typically comprises the majority of killer whales found in Washington. The population travels more extensively during other times of the year to sites as far north as the Queen Charlotte Islands in British Columbia and as far south as Monterey Bay in California.[41] As NMFS recently acknowledged, "new information … confirms that … [S]outhern [R]esidents spend substantial time in coastal areas of Washington, Oregon and California and utilize salmon returns to these areas."[42] These coastal waters are recognized as an essential foraging area for this critically endangered population in the winter and spring, and are currently under consideration to be designated as critical habitat for the SRKW.[43]

While it is known that imidacloprid breaks down rapidly in water in the presence of light, it still remains persistent in water in the absence of light. It has a water solubility of .61 g/L, which is relatively high.[44] In the dark, at pH between 5 and 7, it breaks down very slowly, and at pH 9, the half-life is about 1 year. In soil under aerobic conditions, imidacloprid is persistent with a half-life of the order of 1–3 years. On the soil surface the half-life is 39 days.[5] Major soil metabolites include imidacloprid nitrosamine, imidacloprid desnitro and imidacloprid urea, which ultimately degrade to 6-chloronicotinic acid, CO_2,

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[41] Wiles, G. J. 2004. Washington State status report for the killer whale. Washington Department Fish and Wildlife, Olympia. 106 pp.

[42] Michael J. Ford, Nat'l Marine Fisheries Serv., Status Review Update of Southern Resident Killer Whales 26 (2013). In fact, evidence indicates that
Southern Residents spend the majority of time in coastal and offshore waters. Cf. M. Bradley Hanson, et al., Assessing the Coastal Occurrence of
Endangered Killer Whales Using Autonomous Passive Acoustic Recorders, 134 J. OF THE ACOUSTICAL SOC'Y OF AMERICA 3486, 3486 (2013) [hereinafter Coastal Occurrence] (explaining that "on average the whales occur in inland waters less than half of the days each year")

[43] 12-Month Finding on a Petition to Revise the Critical Habitat Designation for the Southern Resident Killer Whale Distinct Population Segment, 80 FR 9682, published 2/24/2015.

[44] Flores-Céspedes, Francisco; Figueredo-Flores, Cristina Isabel; Daza-Fernández, Isabel; Vidal-Peña, Fernando; Villafranca-Sánchez, Matilde; FernándezPérez, Manuel (January 18, 2012). "Preparation and Characterization of Imidacloprid Lignin–Polyethylene Glycol Matrices Coated with Ethylcellulose". *Journal of Agricultural and Food Chemistry*. **60** (4): 1042–1051. PMID 22224401. doi:10.1021/jf2037483. [5] Matthew Fossen (2006). "Environmental Fate of Imidacloprid" (PDF). Retrieved April 16, 2016.

and bound residues.[45], [46], [47] Chloronicotinic acid is recently shown to be mineralized via a nicotinic acid (vitamin B3) pathway in a soil bacterium.[48]

A 2012 water monitoring study by the state of California, performed by collecting agricultural runoff during the growing seasons of 2010 and 2011, found imidacloprid in 89% of samples, with levels ranging from 0.1-3.2 μg/L. 19% of the samples exceeded the EPA threshold for chronic toxicity for aquatic invertebrates of 1.05 μg/L. The authors also point out that Canadian and European guidelines are much lower (0.23 μg/L and 0.067 μg/L, respectively) and were exceeded in 73% and 88% of the samples, respectively.

It is important to note that both varieties of burrowing shrimp found in Willapa Bay and Grays Harbor, Washington are *native* to these waters and thus play a role in the natural ecosystem. However, the Willapa Grays Harbor Oyster Growers Association (WHGOGA), grows *non-native* clams and oysters. Control of burrowing shrimp is also likely to reduce the

[45] Federoff, N.E.; Vaughan, Allen; Barrett, M.R. (13 November 2008). "Environmental Fate and Effects Division Problem Formulation for the Registration Review of Imidacloprid". US EPA. Retrieved 18 April 2012.

[46] Canadian Council of Ministers of the Environment (2007). *Canadian water quality guidelines: imidacloprid: scientific supporting document* (PDF). Winnipeg, Man.: Canadian Council of Ministers of the Environment. ISBN 978-1-896997-71-1.

[47] [European Draft Assessment Report: Imidacloprid. Annex B, B.7. February 2006]

[48] Madhura Shettigar, Stephen Pearce, Rinku Pandey, Fazlurrahman Khan, Susan J. Dorrian, Sahil Balotra, Robyn J. Russell, John G. Oakeshott, Gunjan Pandey. Cloning of a Novel 6-Chloronicotinic Acid Chlorohydrolase from the Newly Isolated 6-Chloronicotinic Acid Mineralizing Bradyrhizobiaceae Strain SG-6C. DOI: 10.1371/journal.pone.0051162
http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.005116

quality of essential fish habitat for federally managed fish species, including Pacific salmon, groundfish, and coastal pelagic species, by reducing prey availability. Based on conversations that Washington State Department of Ecology had with National Marine Fisheries Service (NMFS) prior to 2015, Ecology is clearly aware that imidacloprid is a persistent broad spectrum pesticide that will kill nearly all benthic organisms on the acreage directly treated. NMFS believes impacts to benthic prey species would be affected beyond the area to be treated, including areas where the spray has drifted, or carried off-site by tidal currents. These benthic organisms are prey for many species of fishes that are listed under the ESA, managed under the MSA, and others, including Pacific salmon, groundfish, coastal pelagic species, herring, sand lance, and smelt. The ESA-listed Pacific salmon from the Columbia River use the coastal estuaries to rear. Activities reducing available prey directly affect their growth, and hence their survival (NMFS 2009). Salmon and forage fish are intrinsically important, and also are important economic resources. Millions of dollars are spent each year on salmon recovery efforts.[49]

Southern Resident killer whales are dietary fish-specialists and depend on abundant populations of Chinook salmon for their survival, social cohesion and reproductive success.[50] Experts anticipate that climate change and ocean acidification will contribute to further significant declines in regional salmon abundance during the coming decades, thus impeding Southern Resident recovery.[51] After over a decade of federal protection, the population has yet to show signs of significant recovery, with 76 members total as of October 2017 — this is TWELVE members fewer than when they were initially listed. The 77th SRKW member is Lolita, who currently resides in Miami Seaquarium[52]. This critically endangered populations' survival remains in question and is far from guaranteed.[53]

Based on the natural history and behavior of the endangered SRKWs it is imperative that prey species, specifically Chinook salmon, of sufficient quality and quantity are available to support not only individual growth, reproduction, and development, but to further encourage the overall growth of this population. Prey depletion is recognized as one of the major threats to the survival and recovery of the SRKW community, and rebuilding depleted salmon stocks is listed as a top priority for the population.[54]

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[49] NMFS comment letter on draft NPDES Permit and DEIS on use of Imidacloprid, December 8, 2014.

[50] Center for Biological Diversity, Petition to Revise the Critical Habitat Designation for the Southern Resident Killer Whale (*Orcinus orca*) under the Endangered Species Act 5 (Jan. 16, 2014).

[51] See, e.g. Lisa G. Crozier et al., Predicting Differential Effects of Climate Change at the Population Level with Life-Cycle Models of Spring Chinook Salmon, 14 GLOBAL CHANGE BIOLOGY 236, 237, 247 (2008) (predicting that global warming and changing ocean conditions will lower survival and fertility among all populations of Pacific salmon (*Oncorhynchus* spp.)

[52] Amendment to the Endangered Species Act Listing of the Southern Resident Killer Whale Distinct Population Segment, 80 FR 7380, published 2/10/2015.

[53] Olesiuk, P. F., M. A. Bigg and G. M. Ellis. 1990. Life history and population dynamics of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Report of the International Whaling Commission (Special Issue 12):209-243. Estimates neonate mortality between 37-50%.

[54] National Marine Fisheries Service. 2008. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

Spraying *Imidacloprid* directly into any natural body of water that supports other life forms other than the one being targeted by the poison is at best, reckless. If the Department of Ecology allows this permit, it will set a precedence that the industry will continuously reference. There are many others growing shellfish with non-chemical methods, including the two largest companies operating in both estuaries, Coast and Taylor, which opted out of the current permit application. Only a few small Growers on the entire West Coast persist with efforts to obtain a pesticide permit.

In closing, instead of allowing this dangerous pesticide to be sprayed, we urge the Department of Ecology to work with growers to find creative alternatives that will not threaten important ecosystems.

Thank you for your thoughtful consideration of these comments.

Sincerely,

Shari L. Tarantino

President, Board of Directors

p: 206 379-0331 e:
orcaconservancy@gmail.com
w: orcaconservancy.org

Commenter: Margaret Barrette - Comment O-17-1

(Email Submission)

Attached are comments I've just submitted through the Department of Ecology Public Comment portal. Please let me know if you have any issues accessing this file or need additional information.

PCSGA

PACIFIC COAST SHELLFISH GROWERS ASSOCIATION

November 1, 2017

Mr. Derek Rockett, Permit Writer

Department of Ecology, Southwest Regional Office

PO Box 47775

Olympia, WA 98504-7775

Via E-mail – burrowingshrimp@ecy.wa.gov

Dear Mr. Rockett,

Thank you for providing an opportunity to comment on the Draft Supplemental Environmental Impact Statement (SEIS) relating to the Willapa Grays Harbor Oyster Growers Association's (WGHOGA) permit application to use the pesticide Imidacloprid on burrowing shrimp in Willapa Bay and Grays Harbor. These comments are submitted on behalf of the members of the Pacific Coast Shellfish Growers Association (PCSGA).

For nearly a century, PCSGA has supported shellfish growers from Washington, Alaska, Oregon, California, and Hawaii on a broad spectrum of issues including environmental protection, shellfish safety, regulations, technology, and marketing. Our members represent multiple generations of families who, through their farms, provide much needed economic contribution to our rural coastal communities. For example, the oyster industry is the largest private employer in Pacific County, accounting for approximately 1,700 family-wage jobs.

The sky-rocketing populations of burrowing shrimp in Willapa Bay and Grays Harbor are altering the ecosystem, turning tidelands into muck, and destroying critical habitat for birds, fish, shellfish, and phytoplankton. This unchecked progression and broad environmental impacts which the shrimp cause can only be slowed. Our members have spent much of the past decade exploring options to address an infestation of burrowing shrimp which has left once healthy oyster growing lands, eelgrass beds, and bird feeding grounds entirely unproductive.

The PCSGA's Board of Directors, which includes representation from the regions of both Puget Sound and Willapa Bay, as well as other west coast states in which we have members, took a position in support of the use of legally approved methods necessary to conduct Integrated Pest Management (IPM). The current permit application before Department of Ecology is a necessary step in allowing shellfish growers access to effective tools and methods under IPM.

The findings of the SEIS support the issuance of a draft permit for the use of Imidacolprid to control burrowing shrimp in Willapa Bay and Grays Harbor. There has been appropriate analysis and sufficient evidence to support the alternative (previously called "Alternative Four") within the SEIS, which allows IPM on up to 500 acres per year in Willapa Bay and Grays Harbor with no aerial applications by helicopter. This alternative, which is smaller in scope and different in method from the 2015 SEPA process, reflects best available science and a refined scope of the IPM intended to be used. Additionally, the mitigation measures considered for this alternative seem to adequately offset the potential impacts. Department of Ecology is encouraged to accept this alternative as preferred and continue with the process towards issuance of a draft permit.

Thank you again for engaging the public in this process and requesting review and comments. If you need additional information from me, please do not hesitate to contact me at margaretbarrette@pcsga.org or 360-754-2744.

Respectfully,

Margaret Pilaro Barrette

Executive Director

Commenter: Tim Hamilton - Comment O-21-1

(Email Submission)

To: WDOE
Derek Rockett, Water Quality Program

Attached are 4 PDF files of the Advocacy's comments on the draft SEIS on spraying in Willapa Bay and Grays Harbor. I would appreciate a response confirming receipt and delivery. If there are any problems with viewing or downloading the files, please notify me.

Twin Harbors Fish & Wildlife Advocacy

PO Box 179
McCleary, WA 98557 thfwa@comcast.net

October 31, 2017

Derek Rockett
Water Quality Program
Washington State Department of Ecology
Southwest Regional Office
PO Box 47775
Olympia, WA 98504

RE: Draft SEIS, Burrowing Shrimp Control (Willapa Bay & Grays Harbor)

Mr. Rockett:

The Twin Harbors Fish & Wildlife Advocacy (Advocacy) is a non-profit organization based in Washington State. The purpose of the Advocacy is "*Provide education, science, and other efforts that encourage the public, regulatory agencies and private businesses to manage or utilize fish, wildlife and other natural resources in a fashion that insures the sustainable of those resources on into the future for the benefit of future generations.*" (www. thfwa.org).

The Advocacy opposes adoption of the Draft Supplemental Environmental Statement as currently written. The document is plagued with numerous inadequacies and uncertainties. The draft is also excessively reliant upon the work product of an individual who openly admits to being biased on behalf of WGHOGA and its members.

As an example, the document does not adequately review the economic impacts on small businesses. WDOE is fully aware that media reports on spraying in Willapa Bay and Grays Harbor resulted in a "backlash" of negative reactions from the public at a level high enough the applicants withdrew their previous permit. Boycotts of shellfish from Twin Harbors immediately surfaced. The "Brand Value" of Willapa Bay was significantly impacted. Adoption of this flawed document will further damage those shellfish growers on the coast and elsewhere in the state and at the same time, diminish WDOE's public support by once again creating the only area of the nation wherein shellfish beds are allowed to be treated with insecticides.

During the recent hearing in Lacey, WDOE staff could not identify any independent analysis of the economic impacts or adequately explain how the analysis was conducted. Apparently, the economic analysis was limited and focused on input from the applicant and those members who desire to use the spraying permit. This limited view does not adequately consider the impacts on those shell fish growers that do not spray their beds. They will undoubtedly be impacted by the loss of brand value and face marketing difficulties due to fact they just happen to grow in Willapa Bay and Grays Harbor. Then, since the product is exported out of the state, consumers elsewhere will likely not be able to determine between coastal shellfish and Puget Sound shellfish creating a potential of economic harm to shell fish growers throughout the state.

The document also builds from the original EIS. Both the EIS and the Draft SEIS are a classic "house of card" resting on a foundation reliant upon commentary, data, and research conducted by one primary participant who has shown a history of bias.

A review by the Washington State Executive Ethics Board of a complaint filed against Mr. Kim Patten has resulted in an ethics citation for activities related to WGHOGA's pursuit of spraying permits in Willapa Bay[55] In his written response to questioning by the Board[56], Mr. Patten refers to WGHOGA and its members as his "clients". Individual members of WGHOGA are referenced as "friends". When reviewed in entirety, Mr.

[55] Ethics Board Findings_Patten_Redacted.pdf (Attached)

[56] Patten Response to complaint.pdf (Attached)

Patten's comments leaves a clear impression that he considered getting approval of spraying applications as his own personal goal.

In addition, the Ethics Board noted that Mr. Patten crossed the line into an area of financial conflict of interest when he entered into a contract with a member of WGHOGA (Brian Sheldon) to harvest the clams on Patten's own clam beds. Further, Mr. Patten submitted communications and comments wherein he identifies himself as a commercial shellfish grower using stationary and his title as an employee of Washington State University.

Mr. Patten's relationship with WGHOGA and its members has long been a matter of concern for members of the public involved in WDOE processes. Previous permits were plagued by WGHOGA members refusing to allow state staff access to plots for the required follow up testing. Then, Mr. Patten was allowed to access to conduct the testing unsupervised. This type of behavior does not pass the "smell test". Clearly, Mr. Patten is WGHOGA's "go to guy".

Another example is Mr. Patten securing an extension of permission from the EPA in April 2013 to test spraying imidacloprid against burrowing shrimp[57]. Local citizens allege that the conditions expressed in the permit were not followed. The Advocacy's review of the permit found the allegations had merit.

Simply put, even if he's an outstanding researcher worthy of praise, Mr. Patten has acted as an aggressive proponent of these permits rather than a fact finder and researcher. As a result, all of the work product produce by Mr. Patten is tainted due to his actions and expressions of bias. Further, all of the work product identified in the draft SEIS produced by others that either relied upon input from Mr. Patten or, data collection or testing conducted by Mr. Patten, is likewise tainted. As a result, the original EIS and the SEIS are both fatally flawed. Neither should be used to support granting of any spraying activity in Willapa Bay or Grays Harbor. The EIS and SEIS should be redrafted without reliance upon Mr. Patten's work product.

Finally, WDFW had not provided comments at the point of the meeting in Lacey. Proponents of the permit have apparently claimed fish runs, etc. are not a problem worth recognizing in Willapa Bay. Having studied the Bay fisheries and worked with WDFW for over 5 years, the Advocacy strongly disputes such commentary.

The decline in coastal fish runs is widely known and spawner escapement goals are routinely missed creating a risk of ESA intervention. Such is already the designation for Green Sturgeon who's diet is reliant upon burrowing shrimp. In 2015 the WDFW Commission adopted the Willapa Bay Salmon Management Plan to recover runs while avoiding ESA designation of a local salmon stock. (http://wdfw.wa.gov/commission/policies/c3622.html). Without a full assessment of the potential impact on fish and wildlife, the draft SEIS is once again fatally flawed.

Respectfully,

[57] EPA Approval 2013.pdf (Attached)

Tim Hamilton
President

Attachment 4

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
CHEMICAL SAFETY AND
POLLUTION PREVENTION

Kim Patten
Washington State University
Long Beach Research and Unit
2907 Pioneer Rd.
Long Beach, WA 98631

APR 1 1 2013

Dear Dr. Patten:

Subject: Request for extension of experimental use permit to use imidacloprid against burrowing shrimp
Nuprid 2F, EPA Reg. No. 228-484
EPA Experimental Use Permit No. 86414-EUP-1
New Effective Dates: April 11, 2013 to April 10, 2014
Quantity Authorized: 30 pounds of active ingredient per year applied to a maximum of 60 acres

On the basis of the information furnished by the applicant and the annexed program, an Experimental Use Permit (EUP) under Section 5 of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended (86 Stat. 983), is hereby extended for the named pesticide. Shipment/use under this Permit is subject to the provisions of 40 CFR 172.

Prior to continuance of this experimental program beyond the original expiration date in any State, you are to notify the State lead agency of the States in which your experimental program will continue to be conducted of the specific testing program (when, where, how much, etc.).

Prior to the shipment/use of this material, you must consult with the state pesticide regulatory official of the states in which your experimental program will be conducted and obtain a state permit or license if such is required. Issuance of this federal permit does not negate the need for permission from individual states. Failure to do so may result in revocation or modification of this experimental use permit.

Based upon the experimental program submitted, this product may be shipped for use under this permit to Washington for use in Willapa Bay and Grays Harbor.

The labeling submitted in connection with the application for an EUP is acceptable. This labeling must be used for all shipments under this experimental use permit.

Sincerely,

John Hebert (PM 07)
Insecticide-Rodenticide Branch
Registration Division (7505P)

Enclosure

NUPRID 2F FOR EXPERIMENTAL USE ONLY

Experimental Use Permit Number: 86414-EUP-1

NOT FOR SALE TO ANY PERSON OTHER THAN A PARTICIPANT IN THE EXPERIMENTAL USE PROGRAM

Permittee: Kim Patten, Extension Specialist, Professor Washington State University Long Beach Research and Unit 2907 Pioneer Road Long Beach WA 98631

ACTIVE INGREDIENT:
Imidacloprid: 1-[(6-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine 21.4%
OTHER INGREDIENTS: 78.6%
TOTAL: 100.0%
Contains 2 pounds of imidacloprid per gallon.

KEEP OUT OF REACH OF CHILDREN CAUTION – CAUCION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

EPA Permit No. 86414-EUP-1

ACCEPTED

For shipment and use of product for experimental purposes under the provision of the Federal Insecticide, Fungicide, and Rodenticide Act, subject to attached comments.

Permit No. 86414-EUP-1

Issued on APR 11 2013

FIRST AID	
If swallowed:	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
If inhaled:	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible.
If on skin or clothing:	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
If in eyes:	• Hold eye open and rinse slowly and gently with water for 15-20 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
NOTE TO PHYSICIAN No specific antidote is available. Treat the patient symptomatically.	

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS CAUTION
Harmful if swallowed, inhaled, or absorbed through skin. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT (PPE) Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves made of any waterproof material such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene, polyvinylchloride (PVC) or viton
- Shoes plus socks
- Protective eyewear when working in a non-ventilated space Follow manufacturer's instructions for cleaning/maintaining PPE. If instructions for washables do not exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

ENGINEERING CONTROLS STATEMENTS When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Users must:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. A copy of this label must be in the possession of the user at the time the product is applied.

READ THIS LABEL: Read the entire label and follow all use directions and precautions.

MIXING INSTRUCTIONS: To prepare the application mixture, add a portion of the required amount of water to the spray tank, begin agitation, and add the Nuprid. Complete filling tank with the balance of water needed. Be sure to maintain agitation during both mixing and application. **Do NOT formulate this product into other end-use products.**

APPLICATION INSTRUCTIONS
To test efficacy to burrowing shrimp, transport, dissipation, and non-target effects in Willapa Bay and Grays Harbor, apply at a maximum rate of 0.5 lb a.i./ac using the following properly calibrated application equipment:

- helicopters equipped with boom 3/4 as long as rotor diameter equipped with Accu-flo™ or similar large-orififced nozzles designed for precise application.
- backpack sprayer equipped with 5' 11025 a.i. noozle boom with a 11' pattern at 55 psi and 15 to 20 gpa depending on ground type.
- dual 10' or single 12' boom with 8002 nozzles mounted on a semi- amphibious vehicle (Argo™) at ~ 20 gpa.

RESTRICTIONS:

- Do not harvest clams or oysters within one year after treatment.
- All ground must be properly staked and flagged to protect adjacent shellfish and water areas. For aerial applications, the corners of each plot marked for treatment shall be marked so the plot is visible from an altitude of at least 500 ft.
- For aerial and ground-based topical

applications and ground-based subsurface injection, all applications must be on beds exposed at low tide.

- All applications must occur between May 1 and October 15.
- A 200-foot buffer zone must be maintained between the treatment area and the nearest shellfish to be harvested when treatment is by aerial spray; a 50 foot buffer zone is required if treatment is by hand spray.
- Do not apply aerially during the July 4 or other holiday weekends
- During aerial applications, all public access areas within one-quarter (¼) mile and all public boat launches within a one-and-a-half (1½) mile radius of any bed scheduled for treatment shall be posted. Public access areas shall be posted at 500 foot intervals at those access areas more than 500 feet white material. Lettering shall be in bold black type with the word "WARNING" or "CAUTION" at least one-inch high, and all other words at least one-fourth (¼) of an inch high. Signs will include a map of the inlet that wide. Signs shall be a minimum of 8½ x 11 inches in size, and be made of a durable weather-resistant, indicates the location of the treated area and an extended buffer that extends one-fourth (1/4) mile the area's perimeter and the statement "Do Not Fish, Crab, or Clam within 1/4 mile of area treated with experimental material, as indicated by the circle on the map". Signs shall be posted so they are secure from the normal effects of weather and water currents, but cause no damage to private or public property. Signs shall be posted at least 2 days prior to treatment and shall remain for at least 3 days after treatment.

SPRAY DRIFT MANAGEMENT

The interaction of many equipment and weather related factors determine the potential for spray drift. Wind speed at the time of application is not to exceed 10 mph to minimize drift to adjacent shellfish and water areas. Drift potential increases at wind speeds of less than 3 mph (due to inversion potential) or more than 10 mph. However, many factors, including droplet size and canopy and equipment specifications determine drift potential at any give wind speed. Do not apply when winds are greater than 10 mph or during temperature inversions.

Restrictions During Temperature Inversions

Because the potential for spray drift is high during temperature inversions, do not make ground applications during temperature inversions. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain close to the ground and move laterally in a concentrated cloud. Temperature inversions are characterized by increasing temperature with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however if fog is not present, inversions can also be identified by the movement of smoke from a ground source. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical mixing. The applicator is responsible for considering all of these factors when making application decisions.

Importance of Droplet Size

An important factor influencing drift is droplet size. Small droplets (<150-200 microns) drift to a greater extent than large droplets. Within typical equipment specifications, applications are to be made to deliver the largest droplet spectrum that provides sufficient control and coverage. Formation of very small droplets may be minimized by appropriate nozzle selection.

Mixing and Loading Requirements

The use of a properly designed and maintained containment pad for mixing and loading of any pesticide into application equipment is recommended. If containment pad is not used, maintain a minimum distance of 25 feet between mixing and loading areas and potential surface to groundwater conduits such as field sumps, uncased well heads, sinkholes, or field drains.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal. Pesticide Storage: Store in a cool, dry place and in such a manner as to prevent cross contamination with other pesticides, fertilizers, food, and feed. For containers smaller than 5 gallons: Non-refillable container: Do not reuse or refill this container. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and local authorities. Plastic containers are also disposable by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

Washington State Executive Ethics Board

2425 Bristol Court SW • PO Box 40149 • OLYMPIA WA 98504-0149
(360) 664-0871 • Fax (360) 586-3955 • http://www.ethics.wa.gov

INVESTIGATIVE REPORT AND BOARD DETERMINATION OF REASONABLE CAUSE

CASE NUMBER:	2017-012
DATE:	July 20, 2017
RESPONDENT:	Kim Patten, Director WSU Pacific County Extension
EMPLOYING AGENCY:	Washington State University

I. INVESTIGATION

A. Background and Summary of Complaint

On January 12, 2017, the Executive Ethics Board (Board) received a complaint alleging that Kim Patten (Mr. Patten), Director of the Washington State University (WSU) Pacific County Extension Office, may have violated the Ethics in Public Service Act. The complaint alleges that Mr. Patten used state resources to conduct research for his personal benefit and that his personal involvement with the commercial shellfish industry is in conflict with his official duties.

B. Scope of Investigation and Relevant Facts

Board staff reviewed the complaint and all supporting documents, interviewed Mr. Patten, reviewed email records from Mr. Patten's WSU.edu and WSU Gmail accounts, and reviewed Mr. Patten's state owned computer hard drive.

Based upon the investigation, staff determined the following:

1. Mr. Patten has been employed with the WSU Research and Extension Unit located in Long Beach since 1990. In 2004, Mr. Patten became the Extension Professor, and in 2012, he became the Director of the Long Beach Extension Unit.

2. As Director of the Long Beach Extension Unit, Mr. Patten's primary duties are to conduct research and provide education in all aspects of the cranberry, shellfish and other local agriculture in the Pacific County community. Mr. Patten's stakeholders are cranberry and oyster growers, both private and commercial, along with state and federal agriculture and natural resources managers and their related agencies.

3. Mr. Patten uses two different email accounts in his position as the WSU Extension Unit Director. Pattenk@wsu.edu is the official email account used by employees of WSU and is maintained by WSU. Pattenk.wsu@gmail.com is an authorized email account used by WSU employees who work in remote areas where access to the official email account is not readily accessible, but is not maintained by WSU. Mr. Patten uses the pattenk.wsu@gmail.com account to conduct both WSU official and personal business.

4. Mr. Patten indicated in his response to Board staff that he considers the shellfish industry a very important "client" in that they are the major employer and economic engine for the region. Mr. Patten further indicated that he was officially assigned to work on the shellfish pest issue by deans and directors at WSU.

5. Mr. Patten indicated in his response to Board staff that he has the exact same relationship with the shellfish industry as he has with other agriculture industries within the Long Beach area. The cranberry industry provides the WSU Extension Unit office, lab, and utilities with no cost to WSU. The shellfish industry rents office space at the WSU Extension Office from the cranberry industry but the office space is not currently being used.

6. WSU Extension Unit Strategic Goals:

Enhance Natural Resources and Environmental Stewardship:

- Improved economy and quality of life.
- Resolve natural resource conflicts.
- Improve ecosystem management.
- Solve complex issues of water and fisheries management.
- Control spread of non-native invasive species.

Enhance Economic Opportunities for Agricultural Enterprises while Protecting Washington's Resources:

- Increase profitability and competiveness of agriculture and food enterprises.
- Reduce market risk to agricultural producers.
- Increase application of alternative agricultural systems.
- Increase application of integrated pest management and conservation strategies.

7. Mr. Patten indicted in his response to Board staff that he would attend some local, state, and regional shellfish grower meetings. At these meetings, he would speak on different topics and obtain feedback on issues affecting the industry. Mr. Patten further indicated that he would do the same thing for the cranberry industry.

8. Brian Sheldon (Mr. Sheldon) is an owner of the Northern Oyster Company and a Board member of the Willapa-Grays Harbor Oyster Growers Association (WGHOGA), a non-profit organization made up of privately owned oyster growers from the Willapa Bay and Grays Harbor area.

9. On October 20, 2010, the Washington State Noxious Weed Control Board (Weed Control Board) received a letter from the Northern Oyster Company regarding a request by Pacific County to list *Zostera japonica* (Zj), a non-native eelgrass, as a Class C noxious weed. The letter indicated that Zj was invading shellfish beds, altering the ground so that it was becoming "un-farmable" and having an impact on the Northern Oyster Company's ability to

continue farming oysters. The Weed Control Board did not list Zj as a Class C noxious weed in 2010.

10. On April 25, 2011, the Weed Control Board received another letter from the Northern Oyster Company requesting Zj be added to the Class C noxious weed list.

11. In August 2011, the Washington Department of Ecology (Ecology) received a letter from the WGHOGA requesting it begin the process of developing a new National Pollutant Discharge Elimination System (NPDES) permit allowing shellfish growers to control Zj with Imazamox, an aquatic herbicide. In response to the WGHOGA's request, Ecology's Water Quality Program (WQ) made a tentative decision to issue a new NPDES permit for controlling Zj with Imazamox.

12. On September 6, 2011, the Weed Control Board approved adding Zj to the 2012 Class C noxious weed list. On December 15, 2011, the Weed Control Board voted to add Zj as a Class C noxious weed for commercially managed shellfish beds only.

13. As part of the NPDES permit development process, WQ issued a public notice on February 1, 2012. After the initial public comment period, Ecology decided to reduce the scope of the permit and require an Environmental Impact Statement (EIS). The public comment period ended on March 9, 2012 at 5:00 pm

14. On March 7, 2012, Mr. Patten submitted a comment on the proposal as a private tideland owner from his pattenk@wsu.edu email account.

From:	Kim Patten
To:	Hamel, Kathy (ECY)
Subject:	Public comment - NPDES eelgrass.
Date:	Wednesday, March 07, 2012 3:43:56 PM

I am submitting a public comment on the NPDES for Japanese Eelgrass Management on Commercial Shellfish Beds General Permit.

I strongly encourage Ecology to issue this permit. As a private tideland owner in Willapa Bay for the past 22 years I've seen Japanese eelgrass change my recreational calm bed from a sandy easy- to -access productive bed to an unproductive muddy mess. I've been at a loss on how to recondition the bed into something useful. I've worn out rakes trying to clean the Japanese eelgrass out of my bed, all to no avail. Since private tideland owners are not covered by this permit, I would consider converting my bed to a commercial bed just to be covered by this permit and be able to remove the japonica.

Thank You

--
Kim and Andrea Patten
Tideland owner
Withheld
[redacted]

15. In 2012, the Washington Department of Fish and Wildlife (WDFW) and the Wildlife and Willapa Oyster Committee funded a grant for the research on estuary use of Imazamox.

16. On March 8, 2012, Mr. Patten submitted an application for an Experimental Use Permit (EUP) to apply the herbicide Imazamox on aquatic sites with the Washington State Department of Agriculture (WSDA) in connection with this grant and research.

17. The WSDA application identified property owners of four sites to be used in the experimental application of Imazamox:

- Brian Sheldon
- Taylor Shellfish
- Eric Hall
- Kim Patten

18. Each test site consisted of approximately ¼ of an acre of clam beds for each location for a total area of .98 acres.

19. The application identified the following individuals would be applying the herbicide to the site:

- Kim Patten
- Chade Metzger
- Nick Halderman
- All WSU employees.

20. The EUP application indicated that the ending date for the research was October 31, 2012.

21. In July of 2012, Mr. Patten submitted the final report on the impact of Zj and Imazamox to WDFW and the Wildlife and Willapa Oyster Committee.

22. On March 8, 2013, Mr. Patten again submitted an application to the WSDA for the EUP of Imazamox at the same four sites and the same three individuals as listed in in the 2012 EUP application. The ending date for the research was October 31, 2013.

23. Mr. Patten indicated in a response to Board staff that a EUP is only good for one year. In 2013, the main objective of his research was to conduct additional efficacy studies on Zj seedling control. Mr. Patten further indicated that he was trying to refine all gaps in efficacy he had in order to be sure everything was in order for the 2014 NPDES permit.

24. Mr. Patten indicated in a response to Board staff that when he applies for a EUP he adds all sites available for him to use at the time of the EUP application knowing he might not use some of those sites because if sites are not listed, he cannot use them. He further

indicated that he has dozens of projects going each year and he would rarely accomplish all of them but if he didn't include them on the EUP he would not be able to undertake those projects.

25. Mr. Patten also indicated in a response to Board staff that finding test sites for his research is one of his biggest challenges. The work tends to be destructive and growers need to be comfortable with that. They would crush shellfish accessing the site, they would harvest most of the crop on the test plots for destructive sampling purposes, and growers would have to agree to not harvest until the tests are completed.

26. Mr. Patten indicated in response to Board staff that for this particular research project the studies would be sited near the Nahcotta shellfish growing region on the Long Beach Peninsula, where Zj has formed large "meadows." Those sites were identified using the following criteria:

- They needed to be easily accessible (less than one hour boating or walking);
- needed to have gravel, clams and Zj;
- needed to have property owner's permission to treat and harvest from their site;
- sites could not be harvested until after the research had concluded; and
- the sites must be different enough locations across the bay to reflect the variation of effects that might occur.

27. Mr. Patten indicated that he chose the sites used in the research based on the above criteria. Mr. Patten further indicated that his site was actually a poor site and his last choice but he could not find anything further south down the bay.

28. Mr. Patten also indicated in a response to Board staff that he used about ½-acre of his clam farm. He put out 12 replicated plots within that ½-acre area. Each plot was 8 feet by 10 feet. There were six treated and six untreated control plots. The total area sprayed was about 480 square feet. These plots were destructively harvested to obtain number of clams, size and meat weight.

29. On September 26, 2013, the Weed Control Board announced a public hearing to consider changes to the 2014 noxious weed list. The hearing was scheduled for November 5, 2013 in Wenatchee, Washington. The announcement indicated that the Weed Control Board had several proposed changes for 2014. One of the proposed changes was reinstating the original 2012 listing of Zj as a noxious weed on commercially managed shellfish beds only. In 2013, the Weed Control Board had removed the modification of Zj and listed it as a noxious weed on all shellfish beds, commercial and private.

30. On September 27, 2013, Mr. Patten responded in opposition to the proposed changes from his pattenk@wsu.edu email account. In Mr. Patten's response to the Weed Control Board, he indicates that he is responding as a private landowner and as a scientist.

- **Private Landowner**: "As an owner of 2 acres of noncommercial clam ground in Willapa Bay, I find it unacceptable to learn that I will be unable to control

Japanese eelgrass on my own property.... going back to the 2012 listing I no longer have any options."

- **Scientist**: "By restricting this listing to the 2012 wording, you are essentially preventing the management of this invasive weed for the purpose of maintaining or restoring critical habitat for an ESA (Endangered Species Act) - listed species. You will no doubt hear testimony that *Z. japonica* provides valuable forage habitat for waterfowl along the Pacific Flyway. This is not a reason to justify going back to the 2012 weed listing..."

Mr. Patten's response consisted of three pages of text including two graphs and two attachments. The document was created on September 27, 2013 at 10:45 am and was last saved on September 27, 2013 at 12:03 pm. Total edit time was 53 minutes.

31. Mr. Patten told Board staff that he used his personal farm as an example of the effect of going back to the 2012 Weed Control Board modification of Zj as a noxious weed for all of the small private non-commercial shellfish farms in Willapa Bay.

32. After deliberation on the oral and written testimony received from the public comment period, on November 7, 2013, the Weed Control Board decided to leave Zj as classified rather than reverting back to a Class C noxious weed on commercially managed shellfish beds only.

33. On November 28, 2013, Mr. Patten received an email on his WSU Gmail account from Mr. Sheldon regarding Mr. Patten leasing his clam farm to Mr. Sheldon to harvest clams. By entering in to the agreement, Mr. Patten was converting his clam farm to a commercial clam farm.

Brian Sheldon <oysters@willapabay.org> Thu, Nov 28, 2013 at 10:35 AM
To: Kim Patten <pattenk.wsu@gmail.com>

Hi Kim,

Happy Thanksgiving.

I drafted up a simple lease agreement for your tideland, see attached. Take a look and modify as you want. If it looks ok we can sign and I can get the harvest site application sent in to DOH. I'll get you a copy of the Harvest site application so you'll have it for your records.

If you can get me a property description I'll shoot the north and south lines in from the survey corners so we can get some more permanent lines set.

Thanks,
Brian

11-28-13 Lease Agreement.docx
18K

34. On Saturday, November 30, 2013, Mr. Patten responded from his pattenk.wsu@gmail.com account

Kim Patten <pattenk.wsu@gmail.com> Sat, Nov 30, 2013 at 9:37 PM
To: Brian Sheldon <oysters@willapabay.org>

Looks fine.
I need to get the property information from my safe deposit box on Monday. I'll get it to you then.

WSU Extension programs are available to all with out discrimination.

[Quoted text hidden]

35. On December 1, 2013, Mr. Sheldon responded:

Brian Sheldon <oysters@willapabay.org> Sun, Dec 1, 2013 at 9:54 AM
To: Kim Patten <pattenk.wsu@gmail.com>

I'll be out of town at the Conservation District meetings in Cle Elum until late Wednesday. We can meet when I get back to sign and more ahead. I'd like to get the lines set before I put the crew there so we're harvesting up to the north and south lines. If you get the prop description and can e-mail it to me I'll convert it so we can shoot the lines in and set some more permanent markers on your north and south lines.

Today is Basketball so I'll be in Kelso. Go Ilwaco!!!

Thanks,
Brian

From: Kim Patten

36. On Wednesday December 4, 2013, Mr. Patten responded using the pattenk.wsu@gmail.com account with the property description. On December 5, 2013, Mr. Sheldon responded to Mr. Patten.

Brian Sheldon <oysters@willapabay.org> Thu, Dec 5, 2013 at 9:03 AM
To: Kim Patten <pattenk.wsu@gmail.com>

Hi Kim,

Just got back into town. I've got meetings today, but will try to get back on this tomorrow. I'll try to get with you and get the lease signed. After that I can submit the harvest site app to DOH.

Also, Nate at DOE has asked for a meet on December 13th down here. He said they want to discuss some changes they want to make to the draft NPDES permit. If you're available I may be asking you to attend. I asked Nate to send me something on what they are looking at changing. I'll let you know what I find out.

Thanks,
Brian

37. On January 2, 2014, Ecology posted a draft EIS to tribes, agencies, organization, and individuals with an interest in the Ecology proposal to issue a NPDES general permit for the use of the Imazamox on commercial clam beds (excluding geoducks) in Willapa Bay. The public comment period ended on February 15, 2014.

38. At 1:16 pm, on January 17, 2014, Mr. Patten commented on the draft permit from his pattenk@wsu.edu email account. Mr. Patten's comments were specific to Section 4(B) of the draft permit, requiring a 10 mm buffer zone. In his comments, he used his farm as an example of an economic hardship that would be caused by the proposed 10 mm buffer.

> "***My farm***: *As a commercial clam grower with a small parcel of ground thickly covered by Z japonica, this buffer will prevent most of my ground from being farmed. I have a 160' by 200' parcel that is farmable (32,000 ft^2). This buffer removes 16,800 ft^2. My ground produces ~ 0.5 lbs/ft^2 every 4-5 years. I get paid \$0.75/ lb. On ground with japonica my yields have been about half. This totals approximately \$5,000 to \$6,000 in crop loss. I think this is an unreasonable economic impact. The ground does not have drainage swales and there is little chance of "chemical trespassing*."

> "***All farms***: *Not being able to treat up to the buffer zone constitutes a taking of private revenue and right to farm. For every 1 foot of property line on a clam farm, a grower can lose ~ \$10 of net revenue (assumes an average yield of 1 lbs/ft^2 of clams every 3 years, with the grower netting \$1/ lbs and a 30% reduction in yield with Z. japonica). Using an example of a small 3.5 acre clam farm (1000' by 160') a grower would lose \$23,000 (2320 ft of property line x \$10/ft) every three years having to accommodate this buffer. This buffer would cost a small grower over \$7,000 a year in lost revenue. This constitutes a very significant economic impac*t."

39. On April 2, 2014, the NPDES general permit was issued by Ecology for the use of the Imazamox on commercial clam beds (excluding geoducks) in Willapa Bay. After consideration of the public comments made by Mr. Patten and others, Ecology did not remove the 10 mm buffer zone in the application process.

40. The effective date of the permit was May 2, 2014, with an expiration date of May 2, 2019.

41. On March 27, 2014, Mr. Patten again applied to the WSDA for a EUP to spray Imazamox in the Willapa Bay. Mr. Patten indicated in a response to Board staff that this application was to conduct some early timing studies to look at when Zj seedlings would emerge in an effort to determine the best time to use Imazamox to affect the germinating Zj seedlings. For this experiment, he needed to conduct several small timing studies.

42. The 2014 EUP only identified one site location owned by Taylor Shellfish Company, removing his site and the two sites owned by Brian Sheldon.

43. Mr. Patten indicated in his response to Board staff that the NPDES was issued in May 2014 and he no longer needed the EUP. The 2014 EUP was only used on .1 acres owned by Taylor Shellfish Company to conduct seedling-timing studies as indicated above.

44. Mr. Patten further indicated that after the NPDES was issued in April 2014 he treated his entire ½-acre clam farm.

45. Mr. Sheldon's company, the Northern Oyster Company, commercially harvested clams from Mr. Patten's 1/2 acre clam farm in 2014. According to the lease agreement, Mr. Patten was paid $0.70 per pound of clams. Pounds of clams were based on washed clams as prepared for shipping.

46. Mr. Patten indicated in a response to Board staff that at that time the average price was about $0.60 to $0.70 per pound depending on the size and quality. He recalled that he was paid $0.60 per pound.

David Killeen, Senior Investigator

II. APPLICABLE LAW

The complaint alleges violations of the following sections of the Ethics in Public Service Act:

RCW 42.52.020 – Activities incompatible with public duties states:

> No state officer or state employee may have an interest, financial or otherwise, direct or indirect, or engage in a business or transaction or professional activity, or incur an obligation of any nature, that is in conflict with the proper discharge of the state officer's or state employee's official duties.

RCW 42.52.160(1) – Use of persons, money, or property for private gain, states:

> No state officer or state employee may employ or use any person, money, or property under the officer's or employee's official control or direction, or in his or her official custody, for the private benefit or gain of the officer, employee, or another.

WAC 292-110-010 Use of state resources, prior to April 2016, states, in part:

> .....
>
> (2) **The following are permitted uses:**
>
> (a) Use of state resources that is reasonably related to the conduct of official state duties, or which is otherwise allowed by statute.
>
> (b) An agency head or designee may authorize a use of state resources that is related to an official state purpose, but not directly related to an individual employee's official duty.

(c) An agency may authorize a specific use that promotes organizational effectiveness or enhances the job-related skills of a state officer or state employee.
(d) A state officer or employee may make an occasional but limited personal use of state resources only if each of the following conditions are met:

(i) There is little or no cost to the state;
(ii) Any use is brief;
(iii) Any use occurs infrequently;
(iv) The use does not interfere with the performance of any officer's or employee's official duties; and
(v) The use does not compromise the security or integrity of state property, information, or software.

K. Reynolds

Kate Reynolds, Executive Director
Executive Ethics Board

III. BOARD REASONABLE CAUSE DETERMINATION AND ORDER

Based upon the investigative report, we, the Washington State Executive Ethics Board determine the following:

Dismissal
Pursuant to RCW 42.52.425, IT IS HEREBY ORDERED that the complaint is DISMISSED for the following reason:

____ Any violation that may have occurred is not within the jurisdiction of the board

____ The complaint is obviously unfounded or frivolous

____ Any violation that may have occurred does not constitute a material violation because it was inadvertent and minor, or has been cured, and, after consideration of all of the circumstances, further proceedings would not serve the purposes of this chapter.

Reasonable Cause
Pursuant to RCW 42.52.420, IT IS HEREBY ORDERED

_✓_ There IS reasonable cause to believe that violation(s) of RCW 42.52 have been or are being committed and the penalty may be:

- ☐ GREATER THAN $500
- ☑ $500 OR LESS
- ☐ NONMONETARY

_____ There IS NOT reasonable cause to believe that violation(s) of RCW 42.52 have been or are being committed and the complaint is CLOSED.

DATED this 8th day of September, 2017

Anna Dudek Ross, Chair

Samantha Simmons, Vice-Chair

John Ladenburg, Member

Lisa Marsh, Member

Shirley Battan, Member

Response to question re: Conflict of Interest Case with Kim Patten

Wednesday, October 04, 2017

1. What is your official relationship with the commercial shellfish industry?

   My official relationship is the same as any of my other clientele. This would include the commercial cranberry industry, the timber industry, the cattle industry, Willapa National Wildlife Refuge, The Nature Conservancy, Washington State Dept. Fish and Wildlife, the County Commissioners, Pacific County Economic Development Council, and the citizens of SW Washington. I work with them to help solve problems and issues that they face, provide outreach services, and conduct applied research. This is all part of my job description. I consider the shellfish industry a very important clientele, in that are the major employer and economic engine for our region. In addition, I have been officially assigned to work on these shellfish pest issues by deans and directors at WSU. I also represent WSU as their representative on the USDA's Western Regional Aquaculture Committee. Basically, I work with the industry at part of my official role with WSU.

2. Do you have that same relationship with other agriculture industries in the Long Beach area, i.e., the cranberry industry?

   Yes, exactly the same. However, the cranberry industry has and continues to provide the office, lab, water, septic, power and the research farm to WSU without cost. This has been ongoing since 1993 when the university sold them the farm, contingent on them providing those services. The shellfish industry rents an office space at WSU Long Beach from the cranberry industry. Currently that space is unoccupied, but they have housed their employees there on/off for the past several years.

3. Is it a part of your official duties to assist the commercial shellfish industry to increase production and/or are your official duties to ensure that the environment is protected? How do you balance the two?

   Basically my job is to enhance environmental and economical sustainability of the natural resource industries in SW Washington. These two objectives are not at odds.

See attached official position description (below is the section that is germane).

🕘 Programmatic Responsibilities (80%)

Location of work – The office location for this position is the Cranberry Research Station at Long Beach, Washington. The primary geographic region served by the position is coastal Pacific and Grays Harbor Counties with attention to other areas of the district and state as synergistically beneficial to the Extension cause and in line with applicable subject matter expertise of this position. The primary scope of work for the position includes research and education relevant to all aspects of cranberry production including related issues of water quality and invasive species. In addition, this position works in collaboration with other local agricultural and shellfish producers and natural resources managers to address issues of local relevance.

Target audiences for the position include cranberry and oyster growers along with related state and federal agricultural and natural resources managers and their related agencies.

Also see WSU Extension Goals below and the percentage of my FTE allotted to each (from job description).

WSU Extension Strategic Goals addressed by this position.

- **Enhance Natural Resources and Environmental Stewardship - <u>30%</u> FTE** 3.1 Improved economy and quality of life.

3.2 Resolve natural resource conflicts.
3.3 Improve ecosystem management.
3.4 Solve complex issues of water and fisheries management.
3.5 Control spread of non-native invasive species.

- **Enhance Economic Opportunities for Agricultural Enterprises while Protecting Washington's Resources - <u>70%</u> FTE**

4.1 Increase profitability and competiveness of agriculture and food enterprises.
4.2 Reduce market risk to agricultural producers.
4.3 Increase application of alternative agricultural systems.
4.4 Increase application of integrated pest management and conservation strategies.

Below are two example of some recent publications to demonstrate that my work is not at odds with the environment. Both of these projects were related to the work I was doing with shellfish.

Moser M, Patten K, Feist B, Lindle S. In press. The importance of estuarine habitat to threatened green sturgeon (Acipenser medirostris). Journal of Experimental Marine Biology and Ecology.

Patten K, O'Casey C. 2007. Shorebird and waterfowl usage of Willapa Bay, Washington in response to invasive *Spartina* control efforts. Journal of Field Ornithology. 78. 395-400.

4. Explain your personal relationship with the shellfish industry?

I've worked with them for 27 years on pest management-related issues. Initially it was with *Spartina* control. Starting in the late 1990s I started to conduct research on other issues affecting their livelihood. This included invasive eelgrass and burrowing shrimp.

I attend some of their local, state and regional grower meetings. This is normally to give a talk or obtain stakeholder feedback (as required by my job description). This is similar to what I do in the cranberry industry. I have good friends in the industry, but no different than what I have in the cranberry industry or any of my other clientele groups. It is a small community and we all know each other.

5. Do you believe your personal relationship with the shellfish industry is in conflict with your job duties to protect the environment? Explain.

No. In fact the opposite is true. My work with the shellfish industry resulted in the elimination of the most serious threat that the ecology of Willapa Bay ever faced – invasive *Spartina*. This was work done with the shellfish industry, The Nature Conservancy (TNC), the National Wildlife Refuge, EPA, NOAA, The Army Corps of Engineers, WDFW and WDNR. My work was key to its success. Without my effort, the shellfish industry and all the shorebird habitat in Willapa Bay would have ceased to exist. It has been the largest, most successful restoration of shorebird habitat in the United States. I have been recognized and honored for this environmental contribution at the state, region and national level. This win-win approach is the model on which I base the rest of my work.

Everything I do with the shellfish industry is also highly regulated by EPA and Department of Ecology. I obtain all the permits required and work closely with these agencies to make sure that any of the programs that I develop have minimal impact to the environment. I work to collect information to help the agencies obtain the permits. I have often been funded by these agencies for that work. Because some of the methods I have worked with and developed involve pesticides, it is often perceived that they are incompatible with environmental protection. For that reason, most of the very work I am involved in is to assess and report the impact of those pesticides, irrespective of results, good, bad or neutral. These results have been used to develop the permits and SEIS for many situations.

My work is no different than thousands of other Extension professionals in the US who work on crop protection. We conduct applied research to develop tools to be used by the agriculture and aquaculture industries. The only exception is that I do much of my work in an estuary, which gets extra scrutiny by environmental groups.

6. In 2012 you conducted research into the use of Imazamox to control Japanese Eelgrass, (Research plan for estuary use of imazamox in 2012*).

   *Correction to this statement – I've had ongoing research on this from 2007 to 2017, not just 2012.

a. Who funded this research?

   Wash Dept. of Fish and Wildlife funded that research.

b. Were you paid by WSU (time/resources) to participate in the research?

No, my position is not grant funded. I am a salaried professor at WSU. I am state-funded and that funding is administrated by WSU. No direct or indirect funds went to my salary from this project. I am required to provide an 'effort certification' form to WSU on all funded projects.

They state what percentage of my efforts goes with each project. Those records are maintained at WSU, but most projects are only list as 1 to 2% of my time.

c. How were the four test sites selected?

I am not entirely sure which four sites you are referring to. Over the ten+ years of my work on imazamox there have been many dozens of sites. Below are titles of papers I've published that detail those sites and why they were chosen. I've attached those few papers.

Patten K. 2015. Imazamox control of invasive Japanese eelgrass: efficacy and nontarget impacts. Journal of Aquatic Plant Management 53:185-189.

Patten K. 2014. The impacts of nonnative Japanese eelgrass (*Zostera japonica*) on commercial shellfish production in Willapa Bay, WA. Agricultural Sciences. Published Online. SciRes.http://www.scirp.org/journal/as. http://dx.doi.org/10.4236/as.2014.

Ruesink J, Freshley N, Herrold S, Trimble A, Patten K. 2014. Influence of substrate type on nonnative clam recruitment in Willapa Bay, Washington, USA. Journal of Experimental Marine Biology and Ecology. 459 (2014): 23–30.

Basically, the criteria for site selection depended on the objective.

If I wanted to assess control then I used easy to access sites that had good densities of *japonica* all along the LB peninsula. These were small plots with no shellfish on them.

If I wanted to assess environmental/ecological impacts then I needed large sites that could be treated and monitored without other activities going on in those sites. For these I used small portions (0.5 to 5 ac) of a 1000 acre tract owned by Taylor Shellfish between Oysterville and Nahcotta. These were also used to assess off-site movement of imazamox and treatment effects on megafauna (birds and fish) and infauna (benthic invertebrates). Those plots had no shellfish on them at the time of the experiments. These ecological impact assessments have been done over the past ten- year time frame (2007 to 2017), and are just now finishing.

If I needed to assess the impact on clam production then I used commercial clam farms that were infested with *japonica*. Mine was one of those. Bear in mind that during this part of the research I was limited to 1 acre per year. So if I had four sites to assess impacts to clams, and four or five sites to assess efficacy, then any given site might have only had 500 to 1000 ft^2 treated with imazamox. This would have been done in small replicated plots, (8 treated and 8 untreated plots, each plot~ 100 to 120 ft^2). The size, shape, and number of replications depended on the year.

To qualify for sites to assess impact on clam production, I needed the site to have the following features: 1) easy access by walk from shore, 2) a decent density of young and mature clams, 3) the site was not going to be commercially dug within 2 years, 4) agreeable grower, 5) the site would not have other things done to it (gravelling, harrowing, any other eelgrass control), and 6) the site would not get fouled by macroalgae that could kill the clams. I had very limited choice in sites that met all these criteria. I think I had about 7 total sites when I started this work, but only ended with 5 valid sites, as their clams died off due to macro-algae fouling on two of them.

One critical aspect of field research is to have as many replicated sites as possible. This is the gold standard. You can not make any inference on production from one site. You need to have multiple sites that represent different habitats. With that in mind, sites need to be spread out over the bay. I normal expect one or two sites to be lost with this type of work. My site was the most southern site in this particular study.

d. Did the four sites benefit from this research, did they become more productive?

You can read my research for the details. Some were more productive, others less so. But again, this is only within the small treated areas, not the entire site. As mentioned I could only treat 1 total acre in the bay. I used less than half of this amount on this particular study. So due to this limited area per site, the actual benefit to any shellfish grower was almost non-existent. Futhermore, any gain that was on the site as a result of the treatment was lost to them during our harvesting of the plots. We dug and processed the clams from the treated site and untreated sites. We measured and weighed (fresh and dry weight) the samples of the plots. This process is destructive. There was nothing left but dried clam meat. In fact, growers could actually lose productivity from my research plots. It is actually difficult to convince growers to let me use their sites as part of research plots for that very reason. In cranberries I get Ocean Spray to compensate growers for the research I do on their beds that results in crop loss. Compensation for crop loss is not an option for shellfish growers.

e. What would you estimate the cost of this research per site?

Again, it depends on which research project and which year and which sites. To put out one experiment at one site and only look at clam production would cost between $500 and $5,000. The cost depends on how many years you collect data. The treatment part is cheap, $250/site. But it costs ~ $250 to $5000/site to harvest and process the data. These are never done in isolation, so it is impossible to be exact on the cost per site. Also the cost is dependent on the clam density and number of replications per site. If there are a lot of clams to harvest per plot and a lot of replications, it costs more. Each clam has to be weighed and measured; this is the costly part. If I have only eight replications and the yield is very low, it could be done for under $500 to $1000.

If we are doing any experiments that involve chemical analysis of imazamox in water or sediment then the cost goes up very fast. It runs about $300/sample to collect and analyze imazamox. If I am doing any detailed assessment of ecological impacts then the cost also go a lot. For example we just finish looking at how imazamox treatments affect shorebird foraging. It required over 35 visits to the site. Finally, the cost are contingent on the granting agencies and if they pay indirect cost. That cost is 28% added on to the cost of the project.

If you have a specific project you want a cost for then I can provide an estimated, but I need more details.

7. Were there other years in which research was done regarding the use of Imazamox to control Japanese Eelgrass in which you used your personal property to participate in the research? If so please provide that information.

Over the past 27 years, I have used my property to conduct many different research projects. This was done mainly for convenience. Here is a list of projects that have been done on my property.

a) I conducted research on *Spartina* control in the salt marsh from 1991 to 2008.

b) I conducted research on eelgrass control from 1993 to 2007. This work was on efficacy before it was a clam farm (just bare sand, and new *japonica* starting to spread on to it). I had a few small plots scattered on the site.

c) The site was used to study the interaction between *japonica* and *Spartina*. This was an ecology study by a graduate student from UC Davis.

d) The site was used in cooperation with a Western Washington University project to look at erosion rate post-*Spartina* control (mid 2000's).

e) I used the site as part of a project to assess shorebird/waterfowl use of treated and untreated sites (mine was within a large network of treated sites). This was a monitoring experiment where I just included my site as part of the larger site. I treated my ground using my own time and money (not part of WSU) to remove all the *japonica* from the clam farm (as allowed per permit). We just used the site to monitor shorebirds.

f) I used the site between 2010 to 2012 on a project to assess the impact of *japonica* on clams. The site was one of 5 sites we used to study the effect of japonica on yield that year. At this site I had 8 replications of 3 by 4 m plots, ~ 960 ft^2 treated.

h) The site was used by a marine ecologist at UW to study the interaction between *japonica* and *marina* eelgrass.

i) I've also used my garden to conduct field research for the USDA. In this site I evaluated crosses for a new type of berry for their suitability to a coastal climate.

In summary, it has been commonplace for me to do work on my property. None of these provide any economic gain. It is just a matter of convenience, saving time and money to do the work off-site. Most of the work on the tideflats has to be done in the very early morning during low tide. To work off-site requires a 30+ minute drive and a 30 to 60 minute walk. This can be a pain when low tides are at 5 to 6 am. Whenever possible, I find it much more practical to walk out my door to do the work. However, if I include all the experiments I have done in the bay over the past 27 years, I would say that <u>much less than</u> 1/10 of 1% were done on my own property.

8. Have you used other state resources, emails, time to support the use of Imazamox to control Japanese Eelgrass on your personal property, i.e., sending emails to the Department of Ecology from your WSU email account to support the use of Imazamox to control Japanese Eelgrass?

I use my work computer/ email to send emails to EPA/DOE/WSDA/WDFW and other state and federal agencies for all sorts of permits and efforts. This has included permits that would support many different types of large state-regulated efforts that affect industries and the areas that I work in. For example, I have done so regarding *Spartina* control, aquatic weed control, aquatic herbicide permits, control of burrowing shrimp with imidacloprid, control of cranberry insects and diseases with numerous pesticides, coastal erosion issues, many EIS's, NPDES's, Shoreline Master Plans, wetland regulations, endangered species, noxious weed listings and control,
Special Local Needs for Pesticide uses (SLN) and Section 18s, and hearings by state agencies. If I have expertise in an area, and there is a public hearing on a subject that affects the industries that I work with, then I think it is a good investment of my time to provide comments. This week, for example, I provided public comment on surfactants in 'The Washington State Department of Ecology (Ecology) Draft Supplemental Environmental Impact Statement (EIS) for Aquatic Plant Management'. Why did I provide comment? Because I have 20 years of experience in this field, and am considered an expert, and I think their EIS missed an important aspect of surfactants that could impact the environment. I consider it part of my job to work with agencies. I am often called to testify in front of agencies' hearings or expert panels. For *japonica* I was asked to be part of several expert panels and white papers for Ecology, and to testify in defense of the NPDES for Ecology in front of the Shoreline Hearing Board. So yes, I do use my WSU email for the purpose of providing my expert opinion, especially when

I am one of the foremost authorities in the world on a subject. In this case, it happened to be the use of the herbicide imazamox to control Japanese eelgrass.

9. What is your official relationship with Brian Sheldon?

Brian and I have served on many different county and local committees over the years. Brian and I have worked on projects together related to burrowing shrimp control. Brian and I are often cohosts of many different tour groups on the bay (college classes, state and federal agencies, etc.).

Brian and I have a contract for the harvesting of clams on my property. He sends in his crew every four to seven years to dig clams on my ground and I get paid $0.65 or 0.70/lb for them. He has this same contract with many other land owners that have small commercial clam grounds.
He has only harvested once on my ground. The next harvest will be in three or four years.

10. How do you know him?

Brian and his family are all my friends. I've worked with his wife on the school board for 8 years. I've worked with his dad on *Spartina* for 27years. He is active in the local community and so am I. As I mentioned we are on many of the same community boards together. He has kids in same school that I did, and he often talks about school-related issues with me.

11. In November 2012 did you enter into a personal business transaction with Mr. Sheldon? Explain.

See above. I am not sure the exact time period we signed the contract, but it was around that time. He harvested clams in 2014. This was my first commercial harvest. The site is high ground and not very productive. Normally a good site can be harvested every 4 years. I received a little over $4,000 for the clams he harvested.

12. Does Mr. Sheldon have a private interest in your research on the use of Imazamox to control Japanese Eelgrass?

1. I am not sure what you mean by this question. Does he gain financially from my research? Yes, but he is no different than any other clam grower in Willapa Bay. He also has a private interest in my work on *Spartina* and burrowing shrimp control, just as does every other shellfish grower in Willapa Bay. Did he support my research with money? No. Did he elicit this research effort? No. Did he even know I was doing this research work? No, not until the later years when it was well underway. Did he gain anything from me putting out plots on his property? No. We did have one set of plots at one of his sites, but that site was a failure and had no clams. Did he treat his property with imazamox, once there was a NPDES and thereby have improved clam yield? Yes he did, as did other growers. The whole purpose of this research on the use of imazamox to control Japanese Eelgrass was to find methods to improve manila clam production in Willapa
Bay. This is basically the third leg of WSU's land grant university mission statement
"To apply knowledge through local and global engagement that will improve quality of life and enhance the economy of the state, nation, and world". I've been told by growers that overall this project has increased their production significantly and add several millions of dollars to the local economy.

I view this in a similar way to how my friends who are cranberry farms benefit from my work on
insecticides to control a major cranberry insect pest. Eventually my work results in a registration of a product that my friends use to control insects on their farm. My friends benefit, but so does the entire industry. I don't work on this project because they are a problem on my friends' farms, Brian Sheldon's farm or anyone else's farm. I work on these problems because they are major priorities to the respective industries. You can assess for yourself the industry's needs and priorities - see 'Pest Management Strategic Plan Bivalves Oregon and Washington'
https://ipmdata.ipmcenters.org/documents/pmsps/OR-WAbivalvePMSP.pdf.

13. Have you ever testified in court of law regarding the use of Imazamox to control Japanese Eelgrass? If so, was that as an employee of WSU or some other interest? Please explain.

Yes, the State Attorney General requested that I testify at the State Pollution Control Hearings Board in defense of Dept. of Ecology for their NPDES permit. The Attorney General representing Ecology worked with the Attorney General representing WSU to assure that my testimony/ expert witness was appropriate. I believe I was subpoenaed to provide this testimony, but can't recall the details. I think that AG has moved on, but the contact was Gordon Karg, AAG, Washington State Attorney General's Office, Ecology Division. Why was I called to testify in this regard? It was my data that was used to develop the permit for Ecology, and I was the foremost expert in the area.

14. Did you receive compensation, in any form, for your testimony from anyone in the commercial shell fish industry?

No compensation was received. However, we did have working dinners and lunches with the AG during the hearing, and I don't recall paying for those meals. Someone paid for those them. It could have been the AG office, Ecology, or the shellfish industry; I am not sure.

In fact the testimony actually cost me time and money. I lost three days of office work, plus the cost of travel, lodging and other meals. I paid for those costs out of my extension travel budget that I get from WSU. The time was just lost work time. I had to compensate for this by working longer on other days to get my projects done.

Commenter: US Fish and Wildlife Service

(Email Submission)

PDF of DEIS 2017 Imidacloprid Letter attached.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

NOV - 1 2017

D. Rockett, Permit Writer
Washington State Department of Ecology
Water Quality Program
P.O. Box 47775
Olympia, Washington 98504-7775

Dear Mr. Rockett,

On September 18, 2017, the Washington State Department of Ecology's (Ecology) Water Quality Program, Aquatic Pesticide Permits Program, announced the availability of a Supplemental Environmental Impact Statement (EIS) addressing four alternatives for control of native burrowing shrimp (ghost shrimp, *Neotrypaea californiensis*, and mud shrimp, *Upogebia pugettensis*) on commercial shellfish beds in Willapa Bay and Grays Harbor, Washington. The Supplemental EIS was prepared pursuant to the requirements of the State Environmental Policy Act (SEPA), and provides and assesses new sources of information that were not available when Ecology published and took comment on the 2014 Draft EIS (Ecology 2014), the 2014 proposal to issue a National Pollutant Discharge Elimination System (NPDES) Individual Permit/State Waste Discharge Permit to the Willapa-Grays Harbor Oyster Growers Association (WGHOGA) for use of the aquatic pesticide imidacloprid, and the 2015 Final EIS (Ecology 2015). The public comment period closes on November 1, 2017.

Background Information

WGHOGA has submitted to Ecology an application and request for a NPDES Individual Permit. WGHOGA has made changes to their earlier 2014-2015 application and request for a NPDES Permit. Whereas the permit issued by Ecology to WGHOGA on April 16, 2015 (Permit No. WA0039781), and subsequently withdrawn on May 3, 2015, permitted a proposed use of the neonicotinoid pesticide imidacloprid to treat commercial shellfish beds on up to 2,000 acres per year (total) in Willapa Bay and Grays Harbor, WGHOGA's current application and request seeks a permit for treatment of 500 acres per year (total) in Willapa Bay and Grays Harbor.

WGHOGA's 2017 request for a NPDES Permit also proposes a change for the methods of pesticide application. Aerial spraying (i.e., from helicopters) was previously a proposed method of application, but is no longer being requested by WGHOGA. WGHOGA's 2017 request for a NPDES Permit instead seeks approval for application of imidacloprid (flowable liquid and granular solid formulations) to commercial shellfish beds at low tide using only boats and/or ground-based equipment.

The Supplemental EIS describes and assesses four alternatives: 1) No Action – No Permit for Pesticide Applications (Alternative 1); 2) Continue Historical Management Practices – Carbaryl Applications with Integrated Pest Management (IPM) (Alternative 2); 3) Imidacloprid Applications with IPM on up to 2,000 acres per year in Willapa Bay and Grays Harbor, with aerial applications by helicopter (Alternative 3; i.e., the Preferred Alternative from the 2015 Final EIS); and, 4) Imidacloprid Applications with IPM on up to 500 acres per year in Willapa Bay and Grays Harbor, with no aerial applications (Alternative 4) (Ecology 2017). According to the Supplemental EIS, Ecology is currently not proposing an action, making a decision whether to issue a NPDES Waste Discharge Permit and Sediment Impact Zone (SIZ) authorization to WGHOGA, or identifying a preferred alternative. We understand that "Alternative 2 is no longer being considered as an alternative, since Ecology denied the application for extension of … permit No. WA0040975 in May 2015." (Ecology 2017, p. iii)

The U.S. Fish and Wildlife Service, Washington Fish and Wildlife Office (USFWS), issued a letter during the public comment period for the 2014 Draft EIS (USFWS 2014; Letter to Rich Doenges and Heather Bartlett, December 8, 2014). Our letter expressed concern about the proposed use of imidacloprid to control burrowing shrimp in Willapa Bay and Grays Harbor, and voiced support for the continuation of limited field trials under an Experimental Use Permit.

Since 2015, Ecology has obtained and reviewed additional information about the impact(s) of imidacloprid on aquatic and terrestrial species and their habitats, and has analyzed the data from additional field trials completed in Willapa Bay and Grays Harbor. The Supplemental EIS presents and assesses these new sources of information (Ecology 2017), including the information provided by three recent comprehensive literature surveys; two completed by the U.S. Environmental Protection Agency (EPA) during 2015 and 2017, and a third completed by Health Canada during 2016. These new sources of information identify known adverse impacts and additional significant uncertainties and concerns regarding fate, transport, and toxicity of imidacloprid in the environment.

<u>Control of Native Burrowing Shrimp with Imidacloprid</u>

WGHOGA has submitted an application for a 5-year NPDES Permit to chemically control burrowing shrimp on commercial shellfish (*e.g.*, clam and oyster) beds in Willapa Bay and Grays Harbor using the pesticide imidacloprid. Often used in agriculture, imidacloprid is the most widely used pesticide belonging to the class of systemic pesticides known as neonicotinoids. Imidacloprid acts as a neurotoxin in arthropod invertebrates (insects, crustaceans, zooplankton, etc.), by interfering with the transmission of stimuli in the nervous system, and causing blockages in neuronal pathways resulting, over time, in tetany, paralysis, or death (Health

Canada 2016; EPA 2017). Imidacloprid binds irreversibly to receptors, increasing the likelihood that exposed individuals may suffer sub-lethal effects, or chronic effects, with consequences for survival.

The EPA has approved several Section 3 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) labels for products containing the active ingredient imidacloprid. For each of these products, excluding only the flowable liquid and granular solid formulations proposed for use by WGHOGA (Protector 2F and Protector 0.5G), the EPA includes an explicit label warning that imidacloprid must not be applied directly to water or where surface waters are present (i.e. intertidal areas). Many of the EPA approved labels and formulations contain the same percentage of the active ingredient.

Ghost shrimp and mud shrimp – the two varieties of burrowing shrimp found in Willapa Bay and Grays Harbor – are native to these waters and tidelands. Burrowing shrimp play a significant ecological role in these systems. Their normal behaviors, including burrowing and deposit-feeding, affect and regulate benthic properties and processes (grain size, nutrient exchange, organic deposition), and influence benthic community composition and trophic pathways. Burrowing shrimp create unique habitat types that support additional native species. It is believed that mud shrimp are in decline throughout significant portions of their range (Feldman *et al.*, 2000; Chapman *pers. comm.*, 2017).

WGHOGA has tested and applied a number of physical and chemical methods of control for burrowing shrimp. While historically some shellfish growers and farm operators in Willapa Bay and Grays Harbor have used carbaryl (1-naphthol n-methyl carbamate) to chemically control burrowing shrimp on commercial shellfish bed (Labenia *et al.*, 2007; NMFS 2009), there is no current, valid permit for the application of carbaryl, and Alternative 2 (Carbaryl Applications with IPM) is no longer being considered by Ecology (Ecology 2017, p. iii).

WGHOGA and their research partners obtained an Experimental Use Permit to test and conduct field trials using imidacloprid to control burrowing shrimp on shellfish beds in Willapa Bay and Grays Harbor. Since 2008, WGHOGA and their research partners have been conducting limited field trials (including larger acreages during 2014) to evaluate fate and transport, persistence in sediment and water, and effects to target and non-target invertebrate species (Ecology 2017).

General Comments

As was stated in our previous comment letter addressing imidacloprid and these specific proposed practices (USFWS 2014), there is substantial scientific evidence documenting the persistence of neonicotinoids in natural systems (marine, freshwater, and terrestrial environments), and documenting direct and indirect adverse impacts on non-target invertebrate species, vertebrate species, and overall ecosystem functions (Chagnon *et al.*, 2015; Gibbons *et al.*, 2015; Morrissey *et al.*, 2015; Health Canada 2016; EPA 2017). New scientific evidence compiled and reviewed by Ecology, including the findings from field trials conducted during 2012 and 2014, establishes with certainty that these proposed practices would have acute adverse impacts to sediments and sediment quality, the benthic community, and free-swimming crustaceans and zooplankton, both on and off of (i.e.. adjacent to) the treated shellfish beds (Ecology 2017). This scientific evidence also points to significant information gaps and uncertainties regarding a number of important issues and potential consequences (e.g., efficacy, persistence, sub-lethal effects, indirect and chronic effects (Health Canada 2016; EPA 2017)), some of which are not adequately described or addressed in the Supplemental EIS.

Considering the best available scientific information regarding imidacloprid, and these specific proposed practices, the USFWS does not agree that all of the potentially significant adverse impacts and effects are adequately known and understood. We do not agree that all of the potential adverse effects (Health Canada 2016; EPA 2017) will be "short-lived" or limited in duration.

The USFWS does not support either Alternative 3 or Alternative 4 (Imidacloprid Applications with IPM). We do not support issuance of a NPDES Permit or SIZ authorization to WGHOGA at this time. The USFWS supports Alternative 1 (No Action), and we suggest that limited field trials using boats and/or ground-based equipment should continue under the Experimental Use Permit.

<u>Specific Comments Relating to Alternative 3 and Alternative 4</u>

- Alternatives 3 and 4 (Imidacloprid Applications with IPM) would have acute adverse impacts to sediments and sediment quality, the benthic community, and free-swimming crustaceans and zooplankton, both on ("on-plot") and off ("off-plot") the treated shellfish beds:
    - According to an internal memorandum, Ecology's Toxics Cleanup Program evaluated the findings from field trials conducted during 2012 and 2014 and concluded that they represent threshold exceedances of the State's Sediment Management Standards (SMS). "Monitoring results show that acute endpoints have been exceeded both on-plot (in 2012 and 2014) and off-plot (2012)." (Toxics Cleanup Program 2017) There were, "...unavoidable adverse impacts in high total organic carbon (TOC) areas ... Ecology and WGHOGA did not see adequate recovery of the benthic invertebrate population." (Toxics Cleanup Program 2017) Ecology's Toxics Cleanup Program has stated that these practices are likely to cause exceedances of the SMS where TOC is high (North Willapa Bay, Cedar River vicinity; South Willapa Bay), and that such exceedances should not be allowed under a SIZ authorization issued pursuant to the State's sediment management regulations.
    - The best available scientific information demonstrates that imidacloprid is highly toxic to freshwater invertebrates. There is also a growing body of scientific evidence to suggest that imidacloprid has, or is likely to have, a similar high toxicity in marine and estuarine invertebrates (Morrissey *et al.*, 2015). Where the product is applied directly to water, or where surface waters are present (as per Alternatives 3 and 4), estimated on-plot and off-plot environmental concentrations

will be dramatically higher (even orders of magnitude higher) than the acute biological endpoint criteria identified by the EPA and Health Canada (Health Canada 2016; EPA 2017).

- Information included in the Supplemental EIS clearly demonstrates Alternatives 3 and 4 will cause mortality and tetany (or indirect mortality) in Dungeness crab (*Cancer magister*). However, the field trials and studies likely underestimate the total numbers of acutely and adversely affected crab (on-plot and off-plot), and do little to evaluate the likely scale or size of acute and adverse effects to other members of the benthic community, other free-swimming crustaceans, or zooplankton.

- Alternatives 3 and 4 (Imidacloprid Applications with IPM) would have uncertain and unquantified impacts and effects, including some that we recommend must be more sufficiently analyzed and described in the Final Supplemental EIS:

  - WGHOGA's proposed aquatic use of imidacloprid is unique. Other than the limited field trials completed to date in Willapa Bay and Grays Harbor, there have been few studies that have evaluated the impacts of direct application of imidacloprid to marine waters or tidelands. Additional, limited field trials may be warranted. These field trials should further investigate efficacy, persistence in and long-term impacts to sediments, sub-lethal but biologically significant effects to target and non-target species, potential indirect chronic effects to target and non-target species, and potential indirect effects to food webs (predator-prey dynamics) and ecosystem functions.

  - There is no well-defined methodology for determining the treatment threshold. Efficacy has been highly variable and the target species may frequently and rapidly rebound in numbers or density. It is also unclear whether or not the target species may become resistant to the application of imidacloprid over time.

  - The Supplemental EIS acknowledges, but does not adequately address, persistence in, and long-term impacts to, sediments and sediment quality. The results of multi-year studies in the aquatic environment are not yet available to describe how imidacloprid and its primary metabolites accumulate in sediments, or to assess the potential for chronic, long-term sediment toxicity effects on benthic invertebrate communities. Neonicotinoids, including imidacloprid, operate with a mode of action that suggests a significant potential for additive, synergistic, and cumulative effects. We are concerned even comparatively low concentrations may contribute to significant adverse biological effects over lengthened or repeated, chronic exposures.

  - The Supplemental EIS acknowledges, but does not adequately address, sub-lethal effects to target and non-target species. Much of the available scientific information addresses lethal biological endpoints only. When combined with other sources of sub-lethal effects and stress, these exposures may result in unforeseen adverse impacts to the survival, growth, or reproductive success of target and non-target species (benthic invertebrate community, free-swimming crustaceans, or zooplankton) (Chagnon *et al.*, 2015; Morrissey *et al.*, 2015).

- The Supplemental EIS acknowledges, but does not adequately address, potential indirect effects to food webs (predator-prey dynamics) and ecosystem functions. The Supplemental EIS does not speak definitively to the likely scale of foreseeable impacts to the target species, the non-target benthic invertebrate community, free-swimming crustaceans, or zooplankton. Because of these limitations, the Supplemental EIS makes no compelling argument regarding potential indirect effects to food webs (predator-prey dynamics). The best available scientific information demonstrates that ubiquitous use of neonicotinoids in the terrestrial environment has resulted in instances of reduced prey availability, with consequences for growth and survival (e.g., in birds) (Chagnon *et al.*, 2015). Alternatives 3 and 4 may have this same or a similar potential.

Specific Comments on Various Concerns and Current Topics for Consideration

- WGHOGA claims, in the absence of an approved chemical method of control for burrowing shrimp, significant tideland acreages historically used to farm oysters and clams will no longer be economically viable. However, content included in the Supplemental EIS suggests that alternate shellfish culturing methods and practices, including placement of gravel and oyster shell ("frosting"), could be used economically on the affected tidelands (Ecology 2017, pp. 1-4, 2-8, 2-9, 2-11, 2-12). Ecology should clarify the economic viability of using one method over the other.

- Ecology is unable to quantify the total acreage of commercial shellfish beds that would be treated with imidacloprid under any future permit. Growers might conceivably re-apply the pesticide to the same acreage several times over the term of the permit. The Final Supplemental EIS should provide a more accurate and reliable estimate of the total affected acreage, both on-plot (treated commercial shellfish beds) and off-plot (adjacent affected tidelands). If reapplication to the same acreage is possible and likely over the term of the permit, Ecology in the Final Supplemental EIS should better assess and describe what implications this may have for persistence, indirect effects, and chronic effects.

- The Natural Resources Defense Council recently sued the EPA over the registration and use of products that contain neonicotinoids, including imidacloprid, acetamiprid, and dinotefuran. According to the complaint, neonicotinoid pesticides pose risks to numerous species listed under the Endangered Species Act (ESA), including pollinators (bees, butterflies), birds, and fish. At least five of the federally-listed species specifically mentioned by the Natural Resources Defense Council occur in western Washington.

- In a suit and complaint brought by the Center for Food Safety against the U.S. Army Corps of Engineers (Corps), the plaintiffs argue that the Corps has failed to properly administer its authorities, and has improperly permitted commercial shellfish aquaculture, in violation of the National Environmental Policy Act, Administrative Procedure Act,

  Clean Water Act, and ESA. The complaint filed by the Center for Food Safety specifically mentions and addresses pesticide use in shellfish aquaculture.

- Content included in the Supplemental EIS suggests that there would be no direct adverse effects to birds or fish, including those listed under the ESA. However, the Supplemental EIS does acknowledge that potential indirect effects to food webs and prey availability are a significant uncertainty, sources of prey could be reduced for shorebirds that feed exclusively on invertebrates, and granular imidacloprid pellets could be consumed and lead to toxicity or sub-lethal effects (including reduced reproductive fitness) in birds. The indirect effects to food webs potentially caused by neonicotinoids is of particular concern to the USFWS because of the numerous migratory bird species that depend on habitats of Willapa Bay and Grays Harbor as part of their migratory pathway (Chagnon *et al.*, 2015). Grays Harbor supports migratory bird habitats of hemispheric importance as classified by the Western Hemisphere Shorebird Reserve Network (WHSRN). Over half a million shorebirds stage in Grays Harbor annually as they migrate along the Pacific Flyway. WHSRN has also recently designated Willapa Bay and the Long Beach Peninsula a place of international importance because these habitats support over 10 percent of the Pacific Coast populations of dunlin (*Calidris alpina*), red knot (*Calidris canutus*), and short-billed dowitcher (*Limnodromus griseus*).

In closing, the USFWS remains unconvinced, even with the new scientific evidence included in the Supplemental EIS, that Alternative 3 and Alternative 4 can be implemented in a manner that ensures minimal adverse impacts to aquatic and terrestrial species and their habitats. In fact, the best available scientific information indicates that neonicotinoids present significant acute and chronic risks to non-target organisms, and have known adverse environmental impacts. USFWS acknowledges that additional field trials may be warranted and will be necessary to adequately address the outstanding issues and concerns highlighted in this letter, and to improve our knowledge regarding applications of imidacloprid, especially in the estuarine and marine environments.

We appreciate the opportunity to comment and express our concerns regarding Alternatives 3 and 4 (Imidacloprid Applications with IPM). If you or your staff have any questions, if our comments require further explanation, or you would like to discuss these matters, please contact Ryan McReynolds (ryan_mcreynolds@fws.gov; 360.753.6047), or Jay Davis (jay_davis@fws.gov; 360.753.9568).

Sincerely,

Eric V. Rickerson, State Supervisor
Washington Fish and Wildlife Office

cc:
Willapa NWR, Ilwaco, WA (J. Ferrier)
Grays Harbor NWR, Hoquiam, WA (G. Nakai)
USFWS, Regional Office, Portland, OR (R. White)
NMFS, Lacey, WA (S. Anderson)
NMFS, Lacey, WA (T. Hooper)

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Commenter: Douglas Steding - Comment O-20-1

(Email Submission)

On behalf of our client, the Willapa/Grays Harbor Oyster Growers Association, we are submitting the attached comments in support of the Draft SEIS referenced above. Can you please confirm receipt?

Douglas Steding, Ph.D.
dsteding@nwresourcelaw.com
(206) 971-1567

NORTHWEST RESOURCE LAW PLLC

November 1, 2017

VIA E-MAIL AND ELECTRONIC SUBMITTAL

Derek Rockett

Ecology Water Quality Program

P.O. Box 47775

Olympia, WA 98504-7775

Email: burrowingshrimp@ecy.wa.gov

Dear Mr. Rockett:

The Willapa/Grays Harbor Oyster Growers Association ("WGHOGA") submits these comments in support of the Draft Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington (the "Draft SEIS") issued by the Washington Department of Ecology for public comment on September 15, 2017.

WGHOGA is supportive of issuance of a National Pollution Discharge Elimination Permit ("NPDES") as analyzed in the preferred alternative of the Draft SEIS, and offers the following comments that (1) emphasize the economic importance of the shellfish industry in Pacific and Grays Harbor County; (2) stresses the importance of a burrowing shrimp control program as part of the continued economic viability of the shellfish industry in those two counties; and (3) clarifies, corrects, or provides additional details relevant to the analysis undertaken by Ecology in the Draft SEIS.

A. Economic Importance of the Shellfish Industry and the Need to Control Burrowing Shrimp

Willapa Bay is the largest producer of farmed oysters in the United States. Combined with Grays Harbor, this area along the southwest Washington coast produces approximately 25 percent of all oysters in the United States. Willapa Bay is also a crucial component of the shellfish economy in Washington State, producing approximately 65 percent of the oysters and 13 percent of the clams harvested in Washington State. Shellfish aquaculture is the largest private employer in Pacific

County and a significant private employer in Grays Harbor County. It is one of the major industries in southwest Washington, and has increased in relative importance following declines in the timber and fishing industries.

Since at least the 1940s, two native species of burrowing shrimp (ghost shrimp, *Neotrypaea californiensis* and mud shrimp, *Upogebia pugettensis*) have caused impacts to Pacific Coast commercial clam and oyster production by disrupting the structure and composition of the substrate, causing these shellfish to sink and suffocate and eelgrass and crab habitat to disappear. Until recently, commercial shellfish growers in Willapa Bay and Grays Harbor, Washington, have successfully used the N-methyl carbamate insecticide "carbaryl" to control burrowing shrimp on culture beds receiving young oysters. The use of that chemical was phased out in favor of developing the least impactful method of burrowing shrimp control possible. WGHOGA is now seeking permit approval from the Department of Ecology to use the insecticide "imidacloprid" as a replacement for carbaryl for burrowing shrimp control in the aquatic environment of these two estuaries. The current proposal is to treat approximately 1.1 percent of total tideland area in Willapa Bay and 0.02 percent of total tideland area in Grays Harbor annually.

Without the ability to treat the tidelands, not only will there be loss of ecological value within these benthic habitats, there will be significant economic impacts to the region. In 2013, Northern Economics prepared an economic impact assessment of aquaculture in Washington, Oregon, and California for the Pacific Shellfish Institute ("PSI"). The input-output analysis determined that for every dollar spent by shellfish growers, a total of $1.82 worth of economic activity is generated in Washington. In addition, every dollar spent by shellfish growers generates approximately $0.76 in wages, and for every

$1 million spent by the industry, nearly 27 jobs are created. Based on these calculations, the PSI study estimated that shellfish farmers in Washington spent approximately

$101.4 million in the Washington economy in 2010, which in turn generated approximately $184 million. Shellfish farmers generated 1,900 direct jobs and paid $37 million in labor income in 2010, and they generated 810 additional jobs through indirect or induced activity. Further, the PSI study found that shellfish aquaculture in Pacific County in 2010 generated more than $90 million in total economic output, 1,580 jobs, and more than $45 million in labor income. In Grays Harbor, shellfish aquaculture generated almost $12 million in total economic output, 210 jobs, and almost $6 million in labor income in 2010. Not captured in the PSI study are the economic benefits from shellfish aquaculture in the form of "upstream" jobs.

If burrowing shrimp are not effectively controlled with pesticide treatments, then commercial shellfish production in Willapa Bay and Grays Harbor will likely be reduced 80 to 90 percent. In 2016, WGHOGA surveyed the members seeking permit coverage under the current application, and asked them to project bed losses over the next five years. The results of that survey indicate that cumulative losses will result in almost 500 acres of seed or nursery ground, 575 acres of fattening beds and more than 530 acres of clam beds lost by the end of year five. The resulting economic loss to WGHOGA members is estimated at an annual production value of $9600 per acre for oyster beds, and $13,000 per acre for clam beds. Cumulative losses by year five would total just under $50 million. This loss is production loss only, and does not include indirect economic impacts to the communities that surround Willapa Bay and Grays Harbor or the economic value of the lost habitat associated with the conversion of rich oyster or clam beds into benthic barrens. The direct economic loss number also excludes the losses already experienced by the growers due to not being able to control burrowing shrimp over the past three years and does not consider the real possibility of these growers having to close multi-generational farms due to escalating shrimp infestation.

B. WGHOGA's specific comments on the Draft SEIS

1. Integrated Pest Management Plan from WGHOGA

The Draft SEIS indicates that an Integrated Pest Management Plan (IPM) had not been submitted by WGHOGA by time of publication of the SEIS. WGHOGA notes here that the IPM plan has subsequently been submitted to Ecology, and a copy of that proposed plan is attached as Exhibit A. The plan has five elements, which collectively strive to increase the efficacy of imidacloprid applications, continue efforts to test and develop non-chemical controls of burrowing shrimp, and, ultimately, to reduce the use of imidacloprid over time. In summary the plan includes the following:

- **Burrow Monitoring** - Accurate monitoring of the population densities of burrowing shrimp are fundamental to all aspects of decision making in the IPM plan. WGHOGA will continue to monitor burrow counts on all beds covered under the NPDES permit on a yearly basis. Yearly monitoring will include date of survey, bed name, location, burrow counts, sediment characteristics, and native seagrass presence.
- **Recruitment Research** - Current research suggests that the detection and monitoring of newly settled juvenile burrowing shrimp recruits may be useful to predict bay wide population trends, and could be used to develop an annual

recruitment index. WGHOGA will incorporate young of the year (YOY) monitoring in locations where recruitment is likely to be observed. Data from these monitoring efforts will be useful as WGHOGA develops improved methods to quantify rates of new burrowing shrimp recruitment. Studies are planned to determine whether application of imidacloprid at seasons other than mid-summer would be more effective at controlling shrimp, while still protecting the environment. Improved control may help reduce the need for imidacloprid to treat or retreat shellfish beds to reduce burrowing shrimp.

- **Efficacy Studies** - Efficacy monitoring (i.e., counts of burrowing shrimp burrows before and after imidacloprid treatments) will be conducted during early spring, mid-summer and late summer to help select formulation type and timing for the delivery of imidacloprid to increase efficacy. Continued testing of non-chemical approaches such harrowing of new recruits, disking and dredging between crop rotations will be implemented to slow the establishment of adult populations. The overall goal of these efficacy studies is to determine ways to obtain sufficient burrowing shrimp control while continuing to reduce dependence on chemical use.
- **Damage/Density Thresholds** - WGHOGA will work to quantify the relationship between the density of burrowing shrimp populations and damage to oyster yield. To determine damage/density functions, studies will be undertaken to measure survival, growth, and harvest yield of oysters on beds with different densities of burrowing shrimp, considering the effects of habitat, season, culture technique, and other environmental variables. Initial efforts will focus on developing damage/density functions for the cultural practices suffering the greatest economic loss from burrowing shrimp. The data from this monitoring may help WGHOGA to reduce the need to control burrowing shrimp when they are at densities that, based on current knowledge and experience, require treatment.
- **Continued Research** - WGHOGA will continue to seek alternative physical, biological or chemical control methods that can be more species specific, economical, reliable and environmental responsible and will work with partner organizations to facilitate these activities. This ongoing monitoring will help growers determine the success of their shrimp control program and to aid them in making better management decisions in the future. For example, closely monitoring the beds will help identify dense groupings of shrimp that can be treated with precision, small-scale spot treatments or alert growers when recruitment events have occurred. The end goal is to manage the burrowing

shrimp populations on actively farmed beds, reduce the need for large scale treatments and to achieve efficacy sufficient to reduce the adult shrimp as indicated by burrows counts that are below the damage threshold.

2. Ecological Benefits of Burrowing Shrimp Control

Dr. Richard Wilson, a WGHOGA member, has spent decades sampling and documenting invertebrates and plankton associated with Willapa Bay, and in particular, the effects of burrowing shrimp on the ecology and primary productivity of the bay.

Much of his work has focused on the benthic diatoms, which are important primary producers that form the base of the food web in these shallow estuarine systems. By forming a "biofilm" on the sediment surface, benthic diatoms can be a major food source for some birds (e.g., western sandpipers and dunlin, Mathot et al 2010), and indirectly for many other birds by supporting invertebrates they feed on (e.g., amphipods and benthic copepods), that, in turn, feed on the diatoms. Dr. Wilson's work on this subject is detailed in Attachment A. This Attachment constitutes a part of WGHOGA's comments on the SEIS. A summary of this work includes the following:

- The primary productivity of the intertidal areas of Willapa Bay is driven by the benthic habitat, in particular benthic diatoms that form a dense biofilm on surficial sediments.
- The burrowing ghost shrimp, *Neotrypaea californiensis,* through bioturbation, deleteriously disturbs and continually modifies the intertidal sediments. These actions thereby reduce or eliminate the benthic diatoms and their biofilm habitat, disrupting primary productivity essential to create and maintain the food web in the estuary.
- It is estimated around 9,000 publicly owned intertidal acres of Willapa Bay are subject to this disruption by ghost shrimp and have significantly lost ecological productivity. (Map Attachment A, Fig. 14).
- If ghost shrimp encroachment is not controlled by shellfish growers on their privately-owned lands, another estimated 6,000 - 9,000 acres of productive intertidal habitat that sustains many of the most important estuary species could be lost in the next decade.

WGHOGA strongly believes the final SEIS needs to include a discussion of the positive benefits of burrowing shrimp control. Although the SEIS, in Section 2.11, has a brief discussion of benefits, the majority of this is through a reference to fuller discussions in the FEIS. And, acknowledging that the FEIS is incorporated by reference into the SEIS, and therefore constitutes part of the official record and background for that document, the subject is too important not to be covered in some detail in the SEIS. This is particularly important because the SEIS is notable for its full and consistently conservative discussion of potential negative effects (i.e., erring on the side of concluding impacts will occur) of imidacloprid treatments by WGHOGA. Scientific objectivity, and a commitment to fully informing the public and decision makers in meeting its mandate under SEPA, make it imperative for Ecology to discuss the potential positive environmental effects of the proposed permit in the SEIS itself.

More specifically, WGHOGA notes that the FEIS included numerous discussions of the possible ecological and food web benefits of burrowing shrimp control, but then any such discussion is largely absent from the SEIS. For example, as noted in the FEIS, "Burrowing shrimp control using pesticides under either Alternative 2 (Carbaryl with IPM) or Alternative 3 (Imidacloprid with IPM) would have beneficial environmental effects in the form of preserving the substrate and biodiversity of commercial shellfish beds and promoting native eelgrass density and coverage, thereby improving foraging habitat and prey diversity for birds and fish, and cover for juvenile fish including listed species of salmonids." (FEIS page 2-59). WGHOGA notes again, to meet Ecology's mandate under SEPA, this should be quoted verbatim in the SEIS. The final SEIS should include the following points:

- As ghost shrimp recruit to intertidal areas damage from their bioturbation increases, with resulting loss of the benthic fauna and flora (Attachment A, Fig. 16) through continual disturbance and reductions in primary productivity (as described above). First of the critical intertidal biological elements to be displaced would be the benthic diatoms and their biofilm, followed by decreases in grazer invertebrates due to lack of food or inability to survive on the shifting sediments. Sediment instability with loss of finer sediment fractions would damage or destroy existing eelgrass, plus prevent any new seeds from sprouting.
- With decline and then loss of their food sources and habitats, including oyster bed and eelgrass habitats, higher trophic level forms such as birds and fish will experience reduced food resources. In more extreme cases the burrowing shrimp dominated areas may become unsuitable as foraging habitat for these vertebrates.
- Available evidence is that burrowing shrimp competitively exclude many other types of sediment associated organisms once they successfully recruit to an area. The burrowing shrimp tend to limit the occurrence of other species through constant sediment disturbance and create monocultures.

- Given these impacts, controlling ghost shrimp abundance through imidacloprid treatments via the proposed permit will help to preserve the food web from primary producers to higher-level predators. And by supporting the survival of oyster beds and eelgrass, these imidacloprid treatments will enhance habitat diversity when compared to the uniform mudflat habitats dominated by burrowing shrimp.
- Published scientific studies and reports support the conclusion that burrowing shrimp have negative effects on other species, and that their control provides food web benefits. For example, Ferraro and Cole (2007) examined benthic invertebrates associated with various habitat types (e.g. oyster beds, eelgrass, ghost shrimp mudflats) to help identify high value, critical habitat within Willapa Bay. They showed that shrimp dominated habitat had disproportionately lower macrofaunal biomass (other than of the shrimp themselves) and species diversity than the other habitat types. Other focused studies demonstrate that constant disturbance from burrowing shrimp can limit and exclude eelgrass (Dumbauld and Wyllie-Echeverria 2003; Hosack et al. 2006). These authors note that improvements to native eelgrass density and coverage could also improve recruitment of Dungeness crab and foraging habitat for fish and migratory birds (e.g. black brant geese).
- There are similar improvements from expanding oyster habitat (Hosack et al. 2006) and promoting recruitment of macoma clams (a species foraged on by medium to large migratory shorebirds such as red knot and curlew) that are discussed in the FEIS that are not fully referenced in the SEIS.
- Shellfish growers have pointed out the obvious lack of benthic organisms associated with burrowing shrimp dominated intertidal areas. One example can be seen in Attachment A, Fig. 15 (page 14), which compares two similar oyster growing areas with one having a dominant ghost shrimp population and the other without due to periodic chemical control of burrowing shrimp. The difference in diversity of habitats and species present is plain to the naked eye. WGHOGA members have taken members of the press, scientists, Ecology staff, even Washington Governor Jay Inslee on field tours of Willapa Bay to see just such impacts of burrowing shrimp on habitat and ecosystem diversity and conditions.

More information on these subjects can be found in the following references:

Dumbauld, B.R. and S. Wyllie-Echeverria. 2003. The influence of burrowing thalassinid shrimps on the distribution of intertidal seagrasses in Willapa Bay, Washington, USA. Aquatic Botany 77:27–42.

Ferraro, S. P., and F. A. Cole. 2007. Benthic macrofauna–habitat associations in Willapa Bay, Washington, USA. Estuarine, Coastal and Shelf Science 71:491-507.

Hosack, G.R., B.R. Dumbauld, J.L. Ruesink, and D.A. Armstrong. 2006. Habitat associations of estuarine species: Comparisons of intertidal mudflat, seagrass (Zostera marina), and oyster (Crassostrea gigas) habitats. Estuaries and Coasts 29(6B): 1150–1160.

Mathot, K.J., D.R. Lund, R.W. Elner. 2010. Sediment in stomach contents of Western Sandpipers and Dunlin provide evidence of biofilm feeding. Waterbirds 33 (3), 300-306.

3. Potential Effects on Dungeness Crab

WGHOGA appreciates the detailed assessment in the SEIS of the potential effects of the proposed permit on Dungeness crab. WGHOGA agrees with the SEIS's overall conclusions about potential effects to this species:

> *"most impacts to juvenile crab would be limited to on-plot, and immediately adjacent areas directly sprayed with imidacloprid during low tide conditions. Planktonic forms of Dungeness crab off-plot may be impacted by rising tidewaters carrying imidacloprid. Given the small area that would receive imidacloprid applications each year (if the permit is issued), compared to the total size of Willapa Bay and Grays Harbor, and the small number of animals that would be affected compared to the total number of animals present in these estuaries and surrounding areas, imidacloprid effects are not expected to impact bay-wide populations of Dungeness crab in these estuaries."* (Page 3-28)

WGHOGA, nonetheless, would like to put any localized and short-term impacts to Dungeness crab from imidacloprid treatments into perspective. First, off-plot impacts are unlikely except immediately adjacent to treated areas due to the rapid transport and dilution of imidacloprid by rising tide waters. This limits mortality of planktonic/juvenile recruits to a very small portion of the overall crab population.

This localized loss of planktonic/juvenile Dungeness crab recruits is dwarfed by the natural variability of natural larval recruitment and population sizes for the species. For example, as the SEIS notes, a single female Dungeness crab can produce one to two million eggs during each reproductive cycle (page 2-29). This guarantees that larval forms of this species are not limited by the availability of individuals in the plankton.

Instead, recruitment of juvenile crabs from the plankton is limited by food and predation conditions experienced by the plankton, and ultimately by the physical habitat space available when they settle to the substrate. Thus, the reproductive biology of Dungeness crab ensures that the species can survive even large-scale die-offs of its planktonic forms.

For larger crabs, the size of the commercial fishery gives some idea of just how abundant Dungeness crab are in the Willapa Bay and Grays Harbor estuaries. The Washington Department of Fish and Game management strategy for Dungeness crab is a male only fishery with strict size limits over a controlled pot trap program. Timing of the fishery is controlled as well as the amount that can be harvested (approximately 50% of the total allowable harvest). Historically, Washington coastal Dungeness crab landing data back to 1950 show a large fluctuation in harvest, ranging from a low of 2.5 million pounds in 1981 to a high of 25 million pounds in 2004-05, with an average of 9.8 million pounds (Reed 2009). These commercial catches can be used to estimate the population of large Dungeness crab as follows: 9.8 million pounds crab/1-1.5 pounds per crab is 6.53 to 9.8 million crabs captured. But this represents only half of the population (females are excluded), and only half of the total legal sized male crabs that are available (i.e., due to limits on the allowable harvest). Therefore, a rough estimate of the total number of commercially sized Dungeness crabs is therefore 6.53 to 9.8 million times (2) times (2), which equals 26.1 to 39.2 million individual crab. This large number does not include juvenile Dungeness crab that are too small to be captured or retained in the fishery. A reasonable estimate of Dungeness crab given these data is 50 million or more, which strongly corroborates the SEIS estimate for Pacific County of 10-20 million crab. With a population this size, the loss of 2 or 4 or even 20 juvenile crab/acre treated with imidacloprid is obviously trivial to the overall Dungeness crab population, as the SEIS correctly concludes.

The wide swings in commercial landings of Dungeness crab reveal another important perspective on any localized, short-term effects from the proposed permit. Populations of Dungeness crab are obviously experiencing highly variable recruitment and survival over time. It is believed that this large fluctuation in landings is not a result of harvest patterns, but instead is due to varying ocean conditions including water temperature, food availability, and ocean currents (WDFW 2017) outside of the bays and estuaries where they recruit. In simple terms, the conditions outside of Willapa Bay and Grays Harbor have a much more profound effect on recruitment and population size than anything within these estuaries themselves, including the localized, short-term impacts that might result from imidacloprid treatments under the proposed permit. WGHOGA also notes that the previous burrowing shrimp management technique of using the pesticide carbaryl occurred during this time frame with no discernable effect of commercial landings on Washington’s coast.

Under the proposed permit, WGHOGA’s plots will be treated and then oysters will be introduced and cultivated. Once that occurs the plots then become a refuge for newly settled crab recruits (Armstrong and Gunderson 1985), a valuable nursery habitat for the species. Predation of these new recruits is likely the largest determinant of whether Dungeness crab survive to reach maturity. Of all the predators, other Dungeness crab seem to be the most effective. Cannibalism among Dungeness crabs has been noted by various studies dating back to the 40’s (Pauly et al 1986). Cannibalism is cited as a possible cause of the dramatic population cycles characteristic of the Dungeness crab fishery (Botsford and Wickham 1978). This makes the refuge of the physically and spatially complex oyster beds very valuable to juvenile crabs, as this habitat offers far greater opportunities to hide and forage without being eaten than does any area of simplified mud flat that results when high numbers of burrowing shrimp are present.

The same accords to development of eelgrass beds following chemical treatments to control shrimp control, a benefit noted repeatedly in the FEIS (e.g., page 1-21).

Accordingly, the net effect of treating with imidacloprid to control burrowing shrimp is likely to be a net positive for Dungeness crab because of the enhanced nursery conditions for juvenile crab that will develop on the treated ground.

Given this information, WGHOGA believes the SEIS needs to more clearly state that the proposed permit will likely have net positive effects on Dungeness crab recruitment and survival that would more than offset any impacts to animals present on the plots during treatment. In addition, the SEIS should note that if the permit is denied, the acreage of oyster beds is expected to decline significantly over time due to the expansion of burrowing shrimp, and that this would constitute a long-term and likely permanent impact to Dungeness crab recruitment and survival in Willapa Bay and Grays Harbor.

4. Effects on non-target invertebrates – Dr. Steve Booth's Meta-Analysis of Prior Imidacloprid Trials

The SEIS includes extensive discussion of the observed effects of imidacloprid on non-target invertebrates, referencing both analysis of prior field trials in Willapa Bay in the FEIS, and, for the first time, the 2014 field trials in Willapa Bay. The SEIS also includes an extensive analysis of recent scientific research and papers on the effects of imidacloprid on invertebrates (e.g., EPA 2017). This amounts to a very substantial amount of empirical and research science to support the SEIS's conclusion that impacts to non-target invertebrates from imidacloprid treatments under the proposed permit will be "localized and short-term" (SEIS page 3-30). WGHOGA strongly agrees with that conclusion.

Very recently, Dr. Steven Booth of the Pacific Shellfish Institute led a group of researchers in drafting a scientific paper synthesizing the results from 8 critical empirical trials of imidacloprid that have been conducted in Willapa Bay (Booth et al. 2017). Dr. Booth has conducted all previous analyses of imidacloprid effects on invertebrates during the empirical trials, and is therefore in an unparalleled position to conduct such a follow up analysis. Results from individual trials have been reported previously but, until now, a comprehensive analysis of all data combined has been neither conducted nor published. Sixty analyses were conducted to examine the response to imidacloprid treatment by 6 taxonomic invertebrate groups. WGHOGA obtained permission from Dr. Booth to review his group's paper, which he expects to submit for publication in a scientific journal shortly. Further, Dr. Booth agreed to allow WGHOGA to submit this paper as part of its SEIS comments (as Attachment B), and to provide a summary of its analytical approach and main findings as follows:

Approach:

- A before-after-control-impact (BACI) design was initially applied to all trials.
- Principal Response Curve (PRC) analysis was used to capture and visually represent the change in abundance of each species group on the treated plots relative to the untreated control plots. Variability across trials due to site effects, replicate effects, unexplained effects (i.e., unconstrained variation) and time

(conditioned variance) are removed or compensated for in PRC analysis. The model thus enables a focus on the treatment vs control, and treatment versus time interactions to explain the response of invertebrate species groups, as well as the relative importance of individual species within those groups.

- Concentrations of imidacloprid in surface water, sediment pore water, and in whole sediment that were measured during the field trials are also presented.

Results:

- Only 6 of the 60 PRC analyses showed a significant negative effect from imidacloprid application. Five of these 6 PRCs represented mollusks, which represented < 2% of all organisms sampled among all sites and years.
- Crustaceans were negatively affected in only one of the 8 studies.
- Polychaetes were never negatively affected.
- The large majority of PRCs showed either no significant effect from imidacloprid application (control and treatment plots remained similar), a neutral treatment effect (variation between treatment and control plots without a clear direction positively or negatively), or ostensibly a “positive” treatment effect (treatment plots exceeded control plots).

Conclusions:

- The overall minimal response was likely due to the low concentrations of imidacloprid invertebrates were exposed to and for limited times, physiological tolerance to imidacloprid for some species, and multiple life-history strategies to rebound from natural disturbance and adaptation to a highly variable environment. These strategies include high mobility and dispersal behaviors, high intrinsic rates of reproduction, and rapid development.
- Dr. Booth concluded that long term effects of imidacloprid to manage burrowing shrimp and culture bivalves is expected to lead to a more diverse community of benthic invertebrates compared to otherwise similar estuarine ground with high densities of burrowing shrimp. He notes that burrowing shrimp are ecosystem engineers and control the structure of the immediate benthic community by limiting the survival and recruitment of other invertebrate species. (WGHOGA note - this is a finding also presented in the FEIS based on that document’s review of the scientific literature (page 3-4).

WGHOGA believes that Dr. Booth's paper is an extremely important contribution to the evaluation of whether the proposed permit will adversely affect non-target invertebrates. As the lead invertebrate researcher for all previous empirical trials of imidacloprid in Willapa Bay he is uniquely qualified to analyze the effects of those trials on non-target invertebrates. His PRC analysis of all existing trials is a more robust examination of imidacloprid effects than either results for individual trials, or extrapolation of expected effects based on research papers that examined imidacloprid toxicity in laboratory experiments on one or two species of aquatic invertebrates.

WAGHOGA requests that the final SEIS include a citation and discussion of Dr. Booth's paper. That discussion should acknowledge the conclusions of that study, particularly the conclusion that the use of imidacloprid to treat burrowing shrimp does not result in the reduction of non-target species. Finally, the SEIS should acknowledge that these results corroborate findings in the FEIS that reduction of burrowing shrimp numbers can have positive effects on non-target invertebrates.

5. Location of Annual Treatments Under the Permit

WGHOGA noted with interest the discussion on page 2-14 discussing the potential spatial arrangement of individual plots that would be treated under the proposed permit, and the footnote of that page indicating that the density of the treated plots could influence the magnitude of off-plot environmental effects. WGHOGA wishes to reiterate that the location of plots to be treated will be determined on a year-to-year basis based on the density of burrowing shrimp, the status of individual beds (e.g., which have oysters, which are being prepared for seeding with oysters, etc.), the efficacy of prior treatments, and the business plans of the individual WGHOGA growers.

Because of the inherent spatial variability that results from these variables, WGHOGA believe that it is extremely unlikely that proposed treatments will result in a high density of treatments plots in any given area in any single year. WGHOGA growers that will be covered by this permit have farms that are widely distributed in Willapa Bay and Grays Harbor; these farms are not all clustered in one or two areas. Thus, although WGHOGA does not object to this analysis in the SEIS, it wants to make clear that high density treatments are very unlikely under the permit.

The SEIS correctly states that WGHOGA each year must decide where they wish to treat, and then to submit that plan ("Annual Operating Plan" or AOP) to Ecology for its review and approval. This is appropriate given that the SEIS is not an appropriate venue for reviewing the details of which plots will be treated since this is largely dependent on annual variables. Reviewing which plots require treatment within the AOP allows for more targeted treatment (i.e. only treat areas that require it) that will still be subject to the constraints of the discharge permit.

As the SEIS notes, Ecology is retaining to itself authority to approve or disapprove of each year's AOP, or to request changes in the AOP as a condition of approval. Thus, practically, WGHOGA cannot have a higher density of treatment sites in any given year than Ecology agrees to. In practice, should any AOP propose a high density of treatment plots in any given area, WGHOGA expects that it would agree to sequence the treating of those plots with imidacloprid over the allowable treatment window of April 15 to December 15 to avoid any concerns about the collective effects of such treatments.

6. Size of Plots to be Treated Under the Permit

The SEIS discussed the size of plots to be treated under the permit as follows:

> *"Given the reduced acreage, and the elimination of aerial spraying from helicopters from the 2016 WGHOGA application, treated plots are now expected to be 10 acres or less in size, consistent with most of the prior field studies."* (page 1-36)

This is an important point because all previous field trials of imidacloprid treatments in Willapa Bay, except the 2014 trials, were tests on plots of about 10 acres or less. Thus, the proposed permit would be applied to areas comparable to those for which scientific results of the experimental trials are most applicable. And, these previous trials have demonstrated that the effects of imidacloprid on sediments, water quality, and animals are both localized and temporary, with most trials showing that conditions on treatment and control plots are comparable 14 to 28 days after treatment. This result was also observed in the 2014 trial on which a 90-acre plot was treated, demonstrating that recovery on treatment plots was not significantly impaired even on very large plots.

Thus, the proposed permit has solid scientific evidence to support the conclusion that significant adverse effects will not occur.

WGHOGA reaffirms that it expects to treat plots of 10 acres or less in size under the proposed permit. As noted for Comment 5, under the Annual Operations Plan WGHOGA may propose that plots adjacent to or near one another will be treated in the same year. In such cases it will work with Ecology to determine the timing of such treatments.

7a. Annual Treatment Timing – Clarification and Need for An Extended Treatment Window

The SEIS correctly states that the proposed permit would allow imidacloprid applications during the period of April 15 to December 15, each year. Past treatments of shellfish beds to control burrowing shrimp have occurred almost exclusively in the period of mid-May to early September, primarily because this is the period with large magnitude low tides (i.e., very low or negative) that occur during daylight hours.

WGHOGA anticipates that most treatments under the proposed permit will continue to occur during this "window".

Although most imidacloprid treatments are expected in the window from mid-May to early September, it is important that the permit allow treatments in the entire period from April 15 to December 15. This will allow WGHOGA to test different treatment timing to try and increase efficacy, and ultimately to reduce use of imidacloprid as part of the permit's IPM approach. Two approaches have been discussed by WGHOGA with Ecology. First are early season treatments before most annual eelgrass growth. Past work by Dr. Kim Patten of Washington State University cited in the SEIS (i.e., Section 2.8.4.2) has documented that efficacy of imidacloprid treatments can be hindered when eelgrass is too thick. If early treatments avoid this problem in areas of heavy eelgrass growth then efficacy could improve, and the need for future imidacloprid treatments of such beds could be reduced. Second, fall and early winter applications of imidacloprid would offer an opportunity to treat each year's new recruits of burrowing shrimp (e.g., planktonic forms that settle and burrow into the sediment). These very young shrimp may be particularly vulnerable to imidacloprid treatment, in part because they are found in the surface layers of the sediment, as opposed to being in deep burrows. Again, efficacy may be increased by such treatments, potentially reducing the need for future imidacloprid treatments, which could ultimately achieve the WGHOGA goal of reducing the amount of imidacloprid application needed in the future.

7b. Annual Treatment Timing – Effects on Birds

As discussed in the FEIS, which was incorporated by reference in the SEIS, large migrations of shorebirds and waterfowl migrate through Willapa Bay and Grays Harbor each year. These migrations have specific timing. As stated in the FEIS:

"The overall numbers of waterfowl and shorebirds are lowest in summer, highest in spring and fall, but remain relatively high throughout the winter (USDI/USFWS 1997). Peak migration

> *through Willapa Bay occurs between mid-April and early May."*
>
> (page 3-37)

Given that most imidacloprid applications by WGHOGA will occur in the window of mid-May to early September, the great majority of the spring and fall-winter migrations of shorebirds and waterfowl that pass through Willapa Bay and Grays Harbor have a low potential exposure to imidacloprid applications by WGHOGA. And, as the SEIS correctly concludes based on its review of the scientific literature (e.g., page 3-24 of the SEIS), imidacloprid has extremely low toxicity to vertebrates, including birds. Thus, through avoidance of exposure, and low toxicity, WGHOGA believes there is no potential to impact migrating or resident birds in Grays Harbor and Willapa Bay.

The FEIS (pages 1-21 - 22) and SEIS (pages 1-9, 3-24 - 25), appropriately, also conclude that the potential for direct toxicity to birds is not significant, including for birds listed under the Endangered Species Act. However, the SEIS raises the prospect of possible food chain effects due to the temporary reduction in invertebrate prey on treated plots. WGHOGA believes this is incorrect. The SEIS repeatedly notes that no more than 1.1% of the intertidal area of Willapa Bay, and 0.04% of the intertidal area of Grays Harbor would be treated with imidacloprid (e.g., page 1-3 of the SEIS). Given that 98.9% or more of the intertidal area of these estuaries will be untreated, arguing for food chain effects is scientifically spurious. This is especially true given that the SEIS, in reviewing past experimental trials of imidacloprid in Willapa Bay, concludes that the invertebrates on treatment and control plots are statistically indistinguishable within 14-28 days after treatment in almost all cases. In addition, the FEIS noted that control of burrowing shrimp with imidacloprid could have positive food chain effects (e.g., promote the growth of eelgrass, support existence of oyster bed habitat), but these benefits were not discussed in the SEIS. The SEIS should therefore clarify that negative food chain effects, while theoretically possible, are extremely unlikely. And the SEIS should state that control of burrowing shrimp with imidacloprid could have positive food chain effects as discussed within the FEIS.

8. Planned treatment of shellfish beds with imidacloprid

The SEIS is not explicit in stating that, under the proposed permit, WGHOGA will not apply imidacloprid to any crop of oysters. Instead growers will treat the sediment on shellfish growing ground prior to planting a crop of oysters. WGHOGA members are committed to this approach to the use of imidacloprid, and believe it is important for Ecology in the SEIS, and in its communications about the proposed permit, to make clear that imidacloprid will not be sprayed on crops of oysters. No future consumer of oysters from WGHOGA farms needs ever worry that their product has been treated with imidacloprid.

9. Clarification of bed elevations that will be treated

The SEIS in numerous places states that the proposed permit will be used to treat shellfish beds at elevations from -2 feet to + 4 feet relative to mean lower low water (MLLW). The shellfish growing beds that WGHOGA members own do fall almost entirely within this elevation range, and so the SEIS is correct in concluding that treatments will occur within this elevation band. However, all farm plots have micro-topographical features that are either higher or lower than the surrounding bed. For example, drainage channels can be a foot or more deeper than the beds that they drain. WGHOGA therefore wants to clarify that small portions of their beds treated with imidacloprid may fall outside the -2 to +4 feet MLLW elevation range. In almost all cases, WGHOGA believe such areas will fall within plus or minus 0.5 feet of the elevation range stated in the SEIS.

10. . Use of EPA (2017) to Establish a Toxicity Threshold[1] for the SEIS Analysis

WGHOGA commends Ecology for its comprehensive review of the scientific literature in the SEIS. When combined with the review of an even larger number of scientific papers in the FEIS, it is clear that a majority of the relevant scientific literature has been used to inform the analysis of potential effects of the proposed permit on sediments, water quality, and animals, including invertebrates. While a comprehensive survey of the literature is important, WGHOGA understands that some scientific papers or reports are more valuable or informative than others. The 2017 EPA Risk Assessment of Imidacloprid, referred to in the SEIS as "EPA (2017)," is clearly an especially important reference for evaluating the potential effects of imidacloprid treatments that would be conducted under the proposed permit. This is so because: 1) EPA 2017 is itself a review of more than 100 scientific studies of the effects of imidacloprid, and is therefore comprehensive, 2) it offers the scientific conclusions and opinions of the federal Environmental Protection Agency, the lead agency for implementation of the Clean Water Act and the associated National Pollution Discharge Elimination System

[1] As used here toxicity refers to the concentrations of imidacloprid, usually expressed in parts per billion, that have been observed to cause death or other adverse effects in invertebrates. Toxicity threshold is the toxicity value selected as the minimum known or suspected to cause adverse effects. All imidacloprid concentrations above the threshold are assumed to result in adverse effects.

("NPDES") permit system under which WHGOGA is requesting permit authorization, and 3) its analysis of imidacloprid toxicity includes specific evaluation of effects on marine invertebrates, and 4) EPA (2017) bases its analysis of imidacloprid toxicity on results actually observed in research and experiments, rather than on a statistical modeling of such results.

This last element is important if confusing. Other studies of imidacloprid toxicity, for example the Health Canada (2016) report reviewed in the SEIS, often extrapolate from toxicity levels actually observed in experimental trials using statistical modeling to guess what the lowest possible toxicity might be if more data were available. These results are projections of toxicity that are lower, and often much lower, than anything ever actually observed in scientific studies. These hypothetical toxicity levels are not an appropriate measure for evaluating the potential effects of imidacloprid treatments of the proposed WGHOGA permit. EPA (2017), very appropriately, bases its evaluation of imidacloprid toxicity on effects that have been observed in prior studies.

Even so, EPA (2017) is very conservative in its analysis. It started by selecting the lowest observed toxicity level for any study of marine invertebrates it reviewed that met its data validation and quality control criteria. That value is 33 parts per billion (ppb, equivalent to the microgram/liter or µg/l referred to in the SEIS) for mysid shrimp exposed to imidacloprid for 96 hours. Despite the 96-hour test of this study, EPA assumed that these results would apply to any duration of "acute" exposure (i.e., exposures lasting from minutes up to 96 hours), a very conservative assumption. Also, the study's value of 33 ppb was the estimated concentration that resulted in 50 percent mortality of the shrimp tested, yet EPA effectively treats the value as if it killed all test organisms.

Finally, EPA divided this value of 33 ppb by two in order to build in a factor of safety. The result was a toxicity threshold in EPA (2017) of 16.5 ppb.

The SEIS adopts this EPA derived value of 16.5 ppb as its toxicity threshold (page 3-20). Understanding its origins in EPA (2017), WGHOGA supports Ecology's use of this toxicity threshold (referred to as "toxicity criterion" in the SEIS). But it is important to note just how conservative this threshold is when evaluating potential effects of the proposed permit. Most importantly, imidacloprid concentrations in water under the proposed permit will be diluted immediately upon inundation of the treatment plots by the rising tide. And given that tidal amplitude in Willapa Bay and Grays Harbor exceeds 10 feet (i.e., treatment plots will be covered with 6-10 feet of water, or more, at high tide depending on the bed elevation), and that the period from low tide to high tide is 6-7 hours, meaning that there is zero possibility of a 96-hour direct exposure to imidacloprid in water, either on-plot, or off-plot. In fact, work by Patten and Norelius (2017) cited in the SEIS estimates "dilution by approximately 50% every 4 minutes" during the incoming tide (page A-11). Thus, actual exposures by invertebrates to imidacloprid in water are likely to be on the order of a few hours on-plot (i.e., for the duration of low tide following application, plus the time for the rising tide to cover the plot), and less than an hour off-plot. Further evidence for how conservative the SEIS's toxicity threshold is comes from a full review of the work of Patten and Norelius (reviewed on pages A-10 – 11 of the SEIS). In their trials with Dungeness crab they observed no mortality or tetany (paralysis) in imidacloprid concentrations of 100 ppb for 2 hours in megalopae, in 200 ppb for 6 hours in juveniles, or in 500 ppb in juveniles when the water was diluted by 50% every 4 minutes to mimic conditions during a rising tide. Clearly use of the 16.5 ppb toxicity threshold in the SEIS leads to a significant overestimate of the actual effects to invertebrates that would occur under the proposed permit.

11. SEIS Modeling of Off-Plot Effects

The SEIS recognizes that rising tidal waters will carry imidacloprid from treated plots to off-plot areas, and that this movement could result in off-plot impacts to invertebrates and water quality. WGHOGA noted that the SEIS's references to potential off-plot effects consistently emphasizes "adjacent areas" or "adjacent off-plot areas." WGHOGA agrees with this characterization. If off-plot effects occur due to imidacloprid being carried off the treatment plots, those effects are most likely immediately adjacent to the plots, or in features like drainage channels flowing off the plots, because in such cases the imidacloprid being carried by the first flush of the rising tide will have experienced very little dilution. In addition, adjacent areas are more likely to share the same tidal waters as those that inundated the treatment plots (i.e., water that has crossed the treatment plots before moving to off-plot areas. As distance from the treatment plots increases significant dilution is expected, both from the volume of tidal water present (i.e., that has flowed from the treatment plot to the more distant location), and because much of the tidal water arriving at any individual location will have come from areas other than the treatment plot. For water, this dilution with distance has been verified in field trials in Willapa Bay (SEIS page 3-12). By extension, diluted imidacloprid levels would be expected to have less and less chance of affecting invertebrate populations as distance from the treatment plots increases. WGHOGA notes that researchers that have done empirical trials of imidacloprid in Willapa Bay consistently report that off-plot impacts to invertebrates are either not evident, or are limited to areas immediately adjacent to the treated plots (Dr. Kim Patten and Dr. Steve Booth, pers. comm.).

Given the above, WGHOGA was surprised and disappointed by the modeling of potential off-site impacts conducted in the SEIS (page 3-21). While we recognize that Ecology acknowledged that "this modeling was 'worst case' due to incorporation of several assumptions," (which were overly conservative), the modeling nonetheless presents a false picture of off-plot impacts that contradicts the rest of the SEIS's more scientifically defensible analysis of such effects. WGHOGA believes that this modeling compromises the scientific quality of the SEIS's analysis of off-plot effects. And it gives an unfair and inflammatory talking point to opponents of the proposed permit, that the area experiencing off-plot impacts may be greater than the area of the treated plots.

Although the SEIS, in analyzing the modeling results, concludes that "[a]ctual toxicity to off-plot invertebrates is expected to be less," WGHOGA still feels that the entire modeling analysis should be eliminated. It is inaccurate, misleading, and unhelpful in assessing the potential effects of the proposed permit.

12. Ground Based Versus Aerial Treatment

The SEIS repeatedly and correctly notes that under the proposed permit WGHOGA would not use aerial spraying techniques, including spraying by helicopter. And, the SEIS clearly states that given only ground-based application methods will be used, that the required buffer between treated areas and active oyster beds is 25 feet (page 3-30). Unfortunately, in Chapter 1 there is a repeated discussion of FIFRA registration requirements that mentions aerial spraying, and 100-foot buffers required as part of that aerial spraying (e.g., page 1-16). To avoid confusion by the public and reviewing agencies, WGHOGA suggests that the Final SEIS clearly state that 25-foot buffers will be required under the proposed permit. It is not necessary to insert this in every instance in the SEIS discussing that only ground-based methods will be used. It would be helpful to at least include this clarification in the Fact Sheet, and in Section 2.8.4 which summarizes WGHOGA's proposed permit (Alternative 4).

13. Treating on Weekends

The SEIS states that imidacloprid treatments would not be allowed on "Federal holiday weekends" (e.g., page 1-29). WGHOGA wishes to acknowledge this temporal constraint on the proposed permit, but also to state that imidacloprid applications on weekends other than federal holiday weekends will occur. Such weekend treatments are necessary because there are a limited number of low tides suitable for imidacloprid treatments, and many such low tides occur on weekend days. Thus, logistically, WGHOGA needs the flexibility to treat on such days. All required public and agency notifications discussed elsewhere in the permit would obviously also be complied with for any weekend imidacloprid applications.

14. Factors Controlling Burrowing Shrimp Populations

The SEIS notes that there is some uncertainty about what controls burrowing shrimp populations, then lists several possible anthropogenic factors that may have led to increases in shrimp numbers over time (page 2-5). One potentially important anthropogenic effect is the significant decrease in Columbia River floods due to development of an extensive system of flood control dams. WGHOGA is aware of past work indicating that during large Columbia River floods, a large plume of freshwater or low salinity water traveled north along the coast, likely causing extensive periods of low salinity conditions in Willapa Bay and Grays Harbor. Such an event would be expected to negatively impact burrowing shrimp, as evidenced by their widespread absence or low population numbers in areas where freshwater rivers enter Willapa Bay and Grays Harbor. The timing of the onset of these diminished Columbia River flows (1930's-1950's) corresponds well with observed increases in burrowing shrimp populations.

WGHOGA requests that Ecology include some discussion of this anthropogenic impact in its discussion of factors that may have affected burrowing shrimp populations.

15. Off-Bottom Culture:

The SEIS includes a useful summary of efforts to use off-bottom culture in areas containing burrowing shrimp, and discusses the many market and processing differences between off-bottom and ground culture of oysters (page 2-8 – 2-9). WGHOGA appreciates both this discussion, and the willingness of Taylor Shellfish to share some of its experiences and perspectives on these issues. Nonetheless, WGHOGA expects that some reviewers of the SEIS will submit comments claiming that off-bottom culture is a viable alternative to the purpose and objectives of the proposed permit and the alternatives analyzed in the SEIS. Accordingly, WGHOGA believes Ecology needs to have a more thorough discussion of this topic in the final SEIS. WGHOGA believes the following points should be emphasized:

- Section 2.2 of the SEIS states the purpose and objective of the proposed action: to preserve, restore, and maintain the viability of clams and oysters on commercial shellfish beds. Off-bottom culture was not considered as an alternative in the SEIS because it would not meet the purpose and objectives of the proposed action.

- Off-bottom culture in areas with burrowing shrimp is experimental. Past areas of off-bottom culture have failed when shrimp are present because the substrate is too soft to support the poles, ropes, bags and wires associated with such culture. Often these failures occur slowly over several years so that initial reports of success are ultimately deemed to be failures. In short, off-bottom culture is not a viable alternative for areas containing moderate or high densities of burrowing shrimp.
- WGHOGA confirms what Ecology was told by Taylor Shellfish: the shucked meat market associated with bottom oyster culture and the off-bottom shellfish market "are entirely different products, culture systems, processing, and markets" (SEIS page 2-8). It would be very difficult, and expensive, for WGHOGA members that have applied for the proposed permit to make a shift away from ground-based culture. Furthermore, this would result in large disruptions in the shellfish market, to on-shore processing and support services, and to the local economy of communities surrounding Willapa Bay and Grays Harbor.

16. Clarification on the Pellet Form of Imidacloprid

The SEIS in numerous places discusses that the pelletized version of imidacloprid "dissolve[s] on contact with water from the incoming tide" which would act to limit or prevent accidental ingestion of these pellets by birds or other animals (e.g., SEIS page 1-23). WGHOGA agrees with this assessment within the SEIS, but nonetheless wishes to provide two clarifications based on their collective experience using the pelletized version. First, even when the tide is completely out the surface of the sediment where pellets are contains enough water to result in dissolution of the pellet within a few seconds. Second, the commercial formulation used by WGHOGA (i.e., Mallet) is composed of small particles that have an appearance like coarse salt. Most of these particles are smaller than the visual image generated by the word "pellet," which helps to explain their rapid dissolution on contact with water. WGHOGA will continue to work with the supplier of this material to refine the breakdown characteristics as part of its IPM plan to deliver the maximum efficacy with the minimum level of treatment. Related to refining chemical treatment methods to maximize efficacy, WGHOGA incorporates by reference the analysis performed by Dr. Kim Patten as part of the applications submitted in support of the Sediment Impact Zone Authorization where he analyzed various methods of treatment and resulting efficacy to further this IPM goal of maximum efficacy with minimum treatment amount.

The SEIS in numerous places also discusses that the pelletized version of imidacloprid could be spread by boat. This is correct, but WGHOGA may use a variety of methods to apply the pelletized version, including by hand, or using motorized ground equipment. The discussion of application techniques on page 2-6 of the SEIS is correct in listing a variety of techniques will be used to apply imidacloprid under the proposed permit, whether using the granular or liquid form of this pesticide.

WGHOGA also notes that the SEIS, on page 2-14, indicates the granular form of imidacloprid "would be applied to shallow standing water over commercial clam and oyster beds." WGHOGA wishes to clarify that the pelletized version of imidacloprid may be applied to beds with a wide range of shallow water depths, although most are expected when water is 2 feet or less.

17. Clarification on Partial Treatment of Plots

The SEIS correctly notes that WGHOGA members "request flexibility in being able to only partially spray some plots" (SEIS page 1-3). Although likely obvious, especially given the discussion concerning WGHOGA's IPM plan (Comment 1), WGHOGA wants to clarify that this means than on any given legal parcel, the growers may wish to treat only a subset of that parcel. For example, portions of a parcel may not have high densities of burrowing shrimp, and thus would not need treatment. This flexibility will allow growers to evaluate each parcel based on its site-specific characteristics, and to adopt a range of management approaches based on those characteristics consistent with the goals of IPM plan.

18. Clarification on Use of Personal Protective Equipment by Applicators

The SEIS includes many references to the use of personal protective equipment (PPE) by personnel involved in the application and handling of imidacloprid. To avoid confusion WGHOGA wishes to clarify that the PPE requirements that legally apply are those associated with the pesticide label and registration documents. Page 3-8 of the SEIS is an example where this is correctly referenced. Although applicators may choose to use more PPE than that specified by the label, WGHOGA wants to ensure that the SEIS does not imply that the proposed permit will impose new or different PPE requirements than those on the label and registration documents.

19. Impacts of No Action Alternative

The SEIS (page 2-24) includes a useful summary of efforts to use off-bottom culture in areas containing burrowing shrimp, and discusses the many market and processing differences between off-bottom and ground culture of oysters (page 2-8 – 2-9).

WGHOGA appreciates both this discussion, and the willingness of Taylor Shellfish to share some of its experiences and perspectives on these issues. Nonetheless, WGHOGA expects that some reviewers of the SEIS will submit comments claiming that off-bottom culture is a viable alternative to the purpose and objectives of the proposed permit and the alternatives analyzed in the SEIS. Accordingly, WGHOGA believes Ecology needs to have a more thorough discussion of this topic in the final SEIS. WGHOGA believes the following points should be emphasized:

- Off bottom techniques used in Willapa Bay and Grays Harbor were developed to utilize areas of the bay where bottom culture was not feasible, for instance in high-current areas, or areas otherwise not suitable for bottom culture.
- Areas of the bay heavily infested by shrimp will not support any type of oyster culture because both bottom culture and the equipment associated with off-bottom culture will both eventually sink into the shrimp-infested mud.
- There are areas of the bay where long-line or other off-bottom techniques are already sinking due to shrimp infestations, reinforcing the conclusion that off-bottom culture techniques are not a viable alternative to a shrimp control program.

20. Resubmission of FEIS Comments

WGHOGA is aware that the National Ocean and Atmospheric Administration (NOAA), and US Fish and Wildlife Service (USFWS) intend to submit comments on the SEIS. Ecology will recall that NOAA and USFWS also submitted comments on the FEIS. These comments were extensive, and in WGHOGA's view, contained many inaccurate statements and conclusions that were not supported by either the details of the proposed permit at the time, or the information and analyses in the FEIS. If Ecology recalls those comments, it may not remember that WGHOGA submitted responses to the NOAA and USFWS comments in time for them to be included in the official record for the FEIS. Although WGHOGA does not know what NOAA and USFWS intend to submit in the way of comments on the current permit and SEIS, it is not unreasonable to expect that some of those comments will be the same or like those they submitted previously. Accordingly, WGHOGA has included as Attachments C and D to these comments unedited copies of the responses it prepared and submitted for the FEIS. We hope that these responses provide useful information to Ecology as it works to address the new NOAA and USFWS comments on the SEIS.

Again, WGHOGA greatly appreciates the opportunity to submit these comments on the Draft SEIS, and looks forward to continuing to work Ecology during this permitting process.

Sincerely,

Douglas Steding, Ph.D.

Attachments (4)

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ATTACHMENT A

Comments on Draft SEIS on the use of the nicotine based pesticide imidacloprid to control burrowing ghost shrimp (*Neotrypaea californiensis*) in Willapa Bay and Grays Harbor.

To: Derek Rockett, Permit Writer
Washington State Department of Ecology
Water Quality Program

PO Box 47775

Olympia, WA 98504-7775
http://ws.ecology.commentinput.com/?id-aelUM

Commenter: Richard Wilson, Ph.D.

November 1, 2017

BURROWING GHOST SHRIMP DISRUPTION AND DESTRUCTION

OF THE INTERTIDAL AREA OF BIOTIC PRODUCTIVITY IN WILLAPA BAY

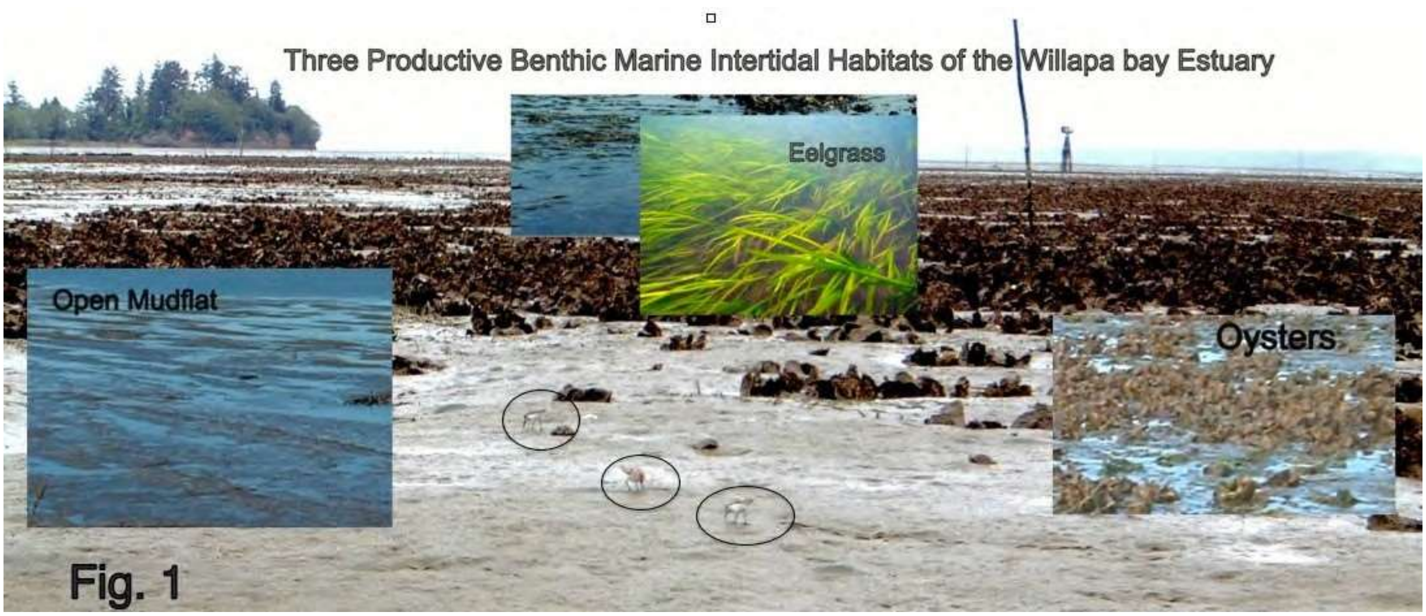
Willapa Bay: A unique shallow intertidal marine sedimentary basin where the combination of geological and biological aspects unite to create a bountiful sustainable food web until reduced or eliminated

by the burrowing ghost shrimp, *Neotrypaea californiensis*

1

INTRODUCTION: *The Draft SEIS fails to inform the readers of the extent of physical and biological damage the burrowing decapod,* Neotrypaea californiensis, *aka ghost shrimp, are imparting on the intertidal benthic habitats of Willapa Bay and Grays Harbor. Their damage effects many more estuarial species besides the oysters and clams. The ghost shrimp have a negative impact on the basic food web so vital to the health of these two important near shore marine areas. The detail of why this benthic area is important and how it operates is left unexplained. It does not mention the important role of how the silicate mineral sediments are converted and which biological groups are important to build the food web. This in turn requires knowledge of these interacting physical and biological aspects and how we must recognize and manage for biotic productivity. Especially important is recognizing the importance of the micro benthos and the dependence of the estuary biota on those populations. What should be proposed in the draft SEIS with the studied use of imidaclopid is recognition of these important relationships and attempting to apply a management strategy to benefi t the entire benthic biota. Destruction by ghost shrimp expansion is far greater and widespread than oysters sinking into a sedimentary colloidal hydrogel of fi ne sand.*

General Benthic habitats: Mud, Oysters and Eelgrass: Many research papers have used specifi c benthic characteristics to defi ne and then evaluate various intertidal estuary habitats for important biotic factors such as productivity. Following from Hosack, et al., 2006, and their sampling study this comment paper will also discuss the Willapa intertidal as; 1) open **Mud**, 2) **Eelgrass** dominated areas and 3) areas with **Oyster** crops on the mudfl at (Fig. 1) and the ghost shrimp impact on each.



First we need to realize the diversity and biomass of the species utilizing the intertidal benthic habitats in the two coastal estuaries. Even without shellfi sh the numbers of species and their abundance, with most being microscopic, is extraordinary. The benthic habitat is where a unique set of physical and environmental aspects come together to provide the conditions to allow basic primary productivity. It is the setting where igneous silicate minerals and fresh water (rain) with atmospheric carbon dioxide react to extract necessary nutrients for the photosynthesizing benthic diatoms to make the carbohydrates and fatty acids (lipoproteins) upon which to build the food web *so essential to all the trophic levels such as the more familiar and visible like fish, birds, shellfish and crabs. Starting with the chemical change known as weathering, which results in freeing soluble materials essential for diatoms to create nutrients and form their frustules (shells,tests). The SEIS seems to point only to damage of bivalve shellfish sinking in the bioturbated sand made soft by ghost shrimp. Those are true impacts on growing shellfish on those areas but is only one relatively small effect. It seems misleading in the negative impact to most other members of the benthos (flora and fauna), which most owe their existence to the benthic contribution the sediment surface provides. We need to understand primary productivity as is instigated by microscopic single celled photosynthesizing benthic diatoms. These are the key combiners and converters of solar and nutrients into essential carbohydrates and lipoproteins. It is important to note the important sediment interface to the marine water in the intertidal presents the closest and best position to combine essential nutrients, solar and soluble silica for the diatoms. This unique combination provides the base of the food web. These benthic diatoms and the biofilm they create are reduced then removed by the activities of a burrowing decapod, the ghost shrimp (*Neotrypaea californiensis*). The important habitat for healthy productivity is the stable sediment surface, which ghost shrimp over time can reduce and then eliminate. The diatoms need those important nutrients that are derived from the igneous silicate mineral sands to produce and package for passage up to the higher trophic levels.. thus sand to shorebirds. Diatoms are key to nearshore marine productivity.*

The three habitat types by Hosack, et al., are based on what the sediments are supporting which in turn can depend on tidal elevation, currents, etc. In general, all require a relatively stable sediment surface made such with adequate proportions of smaller components to stabilize the fine sand (Fig. 2 - meio - between micro and macro). It did not account for the important benthic microscopic assemblage.

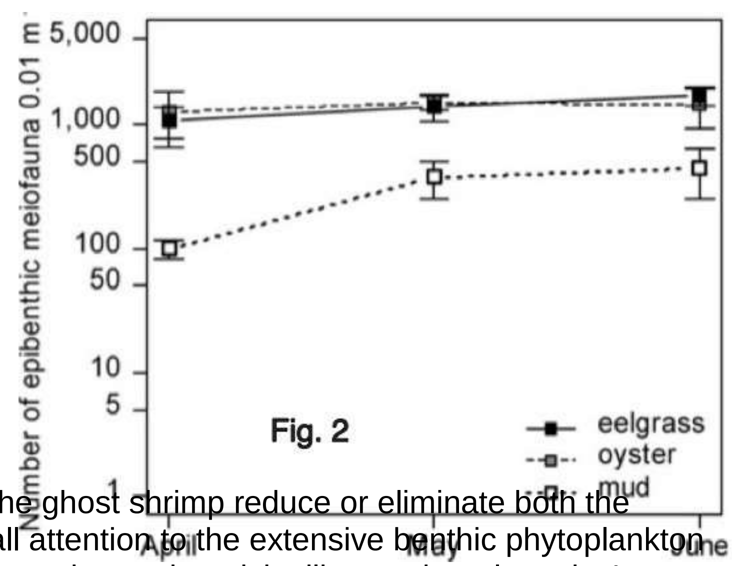


Fig. 2

The important aspect of the nearshore intertidal is what builds the food web, especially the more microscopic benthic components as they form the base of the nutritional sequence. How this compares among the general habitat types will be noted. The ghost shrimp reduce or eliminate both the micro and macro components. The focus is to call attention to the extensive benthic phytoplankton (primarily diatoms) and their significant presence on the nutrient rich silicate mineral sands. It must be noted that often the more highly productive intertidal areas are combinations of mud, eelgrass and shellfish (Fig. 3). The object is to maintain this balance. The clean sediment surface of the intertidal is normally coated by the abundant benthic diatoms and their biofilm. In this regard there are over 80 species, not seen without microscope, identified from the intertidal mudflats of Willapa Bay (Hemphill-Haley, 1995). This productive primary level of the food web is adapted to the daily tidal changes between aquatic and atmospheric and the corresponding fluctuations in salinity, temperature, etc. As will be noted the combination of rain and CO_2 (carbonic acid) on the exposed igneous minerals creates critical components, which will carry through the various levels of the food web. Although even with extremes of changing from aquatic to atmospheric critical exposure to aspects such as solar and temperature at times probably benefit primary productivity.

Oysters and Eelgrass habitats exist due to the stable nutrient rich silicate intertidal sediments. The basis seems to be the open mud or mudfl at that appears barren with respect to larger biotic elements, but retains surface areas open to the rain and sun. Overall the key importance of the intertidal sediments and the phytoplankton adaptation to it must be understood and that action or protection be carefully undertaken should this cease to be the case. The burrowing ghost shrimp through bioturbation can change the intertidal sediments and reduce or eliminate the benthic diatom productivity essential to initiate the food web.

Mud Habitat: What the currents transported**.** The mudfl at**,** basically a fi ne grained igneous silicate mineral sand and silt is refl ective of the change in gravity from stream transport when reaching

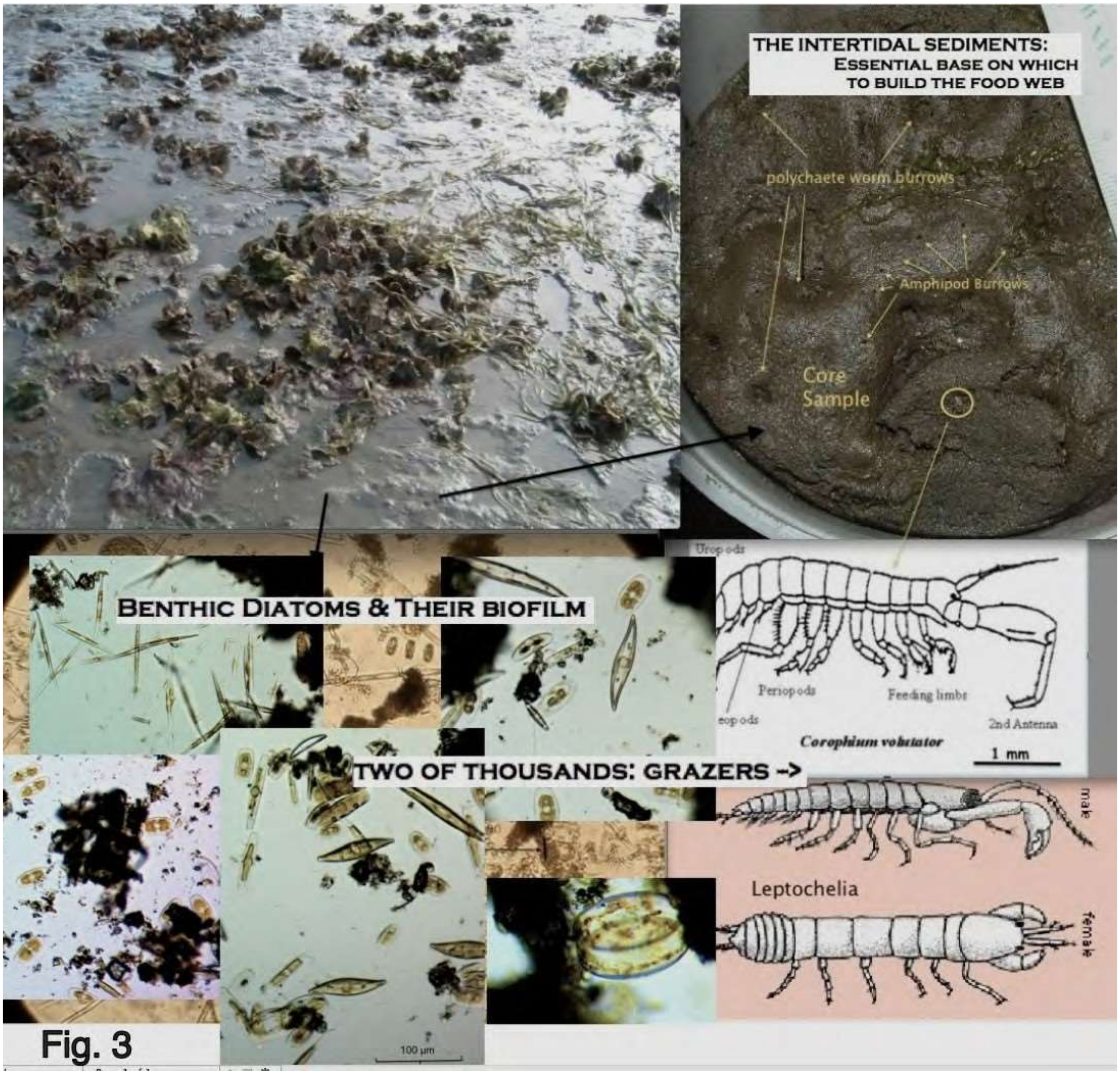


Fig. 3

sea level in the estuaries. Depending upon relative position some organics and another product of weathering, a clay mineral, will add and help stabilize the mix. The tenet here is that a major basis of productivity in both the eelgrass and shellfish (oyster) habitats is the underlying fine grained clastic sediment - the Mud. They each depend on the other but the biotic productivity of the open mud seems to be key to initiate a productivity role for eelgrass and oysters on the sediment surface. Sampling was done on each and will be discussed as such but are integrally connected to the geology and chemical breakdown of the silicate minerals. The following pages will consider all three habitats (Mud, Eelgrass and Shellfish) as dynamic and interchangeable areas of the mudflat and when occupied often take on different but interconnected roles.

Eelgrass Habitat: A closer look on a blade**:** Eelgrass, a seagrass, is used to define a specific type of intertidal area and often is held in high esteem as to habitat value for the biota of the estuary (Fig. 2). However, this rooted seagrass seems to play conflicting roles. Thick eelgrass growth shades the benthic sediments and decreases mudflat productivity that would benefit the other biota. It can block or divert vital tidal currents and allow a composting deleterious layer to form over the silicate sediments eliminating diatoms and over time elevate the intertidal area. However, the long fast growing blades of eelgrass seasonally provide an amazing microbiotic habitat as they become coated with diatoms, their biofilm and microfauna. Eelgrass in its growing season, then serves to increase benthic habitat with diatom attachment areas. Where diatoms are present, consumers will collect and as on the sediment surface, become the prey. The individual members of this epiphytic coating probably also resuspend as do those on the open benthic surface.

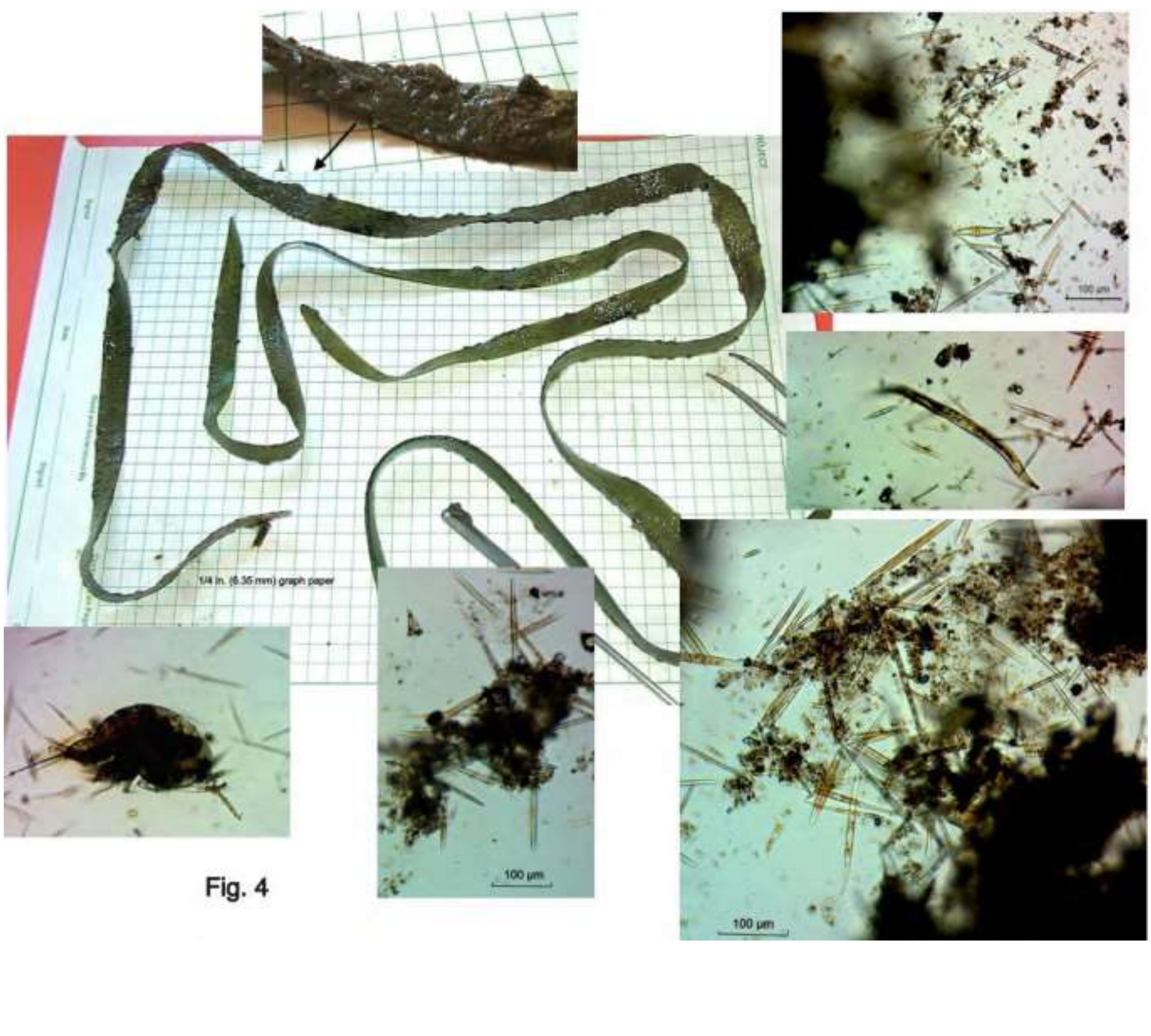


Fig. 4

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Samples of surface coating were scraped from eelgrass blades and diluted with seawater to free diatoms and invertebrates from the biofilm coating. Using the eelgrass blade (Fig. 4) an array of the larger mobile pennate (pointed) diatoms with numerous smaller diatoms in the 5-20 µm range were noted. Invertebrates were intermixed within the biofilm and likely were important prey for higher trophic levels such as fish and crabs or birds at low tide. Since this biotic assemblage especially diatom morphologies, on the blade is very similar, if not identical, to that observed on the open benthic sediments, it is assumed it was inoculated from the adjacent mudflat. Since benthic diatoms on the mudflat seem to remain active all year, those moving with the tide would then be available to catch and grow on eelgrass blades when they are seasonally available.

O**yster Cluster -** A Place of Attachment**:** Following are photomicrograph images of surface samples from the pictured oyster cluster. Fairly large three year old cluster with five live oysters. All eight areas sampled for microscope examination, including the underside shell areas, had fine sediment and micro organisms, especially diatoms. Again, it seems the organic biofilm is key to the adhesiveness of this coating of diatoms, sediment particles and invertebrates. It also seemed

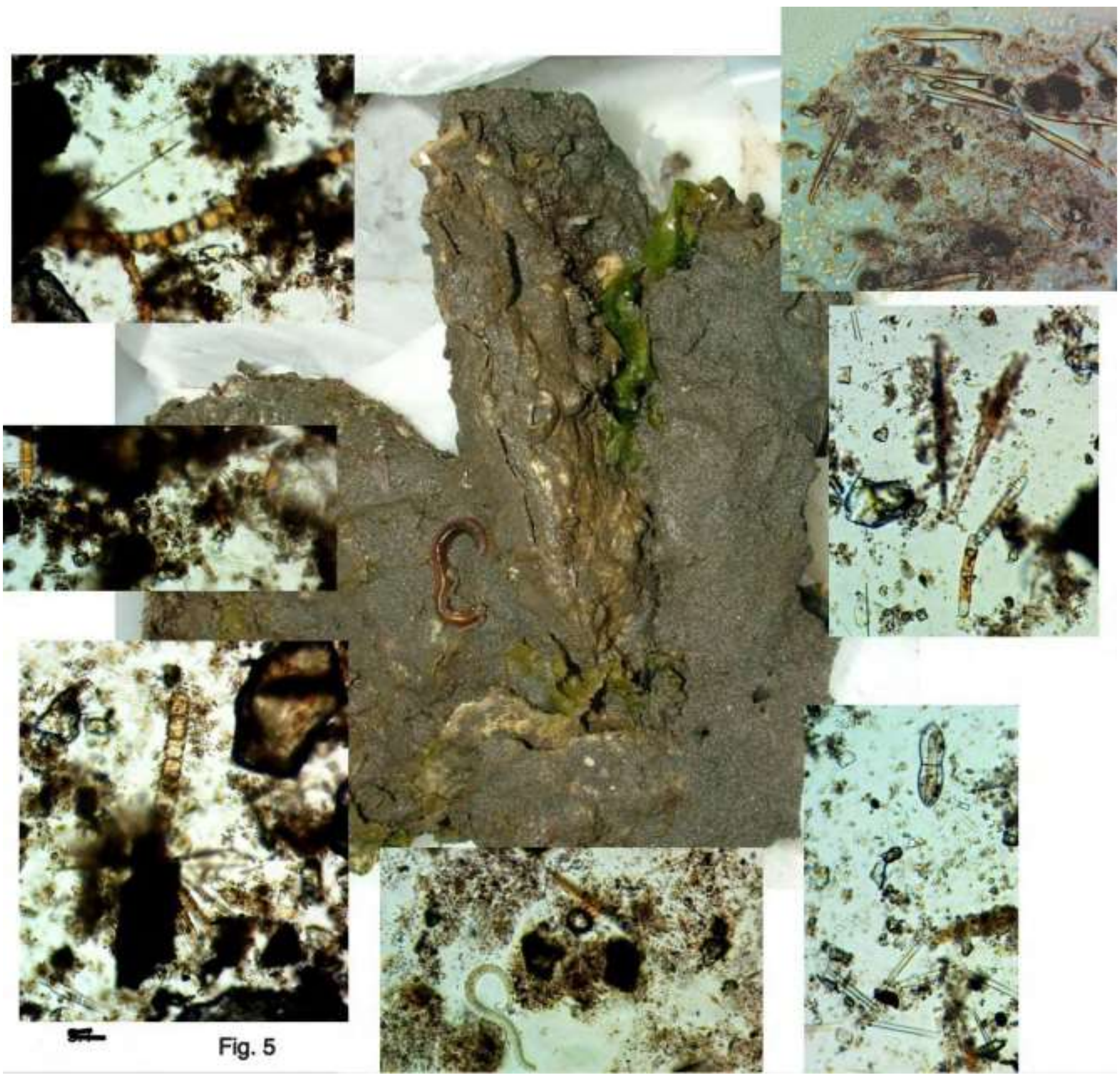

Fig. 5

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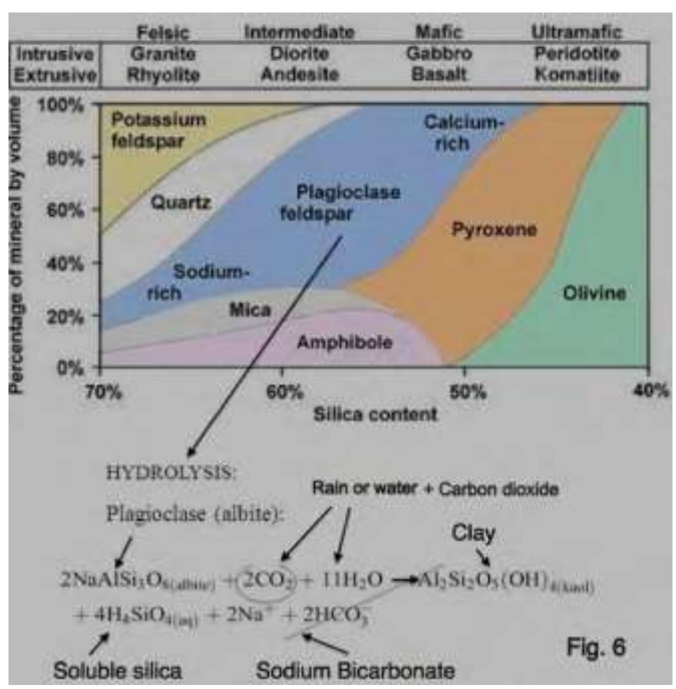
*different diatoms types were on different sampled areas. Although the oyster cluster covered some measure of area of the benthic sediment surface the additional attachment surfaces created was probably at least three times greater. The oyster clusters allow diatom and biofi lm access to nutrients and sunlight. Note worm that had evacuated its burrow between two oysters, plus the barnacles and macroalgae (*Ulva?*). The microscope image dimensions are generally within a*
200-300 µm range.

Igneous Silicate Mineral Sand: When the igneous structures or deposits being uplifted become exposed the silicate minerals crystalized under high pressure and heat that comprise these andesite/basalt igneous rock types begin to undergo a chemical change, e.g. they weather. Those minerals are unstable under normal atmospheric pressure and temperature. Some with iron oxidize but the important chemical change is with freshwater (rain) and carbon dioxide to make available the essential components to support diatoms on which to build the food web (Fig.6). This needs to be understood to realize what the burrowing ghost shrimp modify thus reducing the estuary productivity. First the history of this region plays a big role.

The west coast of North America from California to Alaska holds a geologic history dominated by volcanism ranging in age from Recent back to over 60 million years. For most of that history what is now the western portions of Oregon and Washington were subsiding and were covered by marine waters. There was neither Cascade mountains or Coast Range until later in this sequence. The global crust under this region sink by as much as 3 km (± 10,000 ft.) below sea level allowing it to fi ll with igneous rocks and sediments derived by underwater volcanism and island volcanoes. When the subsiding of the crust stopped about 20 million years ago, uplift and volcanic activity; in response to the the crustal fracturing would provide for the beginnings of the Coast Range (includes Willapa Hills bordering Willapa Bay). A north-south line of volcanism which continues today is the Cascade Range running from northern California to Canada.

The millions of years of volcanic deposition and now by uplift allowed the various watersheds to transport and accumulate igneous silicate mineral sands and silt as deposits in Willapa Bay.

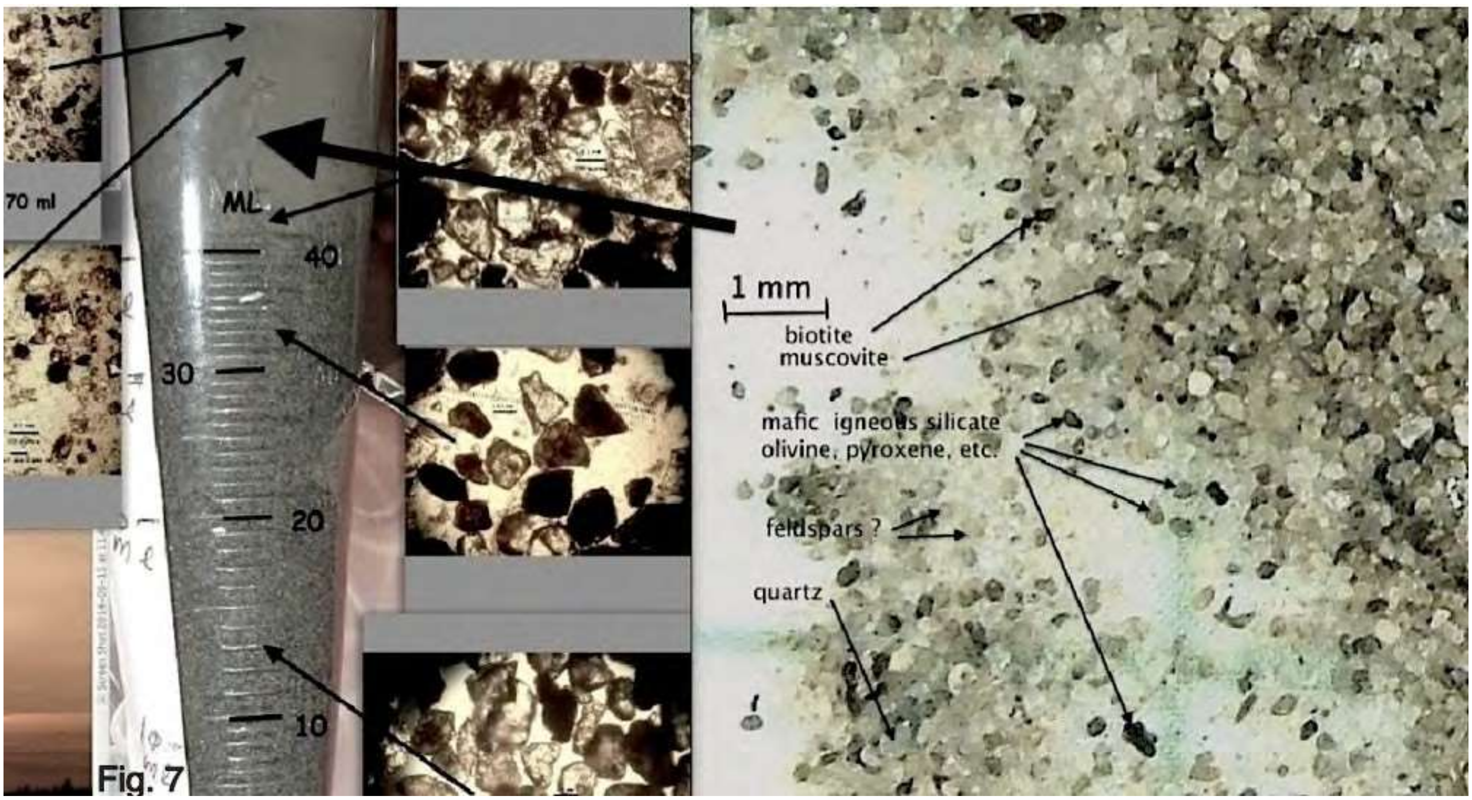
Weathering of these igneous rocks upland keep a rich supply of nutrients in the streams and ground water into the bay. Perhaps the most important process in primary marine productivity is the chemical change (a process of weathering) for exposed igneous origin silicate minerals. The igneous minerals, which crystallized under extreme heat and pressure are unstable at surface temperature and pressure. They can be altered by oxidation or more commonly, the process of hydrolysis. Fresh water (rain) and CO_2 (carbonic acid) will chemically breakdown the igneous silicate minerals when exposed (Fig. 6). The millions of years of igneous intrusions, features and deposition of fi ne grained igneous silicate rock pieces (clastics) allow this important relationship.



Our igneous rock types with relationship to silica content ranged between andesite and basalt (chart) over the 60 plus million years of activity.

The mafi c silicate minerals, those higher in iron and magnesium and lower in silica, are generally most easily weathered by the process of hydrolysis as shown (Fig. 6) This is the same for the other igneous silicate minerals with exception of quartz. As example, a plagioclase, which from the chart can be seen as a dominant igneous mineral group provides an example. Important here are the stable end categories of most silicate minerals; a clay, soluble silicate (silicic acid) and important soluble cations, e.g. Ca, Mg. Fe, Al, Na, Mn, Li, Ti, Zn, Cr, etc. These then are critical for and will be available to the benthic diatoms and thus the marine food web.

The rivers and creeks transport the partially eroded igneous silicate minerals as clastics (sand and silt) plus some weathering products like clay and soluble silicate out on to the mudfl at. Unique for Willapa Bay are the numerous relatively small watersheds cut into the Coastal range, which feed out onto the intertidal. This is unlike most west coast harbors or bays where one larger river enters the ocean and after long transport many of the minerals abrade away leaving primarily quartz sand. When transported sedimentary material reaches sea level where a loss of gravitational energy causes the larger clastics to deposit out fi rst with the smaller and lighter fraction depositing further out into the mudfl at. The igneous silicate fi ne sand, silt and clay deposit make up the



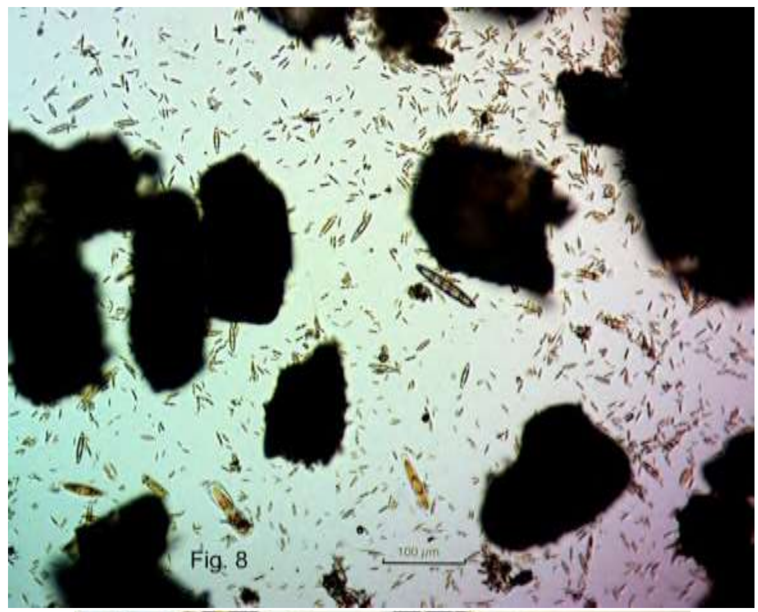
mudfl at. It will become the important base for the benthos to establish. Fig. 7 is of a mid Willapa Bay benthic mudfl at sediment sample mixed in water and allowed to settle by grain size, shape and specifi c gravity in an Imhoff cone (left). The microscope sample (right) was taken midway to show the size and physical diversity of the different silicate minerals. Note the angularity indicating little wear by water transport in the short distance from watershed to the bay.

Of special note is the formation of silicic acid from the hydrological chemical weathering process under atmospheric conditions. Silicic acid, a soluble silicon, is required by the diatoms to form

their frustules (tests/shells). This important source of soluble silica from the watershed and probably the intertidal surface silicate minerals when exposed to rain at low tide. The ground water and streams from the Willapa Hills are rich in soluble silicate. Oceanic upwelling is often touted as the source of silicic acid and other nutrients to build the phytoplanktonic fl ora. Banas, et al., 2007, credits ocean upwelling to diatom abundance within Willapa Bay, which probably does at times contribute nutrients. Their testing strategy and report did not consider the abundant benthic diatoms as critical to the Willapa Bay food web. One problem with this ocean model for total diatom supply is that it does not account for nutrient loss (e.g. soluble silica) and replacement from upland streams and ground water through the process of hydrolysis to remain at stable levels. The huge abundance of diatoms on the sediment surface would indicate a closer source. Thus, an important input of useful minerals, elements and soluble silicate for benthic diatoms are the by products from the constant surface weathering of the uplifted adjacent Coast Range.

Benthic Diatoms: A look among the surface sand grains: Epipelic or benthic diatoms grow on or hang out near the surface of the intertidal sediments at the water/sediment interface. A fi eld study of diatoms by Eileen Hemphill-Haley, 1995, along with taxonomic assistance from Kathleen Sayce, listed over eighty species of benthic diatoms on the intertidal mudfl at surface of Willapa Bay. Sampling the biofi lm on the sediment surface over the years shows the amazing diatom abundance and diversity which I photographed and posted as; *Benthic Diatom & Biofi lm Habitat*.

With optimal conditions such as solar availability and necessary nutrients diatoms can divide and double within days, while producing abundant carbohydrates and lipids and by sheer mass provide the basic primary productivity making the shallow and extensive intertidal areas of Willapa Bay so important. They form the base of the food web. The two images (Fig. 8 & 9) of benthic diatoms from surface mud samples, show part of the abundance and diversity even though samples have been diluted to free diatoms out of the sand grains and biofi lm. The images (Figs. 8 & 9) represent ± one cubic millimeter in volume as they are in a Rafter cell that is one millimeter deep. Both summer samples are from the same oyster growing bed and show some of the variation in diatom morphology and size. If Fig. 8 sample represents say 500 diatoms per mm^3 - how many over a square meter one centimeter deep? The smaller 5-20 µm diatoms in Fig. 8 are at a size we would culture for shellfi sh larvae.



Most benthic diatoms *are mobile* and can glide between sand grains and the biofi lm they secrete to keep associated to the sediment surface or move across the sediment surface to new areas. They can re-suspend into the water column and can even move in mass over the sediment surface with currents or remain on the moist surface with biofi lm *during the low tide. With their biofi lm the diatoms can coat objects or organisms including the blades of eelgrass or even ghost shrimp areas during winter months when the burrowing decapods are inactive. Diatom species have high tolerances for salinity and temperature differences with forms living in both fresh and marine waters or even on a wet surface. Marine shores with volcanic upland areas for nutrient supply (especially silicic acid) seem their forte. Mats of diatoms can remain on the moist sediment surface during the low tide and often are picked up by the fl ood tide and thus transported on the surface as organic slicks (Fig. 10). What is really interesting is how quickly these benthic diatom masses can establish on oyster growing areas which have been harvested and the silicate sand exposed. The fresh exposed sand within a few days or a week, will develop a rich new diatom and biofi lm coating. Testing also confi rmed that when the diatoms are numerous the zooplanktonic grazers are quick to fi nd the food source.*

Recovery was rapid and with a stabilized sedimentary surface in spring and summer, new

Fig. 10

eelgrass sprouts within a few weeks from natural reseeding. This happens by reducing the adult burrowing shrimp which through bioturbation can reduce or prevent this whole renewal of productivity.

Benthic Diatoms and their Biofi lm: When a stable clean sediment composition is present the benthic diatoms drift in with the tide and utilize the surface. Many extrude quantities of an organic extracellular polymeric material (EPS). This organic mixture becomes the

biofi lm substance as it covers and creates an organic slime habitat over the sand and silt surface. The diatoms seem to use it for protective cover while according to research this sticky fi lm holds in place fi ner sediments, provides organic media for a host of other forms such as bacteria plus provides an extra

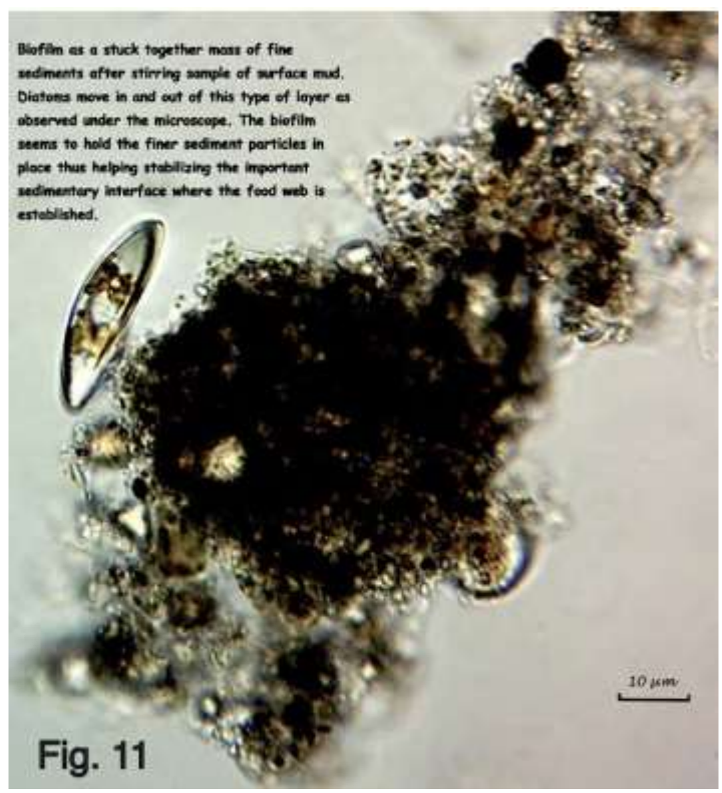


Fig. 11

benthic nutrient source. Various research has EPS composed largely (e.g. ± 90%) of polysaccharides (carbohydrates) with the balance being lipoproteins. The polysaccharides vary and may be composed of neutral sugars, uronic acids, sulfonated sugars, or ketal-linked pyruvate groups. In short, this coating indicates stability of the tidal sediment surface with masses of diatoms using the habitat when ghost shrimp are not dominant.

Why would the diatoms in general produce more carbohydrates and lipids than they can utilize or retain and end up extruding them out? Some reason they get rid of the more starchy carbohydrate material and retain the lipid faction while others suggest they jettison the carbs when nitrogen is more available for lipid formation. They might just produce more than needed when optimal conditions are present. Getting rid of some sticky carbs probably helps account for the high lipid content of diatoms.

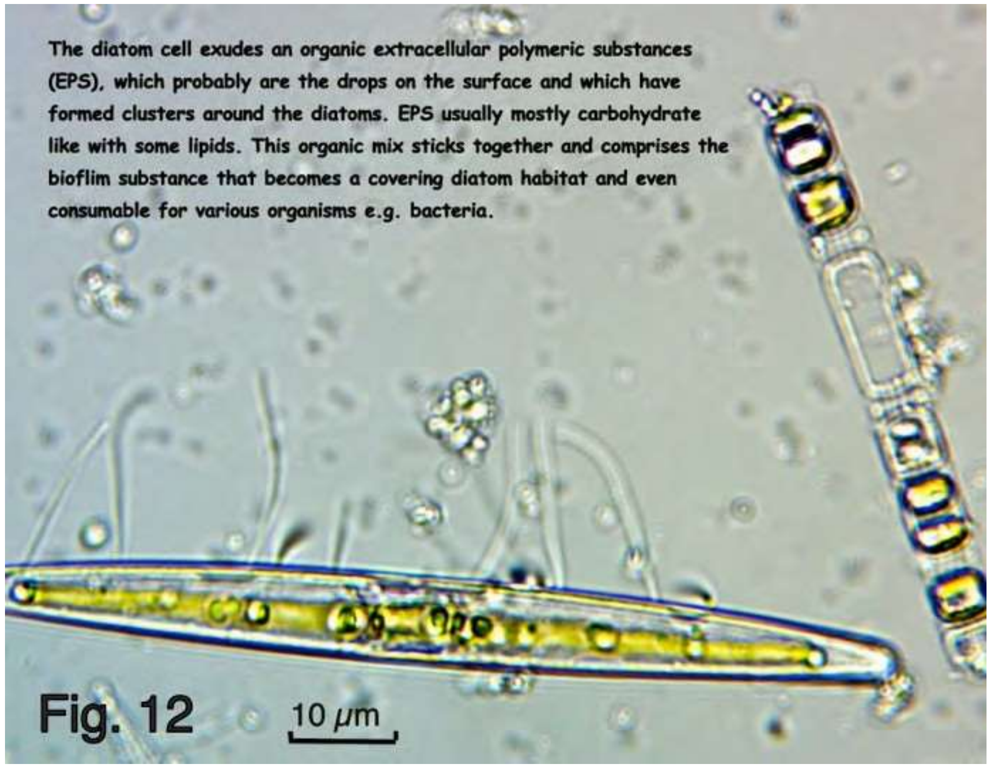


Fig. 12

This surface slime (snot, fi lm, etc.) provides habitat for other biotic elements such as microbial forms, worms, etc. Diatoms have an animal like urea cycle which allows effi cient use of carbon and nitrogen from the environment thus opening pathways for producing high-energy fatty acids (lipids) along with carbohydrates. Some in the science world refer to them as metazoans which is interesting but for the estuary, their primary function is photosynthesis and food production. See L. J. Stal & J. F. C. de Brouwer, 2003 for discussion on the biofi lm production by diatoms. Keep in mind ghost shrimp prevent or remove biofi lm formation.

Diatom Consumers: Attraction to the intertidal surface**:** The next step in forming the food web are the primary consumers. Their role is to consume the lipoproteins and carbs in diatoms and in turn become the prey for higher trophic levels. There are dozens of different invertebrate groups which are attracted to the rich pickings of a stable tidal fl at. Many invertebrates move onto the area (the grazers) with the tide. Some invertebrates fi lter out the benthic diatoms from the tidal currents e.g. shellfi sh and yet others have adapted to remaining on the intertidal surface during the tidal cycle.

Because of their abundance as shown by extensive sampling an informative example involving benthic diatoms and a crustacean, *Corophium*, will hopefully exemplify importance of diatoms for grazers, (drawing of this amphipod, Fig. 3). *Corophium* remains when the tide leaves the mudfl at because it constructs a burrow, however, different in many respects from that of a ghost shrimp. First the abundant small *Corophium* is unlike the destructive burrowing of the ghost shrimp, with a lined burrow about 10 cm (± 4 inches) deep. They give us verifi cation of the richness of the

mudflat if ghost shrimp are not abundant. This amphipod at normally over 10,000 per m^2 is dependent upon the thousands of benthic diatoms they can
reach from their burrow during a daily tide (Fig. 13).

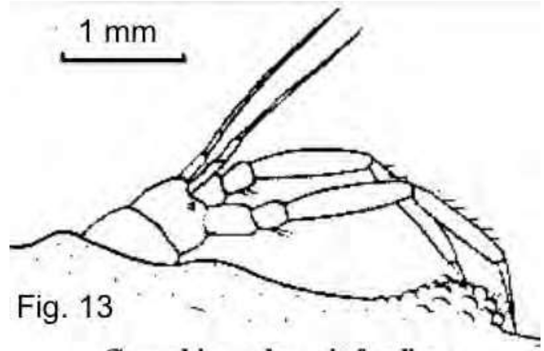


Fig. 13
Corophium deposit feeding
(After Meadows and Reid, 1966)

Corophium, has been the object of extensive investigation due to their importance as a key food source for shorebirds. The decades of study of *Corophium* on the Bay of Fundy and relationship to shorebirds are summarized by the Bay of Fundy Ecosystem Partnership report, *Corophium*. They term this amphipod “Master of the Mudflats” and a Keystone species. Their report, is very interesting reading with many researched aspects of its life, such as each *Corophium* reportedly consumes up to 4,000 benthic diatoms per day, which have to be within reach of the burrow or within a few millimeters (Fig. 13). Illustrations have this amphipod feeding on deposits (detritus) from around the burrow opening but it was later found diatoms were the major nutrient source. This sand flea relative can masticate (chew up) the silica shells thus they could not be identified from stomach samples. Thus, the necessary daily diatom availability, abundance, movement and fecundity are further proved when *Corophium* is present. Also, this key crustacean would not be present in the surface sediments in that abundance if the sediment stability was not present for them to construct and keep a lined burrow. Then their importance as prey for higher trophic forms such as birds and fish. The report on the Bay of Fundy holds a single sandpiper to gain the body weight to migrate, would ingest 10,000 to 20,000 *Corophium* per tidal cycle. Thus, available exposed stable, tidal flat areas with few ghost shrimp are very important especially in the spring here in Willapa Bay when the lower daylight tides open up more feeding area. However, these lower elevation areas are also preferred by the ghost shrimp and if not controlled, will eliminate both diatoms and C*orophium*. This has happened on thousands of public intertidal mudflat acrea and now many oyster farming acres (Fig. 14).

Ken Brooks presented his extensive sampling data and analysis of changes in Arthropod and Mollusk populations before and after application of a pesticide to control ghost shrimp. His sampling protocol and data presents numbers for *Corophium* and *Leptochelia* along with many other invertebrates, on different oyster beds and a control area. His data sheets *Willapa Bay data*, show abundance declining as ghost shrimp numbers increase. They also show the fast recovery about seven weeks post treatment back to the greater than pre-treatment numbers when *Corophium* climbs to over >20,000 per m^2. Most likely *Corophium* is taking in a combination of diatoms and biofilm with the latter being basically a carbohydrate. Thus, the benthic diatom availability, abundance, movement and fecundity are firmly established by the numbers of this amphipod as reported by Ken Brooks. In fact the health of the mudflat might be judged by abundance of *Corophium* and the tube dwelling *Leptochelia*. Beside the diatoms being unable to exist on the ghost shrimp bioturbated mudflat *Corophium* cannot construct a lined burrow in the loose fine sand created by this burrowing decapod and a decrease or end to a key prey species for fish and sandpipers.

Numerous other invertebrate adults and larvae and whether grazing or filtering, including benthic shellfish, are dependent upon the benthic diatoms or their organic biofilm coating and a firm intertidal substrate. It is important to note, while using one well studied, crustacean as example, numerous other adult and larval invertebrate species make up a mass of epibenthic grazing or *filtering predators on benthic diatoms. Examples are obvious from Brook's data sheets (see link above). If ghost shrimp numbers were low, the small benthic Arthropods and Mollusks would normally include about twenty species with often over 30,000 individuals/m² in or on the top sediment layer, biofilm or surface water when the tide is in. Many other invertebrate groups are also present, for example the various worms would contribute greatly to the biomass. Larger consumers of benthic diatoms, of course, includes shellfish. Point here is the benthic diatoms must be a major source of nutrients to a huge important segment of the estuary biota and thus provide the base of the food* web. The ghost shrimp bioturbation will reduce or remove this important process from the intertidal sediment surface.

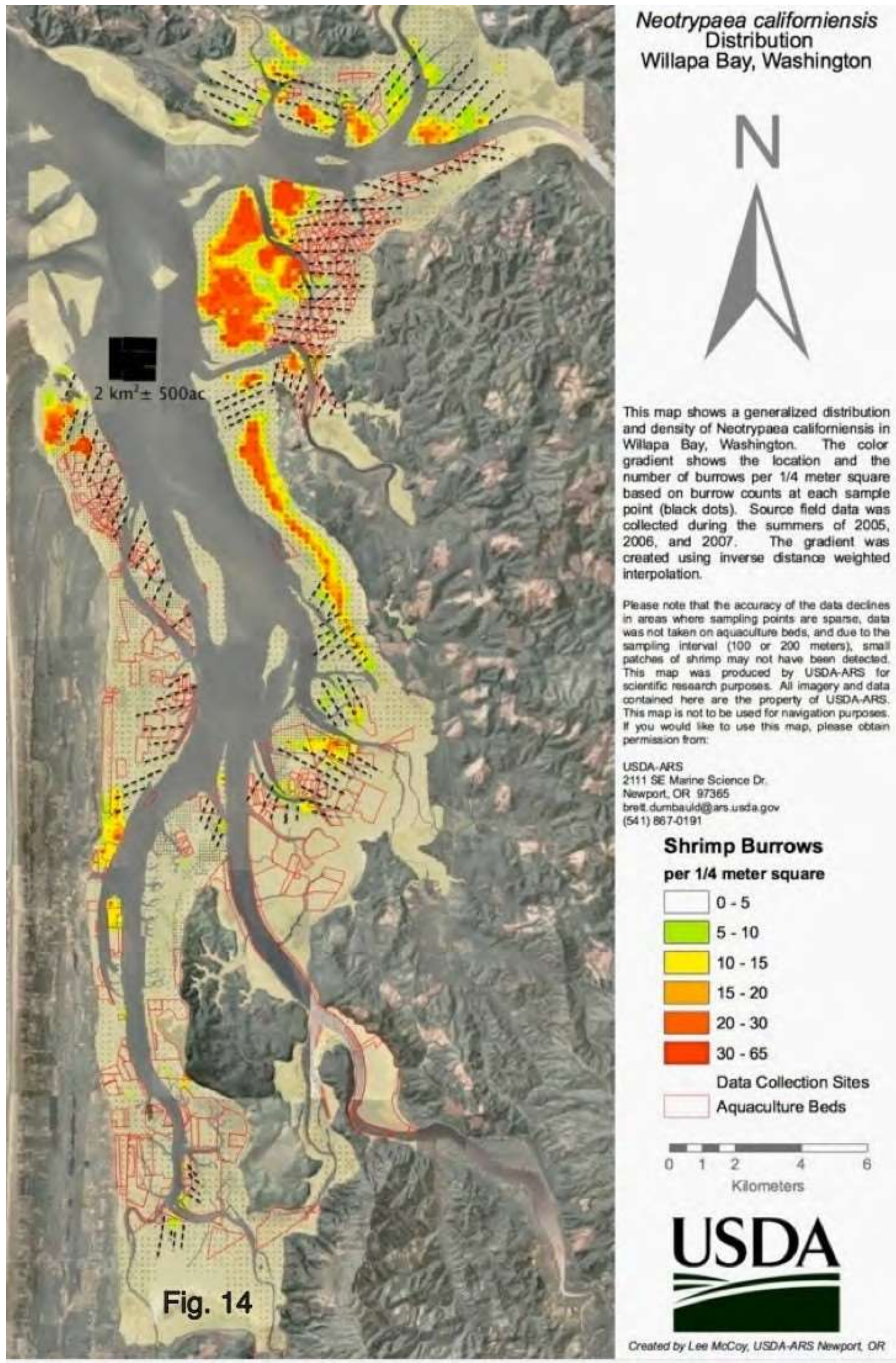
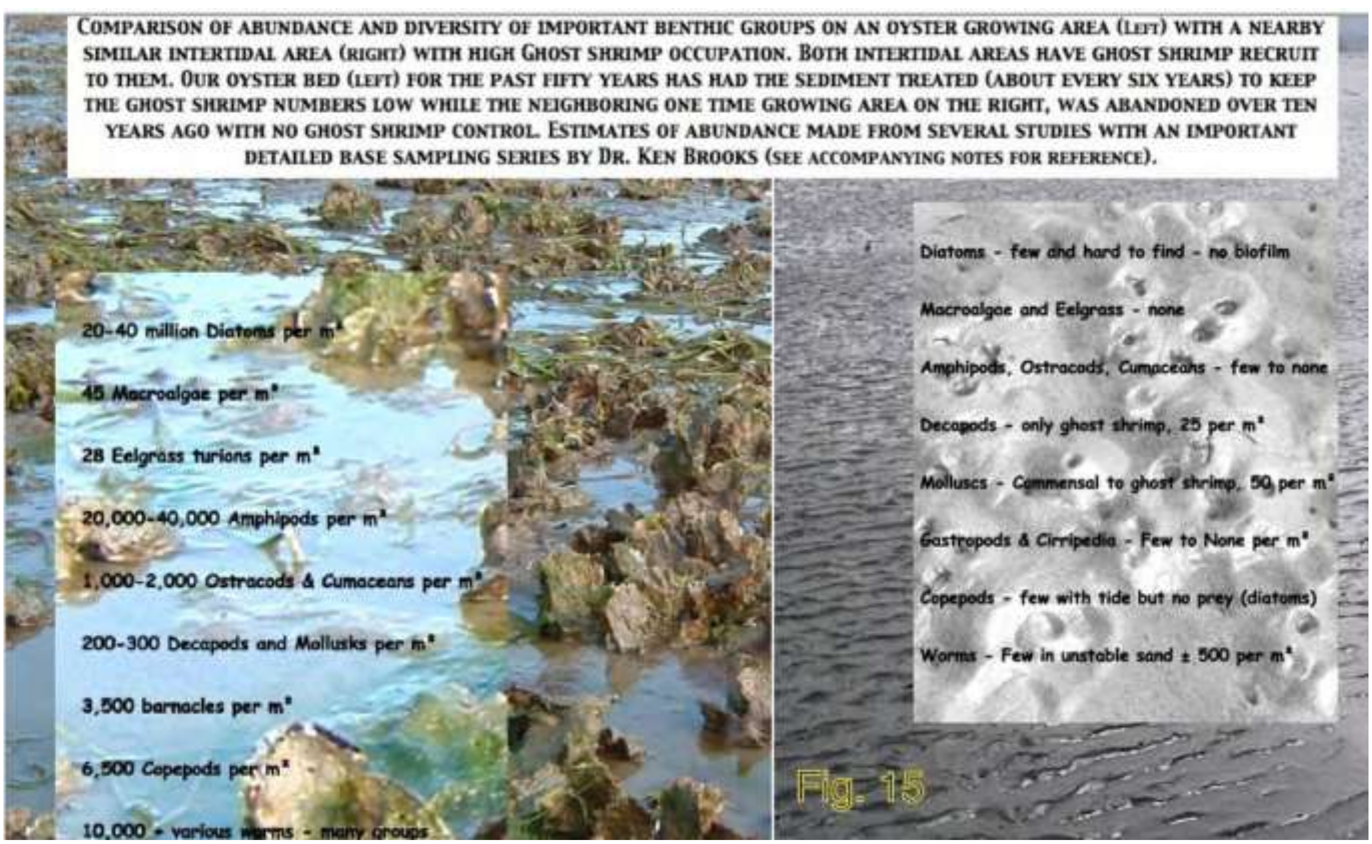


Fig. 14

Ghost Shrimp: How extensive and where are they in Willapa Bay? Dr. Brett Dumbauld is one of most knowledgeable researchers on the burrowing scavenger decapod, *Neotrypaea californiensis*, aka, ghost shrimp. His decades of sampling and research allowed him to construct the map (Fig. 14) displaying the extent of their encroachment over the public intertidal ground in Willapa Bay. He did not survey privately owned oyster growing beds. I indicate areas as dotted lines where encroachment by ghost shrimp can and have generally occurred. They would contain those growing areas which would require periodic control to remain as shellfish growing areas. It would means a loss of most of the benthic fauna and flora on these areas unless treated. Also note his burrow numbers are for 1/4 of a square meter while in order to have a stable surface for oysters, diatoms, etc. a burrow density of less 10 burrows per m^2 is used. The map shows the area covered and represents basically the most productive intertidal benthic habitat areas of Willapa Bay in terms of salinity, sediment composition, currents and elevation. These are conditions which create the prime diatom and crustacean forage areas for shorebirds and fish if ghost shrimp have not taken them over. The map also illustrates that if growers do not keep up a treatment program as part of an IPM program on their own intertidal property more productive intertidal tideland of Willapa Bay will be lost to benthic productivity. Sadly, about half the growers have currently stopped the use of chemical treatment of the sediment and probably will lose this ground for any type of shellfish cultivation. Furthermore, and most important is the loss of the food web for the entire biota. Add to this the fact that no ghost shrimp treatments have been allowed for the past two summers with a resulting increase of ghost shrimp dominated mudflat with destabilization of the benthic sediments and the negative impact on the benthic biota. There are already thousands of public intertidal acres which fall into this category indicated by the red and green areas on Dumbauld's map (Fig. 14). The barren sandy public areas could be reclaimed by reduction of the ghost shrimp but it would take agencies and others to realize the possibility and advantage of increasing forage acreage for managed species like fish, crabs and shorebirds. There are few unique temperate marine intertidal areas like Willapa Bay that can sustain the valuable food web to support a oceanic nursery and rich near shore biota.

It takes several years for the ghost shrimp to achieve their destructive size and abundance to completely modify a heterogenous sand and silt area into a uniform unstable fine grained sand area (Fig. 16). However, when ghost shrimp achieve this and naturally they will, it turns the mudflat from biologically rich to a single dominant species. Sampling shows it starts with loss of benthic diatoms and the primary consumers. Comparison on my own farm of two oyster beds of similar elevation and location near Bay Center, demonstrate this (Fig. 15). One area has had periodic shrimp treatment on a 5-6 year (crop removal schedule) and the other, due to size and



limits on treatment, has been without ghost shrimp control for over ten years. It now is barren of life with over 60 adult ghost shrimp burrows per square meter. The possible abundance fi gures for various taxa are from several studies (mainly Brooks, 1993) and actual counts.

Burrowing Ghost Shrimp Takeover: Ghost shrimp larvae go through a long swimming phase which includes ocean time offshore and then a return in late summer to an intertidal area to start a life within the nearshore sediment. At this stage they are just a few millimeters in size and part of the zooplankton. The following chart (Fig. 16) is based on two comparable oyster mudfl at areas subject to ghost shrimp recruitment: Bed A was treated periodically, while Bed B was not treated. The following (Fig. 16) traces an expected time of settlement and treatment. There is variation among growing areas in this timing to reach adult numbers to cause sedimentary modifi cation.

Plus it depends on the year to year recruitment numbers along with the many physical factors such as weather, elevation, sediment composition, etc.

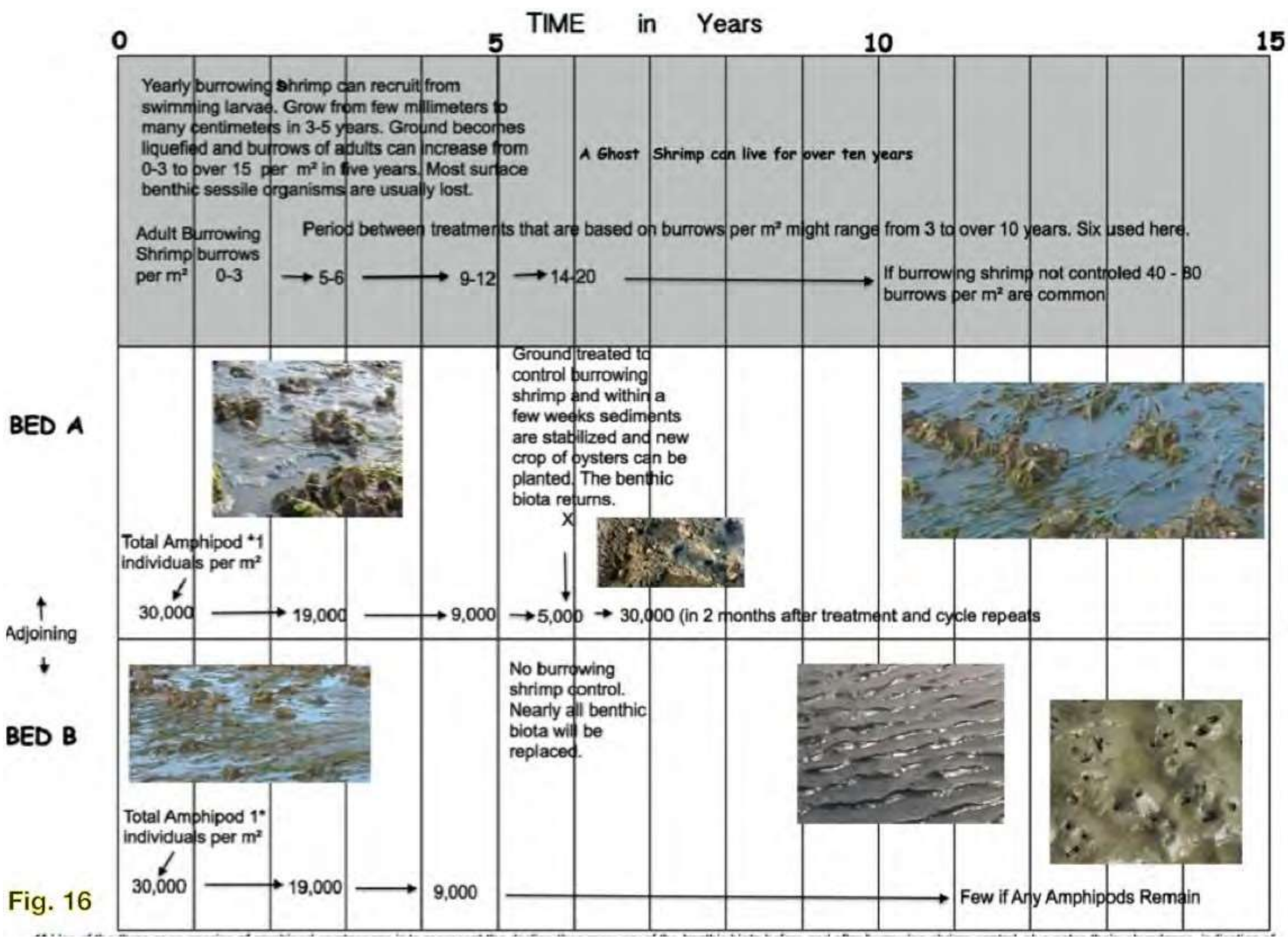
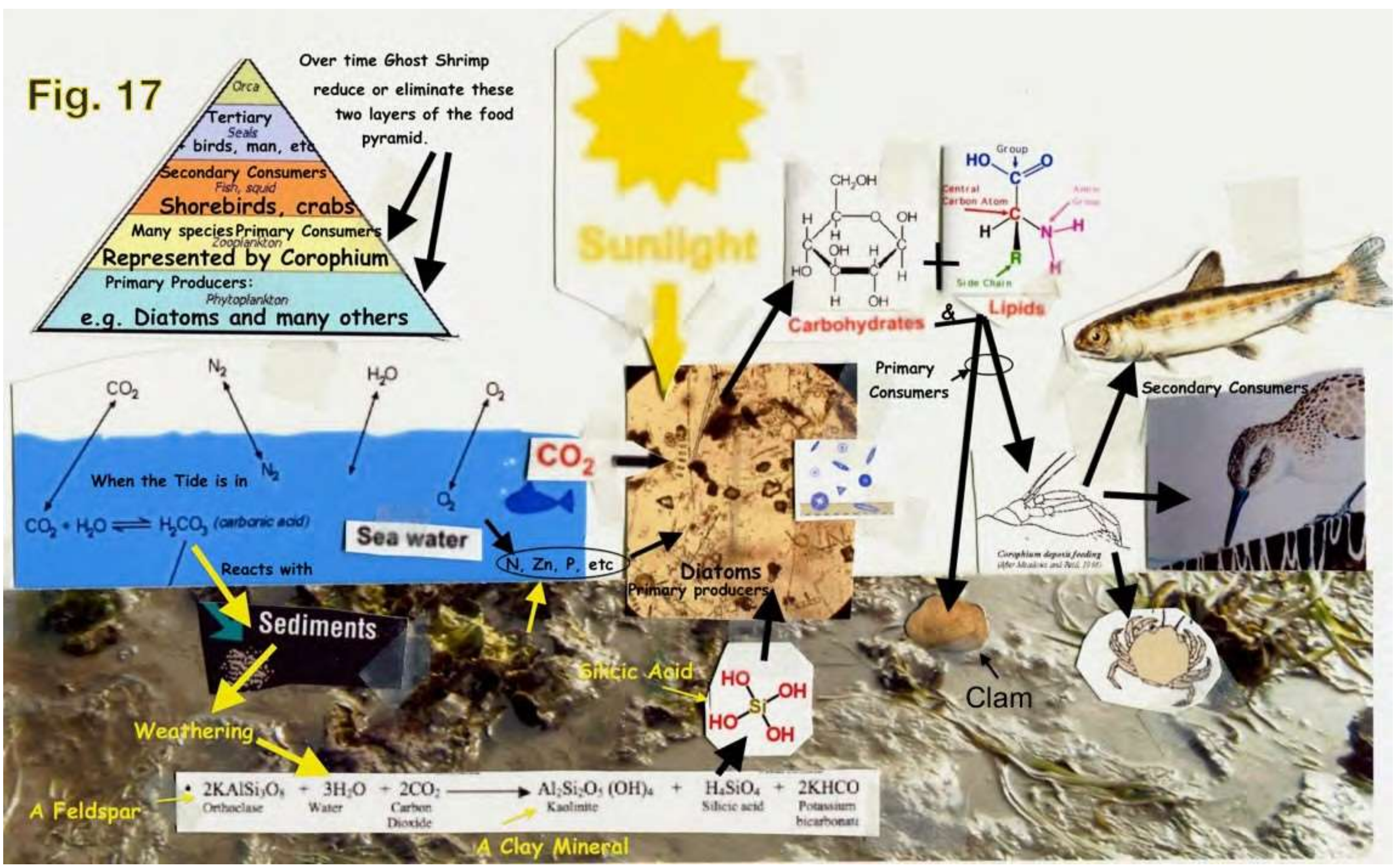


Fig. 16

Fig. 16, 1* The example of abundance of amphipods, mainly *Corophium* and including *Leptochelia* a tanaid, as explained, is their dependence upon the sediment composition and stability to be able to remain when the tide leaves during the intertidal phase and to their importance to the food web.

Ghost shrimp pump water into their burrowing network to bioturbate (mix) with the intertidal fine sand and silt, a process which creates a homogeneous unstable mixture. The finer sediment components (silt, clay, organics, etc.) end up on the surface where tidal or wind/wave energy currents can transport eventually out to sea. Any diatoms and biofilm which might have been on the surface is dispersed also. This results in a lack of sand cohesiveness and compaction with the homogeneous unstable fine sand. It also prevents nearly all other species which are burrowing, rooted, sessile, planktonic or dependent upon the mudflat to vacate or avoid the sediment surface.

The Food Web: Diverted and prevented by Ghost Shrimp**.** In Willapa Bay, around 9,000 acres from Dumbauld''s estimate of over 8,000 acres about ten years ago, have become ghost shrimp dominated areas (map Fig. 14) to the exclusion of nearly all other estuary plants and animals. In short, all those species that once depended upon those intertidal sediment areas to graze, derive nutrients or prey on others are replaced. More acreage is being taken over (invaded) each year and if ghost shrimp are not controlled by shellfish growers another 6-9,000 acres (estimated) of productive prime intertidal land would likely be lost in the next decade. Again, many will ask so what? The simple answer is the primary productivity initiated by benthic diatoms, that if reduced or absent, means less carbohydrates and lipids for numerous diverse primary consumers. They in turn will short the next higher trophic levels. This is critical for the more familiar fish, birds, crabs etc. For example, it must be considered that the decreasing areal extent of forage area due to ghost shrimp will have a direct impact on juvenile fish or migrating shorebird abundance with the decrease in diatoms and key benthic invertebrates. The following (Fig. 17) attempts to illustrate this important function of the Willapa intertidal where the sand to shorebird connection happens.



One of many examples of a functioning food lineage within a healthy food web

SAND TO SHOREBIRD
Peregrine Falcon
Dunlin
Corophium
Benthic Diatoms
Mud
Burrowing Ghost Shrimp Decrease or
Eliminate These First Three Trophic Levels
Fig. 18

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ATTACHMENT B to WGHOGA comments on the Draft Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor

Response of Estuarine Benthic Invertebrates to Large Scale Field Applications of Imidacloprid[*]

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Abstract
The response of estuarine benthic invertebrates to the neonicotinoid insecticide imidacloprid following large scale field applications in Willapa Bay, Washington (U.S.A.) was examined using Principal Response Curve Analysis. A total of 60 analyses were conducted to examine the response of 6 taxonomic assemblages (polychates, non-juvenile polychaetes only, mollusks, non-juvenile mollusks only, and crustaceans, and all invertebrates combined). The response was significant ($p < 0.05$) among 51 of the analysis, but interpretation was often confounded by significant difference between treated and control assemblages before treatment. In general, the response of the treated assemblages relative to the control assemblage usually did not change much over time, indicating a minimal treatment effect on the assemblage as a whole. Only 6 PRCs of 60 showed a significant negative effect from imidacloprid application. Five of the 6 PRCs represented mollusks, which represented < 2% of all organisms sampled among all sites and years. Crustaceans were negatively affected in one of 8 studies. Polychaetes, both with and without juveniles, were never negatively affected. The large majority of PRCs showed no significant effect from imidacloprid application, a neutral treatment effect, or ostensibly a "positive" treatment effect. The overall minimal response was likely due to exposure to low concentrations of imidacloprid for limited times, physiological tolerance to imidacloprid for some species, and multiple life-history strategies to rebound from natural disturbance and adaptation to a highly variable environment. These strategies include high mobility and dispersal behaviors, high intrinsic rates of reproduction, and rapid development. The highly variable environment was reflected in the response as variation among years, sites, replicates, and perhaps haphazard movements of individuals, particularly juvenile bivalves.

1. Introduction
The selective nature of neonicotinoid insecticides towards insects has helped make them the most widely used class of insecticide in the world. Neonicotinoids are agonists of the primary neurotransmitter of the cholinergic nervous system, acetocholine (Ach) (Tomizawa and Casida 2003). That is; they block the transmission of nerve impulses along the central nervous system. Because the molecular structure of the nicotinic receptor site differs between insects and other animals and because they are metabolized differently by insects and other animals, they are selectively more toxic to insects than other animals, particularly vertebrates. Neonicotinoids act systemically so are most effective against pests that feed directly on plant tissues, thus applications are usually foliar or seed dressings (Goulson 2013). Neonicotinoids are "reduced risk" insecticides (Ehler and Bottrll 2000) and are compatible with many integrated pest management programs in a variety of cropping systems.

The effects of neonicotinoid insecticides on terrestrial insects, including non-targets, have been comprehensively assessed and reported (e.g., Goulson 2013, Pisa et al 2014). The most controversial unintended effect of neonicotinoids has been on pollinators of agricultural crops, primarily honeybees (Pisa et al. 2014). Neonicotinoids can directly kill honeybees via spray drift during foliar applications against pest insects, or affect them indirectly when the bees forage for nectar and pollen from treated plants. Neonicotinoids have been implicated, along with Varroa mites and several pathogens (Ellis et al. 2010), as contributing to colony collapse disorder (Gill et al 2012).

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* In final preparation for submission to “Estuarine, Coastal, and Shelf Science”

Reported effects on non-target aquatic invertebrates are much less common. Almost all data related to toxicity of neonicotinoids to aquatic invertebrates come from laboratory and mesocosm studies that feature freshwater. Exposure of estuarine invertebrates to any insecticide is almost always associated with run-off or leaching from upland agricultural use than from direct application (e.g., Kuivial and Hladik 2008, Morrisey et al. 2015). The authors of a recent comprehensive review of neonicotinoid impacts of non-target invertebrates reported, "There are no published works regarding the marine environmental contamination of neonicotinoids" (Pisa et al 2015).

The singular large scale insecticidal use in an estuary, worldwide, has featured applications of the broad spectrum carbamate insecticide, carbaryl, to control burrowing shrimp in coastal estuaries of Oregon and Washington in the U.S.A. (Feldman et al. 2000). Burrowing shrimp (*Neotrypaea californiensis*, *Neotrypaea gigas*, *Upogebia pugettensis* reside in burrows where they disrupt the structural integrity of sediments, causing surface dwelling organisms, including ground-cultivated oysters, to sink and die. Annual applications of carbaryl to mostly non-contiguous commercial oyster beds were begun in the early 1960s. Use was controversial since inception and a near 50 year search for alternative management tactics ultimately lead to the neonicotinoid compound, imidacloprid (Booth 2010).

We examined the response of epibenthic and benthic invertebrates to large scale field trials of the neonicotinoid imidacloprid ((2E)-1-[(6-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine) (IMI) that targeted burrowing shrimp. A total of 8 trials were conducted in 2011, 2012, and 2014 under state and federal experimental use permits in partial fulfillment of requirements for Federal labels and Washington state permits (Booth et al. 2011, Booth and Rassmussen 2011, Booth and Rassmussen 2013, and Booth et al. 2015). Here, we consolidated those studies to describe the response of 6 assemblages of benthic invertebrates at each study and when data from all studies were pooled. Results were interpreted in terms of the physiological susceptibility of particular taxa and the resilience of the taxonomic assemblages in light of adaption to a dynamic and highly variable environment. Relevant life history strategies include high mobility and dispersal behaviors, high reproductive rates, and rapid development. The results also reflected the highly variable environment in terms of differences among study years, sites, and replicates, but also the high variability among species life histories, and perhaps haphazard movement of individuals.

2. Methods

2.1. Experimental design

The experimental design comprised a "before-after-control-impact" (BACI) approach (Green 1979) that featured plots that were treated with liquid formulated IMI (Nuprid® 2F; NuFarm US or Protector ®), granular formulated IMI (Mallet ® 0.5G), or were left untreated to serve as a control plot. In general, a liquid IMI plot and a granular treated plot were compared to a single control plot within a study area. Plots were separated by at last 500m. Application rate for all imidacloprid treatments was 0.5 lb a.i./ac.
Over the course of 3 years, a total of eight trials were conducted among 5 study areas (Figure 1). In 2011, the triple plot design was used at one study area (Bay Center), but only a liquid IMI plot was compared to a control plot at a second area (Cedar River). Triple plots were used at two study areas in 2012 (Leadbetter and Palix). In 2014, 36ha of contiguous tidelands were treated with liquid IMI but an internal 4 ha plot was compared to a 3.6ha control plot located 4 km distant. Imidacloprid treatments were applied in July or August. The liquid formulation was applied aerially using helicopters when plot surfaces were fully exposed during extreme low morning tides The granular formulation was applied using an ATV equipped with a granular spreader during ebb flow prior to full surface exposure during extreme low morning tides (water depth ~ 5 cm).

2.2. Imidacloprid sampling

Comprehensive descriptions of procedures to sample, handle, and analyze samples are presented elsewhere (Booth and Rassmussen 2013, Grue and Grassley 2013, Booth et al. 2015, Patten 2015). Briefly, concentrations of IMI and its breakdown product, olefin, were measured in surface waters, substrate pore water, and sediments before and after treatment according to protocols that were fairly well standardized among study sites and years. Briefly, samples were taken along each of 4 to 6 transects that radiated from plot center and extended up to 480 m off plot, primarily in the direction of tidal currents. Water was sampled at one or two hours after IMI application as the tide inundated the plot treated with the liquid formulation or as it flowed off of the plot treated with the granular formulation, then at 6, 12, and 24 hr later. Porewater and sediments were sampled at 1, 14, 28, and 56 days after treatment according to an iterative process that depended on the results of the previous sample. Seagrass, *Zostera marina*, was also sampled and analyzed for concentrations of IMI.

2.3. Invertebrate sampling

Treated and control plots were sampled at the day before and at 14 and 28 days after treatment (DAT). In 2012, the plot treated with liquid IMI and associated control were also sampled at 56 DAT at one of the two study sites, but only mussels and crustaceans were enumerated. Plot sizes, primary sediment composition, vegetation, treatment dates, and sample sizes characteristics are presented in th Appendix (Table A1).

Invertebrates were sampled using a 10.2 cm internal diameter corer to a depth of 10 cm. In 2011 and 2012, cores samples and identification labels were placed inside one gallon Ziploc® storage bags, transported in coolers from the study sites, and sieved one or two hours later in salt water through 0.5 mm mesh to save time during sampling. In 2014, cores were sieved on site immediately after sampling. Sieved samples were fixed in 10% buffered formalin.

2.4. Sample identification

After at least two weeks, samples were re-sieved through 100 µm mesh using freshwater, transferred to 70% isopropyl alcohol, stained with rose Bengal, and stored until further processing. Invertebrates were sorted from bits of algae, eelgrass, and debris.

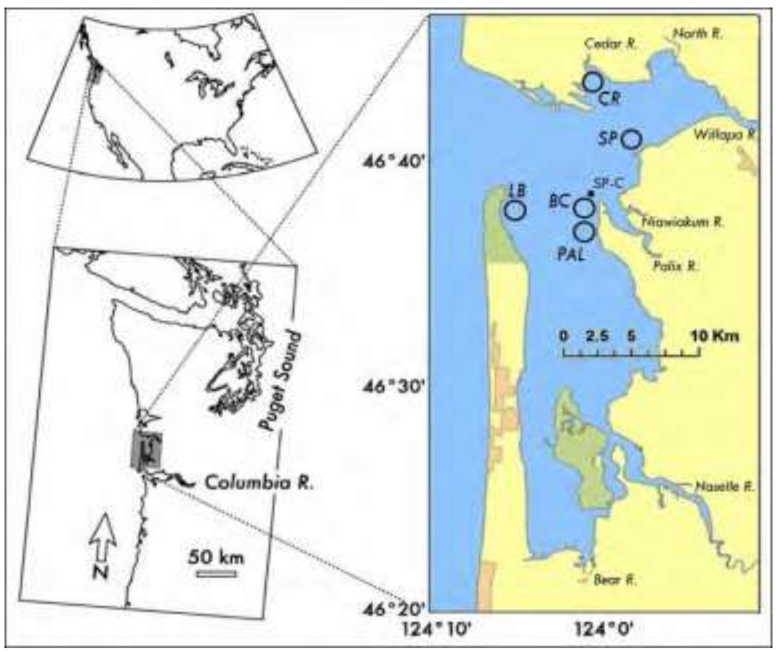

Figure 1. Willapa Bay, WA study sites: Cedar River (CR - 2011), Stony Pt. (SP - 2014), Stony Pt. Control (SP-C - 2014), Bay Center (BC - 2011), Leadbetter (LB - 2012), Palix (PAL - 2012).

Polychaetes were identified, mostly to species, and enumerated by Ruff Systematics, Inc. Crustaceans and mollusks were identified and enumerated by PSI staff to the most specific taxonomic level possible (identifiable taxonomic unit (ITU)).

2.5. Data analysis

Principal Response Curve (PRC) analysis is a multivariate ordination technique that was derived from

Redundancy Analysis (RDA), primarily to simplify assessment of pesticide treatments on abundances of aquatic invertebrates in mesocosms (Van den Brink and Ter Braak 1999) and has since become fairly standard for such experimental systems (e.g., Colville et al. 2008, Lopez-Mancisidor et al. 2008, Mohr et al. 2012). PRC's have also been used to interpret biomonitoring data (e.g., Leonard et al. 2000, Cuppen et al. 2000) and has been favorably compared to other multivariate techniques (Van den Brink et al. 2009). In PRC analysis, effects due to time (conditioned variance) are partialled out, leaving treatment effects plus effects due to the treatment × time interaction (constrained variance) and remaining residual (unconstrained) variance. Removing time from the equation allows the response of a treated species assemblage to be compared to an untreated control assemblage along a horizontal time axis, greatly simplifying interpretation of results. As in RDA, the maximum constrained variance among a set of samples is extracted and projected onto a primary axis, the maximum constrained variance that is uncorrelated with the primary axis is projected onto a second axis, the maximum constrained variance that is uncorrelated with either primary or secondary axes is projected onto a third axis, and so forth, until all constrained variance has been projected. The Principal Response at each sample time is a canonical coefficient (c_{dt}) that represents the maximum variance of species abundances in the treated assemblage relative to the control assemblage that is explained by a single (usually the primary) RDA axis (axis 1). An increase in the canonical coefficient over time represents increasing abundance of the treated assemblage relative to a control assemblage; a decrease in the coefficient over time represents a decrease in abundance. The amount of total variation that is captured by axis 1 axis can be assessed for significance over the entire time series using a Monte Carlo permutation test. An additional Monte Carlo permutation test can be used to determine if the treatment effect (e.g., IMI application) and treatment × time interaction are significant at each sample time. Finally, PRC analysis presents a coefficient (b_k) that expresses the correlation of each species, or taxa, with the basic response pattern of the entire taxon assemblage. The relative abundance of a given ITU at a given sample time = $c_{dt} \times b_k$. Highly weighted taxa (high values of b_k) are highly positively correlated with the basic PRC pattern (e.g. abundances resembles the basic pattern) while taxa with negative taxonomic weights are negatively correlated (abundances resemble the opposite pattern of the entire assemblage).

Principal Response Curve analyses were conducted using the 'vegan' package (v 2.3-3) for the R programming language (v 3.2.2). PRCs were created and analyzed for a total of six metric assemblages of benthic invertebrates (polychaetes, mollusks, and crustaceans, non-juvenile polychaetes, non-juvenile mollusks, and assemblage of all invertebrates categorized by family as the most specific taxon. Studies of liquid and granular formulated IMI were analyzed separately. PRC analyses were conducted on log-transformed abundance data (ln (x) +1, where x = number of individuals per m^2 per taxa. Separate analyses were conducted for each individual test (year, study site, and formulation), and for all sites and years pooled. In addition to the curve, the analysis determined the amount and proportion of conditioned variance (time effects), constrained variance (explained by treatment plus treatment x time effects), or unconstrained (unexplained) variance. Monte Carlo permutation F-type ANOVA (number of permutations = 999) was used to test the significance of a) the amount of constrained variance (e.g., conditional variance was removed as part of the PRC analysis so was expressed in the ANOVA as 0), and b) the response of each treated assemblage relative to the control assemblage at each sample date. PRC analysis output included the amount of constrained variance displayed on PRC. A second Monte Carlo test determined the significance of the PRC diagram (null hypothesis: axis 1 does not represent a significant proportion of the total variance).

3. Results

3.1. Field concentrations of imidacloprid

Concentrations of IMI in surface waters, porewaters, sediments, eelgrass, and associated field and laboratory controls are detailed elsewhere (Booth and Rassmussen 2013, Grue and Grassley 2013, Booth et al. 2015, Patten 2015). A very general summary comparison was that IMI concentrations varied substantially among years and study areas, with a notable difference between formulations (Table A5).

Because on-plot surface waters were sampled on the first post-treatment inundation tide (10 cm deep, ~ 2 hours after treatment (HAT)), and because granular IMI was applied to shallow standing water near the end of the out-going tide, concentrations were generally lower than in samples from the plots treated with liquid IMI while the plot was fully exposed. Concentrations also varied substantially within plots. Concentrations in surface waters also rapidly dissipated. Imidacloprid was detected in only 1 of 10 surface water samples taken at 6 HAT in 2011 and never at any longer post-treatment intervals. Consequently, surface waters were not sampled past 6 HAT in 2012 or 2014.

Concentrations of IMI in porewater declined precipitously according to power functions from initial concentrations (1 hr post-treatment) of 12 ppb in 2010 and 2011 (combined) (Grue and Grassley 2012), ~100 ppb in 2012 (Grue and Grassley 2012), and ~ 150 ppb in 2014 (Booth et al. 2015) to ~ 1 ppb at 14 DAT and to barely or non-detectable (0.04 ppb) concentrations at 28 and 56 DAT (all studies). Concentrations of IMI in sediment sampled from 5 treated plots at 1 DAT in 2012 averaged 21.4 ppb (range was 6.3 to 89 ppb) (Grue and Grassley 2012) and 57.5 ppb (range was 57 – 64 ppb) among 4 sediment samples from the plot treated in 2014 (Booth et al. 2015). Concentrations of a primary metabolite of IMI, olefin, were orders of magnitude lower, if detected at all, in both water and sediment.

Based on an application rate of 0.5 lb a.i./ac, sample depth, specific gravity, and percent moisture, the theoretical maximum concentration of IMI in porewater was 1121 ppb (Grue and Grassley 2012), far higher than sampled here. Most of the difference was due to dissipation into surrounding waters during tidal exchange. Off-site water samples indicated that IMI was sometimes transported several hundred meters from the treated plot, but at extremely low concentrations and only in the first few days after treatment (Grue and Grassley 2012) (Booth et al. 2015). Imidacloprid concentrations were further reduced by molecular binding to the sediments (Grue and Grassley 2012). Binding rates approached 90% in sediments with high amounts of total organic carbon.

3.2. Identifiable taxonomic units

A total of 95 invertebrates were identified to species or the most specific identifiable taxonomic unit (ITU) (Appendix, Table A2).

3.3. Partitioned variances and treatment effects

The percentage of total variance that is conditioned (attributed to time effects), constrained (attributed to treatment effects plus treatment x time interaction effects), and unconstrained (attributed to replicate, site, or unexplained effects) is presented in the Appendix for each PRC analysis (Table A3). Analyses with lower percentages of unconstrained variance were those with lower diversity (i.e., all studies at Bay Center and Cedar River in 2011). Treatment effects were significant in 54 of the 60 analysis and axis 1 displayed a significant amount of the constrained variance In 51 of the 60 PRCs (also Table A3); 49 analysis had both a significant treatment effect and a significant axis 1.

The canonical coefficient (principal response) of the test assemblage was significantly different from the control assemblage before treatment in 40 of the 60 analyses. Hence, a significant treatment effect over all sample dates, as determined by Monte Carlo ANOVAs, was not always informative. Furthermore, the treatment effect was often significant even when the overall proportion of constrained variance (variance due to treatment effects plus treatment x time interaction effects) was low (< 10%). Low constrained variance may be an artifact of the ordination analysis (e.g., the "arch effect" (Gauch 1982)), and have "nothing to do with nature" (Palmer 2016), but analyses with higher proportions of constrained variation are intuitively more explanatory. The more informative analyses were those with a significant percentage of constrained variance and an axis 1 that displayed a significant proportion of the constrained variance. Forty-nine of the 60 PRCs meet these criteria. Unconstrained variance was >75% for 31 and < 50% for 12 of the 49 more informative PRCs.

3.4. Principal response curves

The 60 PRCs are presented in the Appendix (Figures A5 – A14), arranged by study site and year, as trajectories of the principal response were often consistent among the 6 taxonomic assemblages at each study site and year. Response trajectories were less consistent among studies within a given assemblage. Each of the more informative PRCs had one of 3 potential outcomes based on the position of the principal response at the final sample date relative to the pre-treatment sample date (the end response): 1) a negative end response, in which principal response of the test assemblage relative to the control assemblage was lower at the final sample date compared to before treatment (e.g. Figure 2), 2) a positive end response, in which the principal response of the test assemblage relative to the control assemblage was higher at the final sample date compared to before treatment (e.g., Figure 3), and 3) a neutral end point, in which the principal response of the test assemblage relative to the control assemblage was the same at the final sample date compared to before treatment (e.g., Figure 4). Another potential scenario, indicative of a severe negative effect, with a response that is significantly higher than the control before treatment but is significantly lower than the control at both post-treatment sample dates was not realized in our studies.

The status of the end response (negative, positive, or neutral) of each of the 49 PRCs with both a significant percentage of constrained variance and an axis 1 that displayed a significant proportion of that variance is presented in the appendix as Table A6. The end responses of 6 significant PRCs were negative, 5 of which were either mollusks with or without juveniles included, while 1 of the 6 was the assemblage of crustaceans treated with granular IMI at Palix, 2012 (Figure 2). Four of the 6 were from studies of the liquid formulation of IMI. Two of the 5 PRCs with a positive end responses were polychaetes in the combined liquid IMI studies, with juveniles both included and excluded (Figure 3). Three of the 5 featured mollusks. Three of the 5 were from studies of the granular formulation of IMI. The end response of 38 of the 49 PRCs with both significant treatment effects and a significant axis 1 was neutral. The trajectories of 34 of the 38 PRCs were essentially flat. That is, the response was significantly lower for the treated assemblage than the control assemblage at all sample date (e.g., Figure 4), significantly greater for the treated than the control at all sample dates (also Figure 4), or not significantly different between the treated and control assemblage at all sample dates. The trajectories of 4 PRCs shifted either up or down at 14 DAT, but returned to pre-treatment status at 28 DAT. Nineteen of the 38 PRCs with a neutral end response were from studies of the liquid formulation of IMI and 19 were from studies of the granular formulation.

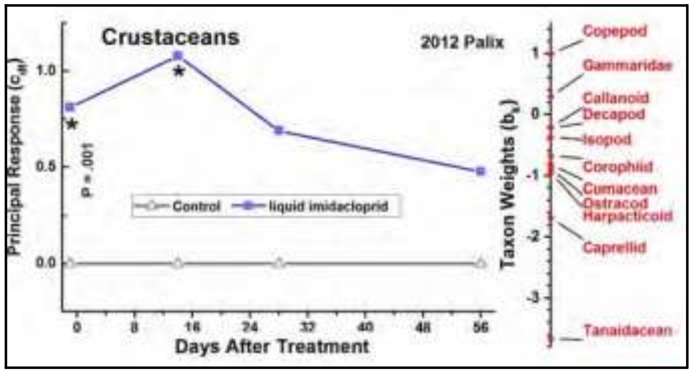

Figure 2. Principal Response Curve of crustaceans before and after treatment with liquid imidacloprid at Palix, 2012. P is

probability that the primary axis (response) is significant. Asterisk (*) indicates the response at each sample date is significantly different from the control (p < 0.05). Weights

indicate taxa that are positively or negatively correlated with the shape of the curve.

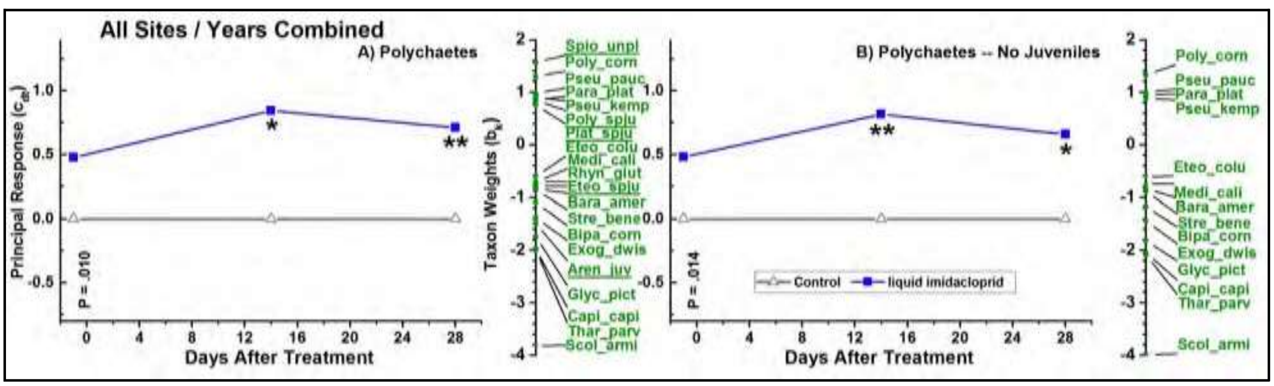

Figure 3. Principal Response Curve of A) all polychaetes (underlined taxa are juveniles) and B) non-juvenile polychaetes before and after treatment with liquid imidacloprid, pooled study sites and years. P is probability that axis 1 (Principal Response) is significant. Asterisks indicate the response at each sample date is significantly different from the control (*, p < 0.05; **, p < 0.01). Weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -.06 and < 0.06 are not shown). Table A2 lists polychaete full names and abbreviations.

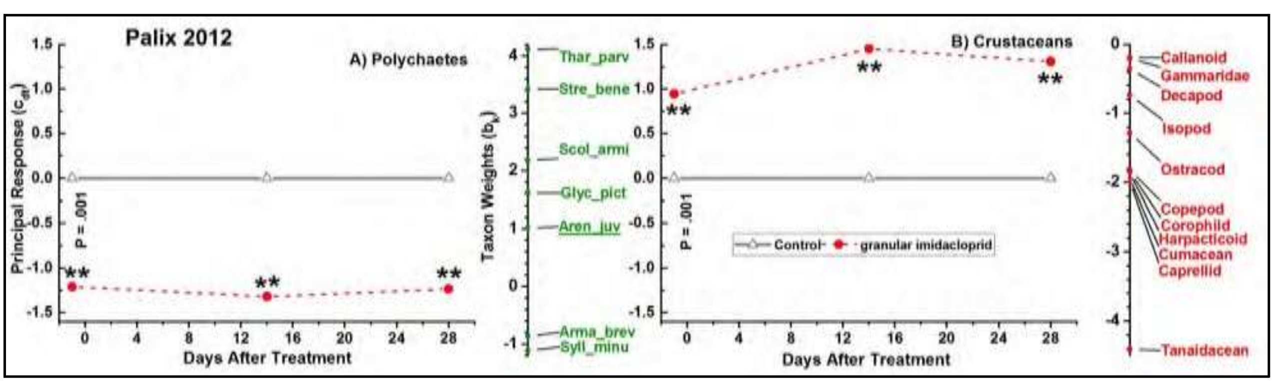

Figure 4. Principal Response Curves of A) Polychaetes (underlined taxa are juveniles) and B) Crustaceans at granular imidacloprid and control plots at Palix in 2012. P is probablility that axis 1 (response) is significant. Asterisks (**)

indicate the response at each sample date is significantly different from the control ($p < 0.01$). Weights indicate taxa that are positively or negatively correlated with the shape of the curve (polychaete weights > -.06 and < 0.06 are not shown). Table A2 lists polychaete full names and abbreviations.

Both the trajectory and the end response of all non-juvenile polychaete PRCs were very similar to those that included juveniles. However, the flat trajectory of non-juvenile polychaetes treated with granular IMI at Leadbetter in 2011 was higher than the control, whereas the flat trajectory was lower than the control at all sample dates when juveniles were included in the analysis. The trajectory or end response of non-juvenile mollusks was different than mollusks with juveniles included in 6 of the 8 comparisons, perhaps most notably in the PRC of all studies combined; the end response was positive with juveniles included, but negative with juveniles excluded from analysis.

Weights of individual species or ITUs were generally not consistent among PRCs of the same taxonomic assemblage among different studies. For example, weights of harpacticoid crustaceans were positive at Bay Center and Cedar River in 2011 and at Stony Pt in 2014, but were negative at Palix and Leadbetter in 2012. Sedentary polychaetes (Sub Class Sedentaria) were not affected more than mobile polychaetes.

In summary, only 6 PRCs of 60 showed a significant negative effect from IMI application, representing studies of both granular and liquid formulations at the 2012 Palix study area and of each formulation when all studies across all years were combined. Five of the 6 PRCs represented mollusks, which represented < 2% of all organisms sampled among all sites and years. Crustaceans were negatively effected in one of 8 studies and polychaetes were never negatively effected. The large majority of PRCs showed no significant effect from IMI application, a neutral treatment effect, or ostensibly a "positive" treatment effect.

4. DISCUSSION

4.1. Toxicological susceptibility

The minor and transitory effects from IMI indicated by the PRC analyses were at least partly due to limited exposure to potentially toxic concentrations. Imidacloprid demonstrably affected estuarine aquatic benthic invertebrates in controlled arenas. Toxicity tests of standard saltwater test crustaceans report LC_{50} values of 361,230 *u*g/L for water flea (*Daphnia magna*) and 10,440 *u*g/L for brine shrimp (*Artemia* sp.) (static 48 hr test, Song et al. 1997). These values were substantially higher than the concentrations sampled in our studies. LC_{50} values of 10 *u*g/L and 1,112 *u*g/L for blue crab (*Callinectes sapidus*) megalope and juveniles, respectively (static 24 hr test, Osterberg et al 2012) and 309 *u*g/L and 566 *u*g/L for larval and adult grass shrimp (*Palaemonetes pugio*), respectively (static 96 hr test, Key et al. 2007). There are no published laboratory studies of IMI effects on polychaetes, but the freshwater oligochaete *Lumbriculus variegatus* suffered 35% mortality after 10 days of exposure to 500 *u*g/kg (ppb) IMI in spiked soil samples (Sardo and Sores 2010). These controlled tests feature exposure to concentrations for much longer time periods than those experienced by organisms in our field trials, as IMI quickly dissipated into surrounding waters or became bound to sediments.

As previously noted, IMI is less toxic to non-insect invertebrates than many other insecticides. Very few, if any studies have been published that directly compared the toxicities of IMI and carbaryl to non-insect invertebrates. An LC_{50} value of 43 *u*g/L was reported for the grass shrimp (*P. pugio*) (Chung et al. 2008). Field studies of large scale applications of carbaryl to manage burrowing shrimp likewise demonstrated that physiological tolerance by individuals is not the only factor determining the ability of assemblages of estuarine invertebrates to rebound from exposure to toxins (Brooks 1993, Brooks 1995, Dumbauld 1994, Dumbauld et al. 2001, Booth 2006). Brooks (1993) described impacts to the epibenthic meiofauna as extremely short-term (< 2 day). A study of the sediment impact zone related to the carbaryl applications similarly showed that minimal effects in terms of both distance from the treated plot (< 180 m) and time since treatment (< 1 yr) (Booth 2006).

4.2. Tolerance of disturbance

Although individuals survived carbaryl and IMI applications by virtue of limited exposure or physiological tolerance, assemblages of estuarine benthic invertebrates were able to withstand the applications due to adaptation to a variety of natural disturbances. Simenstad and Fresh (1995) assessed the effects of disturbance from 5 intertidal aquaculture practices, including carbaryl applications against burrowing shrimp in Willapa Bay, on the epibenthic and benthic communities in Pacific Northwest estuaries. They noted that individual species differ in their susceptibility to disturbance, especially short term (e.g., 2 days post disturbance) but that the epi-benthic and benthic infaunal assemblages are quite resilient long-term (51 days). They concluded that the ability of these communities to rebound from aquaculture related disturbances stems from the communities' natural adaptation to the highly dynamic estuarine environment. "Scant" or "moderate" effects of harvest activities associated with geoduck clam (*Panopea generosa*) aquaculture, which in Puget Sound, Washington (VanBlaricom et al. 2015). Cultured geoduck are harvested by liquifying the sediments that surround each clam within a radius of 15 – 30 cm and a depth of 30 cm or more. The authors noted strong seasonal trends in the structure of benthic communities and that organisms are adapted to not only normal seasonal events, but also more haphazard events such as floods, storms, and even small tsunami and submarine landslides.

The intertidal environment of Willapa Bay is particularly dynamic at both spatial and temporal scales. The estuary itself is relatively shallow, which leads to especially large maximum and minimum tides (Emmett et al. 2012). Velocities of receding and advancing tides can reach several meters/second where gradients are smooth (Patten and PSI pers. obs.). Associated laminar flow transports and distributes sediments across the tideflats (Wheatcroft et al 2013) to erodable channels that can transport "orders of magnitude" greater loads of suspended sediments during peak tidal flows (Wiberg et al 2013). Major drainage channels are often displaced by 100s of meters by the spring following a series of winter storms (Patten and PSI, pers. obs.). Small bivalves reside at shallow substrate depths and are easily dislodged and transported with sediments disturbed by storms or extreme tidal currents (Norkko et al. 2001, Beukema et al. 2002). The juvenile myids and mytillids in our studies were the size of large grains of sand so were particularly prone to dispersal by sediment transport.

Salinity is especially variable in Willapa Bay, and was characterized as "extremely unsteady" in salt balance at the scale of both between and within seasons (Banas et al. 2004). Because the mouth of the estuary and 5 of the 7 primary rivers are located in the northern portion of the estuary, currents generally circulate from north to south (reversible to south-north) so general gradients in sediment type, salinity, and productivity are also north-south (Banas et al. 2004). In the summer months, temperatures in shallow puddles left during low tides can reach 40°C within a few hours on a sunny day in Willapa Bay (Pacific Shellfish Institute monitoring data). These factors, as well as others (i.e., amount and type of vegetation and detritus), also vary at more local scales according to differences in tidal elevation, aspect, proximity to rivers and other upland inputs, and other factors. As noted above, and seconded in the VanBlaricom article, the highly variable estuarine habitat made it hard to identify suitable reference sites and replicate sample stations.

Estuarine epibenthic and benthic invertebrates are well adapted to both seasonal and abrupt environmental changes. They are highly prolific, fecund, and often produce multiple generations per year. Most are mobile, with pelagic juvenile life stages that move not only within an estuary, but among estuaries via ocean currents. In addition to dispersal during dedicated pelagic larval, post-larval, or juvenile life stages, frequent small scale movements over long time periods by settled benthic invertebrates lends resilience in soft-sediment communities at a much larger spatial scale (Pilditch et al.

2015). Immigration, albeit simulated, has been shown to greatly accelerate the ability of a freshwater aquatic macroinvertebrate community to recover after pesticide exposure (Maund et al. 2009).

The variable estuarine habitat was reflected in our PRC analyses as percentage unconstrained variance. Unconstrained variance represents differences among samples, replicates, or sites (e.g., Cuppen et al 2000). The percentage of unconstrained variance was usually higher than those reported in most controlled mesocosm studies, which ranged from ~20% (Cuppen et al. 2000) or more typically ~40% (Maund et al. 2009, Mohr et al. 2012, Van den Brink and Braak 1999) or ~55% (Colville et al. 2008, Lopez-Mancisidor et al. 2008). However, unconstrained variance was 75% and 70% in a study of pesticide runoff effects on aquatic arthropods near conventionally managed and organic orchards in Germany (Schafers et al. 2008), which is more in line with percentages in our analyses.

Percentage of unconstrained variance was greatest in the analyses of combined study sites and years, reflecting the inherent variability therein. Uncontrollable experimental conditions, particularly annual weather conditions and seasonal trends, varied among years and study areas. The inconsistent patterns of taxon weights across study years and sites also reflected both the variable estuarine environment and the various life history strategies among estuarine species (or ITUs). For example, species vary in response (break from diapause, developmental rate) to water temperature.

We suspect that dispersal, high reproductive rates, rapid growth, and perhaps haphazard movement likely accounted for the “positive” treatment effects of IMI. Movement or growth of juvenile bivalves, *Macoma* spp. in particular, onto the plots treated with granular IMI post-treatment may have accounted for the positive end point of the PRC of pooled studies and the negative end point in PRC when juveniles were discarded. Harpacticoid crustaceans were 4 times more abundant on the test plot than the control plot at Stony Pt. In 2014, perhaps due to slightly warmer water temperatures that could have accelerated development, reproduction, and aggregation. Slight differences in the density and development of vegetative cover could have also enhanced the production of meiofauna and associated small benthic infauna (Dumbauld et al. 2009)

4.3. Long-term effects of imidacloprid via burrowing shrimp

Long term effects of IMI used to manage burrowing shrimp and culture bivalves is expected to lead to a more diverse community of benthic invertebrates compared to otherwise similar estuarine ground with high densities of burrowing shrimp. Burrowing shrimp, via bioturbation, are ecosystem engineers (Jones et al. 1994), (alternatively termed bioengineers (Posey et al. 1991, Dumbauld et al. 2009)) of soft-sediment intertidal habitats in many northeastern Pacific estuaries (Dumbauld et al. 2009) and thus control the structure and development of the immediate benthic community. Species diversity was lowest in ghost shrimp dominated habitat compared to six other inter-tidal habitat types (Ferarro and Cole 2007, Ferraro and Cole 2012). The very low relative abundance of mollusks found in our studies also demonstrated the ability of burrowing shrimp to control the local habitat. Suppression of burrowing shrimp allows other benthic organisms, primarily bivalves, to establish, followed by meiofauna that adhere to the bivalve and associated small benthic infauna (Dumbauld et al. 2009). Cultured oysters provide habitat for benthic infauna and physical structure and cover for surface dwellers such as juvenile crab, further enhancing diversity (Dumbauld et al. 2009).

APPENDIX

Table A1. Study site / field plot characteristics.

Year	Site	Treatment	Application Date	Plot Size (ha)	Substrate	Vegetation[1]	Cores / Plot[2]
2011	Bay Center	liquid IMI	July 14	4.2	sand	bare	20
		granular IMI	July 14	4.1	sand	sparse *Z. japonica*	16
		control		4.1	sand	bare	16
	Cedar River	liquid IMI	July 14	2.0	silt	sparse *Z. marina*	16
		control	July 14	0.9	sand	bare	16
2012	Palix	liquid IMI	August 2	3.4	sand	sparse *Z. marina*	15
		granular IMI	August 2	3.4	sand /silt	bare	15
		control		3.4	sand	sparse *Z. marina*	15
	Leadbetter	liquid IMI	August 5	3.2	sand	bare	13
		granular IMI	August 5	2.0	sand	patchy *Z. japonica*	15
		control		2.4	sand	bare	16
2014	Stony Pt	liquid IMI	July 28	4.0	sand	patchy *Z. marina*	15
		control		3.6	sand	patchy *Z. marina*	21

[1] sparse, % cover < 20%; patchy, % cover > 20% and < 1 m^2 and > 5m apart.

[2] Sample sizes are smaller than previously reported due to time-series blocking requirements for permutation tests.

Table A2. List of 96 taxa identified and enumerated from all samples at all sites and years. Table A2b lists abbreviations.

Phylum Annelida

Class Polychaeta

Sub-Class Errantia
Order Eunicida

Family Dorvilleidea

Dorvillea annulata 01

Order Phyllodocida
Family Polynoidea

Harmothoe imbricata 02

Family Goniadidae

Glycinde picta....................... 03

Glycinde sp. [juv]. 04

Family Chrysopetalidae
Paleanotus bellis................... 05

Family Hesionidae

Micropodarke dubia 06

Microphthalmus sp 07

Family Nereididae

Neanthes limnicola............... 08

Neanthes virens................... 09

Neanthes sp. [juv]. 10

Nereis vexillosa.................... 11

Nereis sp. [juv]. 12

Platynereis bicanliculata. . . 13
Platynereis sp. [juv]. 14

Family Syllidae

Exogone dwisula.................. 15

Exogone sp 16

Sphaerosyllis californiensis. 17
Sphaerosyllis sp. N-1............. 18

Syllides minutes.................... 19

Syllides longocirrata. 20

Syllides sp. [juv]. 21

Family Nephtyidae

Nephtys caeca. 22

Nephtys cornuta................... 23

Nephtys sp. unindent. (juv). 24
Bipalponephtys cornuta........ 25

Family Phyllodocidae

Eumida longicornuta............. 26

Eteone californica 27

Eteone fauchaldia 28

Eeone sp. (juv). 29

Phyllodoce hartmanae.......... 30

Phyllodoce sp. [juv]. 31

Sub-Class Sedentaria
Order Orbiniida

Family Orbiniidae

Leitoscololos pugettensis......... 32

Leitoscloplos sp 33

Paraonella platybranchia......... 34

Scoloplos armiger.................... 35

Scoloplos sp. (juv). 36

Order Sabedellida
Family Sabelidae

Unidentifed Sabelid [juv]. 37

Family Oweniidae

Owenia sp 38

Order Spionida Family
Spionidae

Dipolydora quadrilobata.......... 39

Polydora cornuta..................... 40

Pseudopolydora kempi............ 41

Pseudopolydora pauci- branchiata
.... 42

Pygospio californica................ 43

Pygospio elegans.................... 44

Rhynchospio glutaea. 45

Scolelepis squamata 46

Scolelepis sp. [juv] 47

Spionidae unident (post-

larval.. 48

Spiophanes norrisi 49

Spiophanes bombyx 50

Spiophanes sp. [juv] 51

Streblospio benedicti............... 52

Order Terebellida Family
Terebellidae

Poycirrus sp 53

Table A2b. Polychaete name abbreviations. Table A2a lists full name.

Sub-Class Errantia
- Order Eunicida
  - Family Dorvilleidea
    - **Dorv_annu** 01
- Order Phyllodocida
  - Family Polynoidea
    - **Harm_imbri** 02
  - Family Goniadidae
    - **Glyc_pict** 03
    - **Glyci_spju** 04
  - Family Chrysopetalidae
    - **Pale_bell** 05
  - Family Hesionidae
    - **Micro_dubi** 06
    - **Micro_sp** 07
  - Family Nereididae
    - **Nean_limn** 08
    - **Nean_vire** 09
    - **Nean_ spju** 10
    - **Nere_vexl** 11
    - **Nere_spju** 12
    - **Plat_bica** 13
    - **Platy_sp** 14
  - Family Syllidae
    - **Exog_dwis** 15
    - **Exog_sp** 16
    - **Spha_cali** 17
    - **Spha_N-1** 18
    - **Sylli_minu** 19
    - **Sylli_long** 20
    - **Sylli_spju** 21
  - Family Nephtyidae
    - **Neph_caec** 22
    - **Neph_corn** 23
    - **Neph_unid** 24
    - **Bipa_corn** 25
  - Family Phyllodocidae
    - **Eumi_long** 26
    - **Eteo_cali** 27
    - **Eteo_fauc** 28
    - **Eteo_spju** 29
    - **Phyl_hart** 30
    - **Phyl_spju** 31

Sub-Class Sedentaria
- Order Orbiniida
  - Family Orbiniidae
    - **Leit_puge** 32
    - **Leit_sp** 33
    - **Para_plat** 34
    - **Scol_armi** 35
    - **Scol_spju** 36
- Order Sabedellida
  - Family Sabelidae
    - **Unid_Sabe** 37
  - Family Oweniidae
    - **Owen_sp** 38
- Order Spionida
  - Family Spionidae
    - **Dipo_quad** 39
    - **Poly_corn** 40
    - **Pseu_kemp** 41
    - **Pseu_pauc** 42
    - **Pygo_cali** 43
    - **Pygo_eleg** 44
    - **Rhyn_glut** 45
    - **Scol_squa** 46
    - **Scol_spju** 47
    - **Spio_unid** 48
    - **Spio_norr** 49
    - **Spio_bomb** 50
    - **Spio_spju** 51
    - **Streb_bene** 52
- Order Terebellida
  - Family Terebellidae
    - **Poly_sp** 53
    - **Unid_Tere** 54
- Order Cirratulida
  - Family Cirratulidae
    - **Thar_parv** 55
- Order Opheliida
  - Family Opheliidae
    - **Poly_sp** 56
    - **Arma_brev** 57
    - **Ophe_lima** 58
    - **Thor_mucr** 59
    - **Unid_Ophe** 60
- Order Capitellida
  - **Aren_juv** 61
  - Family Capitellidae
    - **Bara_amer** 62
    - **Capit_capi** 63
    - **Mage_hobs** 64
    - **Hete_fili** 65
    - **Noto_tenu** 66
    - **Noto_spju** 67
    - **Medi_cali** 68
  - Family Maldanindae
    - **Saba_elon** 69

Table A3. Percentage variance partitioned by RDA and Monte-Carlo permutation F tests for significance of primary axis (axis 1).

				% Var. Attributed to:			% Trt. Var. Captured	PRC Permutation Test Statistics		
Year	Site	Formulation	Metric	Time[1]	Treatment[2]	Residual[3]	by axis 1	F	Pr(>F)	Sig.[4]
2011	BC	liquid	All Polychaetes	22.6	16.0	61.4	43.3	2.36	.057	NS
			No juv Poly	24.7	15.4	59.9	41.1	2.21	.121	NS
			Mollusks	16.2	17.3	66.5	63.0	3.44	.047	*
			No juv Moll	17.1	14.9	68.0	75.3	3.46	.118	*
			Crustaceans	17.0	15.2	67.8	56.3	2.66	.266	NS
			All Invertebrates	20.3	14.3	65.4	61.2	2.81	.019	*
		granular	All Polychaetes	19.3	37.9	42.8	77.7	12.34	.031	*
			No juv Poly	20.2	41.6	38.2	80.6	15.80	.033	*
			Mollusks	14.2	24.3	61.5	65.9	4.69	.026	*
			No juv Moll	14.4	25.8	59.8	76.2	5.90	.026	*
			Crustaceans	9.2	33.5	57.3	69.6	7.33	.032	*
			All Invertebrates	13.5	36.4	50.1	73.6	9.34	.027	*
2011	CR	liquid	All Polychaetes	17.0	38.1	44.9	71.9	10.97	.027	*
			No juv Poly	13.0	40.2	46.8	74.8	11.60	.034	*
			Mollusks	38.0	12.0	50.0	62.4	2.69	.086	NS
			No juv Moll	33.4	13.5	53.1	69.7	3.19	.112	NS
			Crustaceans	15.5	56.6	27.9	91.3	33.40	.026	*
			All Invertebrates	14.5	52.5	33.0	88.3	25.31	.028	*
2012	LB	liquid	All Polychaetes	3.7	8.7	87.6	80.8	6.99	.007	**
			No juv Poly	3.7	8.9	87.4	81.3	7.20	.005	**
			Mollusks	2.2	2.8	95.0	69.5	1.83	.514	NS
			No juv Moll	1.7	3.2	95.1	84.4	2.56	.423	NS
			Crustaceans	4.2	3.6	92.2	71.2	2.57	.210	NS
			All Invertebrates	2.9	5.5	91.6	68.4	3.61	.037	*
		granular	All Polychaetes	3.7	7.6	88.7	70.1	5.60	.008	**
			No juv Poly	3.8	7.7	88.5	70.6	5.73	.006	**
			Mollusks	2.7	7.6	89.7	86.9	5.40	.003	**
			No juv Moll	1.8	11.4	86.8	90.7	11.12	.001	**
			Crustaceans	2.7	8.3	89	49.5	4.39	.036	*
			All Invertebrates	2.5	7.6	89.9	63.8	5.00	.003	**
2012	BC	liquid	All Polychaetes	10.3	8.4	81.3	83.8	8.29	.001	***
			No juv Poly	11.0	9.1	79.9	87.5	9.50	.001	***
			Mollusks	5.3	4.6	90.1	64.9	3.68	.020	*
			No juv Moll	5.5	5.6	88.9	71.1	5.16	.025	*
			Crustaceans	12.2	8.3	79.5	71.8	7.87	.001	***
			All Invertebrates	7.8	8.3	83.9	74.2	6.61	.001	***
		granular	All Polychaetes	11.8	17.4	70.8	90.8	21.45	.001	***
			No juv Poly	12.4	18.6	69.0	91.5	23.60	.001	***
			Mollusks	7.0	4.5	88.5	68.6	5.40	.010	**
			No juv Moll	3.7	8.9	87.4	74.8	7.56	.006	**
			Crustaceans	6.6	26.8	66.6	91.7	35.51	.001	***
			All Invertebrates	6.8	19.9	73.3	88.3	22.24	.001	***
2014	SP	liquid	All Polychaetes	5.8	20.9	73.3	82.7	26.84	.001	***
			No juv Poly	6.5	18.9	74.6	81.3	23.50	.001	***
			Mollusks	2.8	17.0	80.2	83.5	20.72	.001	***

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No juv Moll	1.5	1.9	96.6	84.7	22.57	.001	***
Crustaceans	2.3	15.0	82.7	85.4	7.87	.001	***
All Invertebrates	3.6	19.2	77.2	86.3	24.53	.001	***

All	All	liquid	All Polychaetes	1.3	2.8	95.9	84.9	9.21	.010	**
			No juv Poly	1.4	2.8	95.8	85.0	8.84	.014	**
			Mollusks	2.1	1.8	96.1	76.4	5.25	.032	*
			No juv Moll	1.3	2.5	96.2	82.1	8.14	.005	*
			Crustaceans	3.5	1.6	94.9	73.1	4.54	.109	NS
			All Invertebrates	1.1	2.0	96.9	79.6	5.78	.045	*
		granular	All Polychaetes	3.2	4.4	92.4	71.9	9.12	.008	**
			No juv Poly	3.3	4.6	92.1	88.5	9.57	.008	**
			Mollusks	1.6	3.7	94.7	77.8	6.70	.012	*
			No juv Moll	1.8	5.0	93.2	76.5	9.08	.004	*
			Crustaceans	2.6	8.2	89.2	81.4	16.59	.001	***
			All Invertebrates	2.1	5.6	92.3	77.4	10.05	.003	**

[1] Conditioned Variation; partialed out of PRC diagaram

[2] Constrained Variantion; includes treatment x time interaction

[3] Unconstrained Variation; due to site effects, replicate effects, and unexplained variation

[4] Significance of axis 1 relative to other axis: *, p > 0.05; **, p > 0.01; ***, p > 0.001

Table A4. Monte Carlo permutation tests for main treatment effects (IMI) and interaction effects (IMI x time).

Year	Site	Formulation	Group	Terms	F	Pr (>F)	Sig.[1]
2011	BC	liquid	All Polychaetes	IMI	1.81	.037	*
				IMI * Time	1.82	.023	*
			Non juv Polychaetes	IMI	2.16	.024	*
				IMI * Time	1.61	.038	*
			All Mollusks	IMI	2.76	.047	*
				IMI * Time	1.35	.124	NS
			Non juv Mollusks	IMI	3.09	.058	NS
				IMI * Time	0.75	.562	NS
			Crustaceans	IMI	2.05	.016	*
				IMI * Time	1.34	.193	NS
			All Invertebrates	IMI	1.69	.026	*
				IMI * Time	1.46	.052	NS
		granular	All Polychaetes	IMI	12.13	.030	*
				IMI * Time	1.91	0.03	*
			Non juv Polychaetes	IMI	15.57	.033	*
				IMI * Time	2.02	.033	*
			All Mollusks	IMI	4.33	.030	*
				IMI * Time	1.39	.064	NS
			Non juv Mollusks	IMI	5.29	.03	*
				IMI * Time	1.23	.217	NS
			Crustaceans	IMI	6.78	.028	*
				IMI * Time	1.87	0.28	*
			All Invertebrates	IMI	9.43	.032	*
				IMI * Time	1.84	.032	*
2011	CR	liquid	All Polychaetes	IMI	10.43	.031	*
				IMI * Time	2.41	.031	*
			Non juv Polychaetes	IMI	11.34	.027	*
				IMI * Time	2.08	.027	*
			All Mollusks	IMI	1.92	.030	*
				IMI * Time	1.20	.371	NS
			Non juv Mollusks	IMI	2.61	.030	*
				IMI * Time	0.98	.404	NS
			Crustaceans	IMI	32.15	.030	*
				IMI * Time	2.21	0.30	*
			All Invertebrates	IMI	24.53	.033	*
				IMI * Time	2.07	.033	*
2012	PX	liquid	All Polychaetes	IMI	8.07	.001	***
				IMI * Time	0.09	.313	NS
			Non juv Polychaetes	IMI	9.30	.001	***
				IMI * Time	0.81	.490	NS
			All Mollusks	IMI	3.58	.005	**
				IMI * Time	0.92	.512	NS
			Non juv Mollusks	IMI	4.88	.005	**
				IMI * Time	1.13	.296	NS
			Crustaceans	IMI	7.64	.001	***
				IMI * Time	1.37	.112	NS
			All Invertebrates	IMI	6.51	.001	***
				IMI * Time	1.20	.120	NS

		granular	All Polychaetes	IMI	21.42	.001	***
				IMI * Time	1.11	.018	*
			Non juv Polychaetes	IMI	23.59	.001	***
				IMI * Time	1.10	.022	*
			All Mollusks	IMI	5.31	.005	**
				IMI * Time	1.28	.170	NS
			Non juv Mollusks	IMI	6.48	.003	**
				IMI * Time	1.81	.065	NS
			Crustaceans	IMI	34.56	.001	***
				IMI * Time	2.10	.001	***
			All Invertebrates	IMI	22.03	.001	***
				IMI * Time	1.58	.001	***
2012	LB	liquid	All Polychaetes	IMI	6.69	.005	**
				IMI * Time	0.98	.112	NS
			Non juv Polychaetes	IMI	6.91	.003	**
				IMI * Time	0.98	.115	NS
			All Mollusks	IMI	1.40	.303	NS
				IMI * Time	0.61	.695	NS
			Non juv Mollusks	IMI	2.45	.158	NS
				IMI * Time	0.30	.827	NS
			Crustaceans	IMI	1.53	.289	NS
				IMI * Time	1.04	.224	NS
			All Invertebrates	IMI	3.27	.031	*
				IMI * Time	1.00	.203	NS
		granular	All Polychaetes	IMI	5.58	.008	**
				IMI * Time	1.21	.024	*
			Non juv Polychaetes	IMI	5.71	.006	**
				IMI * Time	1.21	.019	*
			All Mollusks	IMI	5.31	.003	**
				IMI * Time	1.28	.129	NS
			Non juv Mollusks	IMI	10.61	.002	**
				IMI * Time	0.82	.349	NS
			Crustaceans	IMI	4.27	.017	*
				IMI * Time	2.30	.002	**
			All Invertebrates	IMI	4.82	.001	***
				IMI * Time	1.50	.004	***
2014	SP	liquid	All Polychaetes	IMI	25.76	.001	***
				IMI * Time	3.36	.001	***
			Non juv Polychaetes	IMI	22.95	.001	***
				IMI * Time	2.95	.001	***
			All Mollusks	IMI	19.80	.001	***
				IMI * Time	2.12	.001	***
			Non juv Mollusks	IMI	22.48	.001	***
				IMI * Time	2.09	.012	*
			Crustaceans	IMI	7.66	.001	***
				IMI * Time	1.37	.116	NS
			All Invertebrates	IMI	24.51	.001	***
				IMI * Time	1.95	.001	***
All Years	All Sites	liquid	All Polychaetes	IMI	8.78	.014	**
				IMI * Time	1.03	.001	***
			Non juv Polychaetes	IMI	8.49	.018	*

		IMI * Time	0.96	.001	***
	All Mollusks	IMI	5.01	.021	*
		IMI * Time	0.78	.241	NS
	Non juv Mollusks	IMI	7.89	.002	**
		IMI * Time	0.86	.263	NS
	Crustaceans	IMI	4.14	.125	NS
		IMI * Time	0.70	.090	NS
	All Invertebrates	IMI	5.73	.061	NS
		IMI * Time	0.76	.006	**
granular	All Polychaetes	IMI	9.07	.010	**
		IMI * Time	0.65	.086	NS
	Non juv Polychaetes	IMI	9.53	.010	**
		IMI * Time	0.64	.093	NS
	All Mollusks	IMI	6.21	.007	**
		IMI * Time	1.20	.055	NS
	Non juv Mollusks	IMI	7.67	.006	**
		IMI * Time	2.10	.011	*
	Crustaceans	IMI	15.54	.002	***
		IMI * Time	2.42	.001	***
	All Invertebrates	IMI	9.70	.003	**
		IMI * Time	1.64	.001	***

[1] Significance of effect: *, p > 0.05; **, p > 0.01; ***, p > 0.001

Table A5. Concentrations of imidacloprid ($\bar{x}$ ± S.E., N), confidence intervals (C.I.), and ranges among sites of differing formulation during large scale field trials, 2011, 2012, and 2014.

Formulation	Site[1]	Concentration (ppb)	95 % C.I.	Range	Reference
liquid IMI	Bay Center	11 ± 3, 5	4 – 18	4 – 19	Patten 2011
	Cedar River	1250 ± 150, 2	-656 – 3156	1100 – 1400	Patten 2011
	Leadbetter	1500 ± 0, 1			Patten 2011
	Palix	2400 ± 0, 1			Grue and Grassly 2012
	Stony Pt	796 ± 260, 5	75 – 1715	180 – 1600	Booth et al. 2014
	Coast	230 ± 0, 1			Booth et al. 2014
	Nisbett	290 ± 0, 1			Booth et al. 2014
granular IMI	Bay Center	52 ± 9, 5	26 – 78	27 – 82	Patten 2011
	Cedar River	24 ± 8, 2	-72 – 119	16 – 32	Patten 2011
	Leadbetter	73 ± 0, 1			Patten 2011
	Palix	490 ± 0, 1			Grue and Grassly 2012
liquid IMI	All	685 ± 186, 16	288 – 1082	4 – 2400	
granular IMI	All	97 ± 50, 9	-18 – 211	16 – 490	

[1] Two treated sites not sampled for benthic invertebrates: Coast, adjacent to and treated simultaneoulsy with Stony Pt. with less vegetation and more uniform substrate; Nisbett (2014), N. Willapa near Cedar River, silty substrate.

Table A6. Number of PRCs with a negative[1] , positivie[2], or neutral[3] position of the principal response at the final sample date compared to pre-treatment (PRC end response) for each of 49 PRC analysis with both significant treatment effects and a significant axis 1.

PRC End Response	Year – Study Site – Formulation	No. of PRCs	Taxonomic Assemblage
Negative	2012 – Palix – Liquid	2	Mollusk
			Crustaceans
	All Years, Sites – Liquid	2	Mollusk
			Non-juvenile Mollusk
	2012 – Palix – Granular	1	Non-juvenile Mollusk
	All Years, Sites – Granular	1	Non-juvenile Mollusk
	Total	**6**	
Positive	All Years, Sites – Liquid	2	Polychaetes
			Non-juvenile Polychaetes
	2011 – Bay Center -- Granular	1	Mollusks
	2012 – Leadbetter – Granular	1	Mollusks
	All Years, Sites – Granular	1	Mollusks
	Total	**5**	
Neutral	2011 – Bay Center – Liquid	2	Mollusk
			All Families
	2011 Cedar River – Liquid	4	Polychaetes
			Non-juvenile Polychaetes
			Crustaceans
			All Families
	2012 – Palix – Liquid	4	Polychaetes
			Non-juvenile Polychaetes
			Non-juvenile Mollusks
			All Families
	2012 – Leadbetter – Liquid	3	Polychaetes
			Non-juvenile Polychaetes
			All Families
	2014 – Stony Pt – Liquid	6	Polychaetes
			Non-juvenile Polychaetes
			Mollusks
			Non-juvenile Mollusks
			Crustaceans
			All Families
	2011 – Bay Center – Granular	5	Polychaetes
			Non-juvenile Polychaetes
			Non-juvenile Mollusks
			Crustaceans
			All Families
	2012 – Palix – Granular	5	Polychaetes

		Non-juvenile Polychaetes
		Mollusks
		Crustaceans
		All Families
2012 – Leadbetter – Granular	5	Polychaetes
		Non-juvenile Polychaetes
		Non-juvenile Mollusks
		Crustaceans
		All Families
All Years, Sites – Granular	4	Polychaetes
		Non-juvenile Polychaetes
		Crustaceans
		All Families
Total	**38**	

[1] Response of the test assemblage relative to the control was lower at the final sample date compared to before.

[2] Response of the test assemblage relative to the control was higher at the final sample date compared to before.

[3] Response of the test assemblage relative to the control assemblage was the same at the final sample date compared to before.

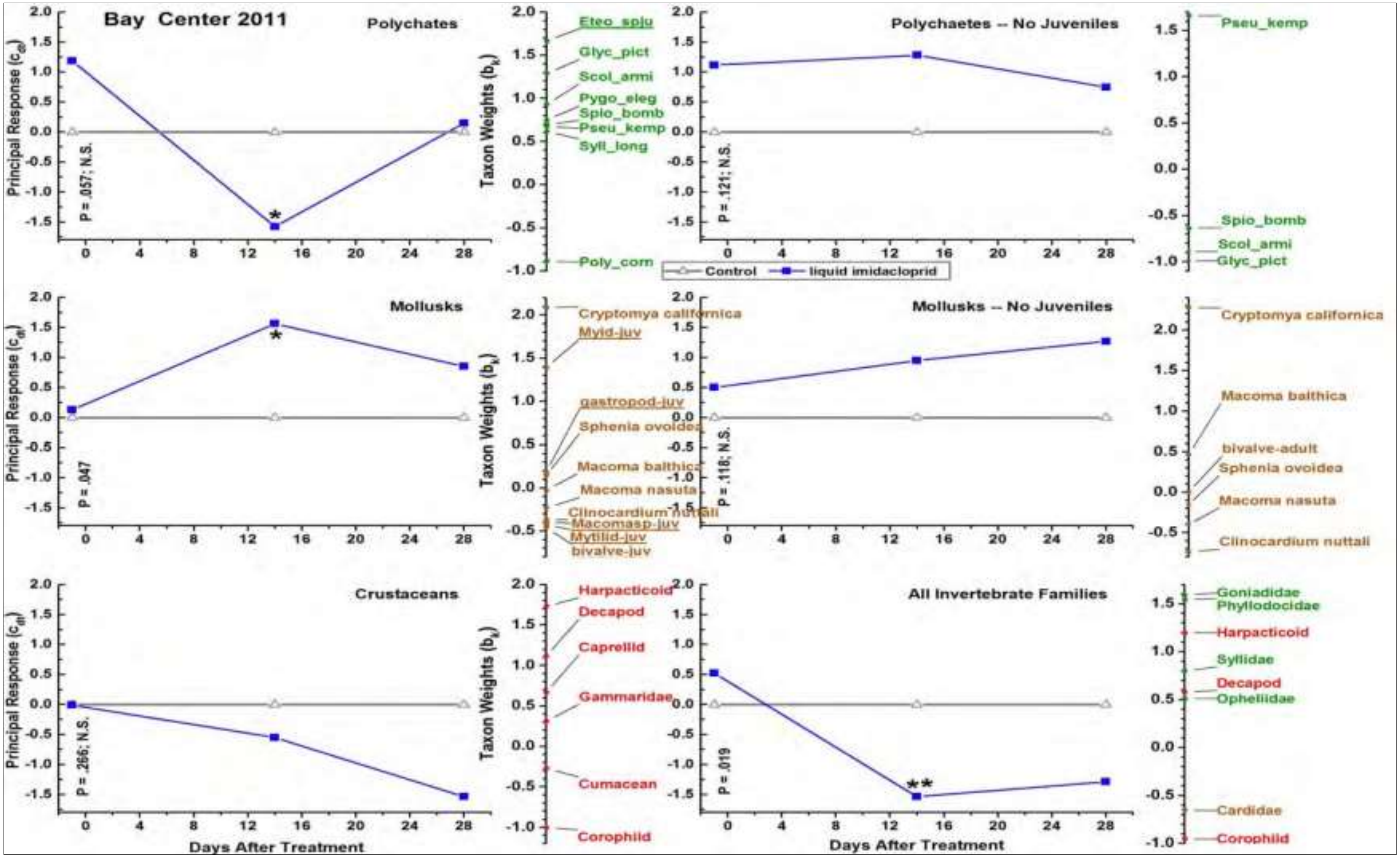

Figure A5. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Bay Center in 2011. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

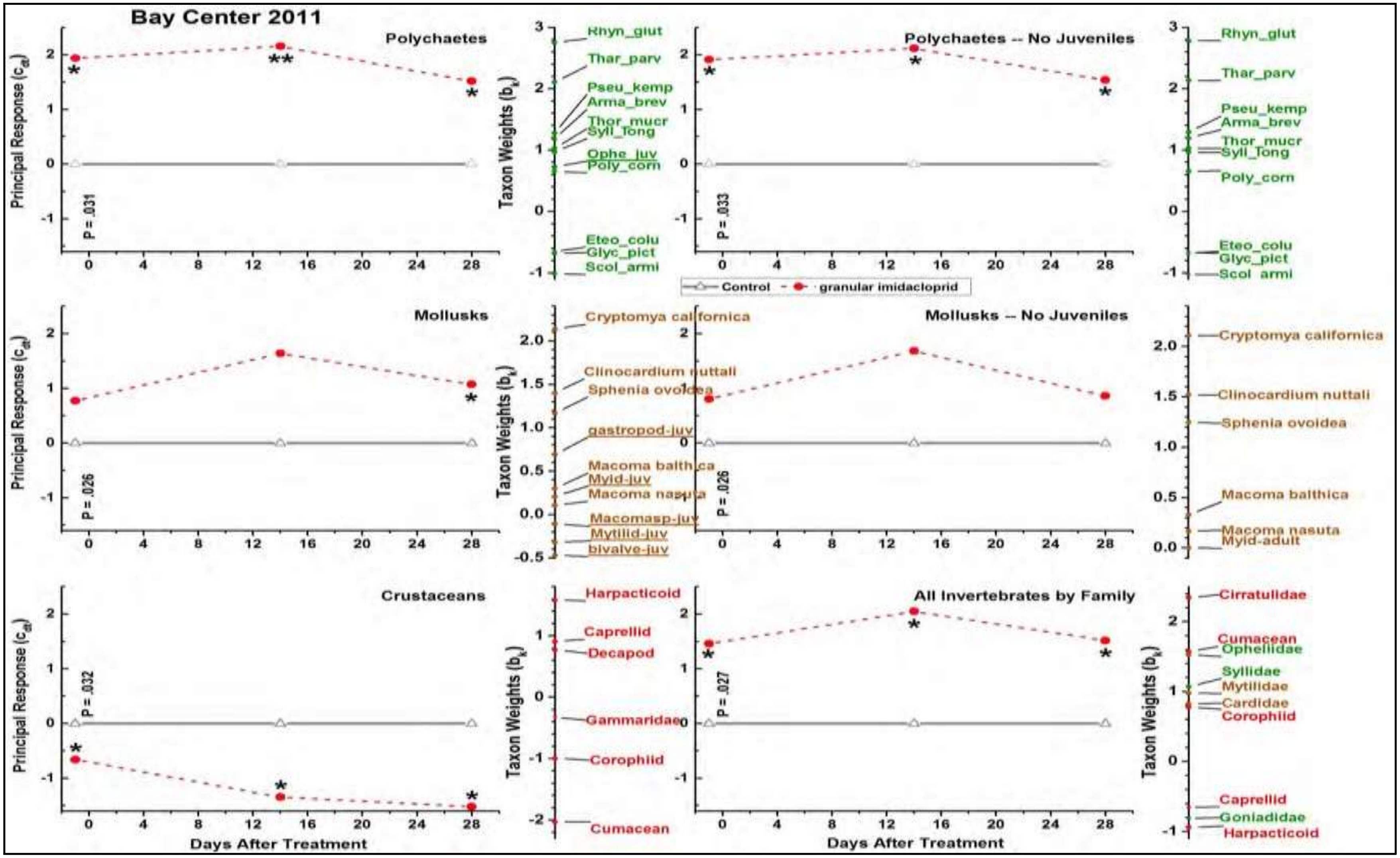

Figure A6. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at granular imidacloprid and control plots at Bay Center in 2011. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

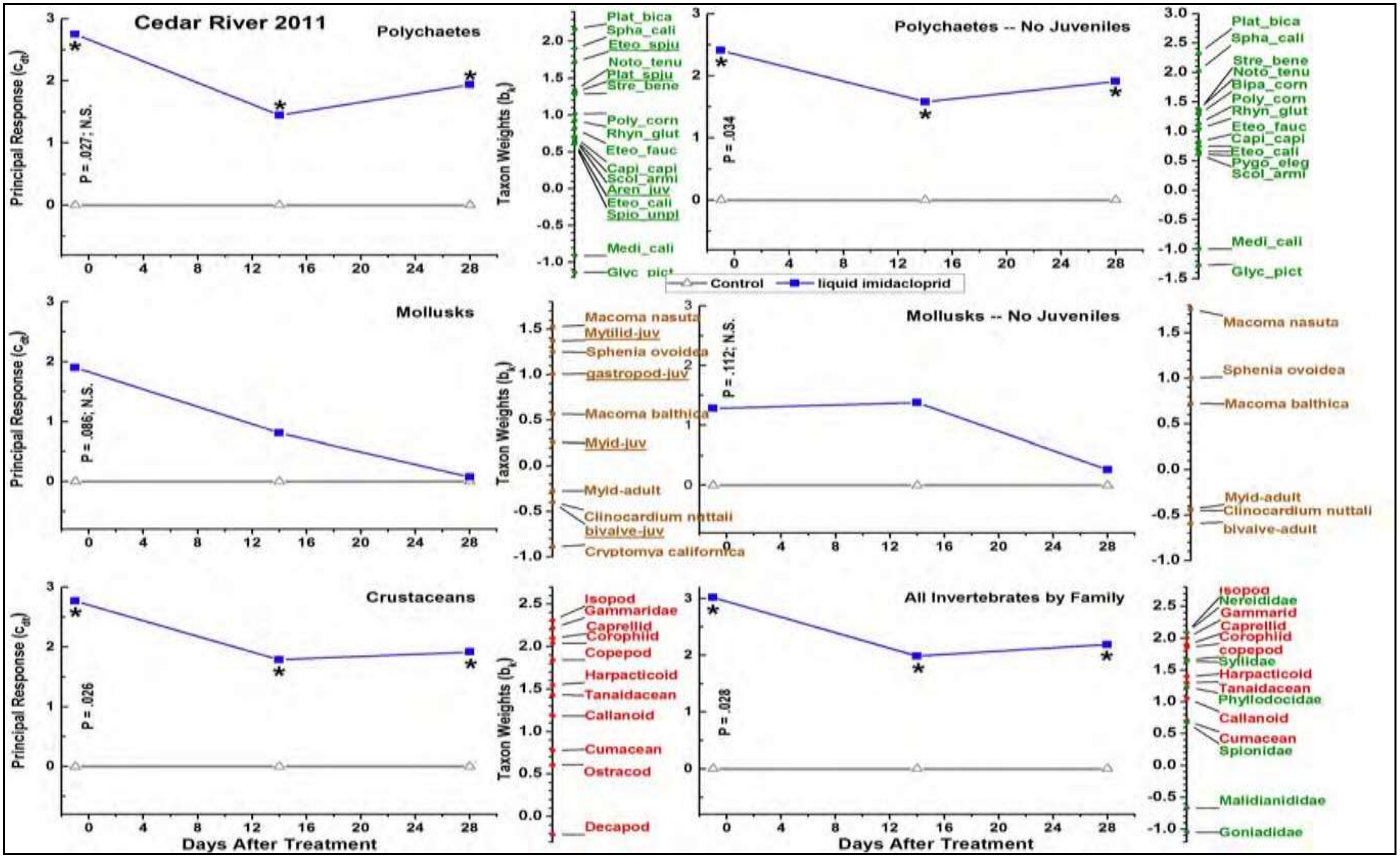

Figure A7. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Cedar River in 2011. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

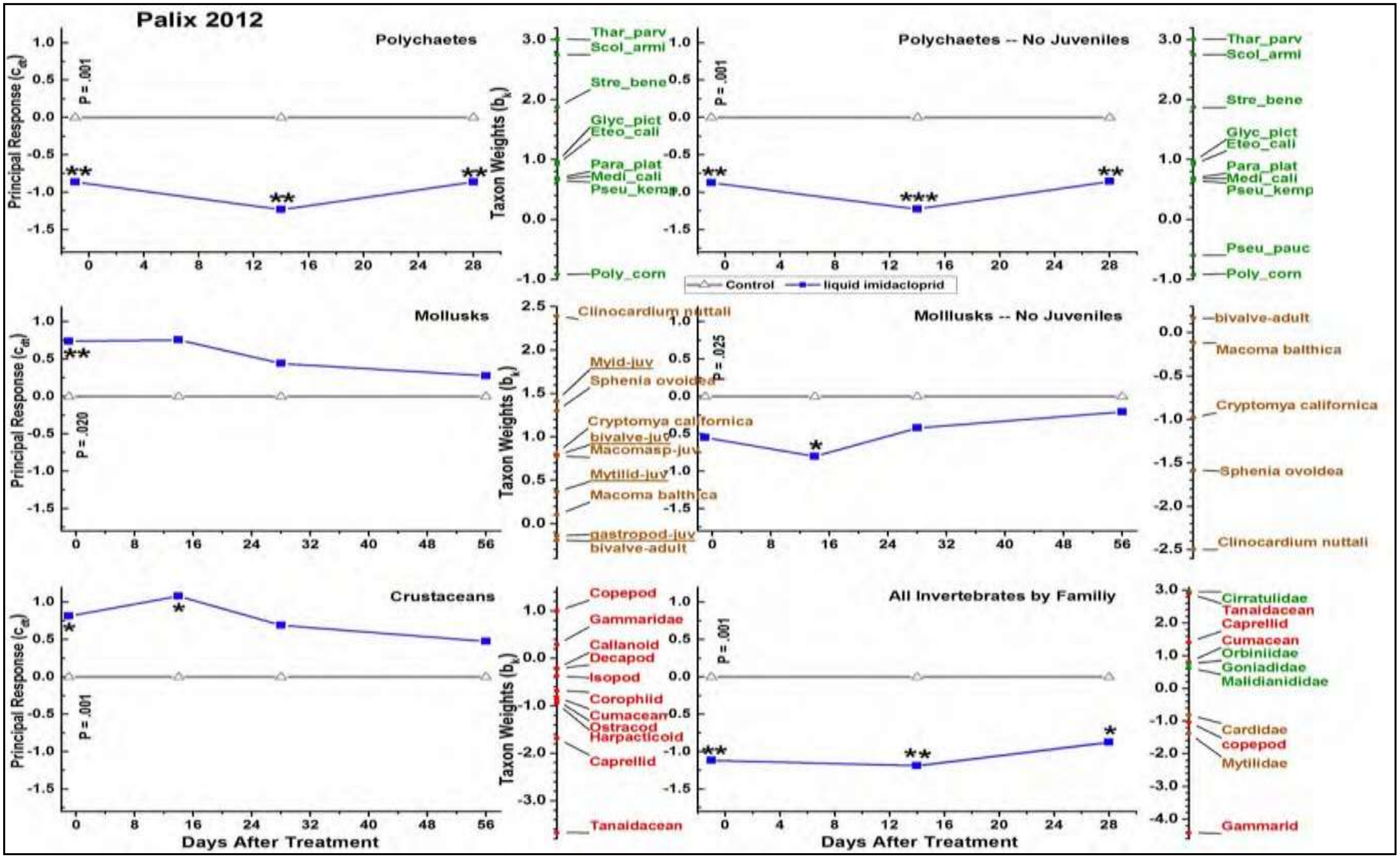

Figure A8. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Palix in 2012. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, p < 0.05; **, p < 0.01; ***, p < 0.001). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

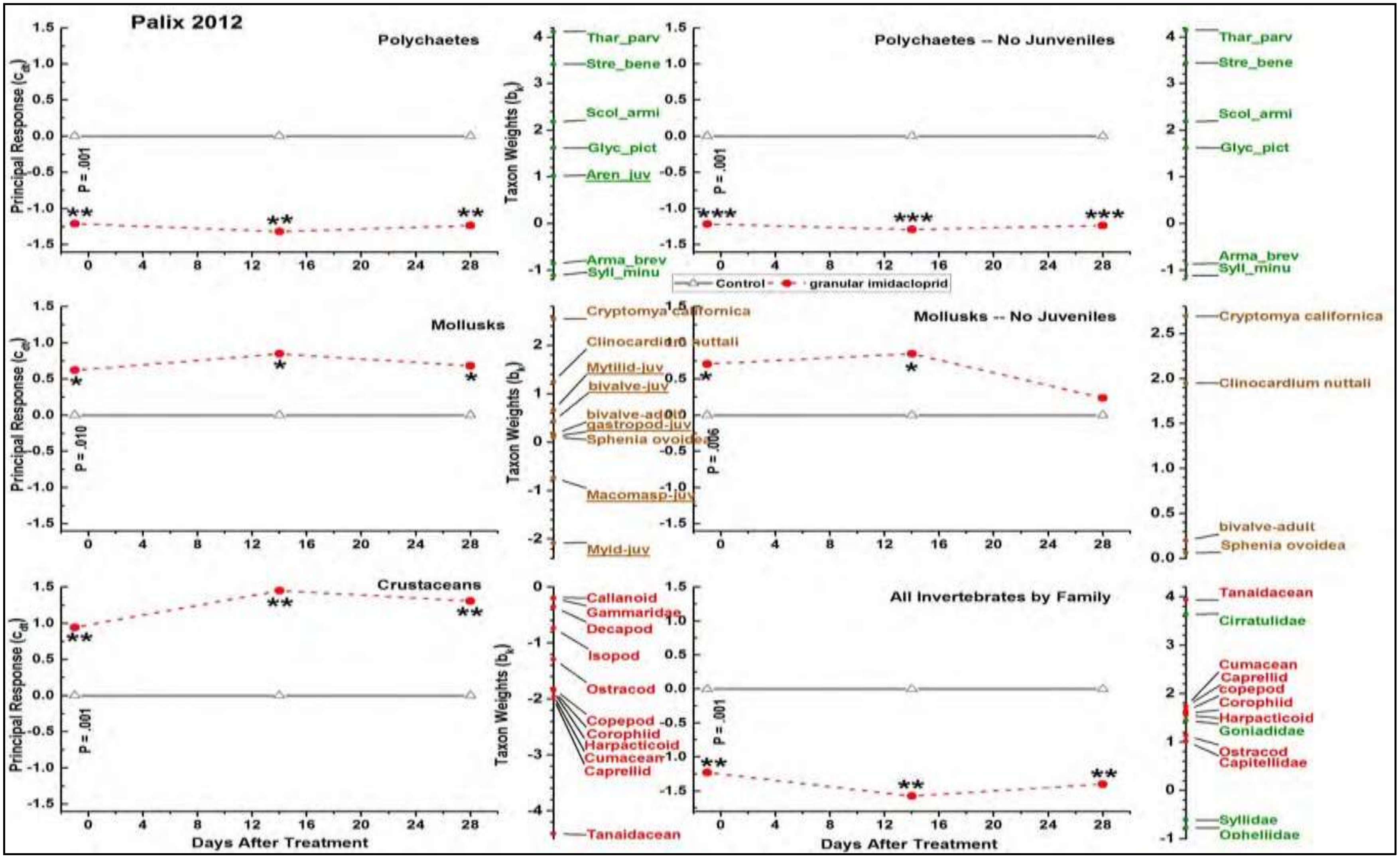

Figure A9. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at granular imidacloprid and control plots at Palix in 2012. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

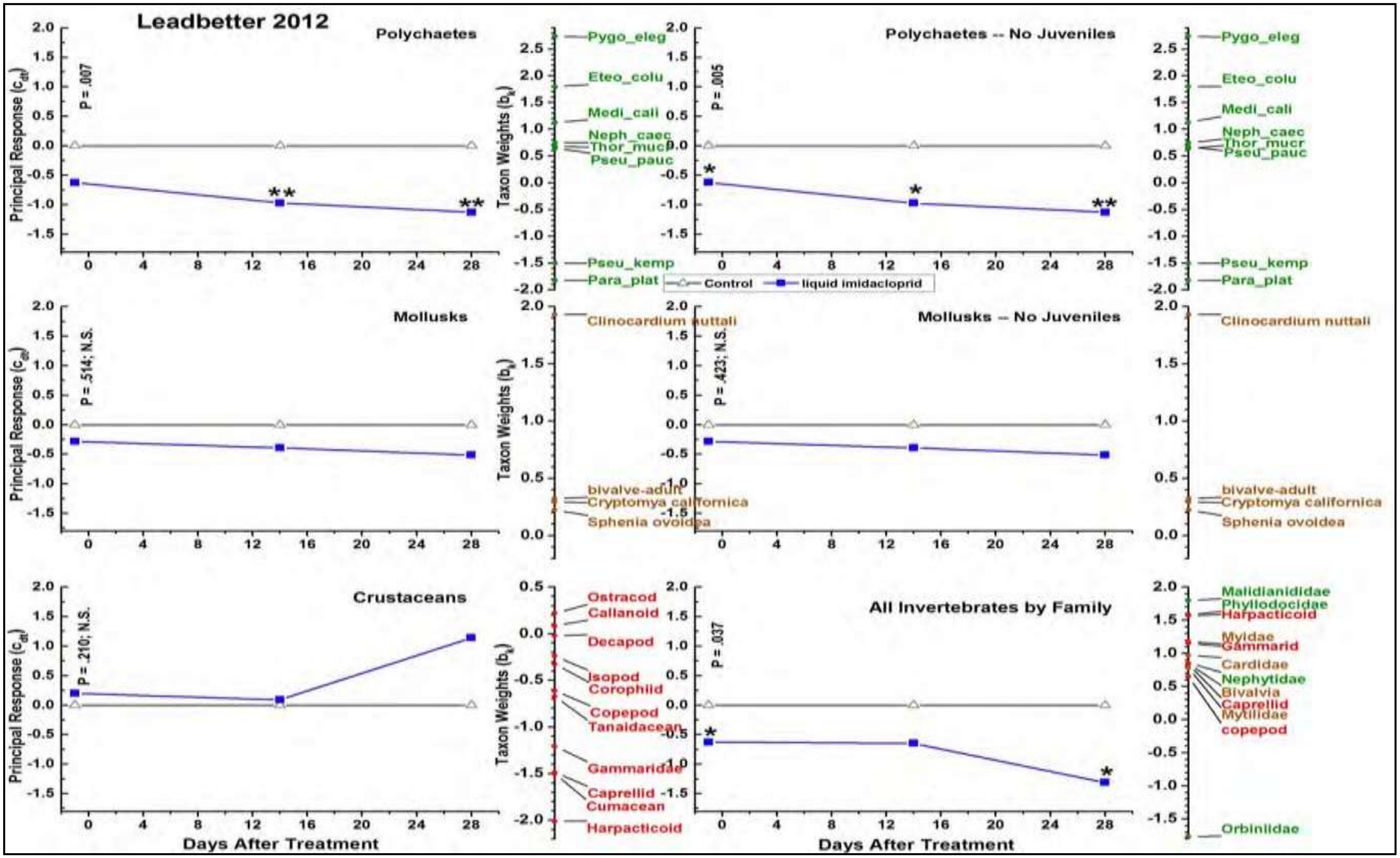

Figure A10. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Lead Better in 2012. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

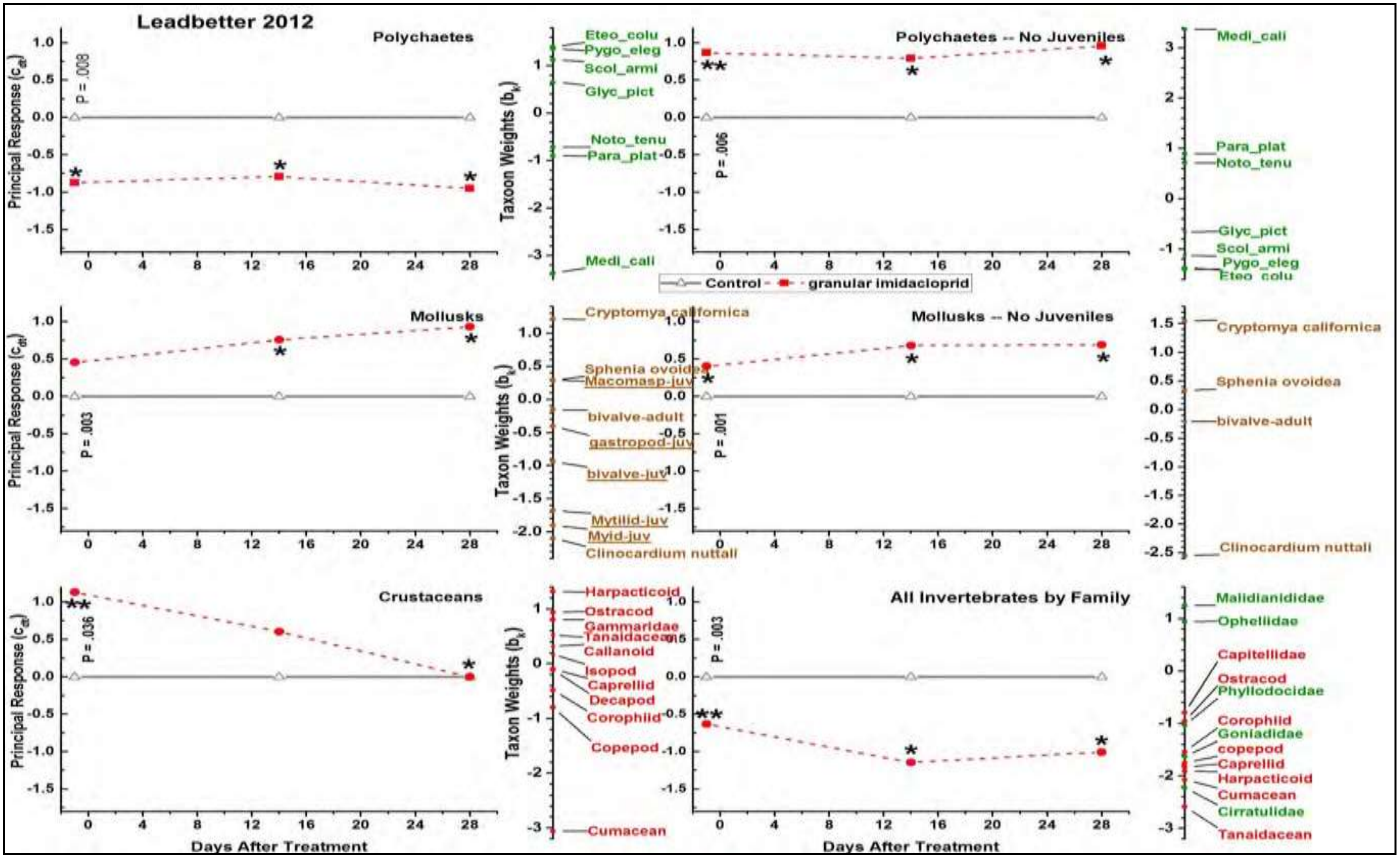

Figure A11. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at granular imidacloprid and control plots at Leadbetter in 2012. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, p < 0.05; **, p < 0.01; ***, p < 0.001). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

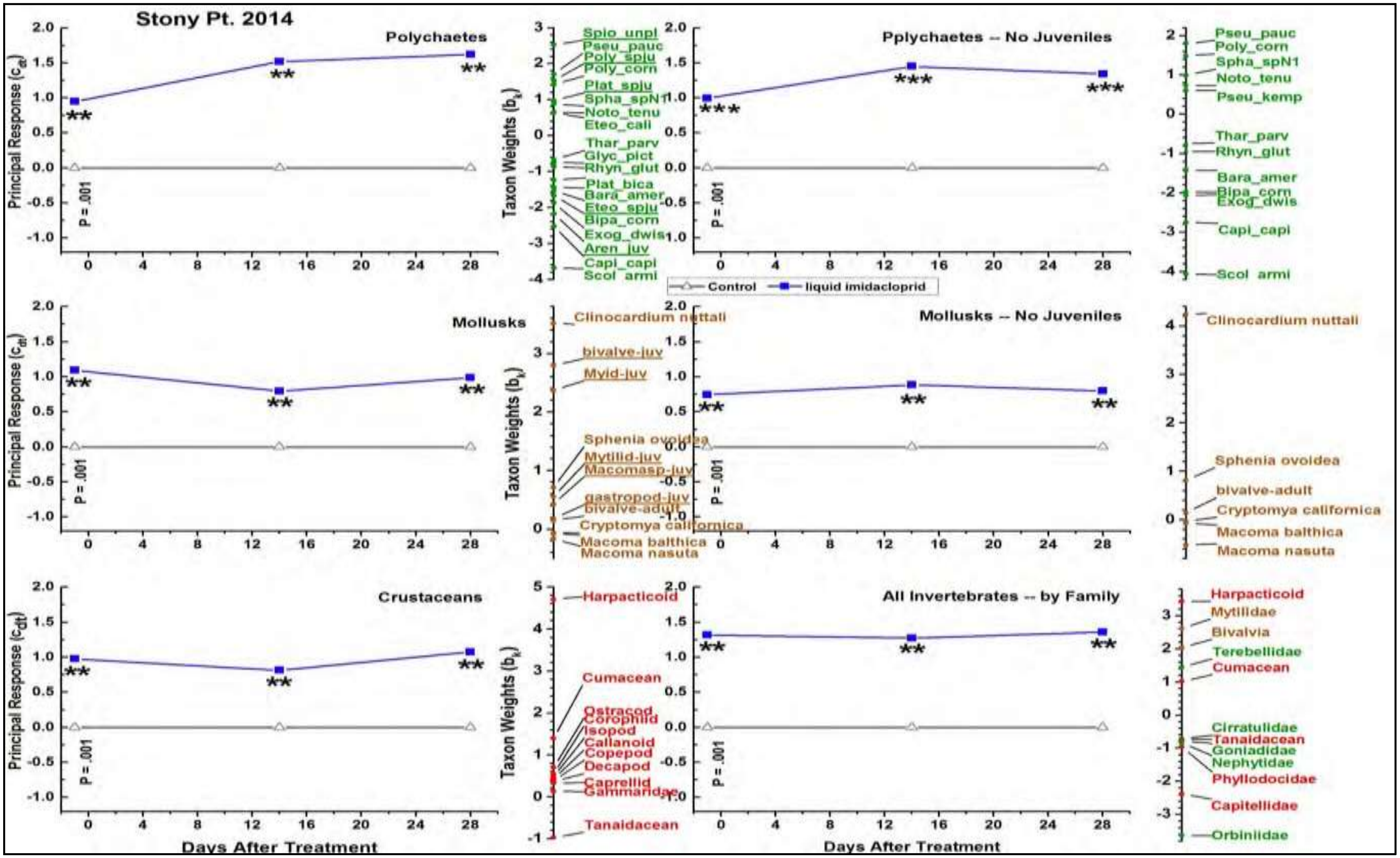

Figure A12. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots at Stony Pt in 2014. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

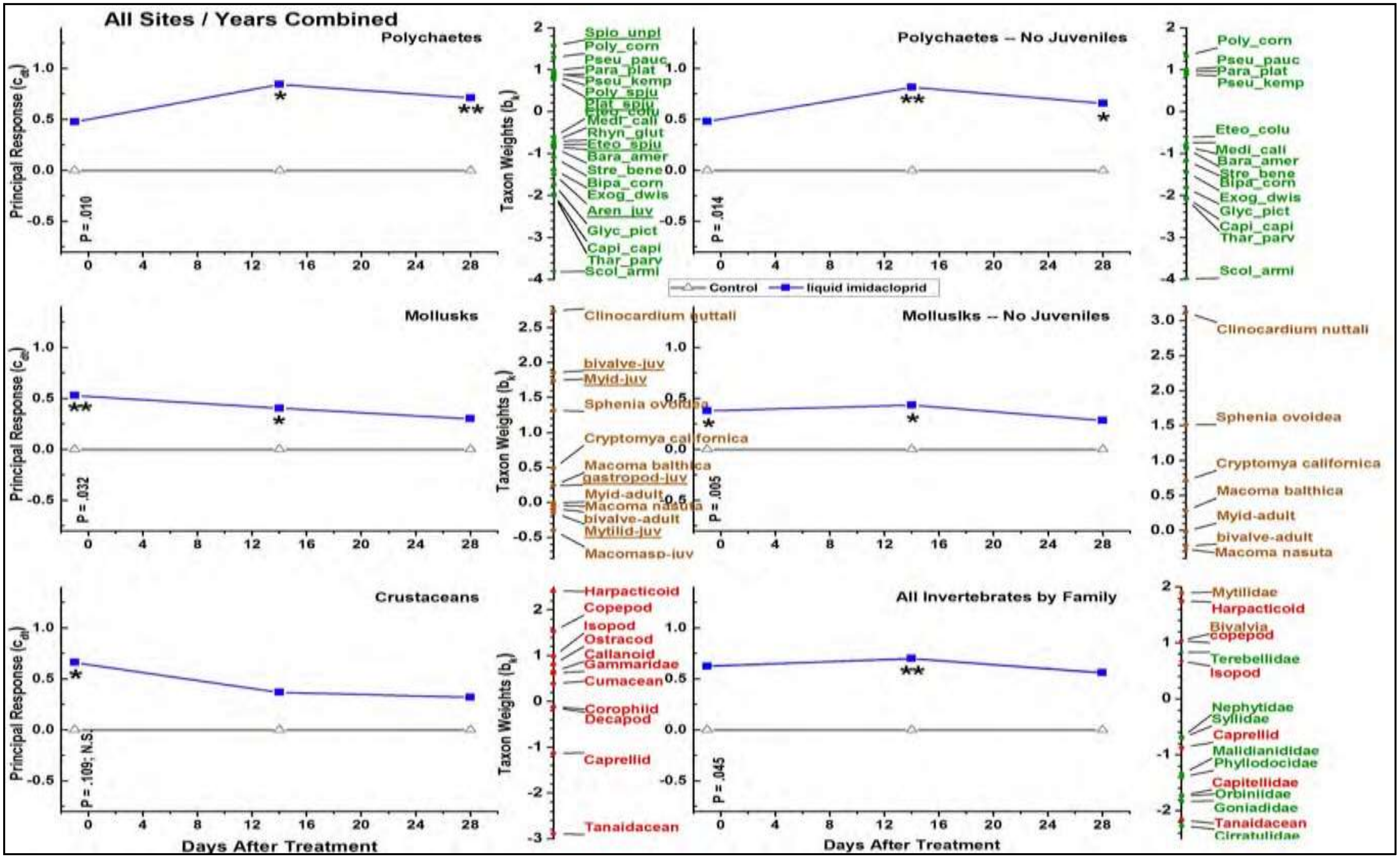

Figure A13. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at liquid imidacloprid and control plots with all sites and years combined. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

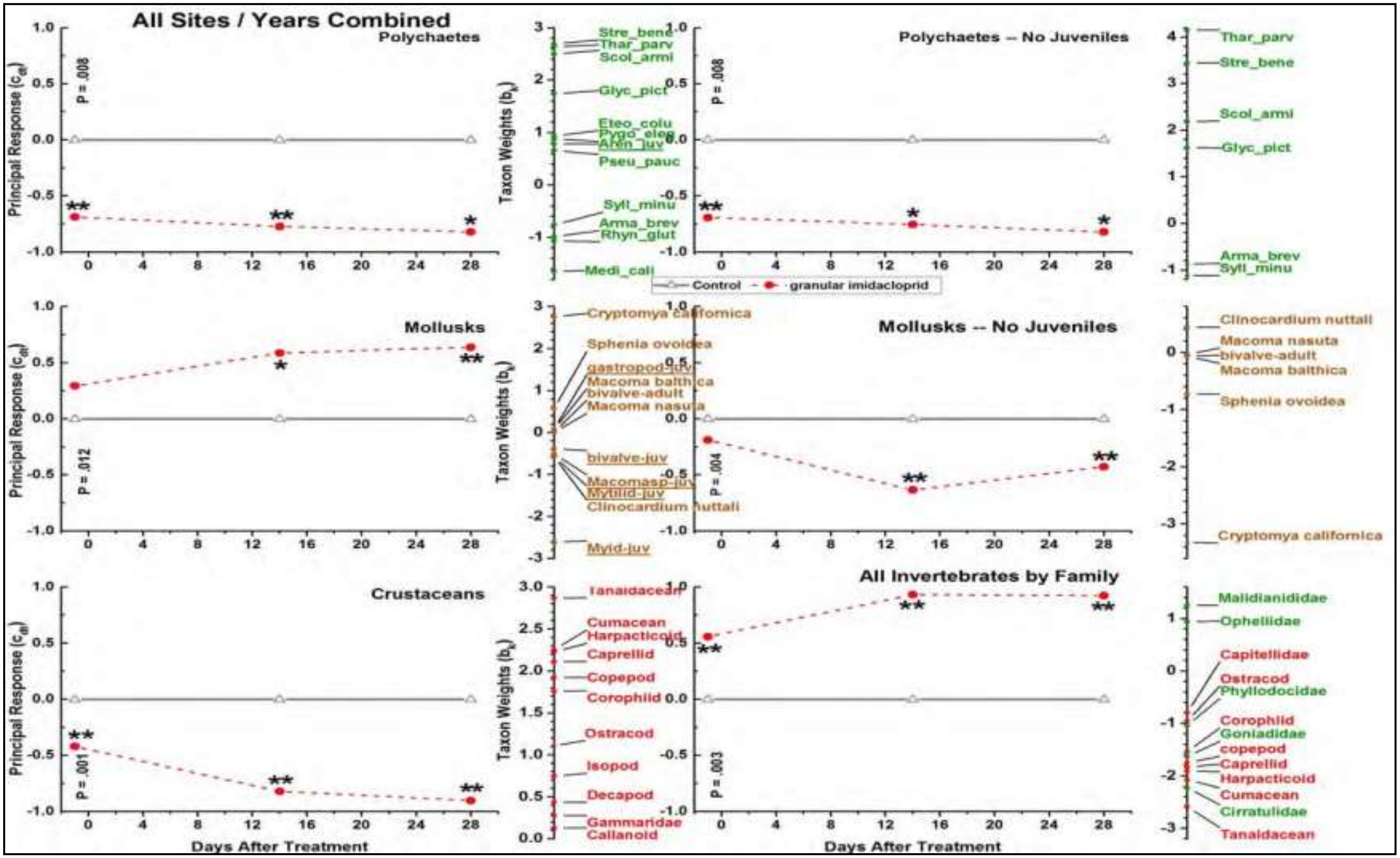

Figure A14. Principal Response Curve of polychaetes (green labels), mollusks (brown labels), crustaceans (red labels) and all groups combined at graunular imidacloprid and control plots with all sites and years combined. P is probability that the displayed primary axis is significant. Asterisks indicates the response at each sample date is significantly different from the control (*, p < 0.05; **, p < 0.01; ***, p < 0.001). Taxon weights indicate taxa that are positively or negatively correlated with the shape of the curve (weights > -0.06 and < .06 for polychaetes are not shown). Underlined taxa are juveniles. Table A2 lists polychaete full names and abbreviations.

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ATTACHMENT C to WGHOGA comments on the Draft Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor

DATE: April 3, 2015

TO: Jesse DeNike, Plauché & Carr

FROM: Jeff Barrett

RE: **NMFS Agency Comments**
12733-02-10

CC: Adrienne Stutes, James Selleck

The information provided within is in response to agency comments for the Willapa-Grays Harbor Oyster Growers Association project.

NMFS Comments

The following information is in response to comments from the National Marine Fisheries Service (NMFS), December 8, 2014.

Comment #1

The draft permit allows significant increases in acreages for shrimp control over previous levels. Specifically, the treatment in Grays Harbor would increase from 200 acres treated per calendar year to 500 acres, and treatment in WIllapa Bay would increase from 600 to 1,500 acres per calendar year for a total of 2,000 acres treated annually. This more than doubles the amount of area previously permitted for treatment with the carbamate insecticide, carbaryl.

Response

The total acreage being proposed does not necessarily represent an increase in the treated area. The higher acreage for imidacloprid is due in part to relative uncertainty on the efficacy of treatment, because imidacloprid is less toxic than carbaryl, and the ability to control burrowing shrimp may require more frequent spraying with imidacloprid. The increased acreage may represent re-spraying areas that have been previously treated, so that the total unique area exposed to imidacloprid in Willapa Bay and Grays Harbor could be much smaller than the acreage allowed. In addition, as growers learn how to best use imidacloprid, it is expected that the total acreage requested for spraying each year will decrease.

Even under the unlikely assumption that all permissible acres are sprayed, and that all acres are unique (i.e., not re-sprayed), 1,500 acres in Willapa Bay represents only 3.33 percent of the total tideland

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acreage (45,000 acres), and 500 acres in Grays Harbor represents only 1.45 percent (of 34,460 acres). Thus, the vast majority of both of these estuaries will not be sprayed in any given year, ensuring that any ecological benefits from unsprayed areas will be present and unimpaired. That includes any ecological benefits from the presence of burrowing shrimp, including as prey to other organisms.

There is also a significant difference in the concentration of chemical applied. The active ingredient for carbaryl was 8.0 pounds per acre, but imidicloprid is only applied at 0.5 pounds of active ingredient per acre, so the total applied active ingredient per year will be drastically reduced. Accordingly, concerns by NMFS of a significant impact to the estuary in general, or to fish in particular, are not supported given that the vast majority of both estuaries will not be affected by imidacloprid treatments and those acres that are sprayed will have much less active ingredient.

Comment #2

[p. 2] *NMFS strongly encourages a more cautious approach. There are far too many unknowns with imidacloprid's use; and issues to be worked out regarding impacts to other aquatic and terrestrial biota. We believe measured increases in acreage treated up to the proposed amount would allow for more effects information to be obtained. Ecology should begin by keeping the acreage as before.*

Response

As with Comment #1 above, the NMFS reviewer is incorrectly assuming that every acre being requested in the permit will be sprayed each year, and that none of the areas sprayed would be sprayed more than once. If re-spraying areas is needed, the total unique acreage sprayed would effectively be smaller than that sprayed with carbaryl. Ecology chose to consider the full 2,000 acres in the EIS to ensure that any possible impacts were reviewed. This decision also reflected the understanding that imidacloprid is not as effective as carbaryl, and in order to obtain sufficient efficacy of shrimp removal using imidacloprid, a more flexible treatment plan could be needed.

Data collected from Willapa Bay documented a large recruitment pulse of burrowing shrimp in the last few years, possibly due to a recruitment cycle (Dumbauld, USDA-ARS, data under review, personal communication). This pulse resulted in a need to treat an extensive area in order to facilitate oyster growing. If future burrowing shrimp recruitment is reduced to levels more normally observed in the past 20 years, then it is possible that the total acreage of uniquely treated areas may be reduced in time to match the previous acreage used for carbaryl application. The issuance of the new permit needs to allow for adequate levels of imidacloprid application in order to match the current recruitment cycle, and ensure the effectiveness of treatment. Without these increased areas, the required effects to control burrowing shrimp may not be achieved.

Extensive field studies conducted by the University of Washington, Washington State University, and the Pacific Shellfish Institute have documented that imidacloprid is much less toxic to non-target organisms than carbaryl. In addition, as mentioned above, the concentration of active ingredient proposed for imidicloprid is significantly lower than that used for carbaryl, and 2,000 acres is the greatest possible area for a potential treatment range. The NMFS reviewer's recommendation that acreage limits for imidacloprid mimic those used for carbaryl ignores the much lower toxicity of imidacloprid, and lower application rates of active ingredient. Accordingly, a direct link in acreages sprayed with each of these two chemicals is scientifically unsupported.

Comment #3

The rationale for these increases, by Ecology, are 1) the growers were concerned with the efficacy of imidacloprid, and 2) growers believed the number of burrowing shrimp have been increasing.

NMFS is not convinced that an increased area for imidacloprid application in necessary, based on the growers' concern with the efficacy of imidacloprid. Trials conducted from 2010 to 2012 indicated that granular and liquid forms of imidacloprid were moderately to highly effective in reducing densities of shrimp. A 500+ acre application at 0.5 lb imidacloprid study occurred in 2014, but the results of this application have not been made available to Ecology or NMFS. NMFS would like Ecology to review data regarding efficacy, water quality, sediment, and benthic results before making a final determination.

Regarding the suggestion by Ecology that growers believe the numbers of burrowing shrimp are increasing, The NMFS has not been provided data from Mr. Rockett of Ecology to support this claim. Sampling results from water chemistry studies conducted during test treatments is not available (at the time of this review).

Response

As above, NMFS makes the assumption that all acres contained in the acreage limits will be sprayed, and that the limits represent unique acres rather than re-spraying areas that have already been treated.

While efficacy studies have been conducted for several years, much of this work has been on small plots or on adult burrowing shrimp only. As noted above, a recruitment pulse of young burrowing shrimp was documented in Willapa Bay. In response, growers are experimenting with imidacloprid to determine the most effective treatment for burrowing shrimp that requires the least amount of chemical. Given the cost of spraying, growers are highly motivated to determine how to use as little imidacloprid as necessary. Prior studies have documented a number of interrelated variables that affect efficacy, including the seasonal timing of spraying (e.g., early versus late summer), the amount of eelgrass that is present, the frequency and depth of water that is retained on the plots during low tide, and the density of burrowing shrimp. The growers require higher acreage limits to ensure they can successfully treat burrowing shrimp, while resorting to a less effective approach of shrimp control. As previously discussed, over time the growers are expected to become more knowledgeable about the use of imidacloprid and therefore more effective at treatment, resulting in fewer acres being sprayed each year. This trend could be accelerated if burrowing shrimp recruitment drops to levels more representative of the past 20 years.

Results from the 2014 field studies have been provided to Ecology, and should be finalized and available to NMFS soon. The 2014 field studies include results of imidacloprid application to large plots on water quality, sediment data, benthic biota, and efficacy in reducing shrimp burrows. Separate scientific data are also in review (Dumbauld, USDA-ARS, personal communication) regarding the recent increases in burrowing shrimp recruitment. The results from the 2014 field studies arrived at the same conclusions as previous work; in particular, that areas treated with imidacloprid have invertebrate communities that are not statistically different than non-sprayed control areas at 14 days following treatment. Thus, the 2014 studies provide additional support for the conclusion that imidacloprid is not producing a significant negative impact on invertebrate communities where it has been sprayed.

Comment #4

[p. 3] *Burrowing shrimp play an important role in the ecosystem. Habitat modifications include beneficial and adverse effects. Shrimp are prey, and an important link in estuarine trophic pathways. Dungeness crab and cutthroat trout feed on shrimp, and control of shrimp is likely to reduce the quality of EFH for ESA fish, salmon, groundfish, and coastal pelagic species.*

Response

The agency's concerns over habitat impacts resulting from the total acreage treated again make incorrect assumptions about the total acres that will be sprayed. For argument's sake, assuming 2,000 acres (of 79,460 acres) will be sprayed every year, this represents only 2.52 percent of the total tidelands acreage in both Willapa Bay and Grays Harbor. With 97.48 percent of the two estuaries left untreated, any negative habitat impacts will be *de minimus*. This is particularly true given that field trials for imidacloprid have uniformly failed to find significant negative effects on non-target invertebrates, at both 14 and 28 days following treatment. Thus, even areas that are sprayed are likely to retain the majority of the invertebrate fauna that were present prior to treatment, or that are present on non-sprayed control areas.

Numerous studies have documented that burrowing shrimp typically reduce the biodiversity and density of other invertebrate species (Dumbauld and Wyllie-Echeverria 1997; Dumbauld and Wyllie-Echeverria 2003; Colin et al. 1986; Doty et al. 1990), and biodiversity on eelgrass and oyster habitats is often greater than on burrowing shrimp habitat (Ferraro and Cole 2007). The burrowing activities of the shrimp alter the habitat quality in a way that is deleterious to many other species, including those that are important prey for fish. Burrowing shrimp are prey for a variety of species, but no fish species listed by the NMFS reviewer feeds exclusively on burrowing shrimp. Most biologists view areas with high biodiversity as being more valuable ecologically, than areas with low biodiversity. We assume NMFS also supports higher biodiversity, and therefore should not object to control of burrowing shrimp on a small percentage of these estuaries on an annual basis. That still leaves an overwhelming amount of acreage for burrowing shrimp, including whatever ecological values in creating habitat or serving as prey organisms that come with their presence.

The DEIS discusses the history of burrowing shrimp control in detail, but it is worth noting that this is not an eradication proposal. The proposed use of imidacloprid is to help maintain the control of shrimp on oyster beds, as has occurred for over 50 years. While burrowing shrimp are native to the area, their populations in the bay expanded significantly in the 1940s. Imidacloprid is being proposed as a less environmentally impactful solution for selective control of burrowing shrimp.

Comment #5

Control of burrowing shrimp may reduce habitat quality for green sturgeon, and green sturgeon may suffer direct effects by ingesting imidacloprid bound sediments. Prey resource is a primary element of green sturgeon critical habitat.

Response

Green sturgeon feed opportunistically on burrowing shrimp, but as described above, imidacloprid is going to be applied to only a small percentage of Willapa Bay and Grays Harbor. The NMFS reviewer provides no evidence that reducing burrowing shrimp on less than three percent of these estuaries per year, which is a maximum level of treatment unlikely to be achieved as discussed in comments above, would have any deleterious effect on green sturgeon feeding. It is not credible to contend that green sturgeon having access to over 75,000 acres of untreated estuary for feeding would be impacted by any reduction in burrowing shrimp on such a small proportion of the remaining area. In addition, review of the NMFS website on green sturgeon[1] indicates a number of factors thought to be contributing to low green sturgeon numbers. None of those threats involve insufficient food. Instead, limits on spawning habitat are deemed “the principal factor in the decline…”

Imidacloprid will be primarily applied on existing oyster habitat. Green sturgeon do not prefer to feed directly in oyster habitat (Kim Patten, WSU, personal communication). No sturgeon feeding pits have been observed, and there is no scientific evidence of green sturgeon feeding in oyster beds.

To the extent that green sturgeon may feed in other areas immediately following imidacloprid treatment, they may encounter and ingest burrowing shrimp containing imidacloprid residues. This theoretical scenario is not scientifically concerning, because one of the advantages of imidacloprid is its extremely low toxicity to vertebrates. High doses of imidacloprid injected directly into white sturgeon and rainbow trout tissue resulted in persistence in the plasma of the fish 36 hours later, but there were

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[1] Available at: http://www.nmfs.noaa.gov/pr/species/fish/ greensturgeon.htm#threats.

no discernable effects to the brain, liver, kidney, or muscle tissues (Frew 2013). Absence of impacts from direct injection of high imidacloprid doses provides strong support that incidental ingestion of exposed shrimp will have no effects on sturgeon or other fish. Another advantage of imidacloprid is that it dissolves rapidly in sediments, and is diluted quickly with the incoming tide. Frew (2013) found concentrations in the sediments following application around green sturgeon foraging habitat to be two orders of magnitude below the threshold value in which effects on sturgeon have been noted in laboratory studies.

As described in the Environmental Impact Statement (EIS), there is no evidence of reduced prey availability or of harmful exposure of imidacloprid to green sturgeon. Thus, there is no scientific basis for the NMFS reviewer's concern over potential effects on essential fish habitat for green sturgeon or any other fish species.

Comment #6

Experiments in imidacloprid-treated rice fields by Hayasaka et al. (2012) showed direct negative effects on the species abundance of the zooplankton community, leading to the indirect suppression of growth in fishes feeding on the zooplankton species. Sanchez-Bayo and Goka (2006) found indirect effects on algae growth in rice fields after changes of the arthropod communities induced by imidacloprid.

Response

This paragraph is a direct copy and paste from the publication "Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid" (Van Dijk et al., 2013). It is not the opinion of the reviewer, using the citations listed. The algae blooms in reference were *Spirogyra* sp., which developed specifically in the absence of *Chironomus yoshimatsui*, a freshwater midge. This study was conducted in a restricted area with no rapid tidal flushing or dispersal mechanisms that exist for imidacloprid in the estuary. More importantly, this study found that biodiversity was not impacted by the use of imidacloprid, and that differences between treatments could not be attributed to imidacloprid due to limited exposure.

More misleading is the study referenced from Hayasaka et al. (2012). That study examined the cumulative effects of two insecticides, imidacloprid and fipronil. The study determined that fipronil was more persistent in the soil than imidacloprid, and that ecological impacts on benthic species and associated fish was a result of the residual fipronil, not imidacloprid.

Thus, both references are inappropriately cited by NMFS. Field studies of imidacloprid in Willapa Bay and Grays Harbor are the best test for expected effects of imidacloprid spraying to support shellfish aquaculture in these estuaries, not obscure references based on freshwater ecosystems. Relevant studies have consistently shown that invertebrate communities are largely indistinguishable between treatment and control plots at 14 and 28 days following imidacloprid treatment in these estuaries. This is strong empirical support for issuance of the permit.

Comment #7

Ecology is clearly aware that imidacloprid is a persistent broad spectrum pesticide that will kill nearly all benthic organisms on the acreage directly treated. NMFS believes will impact benthic prey species in areas where the spray has drifted by tidal currents. Including prey for salmon, groundfish, coastal pelagic species, herring, sandlance, and smelt. Activities reducing prey directly affect the growth and survival of pacific salmon (NMFS 2009). NMFS encourages ecology to take impacts to fish into greater consideration.

Response

This statement is incorrect. It assumes that imidacloprid causes direct mortality in benthic organisms. In fact, nearly all of the field studies with imidacloprid in Willapa Bay have shown that invertebrate communities in treatment and control plots are statistically indistinguishable at 14 and 28 days following treatment. The experimental design of these studies generally makes it difficult to determine if the lack of a treatment effect is due to low indirect mortality or rapid recolonization from surrounding portions of the estuary. The continued presence of native shellfish and some large polychaetes that do not generally migrate supports the conclusion that some taxa suffer no mortality. Regardless, there is no scientific or experimental evidence supporting the reviewer's bold statement of widespread and lingering impacts from imidacloprid treatment.

With respect to vertebrate species, imidacloprid has limited effects except in extremely high concentrations. For example, the lethal toxicity (LC_{50}) of imidacloprid for juvenile white sturgeon was found to be 124 milligrams per liter (mg L^{-1}), and injected concentrations as high as 250 micrograms per kilogram (μg kg^{-1}) had no effect on kinetics of rainbow trout (Frew 2013). Also, these were laboratory studies using direct injections into the tissues, and do not account for rapid tidal dispersal of the chemical or low rates of absorption experienced in the environment. Imidacloprid does not even directly kill burrowing shrimp except at concentrations much higher than those allowed under the permit. Instead, it causes a temporary paralysis response in crustaceans (Gervais et al. 2010). Burrowing shrimp must continuously clear their burrows, and during the temporary paralysis the burrows collapse, suffocating the shrimp. Thus, imidacloprid is highly selective to burrowing shrimp, which makes it an ideal chemical control.

The list of fish species presented by the NMFS reviewer is overly broad. Imidacloprid is not expected to affect many of these species, as they either do not feed directly on the benthic tidelands where imidacloprid will be administered, or are highly mobile species that migrate between habitat types. Studies conducted in the estuaries found no significant difference in fish abundance between the three habitat types discussed here: eelgrass, shrimp-infested areas, and oyster beds (Dumbauld, USDA-ARS, data under review, personal communication). When these fish are found in the nearshore, examination of stomach content is not representative of the respective habitat where they were caught. For example, salmon diets in the estuary were found to be more closely dependent on pelagic insects from other associated habitats. The salmon fed on insects in freshwater prior to migrating through the benthic nearshore habitat. The likelihood of exposure is further reduced, as imidacloprid will only be administered during low tide when fish are not present due to the lack of water. Other proposed methods to reduce any potential for impacts of imidacloprid treatment include waiting until after seasonal out-migration of juvenile salmon completes, and application only during periods of low wind to prevent the accidental spread of imidacloprid beyond established buffers from estuary channels or sloughs.

Comment #8

[p. 4] *NMFS is concerned with delayed, lingering, and latent effects. Experimental studies have found significant effects from persistent, toxic levels below no effects levels. Cumulative effects of neonicotinoids imply that even the lowest concentrations have toxic effects if sustained over a long period, which is especially relevant for species with a long life span such as sturgeon (Van Dijk, et al. 2012). The serious concern about the far-reaching consequences of abundant use of imidacloprid for aquatic ecosystems is justified.*

Response

Data submitted to Ecology for fieldwork in 2011, 2012, and the soon-to-be released data for 2014 all document that imidacloprid in surface water is rapidly diluted by the incoming tide following treatment. Given an approximately 10-foot tidal range and unimpeded mixing within Willapa Bay and Grays Harbor, imidacloprid in water can be expected to dilute to non-detectable levels within one or two tidal cycles at most, and to be below any possible biologically relevant concentration in that same timeframe. Previous work has similarly documented that imidacloprid concentrations in sediment pore water and whole sediments exhibit an approximately exponential decline over 28 days and 56 days respectively. Many sediment samples are below detection levels within 28 days. Given the exponential rate of decline following treatment, imidacloprid is expected to be below detection levels, and ultimately below any possible biologically relevant concentration, within a weeks to a few months at most. Monitoring in 2015 will be conducted to confirm that the areas sprayed with imidacloprid the year prior are below laboratory detection levels. Collectively, all of this empirically derived research information shows that there is no basis to conclude that imidacloprid is persistent in water, sediment pore water, or whole sediments.

Against this body of empirically derived evidence the NMFS reviewer again refers to the Van Dijk publication that was inappropriately applied above, and which does not scientifically support the argument against imidacloprid use in Willapa Bay and Grays Harbor. The reviewer also inappropriately cites the Hayasaka et al. (2012) paper, which in fact describes imidacloprid as not having residual effects.

In addition to the scientific evidence documenting that imidacloprid is not persistent, and therefore will not have chronic, sub-lethal effects, we note that comments by the NMFS reviewer were copied and pasted from the Van Dijk et al. (2012) paper, and are accordingly misleading. That was not an experimental study. The Van Dijk study was a comparison between separate databases from separate locations, which were not paired by direct spatial or temporal scales. The study states, "A significant negative relationship between imidacloprid concentration and macro-invertebrate abundance…does not necessarily imply that imidacloprid is the main cause for lower species abundance." The paper used correlation analysis to draw comparisons of sites with up to three kilometers between the locations where imidacloprid was used and the locations where invertebrate surveys unrelated to the imidacloprid application were conducted (the surveys were part of a separate national monitoring program). The work was also conducted on freshwater ecosystems, examined agricultural runoff of imidacloprid, and often included water bodies with limited flushing. All of these differences from the proposed use of imidacloprid in Willapa Bay and Grays Harbor indicate the reference to this study by NMFS is scientifically inappropriate.

The Van Dijk study acknowledged that imidacloprid does not bind with vertebrate receptors (e.g., green sturgeon), and specifically targets insects. Other studies have confirmed this as well, specifically in showing limited or no effect in sturgeon (Frew 2013). Cumulative effects cited by the NMFS reviewer were not experimentally tested in the Van Dijk paper. Van Dijk cites Hayasaka et al. (2012), as discussed above, which was again based on the simultaneous use of multiple insecticides (imidacloprid and fipronil) in fresh water systems, and is not scientifically relevant when discussing sturgeon in an estuary.

Comment #9

The Puget Sound toxic site recovery standard of 50% recovery to biotic richness and abundance is not sufficiently protective of aquatic resources and their habitats. Applying this standard to acres sprayed and off-site areas affected could represent a huge and continuing loss in biotic production for other valuable species. NMFS recommends the use of an 80% recovery to support listed species and other resources.

Response

This statement of expected impact is unsupported by any scientific or other information. The Department of Ecology is charged with implementing the Clean Water Act, including the NPDES permit under consideration here, in Washington State. As the responsible agency, Ecology developed criteria and standards for assessing the magnitude of impacts to water, sediments, and related biota for NPDES permitted discharges. That includes the entire SIZ program, which is an Ecology created and implemented system, not a component of the federal CWA. As noted above, the Department of Ecology has properly concluded the use of imidacloprid, as conditioned, will comply with the applicable regulations, and the NMFS has not provided concrete or specific evidence demonstrating Ecology's determination is erroneous.

Further, it is important to recognize that the threshold criterion referenced by the USFWS is only relevant when invertebrates on imidacloprid treated sediments show declines in number or types of organisms that approach 50 percent compared to control plots. The experimental results on imidacloprid show that this is rarely the case. Instead, treatment plots often have higher numbers and/or types of organisms than control plots, and in other cases show only small declines in selected taxa.

NMFS's recommended value of 80 percent appears entirely artificial and not based on scientific or regulatory standards. Willapa Bay and Grays Harbor are highly dynamic environments, with shifting species presence and abundance relative to seasonal and tidal fluctuations. Specific species readily migrate through habitats, which can result in shifts in the species complex present, while still maintaining high richness and abundance. The 2011, 2012, and 2014 studies consistently found that invertebrate biodiversity and abundance between treatment plots and control plots, following imidacloprid application, were not statistically distinguishable. As discussed above, the absence of differences could be due to limited effect of imidacloprid to non-target species, to recolonization of treatment beds by species moving back into treated plots from nearby untreated areas, or some combination of the two. Regardless, the lack of differences between treatment and control plots at 14 and 28 days following spraying demonstrates that the effects from imidacloprid treatment are relatively short-lived and site-specific. Also, an 80 percent standard would not be representative of recovery, considering that over 97 percent of the estuaries will be left untreated, and only a very limited number of relative acres will be sprayed.

Comment #10

[pp. 4–5] *NMFS recommends grant programs to research alternates to pesticide use.*

Response

We thank the NMFS for alternative recommendations. It's important to note that extensive alternative approaches have been tested over the years. These pilot studies have included mechanical removal of burrowing shrimp, covering plots with tarps, non-toxic liquid applications, and using above ground stakes for oyster attachment (see DEIS section 1.5). None of these alternatives were successful, however, and disruption of the sediments by burrowing shrimp make it difficult or impossible to anchor any above-ground oyster lines or other structures. There is also a specific market for the product that is produced with ground cultured oysters, and alternative methods may make the product unprofitable or limit production to levels that would not support that market (i.e., for shucked oysters).

It is important to note that the direct effects from mechanical control of burrowing shrimp (i.e., graveling or frosting) are considered more impactful to invertebrate biodiversity and non-target species than from the treatment using imidacloprid (Ferraro and Cole 2007). Physical disruption of the sediments, such as by adding gravel substitutes or compressing the sediments, has greater direct negative impacts to species diversity and habitat within the estuaries than chemical treatment, but requires a larger area of treatment to reach the same efficacy as imidacloprid in controlling burrowing shrimp.

Comment #11

[in the summary] *All required sampling should be conducted every year over the duration of the permit. This requirement would be informative. For example, if the data supported it, yearly sampling results could justify measured increases in acreage treated (up to the proposed limit) in subsequent issuances of the NPDES permit.*

Response

See Comment #4 for the National Pollution Discharge Elimination System (NPDES) permit below.

NMFS Appendix Comments – Draft NPDES Permit

The following information is in response to comments from the National Marine Fisheries Service, December 8, 2014. These address comments to the Draft NPDES Permit.

Comment #1

The permit requires that treatment not cause or contribute to further impairment for any parameter in these estuaries. There is no list of existing impairments provided to determine how the permittee (or the public) can ensure this requirement is attained.

Response

Section 3.2 of the Draft EIS (DEIS) addresses Elements of the Environment. Sediments, air, and surface water quality impairments for each estuary are outlined in Sections 3.2.1 through 3.2.3, respectively. Specific threshold and compliance monitoring is outlined in each section, and all results must be submitted to Ecology as part of the NPDES permit and regulations under the Washington State Water Quality Standards.

Comment #2

Section S2, item number 2 allows the permittee to apply other pesticides for experimental use to an area of one acre or less. What is the procedure the WSDA must go through prior to issuance of these permits?

What outcomes are monitored? Does this go through public process? NMFS requests notification and an opportunity to comment.

Response

Application of other pesticides for experimental use trials has not been proposed by the growers under this permit, nor is it expected at this time. Experimental use of non-listed chemicals is subject to review in the Annual Operations Plan, and must be conducted under a Washington State Experimental Use Permit (NPDES Permit special condition, Section S2.H).

Comment #3

For section S3A; other than water sampling, there are no requirements to sample sediments or benthic communities off-site of the SIZ boundaries.

Response

Survey results from the 2011, 2012, and 2014 field surveys have concluded that imidacloprid dilutes quickly in surface water. Previous work (Frew 2013) also concluded that imidacloprid does not bind to the sediments for extended periods, and that sediment concentrations of imidacloprid fall off quickly with distance from the treatment plot (see, for example, results submitted to Ecology for the 2012 field trials). Similarly, off-site benthic communities have displayed few or no effects from nearby imidacloprid treatments in previous field work. Accordingly, there is limited scientific value in sampling off-site sediments and benthic communities, and such sampling involves significant expense and logistical difficulties. Accordingly, monitoring during the life of the permit correctly focuses on assessment of on-plot sampling.

Comment #4

For section S4B; NMFS does not agree with the Sediment Monitoring Schedule, years should not be skipped given that the data from last summer's treatment are not available. What is the purpose to allow years to be skipped?

Response

Results from the 2014 field trials have been submitted to Ecology, and should be made available to

NMFS shortly. These results indicate that imidacloprid is not persistent in the sediments past approximately 56 days. In fact, in 2014, 7 out of 8 whole sediment samples had concentrations of imidacloprid that were undetectable at 28 days following treatment. These results are consistent with those found in the 2011 and 2012 studies. The scientific evidence indicates that it is highly unlikely that imidacloprid will persist over multiple years. Hence, sediment sampling can be spaced over the length of the permit, in order to align costs and logistical difficulties with expected environmental impacts.

Comment #5

For section S4F; the term representative to the treatment plot is not clearly defined, and does not require sediment samples be randomly chosen. What are Ecology's criteria for selecting samples?

Response

Sediment sampling locations have been chosen using a gridded sample pattern, following recommendations from an Ecology hired statistician. Field scientists are not able to sample in all areas (e.g., areas with high concentrations of shell hash), as these areas do not allow for the proper sampling of sediment. However, if the plot has a mixture of sand and silt sediments, all efforts will be made to sample all sediment types, as has been done in prior year's work, to be representative of the whole bed.

Comment #6

For section S4G; How are 10-acre sample sub-plots selected to be representative of the entire acreage treated? Criteria should be in place and well understood. Random selection of sites is critical.

Response

Ten-acre sub-plots are necessary to carry out a monitoring plan. The sizes of sample sub-plots are based on the maximum area field crews can survey during the 2-3 hour sampling window of the low tide cycle. The sub-plots are generally chosen by the field sampling team based on the location of representative conditions for the entire plot, presence of shells that can interfere with sediment sampling, and the patterns of water flow onto the plots during the rising tide. Although sampling is done on sub-plots, the samples are taken from across the sub-plot area to help ensure representative coverage for the larger plot.

Comment #7

For section S6A1a; What criteria will Ecology use to approve treatment with imidacloprid on grounds that have less than the action threshold of ten burrows per square meter?

Response

Section 2.8.3.3 of the DEIS addresses requirements and restrictions related to the NPDES Permit.

Specifically, a risk profile will be used to define a qualitative scale for burrowing shrimp presence. Sampling at specific locations in the estuaries will be used to determine shrimp recruitment, and draw comparisons from sediment samples taken from treatment sites. Ecology will evaluate the risk profile over time, and work with the growers to address the threshold and determine if adjustments are needed based the efficacy of imidacloprid treatments.

Comment #8

There is no requirement for the permittee to provide elevations of proposed treatment areas or control. Elevation is important to interpreting benthic data. What administrative steps will Ecology follow when it receives a non-compliance notification?

Response

Elevation data is collected by the science team when determining the location of treatment and control plots. These data are verified during the field trials. It is used as part of the criteria for determining if the control plots are truly representative of, or equivalent to, the treatment plots. Ecology will work with the growers, in compliance with the NPDES permit, to address non-compliance of any site parameters.

Comment #9

NMFS feels there are other aspects that are impossible to comment on at this time, because the reference documents are not yet provided. These include details in sampling and analysis, and the Annual Operations Plan. Will there be a public review process on these components of the proposed action?

Response

This statement from the NMFS reviewer is relatively vague. Compliance requirements for the NPDES permit have been well defined in the DEIS, and include a complete list of references for documents related to this proposal. The results from the 2014 field surveys are expected to be available to NMFS soon, and, as described above, they are consisted with previous studies conducted on smaller treatment plots.

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ATTACHMENT D to WGHOGA comments on the Draft Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor

DATE: April 6, 2015

TO: Jesse DeNike, Plauché & Carr

FROM: Jeff Barrett

RE: **Agency Comments**
12733-02-10

CC: Adrienne Stutes, James Selleck

The information provided within is in response to agency comments for the Willapa-Grays Harbor Oyster Growers Association (WGHOGA) project.

USFWS Comments

The following information is in response to comments from the United States Fish and Wildlife Service (USFWS).

Comment #1

Page 3. (Cover Memo). *The stated primary objective is control of burrowing shrimp on commercial shellfish beds. With our previous letter to Ecology, when offering scoping comments (Letter to Donald A. Seeberger, dated February 14, 2014), the Service recommended that the EIS and permit framework should give fair and equal consideration to alternate culturing methods and practices. Control and removal of a native species that performs important ecological functions should not be the primary objective. Instead, this effort should be directed at developing and refining robust IPM methodologies that adaptively manage shellfish production systems to avoid harming ecological resources.*

Comment #2

Page 4. (Page vi). *"At the time of this writing ... there are no known alternatives to chemical applications to effectively control burrowing shrimp." COMMENT – The stated primary objective is flawed. Other alternatives should be given fair and equal consideration, including alternate culturing methods and practices, and a robust IPM methodology with stricter limits on the use of chemical control agents.*

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Comment #3

Page 4. (Pages 1-3). *"With low burrowing shrimp recruitment over the past ten years or so, it has been possible to farm some beds without shrimp control. However, due to the recent large recruitments of burrowing shrimp in Willapa Bay and Grays Harbor, growers are now seeing high shrimp densities in substrate without distinction by crop." COMMENT – Ecology and the WGHOGA acknowledge that burrowing shrimp numbers and densities exhibit cyclical changes over time. There is little or no evidence to substantiate the claims that Willapa Bay and Grays Harbor are currently experiencing anything unusual related to burrowing shrimp recruitment, numbers, abundance, and densities.*

Response to Comments #1–#3

The USFWS is correct in saying that burrowing shrimp are native to Willapa Bay and Grays Harbor. However, as discussed in the Draft Environmental Impact Statement for the proposal (DEIS), burrowing shrimp rapidly expanded in these estuaries during the middle of the 20th century and caused a major decline in oyster production between 1950 and 1965. In recognition of the destructiveness of burrowing shrimp, Washington Department of Fisheries (now Washington Department of Fish and Wildlife [WDFW]) personnel began testing various methods of control during the 1950s, eventually resulting in the use of carbaryl (see DEIS Section 2.4). While burrowing shrimp have a limited ecological role, they have been consistently managed since the 1950s to prevent unlimited expansion throughout these estuaries, particularly on commercial shellfish beds. Further, the enhanced ecosystem functions granted by shellfish and eelgrass beds are far more important than those of burrowing shrimp beds. Shellfish beds provide refuge for juvenile fish and mobile crustaceans (Coen et al. 1999; Grabowski et al. 2005), and important habitat for epibenthic invertebrates, molluscs, polychaetes, and crustaceans (Lenihan et al. 2001; Rothschild et al. 1994). These habitats are lost completely when burrowing shrimp are allowed to take over. High densities of burrowing shrimp are known to significantly reduce both species composition and abundance of other types of invertebrates in this benthic community (see discussion in DEIS, Section 3.1). For example, burrowing shrimp cause significant sediment disturbance in which sedentary species such as deposit-feeding polychaetes, bivalves, tanaids, amphipods, and many other sedentary species are reduced in numbers in burrowing shrimp ecosystems. These invertebrate species are important components of the ecosystem and can be lost completely if burrowing shrimp numbers are allowed to increase unchecked.

USFWS errs in failing to recognize the significant ecological importance of shellfish beds, beyond the habitat functions listed above. In addition to these functions, shellfish beds provide important ecosystem services such as water filtration, which results in decreased suspended solids, turbidity, and increased denitrification. Accordingly, Washington State and Federal law recognize the ecological importance of shellfish beds. WAC 173-26-221 identifies commercial and recreational shellfish beds as critical saltwater habitats that "require a higher level of protection due to the important ecological functions they provide." Similarly, NMFS's Essential Fish Habitat (EFH) Consultation Guidance specifically identifies intertidal and subtidal shellfish beds as types of EFH. See p. 5.3 of the EFH Consultation Guidance, available at: http://www.habitat.noaa.gov/pdf/efh_consultation_guidance_v1_1.pdf. Although burrowing shrimp may partially provide similar ecosystem functions, the detrimental effects of sediment destabilization are far more deleterious than any positive functions they may provide. Furthermore, USFWS apparently interprets this as an eradication proposal. It is not. It is intended to provide shellfish growers in Willapa Bay and Grays Harbor a critical tool for managing burrowing shrimp on a limited number of tidelands similar to what they have been since the 1950s after burrowing shrimp populations dramatically increased.

USFWS expresses concern over the lack of robust Integrated Pest Management (IPM) methodologies for managing shellfish production and burrowing shrimp control. However, the DEIS contains a detailed discussion of the use of IPM methodologies (see DEIS, Section 2.8.4). An IPM plan has been in place since at least 2002 and the WGHOGA is dedicated to implementing this plan and looking for viable alternative or concurrent methods of controlling burrowing shrimp in their shellfish beds. Indeed, given the substantial expense of chemical applications to control burrowing shrimp, and the hundreds of thousands of dollars the growers have had to spend to obtain permits for such use, WGHOGA would happily forgo chemical control of shrimp if non-chemical methods provided sufficient support for their farms.

However, after many years of hard work, WGHOGA and their science advisors have determined that, to date, the non-chemical control and mechanical control methods tried have either failed completely to control burrowing shrimp, or have provided only very limited efficacy that is not sufficient to support oyster culture on WGHOGA farms. Non-chemical treatments investigated by the growers include harrowing, shallow rototilling, clay injection, electroshocking, raking, compaction, hypersaline solution, etc. (see discussion in DEIS, Section 2.8.4). These non-chemical treatments have not been successful for a variety of reasons:

- They have failed to control burrowing shrimp;
- They are impractical on a commercial scale;
- They significantly harm the shellfish crop and/or non-target species; and/or
- They have other negative environmental consequences.

Therefore, the USFWS Comment #1, that “this effort should be directed at developing and refining robust IPM methodologies that adaptively manage shellfish production systems to avoid harming ecological resources,” is in fact achieved through this proposal. We recommend that USFWS fully review the alternative shrimp control methods tried by WGHOGA, and the reasons why these methods have proven not to be feasible, rather than dismiss them out of hand. WGHOGA is very interested in constructive suggestions from USFWS (or any other agency) that would reduce the need for chemical control.

Alternative methods such as line culture or bag culture may work in other ecosystems, or in certain parts of Willapa Bay and Grays Harbor, but they are not ecologically or financially viable as the sole methods of raising shellfish. In areas heavily infested with burrowing shrimp, growers report that the stakes and poles used to support alternative cultural methods fall over rendering these systems ineffective and resulting in high mortality of oysters in the failed systems. In addition, the shellfish market served by WGHOGA includes a large component of shucked oysters, for which ground culture with its high production rates and cost efficiencies is the only viable method. A shellfish culturing method that is good for burrowing shrimp but not economically viable for WGHOGA, is ultimately not an appropriate method.

USFWS also questions claims that “there is little or no evidence to substantiate the claims that Willapa Bay and Grays Harbor are currently experiencing anything unusual related to burrowing shrimp recruitment, numbers, abundance, and densities.” WGHOGA and the Washington State Department of Ecology (Ecology) agree that the recent increase in burrowing shrimp populations is not “unusual.” However, that is not the relevant question. The fact is that the increase in shrimp density is occurring; and as a consequence, shellfish beds are becoming more inundated with burrowing shrimp. WGHOGA agrees that recruitment is cyclical; currently the cycle is pointing towards increased recruitment on shellfish beds. As a result, it is currently very important that the WGHOGA have a tool for controlling burrowing shrimp at their disposal. Imidacloprid would only be used on an as-needed basis.

WGHOGA’s members are wholly committed to maintaining the health and sustainability of the Willapa Bay and Grays Harbor estuarine ecosystems. They are important advocates for water quality and ecosystem health as a whole. Without a healthy ecosystem, they would not be able to maintain a viable shellfish industry in Washington State.

Comment #4

Page 4. (Pages 1-6). *The documentation prepared by Ecology and the WGHOGA refers repeatedly to a single metric or measure of efficacy: Is the practice or treatment sufficient to reduce numbers below the “damage threshold” of ten burrows per square meter? The documentation provides little information to describe where this damage threshold originated, who developed the threshold, and how it is justified. The damage threshold is presented as a given and there is no effort to evaluate whether it is valid and appropriate for its intended purpose. In this sense, the proposed IPM methodology is arbitrary.*

Response

The burrowing shrimp IPM that has been in place since 2001 has consistently worked at developing appropriate methods of determining a damage/density threshold, as well as accurate shrimp population census methods. The existing criteria of 10 shrimp burrows per square meter is the best and most accurate method found to date. This was discussed thoroughly in Dumbauld et al. 2006. In addition, this threshold has been accepted by Ecology and was used in the NPDES permit for carbaryl. Determining burrowing shrimp densities is a difficult task because real densities are often higher than what is seen when identifying burrow numbers. In addition, it can be very difficult to distinguish between shrimp burrows and some polychaete burrows. Therefore, a "damage threshold" of 10 burrows per square meter has been a good measure of extent of the burrowing shrimp population in a given shellfish bed. WGHOGA has determined that they lose shellfish and beds cannot be adequately farmed at densities higher than this.

Comment #5

Page 4. (Pages 2-35). *"Additional field trials were conducted during summer 2014 ... If the results of these studies are available, they will be reported in the Final EIS." COMMENT – The 2014 field trials include the first treatment sites larger than 30 acres, target collection of information from sites where the substrate has a high organic content (influencing persistence), and address deficiencies stemming from earlier work conducted without an approved data sampling and analysis plan (D. Rockett, pers. comm. 2014).*

The National Marine Fisheries Service has requested that Ecology provide results from the 2014 field trials when they become available (T. Hooper, pers. comm. 2014); to date, Ecology has not provided this information.

Response

The results of the 2014 field trials were not available at the time these comments were written. The Draft 2014 Field Report was submitted to Ecology on February 2, 2015. The results from the 2014 field trials corroborate the results from previous years' trials that were conducted on smaller plots (i.e. < 10 acres). Specifically, the 2014 trials found that plots treated with imidacloprid were not statistically distinguishable from unsprayed control plots for the majority of the invertebrate comparisons that were conducted. In addition, the 2014 results again documented rapid dilution of imidacloprid concentrations in water with the first rising tide, and approximately exponential declines in sediment concentrations, with non-detectable levels within 28 days (whole sediments) and concentrations below screening levels at 28 days (sediment porewater).

Comment #6

Page 4. (Pages 2-35). *Ecology should not advance a permit decision until more data is collected (during 2014 and 2015) and shared with the public. A decision to issue the permit and authorize SIZs while relevant and important data remain unavailable would be premature. Ecology should not advance the permit decision until they have fully addressed and can be responsive to science-based concerns regarding fate and transport, efficacy, persistence, and effects to non-target organisms. We recommend to Ecology that the work made possible by the Experimental Use Permit should continue.*

Response

WGHOGA agrees that, as a general rule, more information is better than less when making decisions that could affect the environment. However, the USFWS response ignores the many years of study that have already been conducted to investigate the effects of imidacloprid application to oyster beds. These results are summarized in the DEIS. Results of the 2014 field trials were submitted to Ecology on February 2, 2015. These results were very similar to those from previous years; therefore many of the outstanding questions regarding fate and transport, efficacy, persistence, and effects to non-target organisms can be answered based on multiple years' data.

In addition, the permit, if issued, will require a robust monitoring program, including water, sediment, and invertebrate sampling in both Grays Harbor and Willapa Bay to ensure unacceptable impacts are not occurring. Thus, the permit itself responds to USFWS's request for continued information gathering, including information gathered through an Experimental Use Permit.

Comment #7

Pages 4-5. (Pages 2-47 through 2-56). *Alternatives considered and Eliminated from Detailed Evaluation. Ecology and the WGHOGA document alternative mechanical, physical, and chemical control methods, and describe alternative culturing systems. Many of these practices are flawed in principle and have little or no merit. Others do have merit but were eliminated because they are not economically feasible on relevant spatial scales. However, graveling and frosting are established practices with the specific goal of firming substrates and fostering good conditions for larval attachment, maturity, and growth. Graveling and frosting should have a role in IPM methodologies directed at successful shellfish culturing on tidelands affected by burrowing shrimp. Long-line and stake culturing are also established practices, and are used successfully by some growers and farm operators in these same portions of Willapa Bay and Grays Harbor. Much of the information used to discredit these practices appears to be anecdotal and not based on either scientific studies or rigorous and comparative evaluation. Ecology and the WGHOGA should address more seriously and objectively whether methods of ground• based culturing and production require reevaluation in light of new science and the many concerns related to aquatic pesticide applications. Chemical control methods with lethal and biologically significant sub-lethal effects to non-target organisms should be a last resort and only implemented after a robust IPM methodology has exhausted all other alternatives at each specific location.*

Response

While USFWS alleges some of the Alternatives Considered and Eliminated from Detailed Evaluation are "flawed in principle and have little or no merit," it fails to specify which methods fall into that category. With all due respect to the USFWS reviewers, there is no indication that they have the expertise necessary to critique these alternative methodologies.

Graveling and frosting is an IPM methodology used by growers in those areas where it is financially feasible; however, that alternative is not economically feasible (or ecologically justified) as a sole control method, on the larger scale of oyster farming. WGHOGA is interested in the most ecologically sound AND economically viable methods of shellfish farming. Relying solely on alternative culturing methods such as graveling and frosting will potentially cause lethal and biologically significant sub-lethal effects to non-target organisms such as benthic and epibenthic invertebrates, as well as native and non-native eelgrass. The best scientific and technical information clearly demonstrates use of imidacloprid as part of an IPM program is the best option for effectively controlling burrowing shrimp while minimizing adverse environmental impacts.

USFWS is correct that long-line and stake culturing methods are used successfully in some parts of Willapa Bay and Grays Harbor. However, these methods are not feasible throughout Willapa Bay and Grays Harbor. First, the sediment in many parts of both bays is simply too soft and/or burrowing shrimp densities are too high to sustain these practices. In these areas, the long-lines and stakes sink into the substrate, causing the oysters to be on the ground where they are susceptible to sinking and suffocation due to burrowing shrimp. Second, it is not economically feasible to grow all oysters on long-line or stake culture. This practice, which requires significant capital investment and ongoing costs, is used for oysters that will be sold on the half-shell market, not the shucked market. The majority of oysters cultivated in Willapa Bay and Grays Harbor are destined for the shucked market, and the only economically feasible method for culturing significant quantities of shucked oysters is ground-culture.

At this point in the process, the IPM program has all but exhausted all alternatives as an exclusive method of controlling shrimp in Willapa Bay and Grays Harbor.

Comment #8

Page 5. (Pages 2-55). *A variety of native, biologically and economically important species prey on burrowing shrimp, including smelt (family Osmeridae), herring (family Clupeidae), chum salmon (Oncorhynchus keta), surfperch (family Embiotocidae), flounder (family Pleuronectidae), cutthroat trout (0. clarki), white and green sturgeon (Acipenser transmontanus, A. medirostris), and Dungeness crab (Metacarcinus magister). "Both the green and white sturgeon ... [feed] on burrowing shrimp ... 40 to*

50 percent of the organisms by number and weight ... [found in green sturgeon stomach contents] were burrowing shrimp (Dumbauld et al. 2008)." As far as we know, there is no scientific information supporting Ecology's claim that"...sturgeon generally do not feed on shellfish beds."

Response

Members of the WGHOGA and their Science Team have noted that although green sturgeon do obviously feed on burrowing shrimp, they are not often noticed in the shellfish beds themselves. There has also been a lack of visual observation of sturgeon pits in commercial shellfish beds. All scientific studies conducted on green sturgeon and burrowing shrimp have occurred on mudflats away from commercial shellfish beds (Frew 2013). Researchers working in these coastal estuaries have observed that sturgeon prefer to feed outside of commercial shellfish beds (K. Patten, WSU Extension, personal communication; B. Dumbauld, USDA-ARS, personal communication). In addition, there is no scientific evidence showing that green sturgeon do definitely feed on commercial shellfish beds.

Again, it is important to remember that this is not an eradication proposal, but rather to continue the existing practice of managing burrowing shrimp control activities on limited commercial shellfish beds. Even under the unlikely assumption that all permissible acres are sprayed, and that all acres are unique (i.e., not re-sprayed), 1,500 acres in Willapa Bay represents only 3.33 percent of the total tideland acreage (45,000 acres), and 500 acres in Grays Harbor represents only 1.45 percent (of 34,460 acres). Thus, the vast majority of both of these estuaries will not be sprayed in any given year, ensuring that any ecological benefits from unsprayed areas will be present and unimpaired. That includes any ecological benefits from the presence of burrowing shrimp, including their being prey to other organisms. Any contention of a significant impact to the estuary in general, or to fish in particular, is not scientifically credible given that the vast majority of both estuaries will not be affected by imidacloprid treatments.

Review of the NMFS website on green sturgeon[1] indicates a number of factors thought to be contributing to low green sturgeon numbers. None of those threats involve insufficient food. Instead, limits on spawning habitat are deemed “the principal factor in the decline…”.

Comment #9

Page 5. (Pages 2-57 and 2-58). *Here and elsewhere, Ecology and the WGHOGA have repeated claims that without chemical control of burrowing shrimp there will be “...increased burrowing shrimp activity; reduction in eelgrass growth and density; and reduced biodiversity, which could lead to a reduction in the presence of birds, fish, and other species that feed on organisms that inhabit eelgrass.” Ecology and the WGHOGA claim that Alternative 3 (Imidacloprid Applications with IPM) would “...have beneficial environmental effects in the form of preserving the substrate and biodiversity of commercial shellfish beds, and promoting native eelgrass density and coverage, thereby improving foraging habitat and prey diversity for birds and fish, and cover for juvenile fish including ... salmonids.” COMMENT – The Service does not agree that these claims are justified or established in fact. These claims are misleading, especially in light of the WGHOGA current practice of removing both native and non-native eelgrasses (Zostera marina and Z. japonica, respectively) where they complicate shellfish production.*

Response

USFWS offers no support or specific explanation for its broad statement of disagreement noted in the above comment. In contrast, the DEIS includes extensive information demonstrating the ecological

[1] Available at http://www.nmfs.noaa.gov/pr/species/fish/ greensturgeon.htm#threats

impacts of burrowing shrimp on other species, and of the benefits to many of these species where burrowing shrimp have been controlled. Chapter 3 of the DEIS discusses the results of several scientific papers that have looked at the effects of burrowing shrimp in the benthic communities in which they live. Species composition and invertebrate abundances are significantly reduced in areas with high densities of burrowing shrimp (Posey 1985). General sediment disturbance affects the composition of infaunal and epifaunal invertebrates (Dumbauld et al. 2001; Ferraro and Cole 2007; Posey 1986). There is a reduction in numbers of deposit-feeding polychaetes, bivalves, tube-dwelling invertebrates, and other sedentary species in areas with dense populations of ghost shrimp. The DEIS also includes reference to studies showing the many benefits of shellfish ecosystems, and the fact that these systems are indeed more beneficial habitats for juvenile fish and invertebrates (see DEIS Section 3.1, citing Coen et al. 1999 and Grabowski et al. 2005).

Eelgrass communities are also highly functional as nursery and feeding habitats, and WGHOGA has not proposed control to native eelgrass, only the invasive, non-native Japanese eelgrass. In addition, juvenile fish such as salmon feed very little within the eelgrass beds themselves; they are more likely to feed on insects and other invertebrates on the shellfish beds and use the eelgrass beds as a refuge habitat (Dumbauld and Wyllie-Escheverria 2003; B. Dumbauld, USDA-ARS, personal communication). Shellfish and eelgrass ecosystems are complimentary in supporting juvenile fish and invertebrates. Without the solid substrates that shellfish beds provide as foraging and refuge habitat, juvenile fish such as salmon would find reduced habitat diversity and quality within Willapa Bay and Grays Harbor. This would likely cause a decrease in salmon stocks as they attempt to adapt to an environment that is now largely devoid of food and structures. By extension, denying the permit would hurt fish populations because, over time, shellfish beds would be reduced in areal extent as burrowing shrimp made more and more commercial beds inhospitable to continued culture of oysters. Denying the permit would also likely damage native eelgrass, as native eelgrass is not able to grow in areas dominated by burrowing shrimp (see DEIS Section 3.1). In contrast, as USFWS has recently acknowledged, while eelgrass density and abundance can be reduced in the presence of shellfish aquaculture generally, this reduction is temporary and some impacts are likely offset by the increase in light penetration and fertilization provided by shellfish. Further, USFWS has recognized oyster bottom culture in particular can coexist with eelgrass beds (USFWS 2009).

Comment #10

Page 5. (Pages 2-58 through 2-60). *With our previous comment letter to Ecology (Letter to Donald A. Seeberger, dated February 14, 2014) the Service stated that we do not support large scale chemical treatment of mixed native and non-native eelgrass beds, and that permits proposed for issuance by Ecology do not adequately address mitigation for collateral damage to non-target vegetation. We expect that these chemical control practices will cause significant damage to native flora and fauna, including damage that extends off of the treated beds and sites.*

Response

Comment noted. This comment and reference comment letter (Letter to Donald A. Seeberger, dated February 14, 2014) are in reference to the NPDES permit for imazamox. This permit has already been issued and is separate from the NDPES application for imidacloprid.

Comment #11

Page 6. (Pages 2-61). *Ecology and the WGHOGA claim that if burrowing shrimp are not controlled they will "...proliferate unmanaged, with likely unrecoverable damage ... [causing] significant alterations to the bay-wide ecosystem." COMMENT – Burrowing shrimp are native and perform important ecological functions in these systems. As such, they do not represent an alteration of the bay-wide ecosystem.*

However, chemical control methods do represent an intrusive alteration, and may have unintended consequences.

Response

As discussed above, this is not a burrowing shrimp eradication proposal. It is proposal to maintain burrowing shrimp populations at current and historic levels since they dramatically and unexpectedly increased beginning in the 1950s. The total area of these estuaries that may be treated with imidacloprid is quite small when compared to the total size of Willapa Bay and Grays Harbor. Assuming every possible acre is sprayed, and that none of the permitted spraying is reapplication to areas previously sprayed, a mere 3.3 percent of the total tidelands exposed at low tide in Willapa Bay and 1.5 percent in Grays Harbor may be treated under the proposed NPDES permit. There are good reasons to assume not all acres will be sprayed and many applications will be to previously treated areas, so these already small values are likely overestimates. Regardless, this basic analysis demonstrates that vast areas of both bays will be untreated and fully available for burrowing shrimp. By contrast, if imidacloprid use is not permitted, the amount of shellfish habitat will drastically decline over time, with attendant, negative impacts to fish and other species, as discussed above.

Comment #12

Page 6. (Pages 3-13). *"Based on currently available information and studies, and requirements to comply with the conditions of all applicable pesticide registrations, permits, and regulations (including the Washington State Water Quality Standards and SMS), no significant unavoidable adverse impacts to sediments would be expected with the proposed action (Alternative 3: imidacloprid applications with IPM), or with Alternative 2 (carbaryl applications with IPM)." COMMENT – The Service does not agree that this conclusion is accurate or justified.*

Response

The broad statement of disagreement noted in the above comment is wholly unsupported and USFWS has not shown any particular expertise with imidacloprid in sediments. This comment conflicts with the available scientific evidence that is thoroughly reviewed in the DEIS, and in the recently released results for field trials in 2014. The results of experimental field trials conducted to date show that, under Ecology's stringent requirements, there is little to no long term effect of imidacloprid on the sediments. Persistence time in sediments is low and benthic invertebrates recovery very quickly after treatment (Hart Crowser 2013 and 2015). Studies conducted on both small (< 10 acres) and large (> 40 acres) plots have shown very similar results that imply no significant unavoidable adverse impacts to sediments. Finally, the Washington State Department of Ecology is the sole regulatory agency with expertise in administering the Washington State Water Quality Standards and SMS, and it has concluded that the use of imidacloprid as conditioned in the permit would comply with these regulations.

Comment #13

Page 6. (Pages 3-24). *"A SIZ is the area where the applicable State sediment quality standards of WAC 173-204-320 through 173-204-340 are exceeded due to ongoing permitted or otherwise authorized wastewater, storm water, or nonpoint source discharges (WAC 173-204-200)." COMMENT – The threshold criterion for "minor" adverse effects to sediments and benthos are not adequately protective. The Service expects that the proposed permit and SIZs cannot be implemented without causing significant adverse impacts to sediments and native benthos.*

Response

This statement of expected impact is unsupported by any scientific or other information. Ecology is charged with implementing the Clean Water Act, including the NPDES permit under consideration here in Washington State. As the responsible agency, Ecology developed criteria and standards for assessing the magnitude of impacts to water, sediments, and related biota for NPDES-permitted discharges. That includes the entire SIZ program, which is an Ecology-created and -implemented system, not a component of the federal CWA. As noted above, Ecology has properly concluded the use of imidacloprid, as conditioned, will comply with the applicable regulations, and USFWS has not provided concrete or specific evidence demonstrating Ecology's determination is erroneous.

Further, it is important to recognize that the threshold criterion referenced by USFWS is only relevant when invertebrates on imidacloprid treated sediments show declines in number or types of organisms that approach 50 percent compared to control plots. The experimental results on imidacloprid show that this is rarely the case. Instead, treatment plots often have higher numbers and/or types of organisms than control plots, and in other cases show only small declines in selected taxa.

Comment #14

Page 6. (Pages 3-30, 3-31, 3-33). *"The degree of toxicity of carbaryl to marine vegetation varies considerably (WDF and ECY 1985). Some marine plants and algae are growth-inhibited by carbaryl, while others are not affected." "Imidacloprid ... is taken up … by plants and is present in the foliage of plants. However, this is based on limited information regarding ... marine vegetation." "No studies were available to assess the toxicity of imidacloprid to marine algae." COMMENT – Imidacloprid treatments would overlap significantly with native eelgrass and would expose phytoplankton. If there is little or no information to assess potential effects to these important resources, we do not agree that a finding of no significant adverse impact can be justified for plants.*

Response

As explained in the DEIS, imidacloprid is an acetylcholinase inhibitor, and plants do not have a biochemical pathway involving acetylcholinase (see DEIS Sections 1.7 and 3.2.4). Therefore, plants are not vulnerable to imidacloprid toxicity. Further, any theoretical concern about impacts to plants is ameliorated by the low concentration of imidacloprid, and rapid dilution on incoming tides, that will characterize imidacloprid treatment under the proposed permit. Thus, there is no credible scientific basis for concluding that WGHOGA's proposed use of imidacloprid would have significant adverse impacts to plants.

Comment #15

Page 6. (Pages 3-31). *"While imidacloprid would be applied to areas with high populations of burrowing shrimp on commercial shellfish beds only, research indicates that imidacloprid can move off-site rapidly in surface water and can be detected at least 480 meters (1,575 feet) away from the application site." COMMENT - These findings clearly indicate that effects and damages will not be limited to the treatment sites. Neighboring owners will have their tidelands exposed and affected even if they choose to avoid the practice of using chemical control methods for burrowing shrimp.*

Response

While imidacloprid can move off-site rapidly in surface water and can be detected at least 480 meters away, the concentrations present in the surface water at these distances is generally minimal. Results from the 2014 field studies showed that off-plot concentrations of imidacloprid ranged from 0.054 to 0.55 micrograms per liter (µg/L). These concentrations are very low. A review of the toxicity literature on imidacloprid, required by Ecology as a condition for field trials in 2012, found the most sensitive taxon of invertebrates applicable to these estuaries, mysid shrimp, had an LC50 of 37 µg/L. Using EPA guidance that 10 percent of this value should be considered the threshold for biological impacts, the 2012 studies and documentation submitted to Ecology concluded that 3.7 µg/L could be considered a threshold of concern. The 0.054 to 0.55 µg/L values found in studies of off-site movement of imidacloprid are far below this threshold, despite use of a sampling methodology (collection of water at the front edge of the tidal prism) designed to maximize the amount of imidacloprid collected. Thus, the science shows that offsite movement is very unlikely to impact flora or fauna even on the first tidal flush. In addition, imidacloprid dilutes so quickly in surface water that it is not likely to impact flora or fauna at distances away from the application site. There is no indication that neighboring owners will have their tidelands exposed and affected, and USFWS's contention to the contrary is directly undermined by the actual scientific data.

Comment #16

Page 7. (Pages 3-37). *Statements referring to bull trout occurrences in Pacific Coast drainages is incorrect. Several rivers support local populations and spawning trout. Bull trout occur regularly in Grays Harbor, have been documented in low numbers in Willapa Bay, and represent the southernmost populations of bull trout in North America. The species is listed under the Endangered Species Act (ESA).*

Response

There has been only a single potential observation of bull trout in Willapa Bay, by a technician 1 mile downstream of the Willapa/Forks Creek hatchery (Berg 2002). Tellingly, there is no designated critical habitat for bull trout in Willapa Bay (USFWS 2009).

While bull trout are present in some Pacific coast drainages, they only spawn farther north, and the closest spawning population is in the Quinault River. Any bull trout found in Grays Harbor are migratory adults.

Comment #17

Page 7. (Pages 3-43). *Bull trout occurrence in Willapa Bay is infrequent and only in very low numbers, but it is incorrect to state that bulltrout are unlikely to use habitats on commercial shellfish beds. Bull trout migrate in water less than 10 meters and are opportunistic foragers, traveling to take advantage of seasonal food resources. Bull trout feed on marine forage fish and juvenile salmonids, within eelgrass meadows and other complex nearshore habitats.*

Response

Since there has only ever been a single potential observation of bull trout in Willapa Bay, and there is no designated critical habitat in Willapa Bay, it is unlikely that bull trout will use shellfish bed habitat for foraging in this bay.

The EIS addresses overlapping bull trout foraging habitat and shellfish beds in Grays Harbor. The full shoreline in Grays Harbor is designated critical habitat, based on adult foraging activity. There is no spawning habitat in the rivers that feed into Grays Harbor. Acoustic tagging and sampling of bull trout from 2001 to 2005 found that bull trout are present in the Chehalis River from late February to early July.

Imidacloprid would be unlikely to adversely affect adult bull trout. The area for imidacloprid application would be small in relation to the total tideland area of Grays Harbor. Imidacloprid will generally be applied at low tide when bull trout would not be on the shellfish beds, and thus they would not be directly exposed during spraying. Imidacloprid does not bioaccumulate in invertebrates, and uptake through contaminated prey would therefore be *de minimus*.

Comment #18

Page 7. (Pages 3-45, 3-46). *Grays Harbor and Willapa Bay support the only populations of snowy plover in Washington. Several beaches and sandy pits are currently or recently used, and are designated critical habitat. While nesting occurs at only a few locations, suitable foraging habitats extend to sand and mudflats, sand islands, and open beaches; including areas with the proposed SIZ, and are considered essential for recovery of the species. Graveyard Spit and Leadbetter Point are currently the most productive breeding sites in Washington, and impacts to prey could have significant adverse effects.*

Response

The best information available does not support the statement that Graveyard Spit and Leadbetter Point are the *most* productive breeding sites in Washington. Nesting only occurs at three locations in Washington: the Pacific Coast facing beach of Leadbetter Point, the northwest corner of Graveyard Spit, and Midway Beach. Nesting at Damon Point in Grays Harbor (a single nest) was last observed in 2006, and does not currently constitute a nesting location. Absence of shellfish aquaculture at all these locations means they are at no risk of being sprayed with imidacloprid. Data show that Graveyard Spit and Leadbetter Point actually have limited nesting. Nest success at Leadbetter Point is generally below 20 percent, and represents less than half of Washington nests (WDFW Survey Report, 2013). There were only three nests at Graveyard Spit in 2013. Instead, the majority of nests have generally been found along Midway Beach to the north, making this location the most productive breeding site in the state.

USFWS's claim of impacts to snowy plover foraging is also not supported by the best available information. In fact, the Biological Opinion from the USFWS office in Washington (2009) found that there are no records of snowy plovers foraging or nesting in the bay or along the eastern shore of the Long Beach Peninsula. Thus, according to USFWS itself, snowy plover do not feed in areas where imidacloprid will be used. And even if they did, there is no reason to believe that imidacloprid would reduce foraging success. Snowy plover have a short bill, and can only feed on the upper layer of the beach surface, foraging for small invertebrates. Preferred foraging habitats include undisturbed sparsely vegetated areas of wet or dry beach-sand, preferably above the high tide or the upper tidal area when water recedes (WDFW 1995). The studies cited above showing that control of burrowing shrimp results in increased numbers and biodiversity of other invertebrates give creditability to the argument that imidacloprid treatment would improve foraging for snowy plover, rather than producing any negative impact. In any case, there is no evidence that food is limiting this species. WDFW and USFWS both consider human modifications and disturbance to sand beaches, and nesting habitats, the greatest concern to recovery of the Snowy Plover.

Comment # 19

Page 8. (Pages 3-49). *"Alternative 3 (Imidacloprid Applications with IPM) would provide adequate burrowing shrimp control ... with potentially reduced environmental side effects, compared to carbaryl. Imidacloprid would be unlikely to adversely affect polychaete worms or molluscs (bivalves, snails), including oysters and clams (Hart Crowser 2013; Grue and Grassley 2013; CSI 2013). A potential exception is imidacloprid effects in sediments high in organic matter. The limited information available for such sediments suggests adverse effects to polychaete worms and crustaceans (see Draft EIS Chapter 2, Section 2.8.3.5). A study of imidacloprid effects in high organic soils is expected during the summer of 2015. Results from this trial may result in adjustments to permit conditions during the five-year term of the permit." COMMENT – Ecology should not advance a permit decision until more data is*

collected (during 2014 and 2015) and shared with the public. A decision to issue the permit and authorize SIZs while relevant and important data remain unavailable would be premature. Ecology should not advance the permit decision until they have fully addressed and can be responsive to legitimate scientific concerns regarding fate and transport, efficacy, persistence, and effects to non-target organisms, including several species listed under the ESA and their designated critical habitats. We recommend to Ecology that they should continue limited field trials under the Experimental Use Permit.

Response

See comments above where USFWS also suggested scientific certainty as the standard prior to any permit decision being taken.

Results of the 2014 field trials were submitted to Ecology on February 2, 2015, and therefore were not available to USFWS at the time this comment was drafted. These results were very similar to those from previous years, and confirmed that application of imidacloprid to large commercial shellfish beds did not produce different outcomes than from trials on smaller treatment blocks (e.g., 10 acres). With publication of the 2014 data, the science regarding fate and transport, efficacy, persistence, and effects to non-target organisms can be answered based on multiple years' data. And these trials were on estuarine shellfish beds using application techniques and concentrations that are the same as those proposed in the NPDES permit, making these trials a very good indicator of future effects (or lack thereof).

In addition, most of the commercial shellfish beds in Willapa Bay and Grays Harbor are not located in sediments that are high in organic carbon. Such sediments are typically softer and less desirable to shellfish growers. Field trials are planned to continue in areas of high organic carbon (and in sandy sediments) as part of the required monitoring associated with the permit. Based on the substantial body of scientific evidence already collected, imidacloprid applications can be allowed in areas with sandy sediment (low organic carbon), with high scientific certainty that environmental impacts will not result.

Specific Comments for the Draft Permit

Comment #20

Page 8. (Page 5). *The threshold criterion for "minor" adverse effects to sediments and benthos are not adequately protective. They are not adequately protective of the natural ecosystems in Willapa Bay and Grays Harbor, or the ESA-listed species that occur there. The Service expects that the proposed permit and SIZs cannot be implemented without causing significant adverse impacts to sediments and native benthos, including prey resources on which several listed species depend. Ecology and the WGHOGA acknowledge that there are a number of outstanding issues and concerns regarding fate and transport, efficacy, persistence, and effects to non-target organisms (Ecology 2014, pp. 1-33 through 1-37).*

Therefore, the Service opposes the authorization of SIZs in Willapa Bay and Grays Harbor.

Response

Similar allegations were raised in Comment #13 above, and the response to that comment applies with equal force here. USFWS's concerns regarding the threshold for adverse effects and environmental impact in this comment are not based on specific scientific or regulatory support. In contrast, fellow scientists and the regulators at Ecology have properly researched and relied on the accumulated scientific evidence documenting exponential declines in sediment concentrations of imidacloprid after treatment, inability to distinguish treatment and control plot invertebrate numbers or communities, and past research showing that control of burrowing shrimp actually increases the numbers and biodiversity of potential prey species to fish and birds. In keeping with the nature of scientific investigation and uncertainty, Ecology properly acknowledged that some questions remain, limited the scope of proposed imidacloprid applications, and required a robust yet focused monitoring program to run concurrently with permit implementation as a check on the program, and to decrease scientific uncertainty over time.

Comment #21

Page 8. (Page 6). *"This permit does not convey property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights." COMMENT – Imidacloprid can move off-site rapidly and might be detected at a distance of 1,000 or 2,000 feet from* *the application sites. This fact illustrates that effects and damages will not be limited to the treatment sites. Neighboring owners will have their tidelands exposed and affected even if they choose to avoid the practice of using pesticides to control burrowing shrimp.*

Response

As noted in more detail above, it is very unlikely that imidacloprid would be detected in the water column or sediments at distances greater than 1,000 feet from the application site. To date, only low concentrations of imidacloprid have been found at distances up to 800 feet from the application site, and these are concentrations at which there are no expected effects on non-target organisms. It is very unlikely that neighboring owners will have their tidelands affected significantly, if at all, by the application of imidacloprid on commercial shellfish beds.

Comment #22

Page 8. (Page 6). *The draft permit identifies and proposes to use the following action threshold: "'No oyster or clam bed may be treated with imidacloprid unless the mean burrow count exceeds the determined action threshold of ten burrows per square meter ... If the mean burrow count is less ... a bed may be treated ... provided [that] a justification is approved by Ecology." COMMENT – The documentation prepared by Ecology and the WGHOGA provides little information to describe where this threshold originated, who developed the threshold, and how it is justified. The damage threshold is presented as a given and there is no effort to evaluate whether it is valid and appropriate for its intended purpose. In this sense, the proposed IPM methodology is arbitrary. Ecology has acknowledged that a well-defined method for determining the treatment threshold has not yet been formulated.*

Response

See Response to Comment #4 above.

Comment #23

Page 9. (Page 7). *The draft permit proposes inadequate treatment buffers. Imidacloprid can move off-site rapidly and might be detected at a distance of 1,000 or 2,000 feet from the application sites.*

Response

Results of field trials indicate that imidacloprid dissolves and dissipates rapidly. It is unlikely that imidacloprid will be detectable at distances of 1,000 feet or more from the application sites. If it is detected, the concentrations will be below biologically relevant thresholds. Thus, there is no scientific or other basis for requiring treatment buffers.

Comment #24

Page 9. (Page 9). *"Minor effects, or the maximum allowable biological effects within the SIZ ... are exceeded if ... any one of the following ecological metrics is reduced by more than 50 percent, 14 days after imidacloprid application ... Class Polychaeta abundance and richness, Phylum Mollusca abundance and richness, and Class Crustacea abundance and richness." COMMENT – The threshold criterion for "minor" adverse effects to sediments and benthos are not adequately protective. The Service expects that the proposed permit and SIZs cannot be implemented without causing significant adverse impacts to sediments and native benthos, including prey resources on which several listed species depend. We oppose the authorization of SIZs in Willapa Bay and Grays Harbor.*

Response

See Responses to Comments #14 and #20 above.

Comment #25

Page 9. (Page 21). *"Nothing in this permit excuses a Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations." COMMENT – There has been no consultation under the ESA addressing the effects of aquatic application of imidacloprid, and there is no valid, current ESA coverage for the application of imidacloprid to control burrowing shrimp. To date, no federal action agency has requested consultation with the Services to address the practice and its potential effects to listed species. Without a valid, current incidental take permit or statement addressing the effects of this practice on listed species, parties engaging in aquatic application of imidacloprid lack ESA coverage.*

Response

Impacts to ESA listed species are extensively analyzed in the DEIS (see pages 1-23 through 1-25 and Section 3.2.5.3) and supporting literature. As summarized in the DEIS:

> Based on currently available information and studies, and requirements to comply with the conditions of all applicable pesticide registrations, permits and regulations (including Washington State Water Quality Standards), no significant unavoidable adverse impacts to threatened, endangered or protected species would be expected with the proposed action (Alternative 3: imidacloprid applications with IPM). With the exception of some salmonid life stages, it is unlikely that these species would be present on treatment sites at the time of imidacloprid applications. There is a low probability of adverse effect to birds or large vertebrates. Permit conditions protective of surface water quality would

also be protective of salmonids. The requested Ecology NPDES Permit, if issued, would require discharge monitoring to be conducted to evaluate the effects of pesticide applications. Adjustments to permit conditions could be made throughout the five-year term of the permit.

USFWS has not provided any information demonstrating that WGHOGA's use of imidacloprid would adversely affect ESA-listed species of modify critical habitat. As discussed throughout the rest of this memorandum, its concerns are largely unsupported and directly undermined by the best technical and scientific information available.

Specific Comments for the SIZ Applications and Notices

Comment #26

Page 9. (SIZ Notice, Page 2). *The threshold criterion for "minor" adverse effects to sediments and benthos are not adequately protective. The Service expects that the proposed permit and SIZs cannot be implemented without causing significant adverse impacts to sediments and native benthos, including prey resources on which several listed species depend. Therefore, we oppose the authorization of SIZs in Willapa Bay and Grays Harbor.*

Response

See Responses to Comments #14 and #20 above.

Comment #27

Page 9. (SIZ Notice, Page 2). *"The names and addresses of other landowners affected by the proposed SIZ are listed in Attachment B." COMMENT – Attachment B fails to identify the U.S. Department of the Interior, U.S. Fish and Wildlife Service, as a landowner. The proposed SIZ for Willapa Bay extends onto tidelands located within the Leadbetter Point Unit of the Willapa National Wildlife Refuge (US Fish and Wildlife Service 2011, pp.2-57 through 2-61), and the SIZ for Grays Harbor extends into the Grays Harbor National Wildlife Refuge at Bowerman Basin. If Ecology issues the proposed permit and authorizes the proposed SIZs, we expect that there will be negative direct and indirect effects to the Service's trust resources. We do not support the issuance of an individual NPDES permit at this time and we oppose the authorization of SIZs in Willapa Bay and Grays Harbor, especially in light of the potential for adverse effects to several listed species.*

Response

Comment noted. We apologize for the oversight.

See responses to similar comments above. USFWS's claims of impacts to listed species and the environment are unsupported and undermined by the best technical and scientific information available.

Comment #28

Page 10. (SIZ Application, Pages 5, 11). *"Limited toxicity data are available to quantify the toxicity of degradation products or metabolites, as the majority of studies have focused on the parent compound imidacloprid ... Several studies conducted on insects found ... only the olefin derivative, which occurs as a metabolite in treated plants, has toxicity comparable to imidacloprid (Nauen et al. 1998; Suchail et al.*

2001; Kagabu et al. 2004; SERA 2005; EFSA 2006; Tomalski et al. 2010)." "Seven out of 20 eelgrass samples had detectable concentrations of imidacloprid on the first day post-treatment." COMMENT – We can expect that detectable concentrations of imidacloprid and/or olefin will be present in eelgrass located both on and off of the treatment sites. Eelgrass will, in turn, represent a potentially significant exposure pathway for a variety of wildlife species, including waterfowl.

Response

It is highly unlikely that eelgrass located off the treatment sites would have imidacloprid and/or olefin in their tissues. Imidacloprid and olefin were detected in a minority of eelgrass samples on the first day post-treatment in the 2012 field trials (reviewed in the DEIS), but not again after that, indicating that imidacloprid is not taken up by some eelgrass, and breaks down quickly in eelgrass that does. Patten et al. (2011) reported that eelgrass became established quickly on bare plots treated with imidacloprid, thus indicating that eelgrass is capable of rapid growth when burrowing shrimp are reduced, and is not adversely affected by imidacloprid. Because imidacloprid dilutes rapidly in surface water, it is highly unlikely that imidacloprid would be found in eelgrass off the treatment sites.

Comment #29

Page 10. (SIZ Application, Page 16). *All Known, Available, and Reasonable Methods of Prevention, Control, and Treatment (AKART). COMMENT – With our previous letter to Ecology (Letter to Donald A. Seeberger, dated February 14, 2014), the Service recommended that the EIS and permit framework should give fair and equal consideration to alternate culturing methods and practices. Control and removal of a native species that performs important ecological functions should not be the primary objective. Instead, this effort should be directed at developing and refining robust IPM methodologies, with stricter limits on the use of chemical control agents and an emphasis on adaptively managing shellfish production systems to avoid harming ecological resources. Graveling and frosting are established practices with the specific goal of firming substrates and fostering good conditions for larval attachment, maturity, and growth. Graveling and frosting should have a role in IPM methodologies directed at successful shellfish culturing on tidelands affected by burrowing shrimp. Long-line and stake culturing are also established practices, and are used successfully by some growers and farm operators in these same portions of Willapa Bay and Grays Harbor. Much of the information used to discredit these practices appears to be anecdotal and not based on either scientific studies or rigorous and comparative* *evaluation. Ecology and the WGHOGA should address more seriously and objectively whether methods of ground• based culturing and production require reevaluation in light of new science and the many* *concerns related to aquatic pesticide applications. Chemical control methods with lethal and biologically significant sub-lethal effects to non-target organisms should be a last resort and only implemented after a robust IPM methodology has exhausted all other alternatives at each specific location.*

Response

See responses to similar comments above (e.g., Comments #1–#3 and #7).

Comment #30

Page 10. (SIZ Application, Page 18). *Ecology and the WGHOGA acknowledge that burrowing shrimp numbers and densities exhibit cyclical changes over time. There is little or no evidence to substantiate the claims that Willapa Bay and Grays Harbor are currently experiencing anything unusual related to burrowing shrimp recruitment, numbers, abundance, and densities.*

Response

See Response to similar Comments #1–#3 above.

Specific Comments for the Fact Sheet

Comment #31

Page 11. (Pages 37, 38). *"Dungeness crab and fish were counted on the day of application and again 24 hours after treatment ... The average across all sites and treatments was two affected crab per acre ... The highest count was 3.4 affected crab per acre ... Bird predation of [paralyzed] crab ... appeared to be the main cause of crab mortality." "Birds were observed foraging on and nearby the sites following treatments." COMMENT – Willapa Bay and Grays Harbor support vitally important migratory and resident bird populations. If Ecology decides to issue the proposed permit, we expect that these waterfowl, raptor, and shorebird populations will be exposed to imidacloprid and its degradation products both on and off the treated sites. Birds that forage on the exposed tidelands will encounter and may ingest the granular pesticide product directly. Birds that forage on the exposed tidelands are also likely to ingest contaminated vegetation, sediments, and/or prey items. The western snowy plover, which is listed as threatened and uses sand and mudflats, sand islands, sand spits, and open beaches located in Grays Harbor and Willapa Bay, is likely to be exposed and affected.*

Response

The contention that snowy plover are “likely to be exposed and affected” is demonstrably false. As noted in the response to a similar comment above, the USFWS itself found that there are no records of snowy plovers foraging in Willapa Bay in its Biological Opinion for Snowy Plover (2009). Similarly, the

Service's designation of critical habitat for snowy plover[2] excludes nearly the entirety of both Willapa Bay and Grays Harbor, with the small exceptions being beach areas immediately adjacent to the mouth of these estuaries, which are not areas proposed for spraying with imidacloprid. USFWS is the federally designated lead agency for snowy plover, and therefore the data and information contained within the Biological Opinion for Snowy Plover demonstrate there should not be adverse impacts to this species.

USFWS's wide-ranging conclusion of impacts to other bird species that it does not have specific expertise over is also not scientifically credible. To recap the extensive scientific data reviewed in the DEIS, and results from the 2014 field studies:

- Imidacloprid is applied during a short, low-tide window. Following inundation by the first rising tide, imidacloprid is quickly diluted to levels below which biological effects on even the most sensitive invertebrate taxon (mysid shrimp) are not expected. Subsequent tidal cycles will continue the process of dilution and flushing of imidacloprid.

- Sediments exposed to imidacloprid experience an approximately exponential decline in concentrations, and are usually non-detectable within 28 days for whole sediment and are below biological effects levels within 14 days for sediment porewater. During the time when sediments have detectable concentrations of imidacloprid, these concentrations are very low relative to toxicity thresholds for invertebrates.

- Most eelgrass samples in treated plots have not tested positive for either imidacloprid or one of its primary breakdown products (imidacloprid olefin). No eelgrass sample has had detectable concentrations 14 days after treatment.

- Invertebrates collected from plots treated with imidacloprid are usually not statistically different, in numbers or types of invertebrates, than in control plots not so exposed. Where differences are found, sometimes treatment plots have more and sometimes less invertebrates than control plots. Thus, even where differences occur, they do not support a conclusion that imidacloprid is having a significant adverse impact.

- Imidacloprid has extremely low toxicity to vertebrates, including those bird species reviewed. In general, toxicity is associated with imidacloprid levels that are 2–4 orders of magnitude higher (i.e., 100 to 10,000 times) than levels being proposed for application under the NPDES permit.

- Megafauna that are either dead or in tetany have been observed following treatment, and some birds, notably gulls, have been observed feeding on them. No dead or impaired birds have been observed, however, among those seen feeding on affected megafauna.

[2] Available at http://www.fws.gov/arcata/es/birds/WSP/documents/WSPCH_June2012/6-19-2012_FR_rule.pdf

- Affected megafauna are only seen one day after treatment, indicating that any potential for feeding on such organisms by birds would be limited to a very short period following treatment.

Although not detailed in the DEIS, carbaryl, which has been sprayed on the two estuaries since the 1960s, and which is by all accounts more toxic than imidacloprid to both vertebrates and invertebrates, results in dead megafauna with some subsequent feeding by birds. Yet despite the 50^{+}-year record of carbaryl treatments, dead and impaired birds have not been observed associated with such feeding. This further supports the conclusion that the much less toxic chemical imidacloprid has no potential to directly affect foraging birds.

As to ingestion of pelletized imidacloprid (i.e., Protector 0.5G), this product is used in shellfish beds where extensive areas of standing water are present, even at low tide. Once applied, the pellets rapidly sink to the bottom and dissolve. Thus, direct ingestion of mallet by birds is unlikely both because the habitat, being flooded, is unsuitable for many shorebirds to feed, and because the pellets rapidly dissolve.

In summary, essentially all existing scientific data and analysis, which is extensively covered in the DEIS, supports the conclusion that birds in Willapa Bay and Grays Harbor have not been, and in the future will not be, negatively affected by imidacloprid treatments.

Comment #32

Page 11. (Pages 56-58). *There has been no consultation under the ESA addressing aquatic application of imidacloprid, and there is no valid, current ESA coverage for the application of imidacloprid to control burrowing shrimp. To date, no federal action agency has requested consultation with the Services to address the practice and its potential effects to listed species. Without a valid, current incidental take permit or statement addressing the effects of this practice on listed species, parties engaging in aquatic application of imidacloprid lack ESA coverage.*

Response

See response to Comment #25 above.

Comment #33

Page 11. (Page 59). *"Monitoring data will characterize the spatial extent, fate, and transport of imidacloprid following application, and help to determine if concentration are a concern for non-target organisms." COMMENT – Ecology, the WGHOGA, and their research partners acknowledge that the* *limited field trials performed to date have failed to meaningfully and adequately address a number of outstanding issues and concerns regarding fate and transport, efficacy, persistence, and effects to non-target organisms (Ecology 2014, pp. 1-33 through 1-37). Ecology should not advance a permit decision* *until more data is collected (during 2014 and 2015) and shared with the public. A decision to issue the permit and authorize SIZs while relevant and important data remain unavailable would be premature. Until field trials have adequately addressed the many unresolved questions, and to the satisfaction of all interested stakeholders, Ecology should not advance the permit decision. We recommend that Ecology should instead continue limited field trials under the Experimental Use Permit. We do not support the issuance of an individual NPDES permit at this time and we oppose the authorization of SIZs in Willapa Bay and Grays Harbor. The Service acknowledges that continuing a program of limited field trials would improve the state of our knowledge regarding imidacloprid applications and effects in the estuarine and marine environments.*

Response

See responses above to similar comments about the level of scientific certainty necessary to support permit issuance. The contention that "the satisfaction of all stakeholders" (however broadly "stakeholders" is defined) is not contained in any applicable regulatory standards of which we are aware and, if implemented, would allow any stakeholder to have veto power over the entire process.

See response above about availability of the 2014 field data, which adds tests of large plot spraying to the already existing body of scientific research on imidacloprid effects.

The statement "*Ecology, the WGHOGA, and their research partners acknowledge that the limited field trials performed to date have failed to meaningfully and adequately address a number of outstanding issues and concerns regarding fate and transport, efficacy, persistence, and effects to non-target organisms"* is a gross misrepresentation of what Ecology and the DEIS in fact conclude. Nowhere does the DEIS, draft permit, or fact sheet state or even imply the multiple years' worth of field trials fail to meaningfully and adequately address the listed issues. Rather, these documents present an honest discussion of these studies, along with other appropriate scientific and technical information, including limitations. A robust monitoring program is required in the draft permit to confirm that as the permit is implemented WGHOGA meets all its required conditions under that permit, and that environmental effects associated with that implementation continue to meet regulatory criteria and goals set by Ecology. In short, monitoring being proposed by Ecology focuses on compliance, and confirmation, not on a *post hoc* effort to gather information that is needed to justify issuing the permit, as USFWS contends. Notably, NPDES permits *regularly* require monitoring as a condition of permit issuance, so the monitoring being required here is not unique. Accordingly, additional limited field trials and experimental use permits are not scientifically justified, and needlessly delaying permit issuance for such studies could have extensive and adverse impacts on commercial shellfish beds and the broader environment of Willapa Bay and Grays Harbor.

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Commenter: George Tuttle - Comment A-3-1

Please see attachment "WSDA Final Comments 11.1.2017"

STATE OF WASHINGTON

DEPARTMENT OF AGRICULTURE

P.O. Box 42560 Olympia, Washington 98504-2560 (360) 902-1800

October 31, 2017

Derek Rockett, Program Lead

Washington State Department of Ecology

Water Quality Program

P.O. Box 47775

Olympia, WA 98504-7775

Dear Mr. Rockett,

The Washington State Department of Agriculture (WSDA) has completed our review of the Washington State Department of Ecology's (Ecology) *"Supplemental Environmental Impact Statement for Control of*

Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington – Draft" (DSEIS). I am writing to you on behalf of WSDA in response to your request for comments regarding the DSEIS. We feel that the DSEIS was well written and informative and we appreciate your efforts to provide a scientific perspective on the four proposed alternatives.

During our review we identified a specific area of the DSEIS where we recommend additional discussion.

The DSEIS references the Marine Sediment Quality Standards (WAC 173-204-320) but does not identify how Ecology would implement the sediment management standards if a new NPDES permit and sediment impact zones (SIZ) were issued. Although monitoring requirements were implemented under the previous NPDES permit

to determine if applications of imidacloprid on shellfish beds would comply with the criteria for benthic abundance, the results were inconclusive. Regarding the results from the most recent monitoring studies conducted in 2014 the DSEIS specifically states that, "… as in previous years, variability in benthic abundance collections was high and statistical power was weak" (Department of Ecology DSEIS - Appendix A, Page A-22). Because there is an extremely high degree of variability inherent in the intertidal systems of Willapa Bay and Grays Harbor it is not practical to require the shellfish growers to produce additional monitoring studies that may lack the adequate level of confidence required to determine whether changes in benthic abundance are caused by applications of imidacloprid.

Ecology has also, in the past, required sediment pore water be collected and analyzed. Unfortunately, imidacloprid concentrations in sediment pore water are not an appropriate estimate of toxicity due to the lack of relevant laboratory toxicity studies that would directly associate concentrations of imidacloprid in sediment pore water to invertebrate survival following EPA standardized guidelines. Similarly, comparing concentrations of imidacloprid in sediment pore water to toxicity data derived from laboratory toxicity studies conducted with free swimming invertebrate species in surface water may only provide an indirect and potentially inaccurate estimate of toxicity.

The previous data sets, including the 2014 field trials, were unable to clearly identify a causal relationship between imidacloprid applications and benthic diversity and abundance. Identifying an improved set of monitoring requirements under Alternatives 3 or 4, for example, would allow crucial applications of imidacloprid to occur under the permit while protecting non-target benthic fauna. In the final SEIS please identify standardized monitoring procedures that would be reliable enough to effectively meet the permittees need for regulatory certainty while at the same time generate repeatable and unambiguous data sets so that Ecology can confirm that the assessment needs are satisfied under WAC 173-204-320. Allowing a dual process to proceed under Alternative 3 or 4 will allow imidacloprid applications to move forward while collecting high-quality data sets that would inform both future NPDES permits for imidacloprid as well as federal imidacloprid registrations for estuarine and marine uses.

Please also discuss how and why the decision tree that was used in the previous NPDES permit was developed. In 2014, monitoring was conducted 14 days after applications with imidacloprid. Please discuss why 14 days was specifically selected. Please also outline a timetable for issuing a draft permit and SIZ once a preferred alternative is selected and the final SEIS is released to the public. The addition of this information once incorporated into a final SEIS will help further insure that the requirements of the NPDES permit and SIZs are transparent, reproducible, and do not cause unnecessary economic hardship for the permit applicants.

The DSEIS also specifically mentions conversion of "…ecologically diverse oyster or clam beds into less diverse mudflats containing predominantly burrowing shrimp" (Department of Ecology DSEIS, Page 2-7). Possible conversion from an ecologically diverse community to a less diverse community is of significant concern. In the final SEIS please describe in detail how mudflats containing burrowing shrimp are less diverse than oyster and clam beds. Please provide any relevant data sources and references that may be helpful in understanding how these two ecological communities differ and which one might be considered more desirable from an ecological perspective.

Thank you for providing the opportunity to review the DSEIS and provide our comments. As the delegated state lead agency regarding the use of pesticides use in Washington State, WSDA will continue to offer technical assistance and expertise to Ecology in the development of the NPDES permit and the SIZs. Please feel free to call me at (360) 902-2066 or email me at George.Tuttle@agr.wa.gov if you have any questions and I would be happy to talk with you.

Appreciatively,

George R. Tuttle M.S. - Agency Toxicologist

Office of the Director - Natural Resources Assessment Section

Washington State Department of Agriculture

Cc: Derek Sandison, WSDA Gary Bahr, WSDA Kelly McLain, WSDA Robin Schoen-Nessa, WSDA
Patrick Capper, WSDA Laura Butler, WSDA
Erik Johansen, WSDA

Appendix C

Contents

Preface to Response to Comments

Ecology received 8,287 comments during the comment period via electronic submittal, letters, and testimony at public hearings. The below responses are organized by topic of comment submitted. Numerous comments supported or opposed actions with generalized statements about environmental impacts. Note that such comments, categorized as "Environment General" in Appendix B, are addressed here by specific responses to concerns related to pollinators, avians, food web and habitat, etc.

Response to Comments Related to Pollinators

Pesticide exposure to pollinators is a primary concern, and specifically honey bees, in Willapa Bay and Grays Harbor. Additional information not presented in the 2015 Final Environmental Impact Statement (FEIS), specifically section 3-51 is presented below.

In 2016, U.S. Environmental Protection Agency (EPA) conducted an assessment of the potential risks of imidacloprid to terrestrial pollinators, focusing on honey bees (*Apis mellifera*). Although imidacloprid was deemed by EPA to be "*highly toxic*" to honey bees, their modeled concentrations were also deemed "*conservative*" because they exceeded the levels measured in field studies. In general, scenarios that do not involve direct, on-field exposure by honey bees to imidacloprid did not exceed EPA's toxicity thresholds for the majority of agricultural uses modeled. But, EPA (2016) concluded that some agricultural uses pose significant environmental risks to bees and bee colonies. Many other published studies have also concluded that imidacloprid can cause both mortality and sub-lethal effects in bees and other pollinators. This body of literature, and documentation of increasing levels of bee colony collapse, has combined to raise many concerns about the effects of imidacloprid on pollinators. This remains an active area of scientific research.

In Willapa Bay and Grays Harbor, imidacloprid would be applied on tidelands that are located approximately 0.5 mile or more from the nearest bee hive colonies. Imidacloprid would not be applied on any shoreline or upland vegetation. Therefore, it is unlikely that this use of imidacloprid would impact pollinators in the area. In addition, the 2016 Willapa Grays Harbor Oyster Growers Association (WGHOGA) National Pollutant Discharge Elimination System (NPDES) Individual Permit application specifically excludes aerial spraying of imidacloprid from helicopters, which further decreases the likelihood of impacts to pollinators due to spray drift.

It is highly unlikely that there would be on-plot effects to pollinators because bees and other pollinators are rare or absent from the intertidal, salt-water areas that would be treated. This absence is likely because there are no flowering plants present on the commercial shellfish beds to attract such pollinators. If pollinator use of such areas is assumed to occur, then under Alternative 3 or 4 on-plot impacts would be likely to occur when such use occurs in the interval between chemical spraying and the first rising tide to inundate the sprayed plots. Imidacloprid is acutely toxic to bees that are directly exposed to these chemicals. So, it is reasonable to assume that any pollinators that were so exposed would die.

The No Action Alternative would be unlikely to have either a beneficial or adverse effect on honey bees (or other pollinators) as no insecticides would be sprayed on commercial clam or oyster beds in Willapa Bay or Grays Harbor.

Imidacloprid (Alternative 4) is highly toxic to bees that are exposed to direct contact or residues on flowering plants, and cannot be applied with bees present. Honey bees in lab tests exhibited behavioral responses in short direct exposure doses greater than 12 μg/kg, and cumulative effects on mortality after 10 days of continued exposure (Gervais et al. 2010). Another pathway for imidacloprid fatal exposure to bees is through uptake by targeted plants (Cresswell 2011). In the proposed application of imidacloprid on commercial shellfish beds in estuarine tidelands, this pathway would not exist. Eelgrass is the only flowering plant near the targeted area, and bees do not pollinate eelgrass. The potential for direct exposure to pollinators or their associated plant species would be negligible since honey bees are not attracted to mudflats, bumblebees and similar pollinators prefer terrestrial flowering plants that are not found in the bays (Macfarlane and Patten 1997), and neither are likely to be present over estuarine waters that cover commercial shellfish beds (CSI 2013).

Further, in the professional opinion of the Washington State Department of Agriculture (WSDA), Special Pesticide Registration Program Coordinator (Erik Johansen), there is no risk to bees from the application of imidacloprid (either granular or flowable formulation) to tidal flats.

Response to Comments Related to Avians

The 2015 FEIS provides a discussion of the potential impacts to birds from imidacloprid exposure (Chapter 3, Section 3.2.5, page 3-20 through 3-51). Information not available or reviewed before the 2015 FEIS was issued is presented here.

As with other vertebrates, high concentrations of imidacloprid are required to produce acute toxicity in birds. The Health Canada (2016) risk assessment includes an extensive review of imidacloprid toxicity to different bird species, as well as modeling to compare likely environmental exposure levels (e.g., from eating imidacloprid-containing seed or invertebrates). Health Canada noted a wide range of reported acute and chronic toxicity levels for different bird species, and modes of exposure. It concluded that imidacloprid is *"not expected to pose a risk to birds"* due to low toxicity relative to exposure, and that *"birds are unlikely to feed solely on imidacloprid-contaminated foodstuffs."* The modeled toxicity to small and insectivorous birds concluded that imidacloprid is *"not expected to pose a risk to birds,"* again based on an inherent high toxicity threshold, and because imidacloprid is expected to decline in their prey organisms following treatment with imidacloprid. Similarly, Health Canada concluded that the *"risk to small and medium sized birds is considered to be relatively low."* Health Canada did find that consumption of agricultural seeds treated with imidacloprid could lead to toxicity if ingested by seed-eating birds. Health Canada also evaluated anecdotal reports of birds that had fallen ill, or were dead or dying, following turf treatments of imidacloprid. Health Canada concluded that these reports demonstrate a potential for impacts from pellet applications of imidacloprid, but indicated that this risk could be mitigated by prompt exposure of the pellets to water following application. The use of imidacloprid pellets in Willapa Bay or Grays Harbor is unlikely to impact birds because pellets will dissolve on contact with water from the incoming tide.

Although Health Canada (2016) did not conclude that imidacloprid toxicity in birds is likely, it noted that imidacloprid toxicity to invertebrates could have food chain effects that could indirectly affect birds. Birds that eat invertebrates would be particularly susceptible. Reduction in invertebrates could reduce the levels of food for these species, at least locally, particularly for shorebirds that feed exclusively on invertebrates. However, it is uncertain whether any such reductions could be significant because of the area that would receive imidacloprid applications from on and off-plot drift.

Granular-form applications of imidacloprid on commercial shellfish beds (sand or mudflats) could result in an opportunity for birds to be exposed to this chemical through ingestion of the solid form, but direct exposure would be limited since application techniques flush birds from the site, and imidacloprid dissolves readily in water. In addition, the granular form of imidacloprid uses clay pellets, which presumably are not sought as a prey item by foraging birds. Similar to potential impacts that may be associated with birds eating invertebrate prey organisms that have been exposed to imidacloprid, the risk of birds ingesting the granular form of imidacloprid is not expected to be significant because of the small area that would be treated relative to the total area available for such foraging in Willapa Bay and Grays Harbor.

Another study containing an extensive review of imidacloprid effect on birds is Gibbons et al. (2015). They reviewed 150 previously published studies on the effects of pesticides on vertebrate wildlife, including fish, birds, and mammals. Common to many studies, they found widely varying toxicity of imidacloprid to different species. For birds, they report LC_{50} values ranging from 13,900 to 283,000 µg/L. The authors also reviewed literature to show that imidacloprid can cause sub-lethal effects (e.g., reduced reproductive success) in birds at doses (in food) of 1,000 to 53,400 µg/kg animal weight per day. The authors noted that one of the greatest potential impacts of imidacloprid is from imidacloprid-treated agricultural seeds, where *"ingestion of even a few treated seeds could cause mortality and reproductive impairment to sensitive bird species."* The authors also concluded that sub-lethal effects can occur in birds, particularly those exposed to imidacloprid-treated seeds. Finally, the authors noted the rarity of studies looking at potential indirect effects, in particular how reductions in invertebrates caused by pesticide treatments may reduce the prey available to vertebrate consumers of these animals.

Threatened, Endangered and Protected Species.

Marbled Murrelet. Marbled murrelet critical habitat and foraging habitat do not overlap with areas where imidacloprid applications (Alternative 4) would occur on commercial shellfish beds in Willapa Bay or Grays Harbor; therefore, it would be unlikely to adversely affect marbled murrelet (CSI 2013). Were murrelets to forage in areas where imidacloprid is applied, such use would be at higher tide levels because murrelets are diving birds, ensuring any imidacloprid from treatment would have been diluted to below toxic levels. Potential uptake from consumption of contaminated fish is possible, but such uptake would be minimal given the limited exposure pathways for prey fish species to ingest imidacloprid and the fact that imidacloprid does not bioaccumulate (i.e., it would not persist in fish that were exposed). In addition, fish are highly mobile, so murrelet foraging would be on the larger population of fish in Willapa Bay and Grays Harbor, the vast majority of which would not have been exposed to imidacloprid.

Western Snowy Plover. Granular-form applications of imidacloprid (Alternative 4) on commercial shellfish beds (sand and mudflats) could result in an opportunity for birds to be exposed to this chemical through ingestion of the solid form, but direct exposure would be limited since application techniques flush birds from the site, imidacloprid dissolves readily in water, and only small percentages of total tidelands within Willapa Bay and Grays Harbor would receive imidacloprid applications in any given year. This limited period of potential exposure would be interrupted when the sand or mudflats became inundated by the incoming tide. CSI (2013) found imidacloprid toxicity exposure for snowy plover to have a low likelihood of indirect effects (e.g., through effect on food chains), and concluded that it would be unlikely to have adverse effects. "Flowable" form applications of imidacloprid would result in minimal exposure times for birds (Giddings et al. 2012). Plovers are also generally found only on the ocean beaches on the west side of Willapa Bay and Grays Harbor, not in the bays themselves; therefore, it is unlikely they would be found in the vicinity of the commercial oyster and clam beds. See the 2015 FEIS (Chapter 3, Section 3.2.5.3, pages 3-45 through 3-46) for further discussion on western snowy plover habitat.

Streaked Horned Lark. Streaked horned lark critical habitat is centered on nesting beaches along the coast. Nests are established on bare ground, well above MHHW, and the birds do not forage on or near shellfish beds (Pearson and Hopey 2004 and 2005). Application of imidacloprid (Alternative 4) would be unlikely to adversely affect streaked horned lark or their nest sites because they do not occur on commercial shellfish beds within Willapa Bay or Grays Harbor.

Direct toxicity to birds and mammals as a result of Alternative 3 or 4 is not expected on-plot given the low toxicity of imidacloprid to vertebrates. There could be minor effects to birds and mammals due to the potential short-term reduction in prey items present on treated areas. This would also be true for threatened, endangered, and protected species that occur or forage in the vicinity of treated plots. They are not likely to be present on-plot during the time of application, but may see a minor and temporary loss in prey items.

The No Action Alternative would be unlikely to have a significant beneficial or adverse effect on birds in Willapa Bay or Grays Harbor due to the relatively small proportion of tidelands within each estuary that have been or would be treated with an insecticide for the control of burrowing shrimp populations.

Response to Comments Related to the Food Web and Habitat

Many comments were related to concern for the food web, such as potential trophic cascading effects from indirect mortality of the zooplankton and benthic invertebrates. Imidacloprid application rate to control the burrowing shrimp species is high enough that non-target marine invertebrates such as other shrimp, crab, and polychaete species will be killed inadvertently from acute toxicity. This document, the Supplemental Environmental Impact Statement (SEIS), states that despite concluding that direct effects of imidacloprid on vertebrates are unlikely, EPA (2017) noted that vertebrate groups could be indirectly affected by reduction in invertebrate prey that are susceptible to imidacloprid. The EPA assessment states, "*the potential exists for indirect risks to fish and aquatic-phase amphibians indirectly through reduction in aquatic invertebrates that comprise their prey base*" (EPA 2017).

The spatial and temporal scale of imidacloprid use under Alternative 4 in Willapa Bay would be 485 acres per year or 1.1 percent of the total tideland exposed during a low tide and in Grays Harbor it would be 15 acres per year or 0.04 percent of the total tideland exposed during a low tide. Drift of imidacloprid has been documented at more than 1500 feet due to incoming tides. Ecology modeling from the results of the 2012 monitoring and found exceedances of EPA's acute concentrations of imidacloprid at more than five times the area of the spray plot. Mitigation activities such as more accurate and rotating pesticide application of treated shellfish beds could avoid some unintended impacts. However, there is uncertainty identified in the SEIS (2017) regarding the understanding of chronic toxicity associated with long-term, low-level imidacloprid exposure to invertebrate species.

It is unfeasible to control off-plot drift of the pesticide on incoming tides. There likely would be unavoidable adverse impacts to sediments, benthic invertebrates, and the surface waters outside the treated areas. Surface water monitoring data from 2012 showed extensive distribution of imidacloprid off-plot at levels that exceed the EPA (2017) acute biologic endpoint criteria. Distribution of imidacloprid off-plot at levels that exceed both the EPA (2017) chronic biologic endpoint criteria have not been measured during monitoring and therefore have not been modeled.

Numerous commenters indicated the value of incorporating a more holistic understanding of the Willapa Bay Ecosystem. Ghost and mud shrimp provide numerous important ecosystem services and are seen as playing a critical role in estuarine nutrient cycling (for example see Kozloff 1983, Jensen 2014). They are also a key prey species for vertebrates, from fish (e.g. staghorn sculpin and ESA-listed sturgeon) to grey whales, and throughout the Pacific Northwest are used as bait for recreational fisheries. Feldman et al. (2000) states that burrowing shrimp "are an important link in estuarine trophic pathways" and consist of a significant portion of sculpin diets.

The green sturgeon diet may seasonally consist of up to 50 percent burrowing shrimp (Dumbauld et al. 2008). Prey availability may increase on untreated commercial shellfish beds; however, this effect would be highly localized relative to the full extent of the bays. The control of burrowing shrimp would benefit oyster aquaculture.

Response to WGHOGA comments

WGHOGA commented on the *Ecological Benefits of Burrowing Shrimp Control* section. WGHOGA notes that the FEIS included numerous discussions of the possible ecological and food web benefits of burrowing shrimp control, but then any such discussion is largely absent from the SEIS. WGHOGA list potential benefits from burrowing shrimp control.

The potential benefits listed does not include the negative impacts from the use of a pesticide to control the burrowing shrimp. Additionally, burrowing shrimp characteristics and the ecology of oyster and clam communities is discussed in section 3.1 of the FEIS, Biological Background Information.

WGHOGA commented that the control of burrowing shrimp would likely have net positive effects on Dungeness crab. See section 3.3.5 of the SEIS and "Response to Comments Related to Impacts to Benthic Organisms" for more discussion.

WGHOGA requested that the final SEIS include a citation and discussion of Dr. Booth's paper. Dr. Booth's paper is included in Appendix A. WGHOGA additionally stated that the discussion should acknowledge the conclusions of that study, particularly the conclusion that the use of imidacloprid to treat burrowing shrimp does not result in the reduction of non-target species. WGHOGA also requested that the SEIS should acknowledge that these results corroborate findings in the FEIS that reduction of burrowing shrimp numbers can have positive effects on non-target invertebrates.

Ecology believes that the use of imidacloprid will result in the reduction of non-target species. Section 3.1 of the FEIS, Biological Background Information, discusses the ecology of oyster and clam communities.

WGHOGA states that the proposed permit has solid scientific evidence to support the conclusion that significant adverse effects will not occur. Due to weak statistical power for the studies done in Willapa Bay and new modeling, Ecology has concluded that some significant adverse effects will occur to some of the benthic organisms.

WGHOGA states that negative food chain effects, while theoretically possible, are extremely unlikely and that the SEIS should state that control of burrowing shrimp with imidacloprid could have positive food chain effects as discussed within the FEIS.

Despite concluding that direct effects of imidacloprid on vertebrates are unlikely, EPA (2017) noted that vertebrate groups could be indirectly affected by reduction in invertebrate prey that are susceptible to imidacloprid. The EPA assessment states, "the potential exists for indirect risks to fish and aquatic-phase amphibians indirectly through reduction in aquatic invertebrates that comprise their prey base" (EPA 2017).

Response to Comments Related to Human Health

Information regarding human health in the Willapa Bay area is described in the 2015 FEIS (Chapter 3, Section 3.2.6, pages 3-55 through 3-56). Information regarding human health in the Grays Harbor area is described in the 2015 FEIS (Chapter 3, Section 3.2.6, page 3-56). Human health information reference above is unchanged at the time of this writing, and are incorporated by reference in the SEIS.

The potential impacts to human health of Alternatives 1 (No Action: No Permit for Pesticide Applications, Continue Historical Management Practices) and Alternative 3 (Imidacloprid Applications with Integrated Pest Management, on up to 2,000 acres per year in Willapa Bay and Grays Harbor) were described and evaluated in the 2015 FEIS (Chapter 3, Section 3.2.6, pages 3-58 through 3-60). That information is unchanged at the time of this writing, and is incorporated by reference in the SEIS. A comparison of the impacts of the alternatives is provided in SEIS Chapter 2, Section 2.9, and in the SEIS Chapter 1 Summary.

Alternative 4 would likely have no effect on human health or potentially affect only a very small number of people (primarily pesticide handlers and applicators) in Willapa Bay and Grays Harbor. There would be a risk of exposure to a small number of people who would handle and apply imidacloprid. Up to 500 acres would be treated per year: up to 485 acres within Willapa Bay and up to 15 acres per year within Grays Harbor on commercial clam and oyster beds (see SEIS Chapter 2, Section 2.8.4).

Imidacloprid is a systemic insecticide of the chemical class of chloronicotinyls-neonicotinoids; specifically, it is a chloronicotinyl nitroguanidine. The compound acts on the nicotinergic acetylcholine receptors (nAChR) in the nervous system of insects, blocking the transmission of nervous signals in the post-synaptic region, resulting in paralysis and death. Mammals, birds, fish, and amphibians, are much less sensitive to imidacloprid than certain aquatic invertebrates because of differences in the nAChR receptors in vertebrates. Imidacloprid is not considered acutely toxic to humans via dermal or inhalation exposure routes even though it is designated an acute oral toxicant. The 2015 FEIS discusses in detail potential impacts to humans (Chapter 3, Section 3.2.6, pages 3-58 through 3-60).

The Health Canada (2016) risk assessment evaluated the effects of imidacloprid on humans, using an analysis largely based on studies of other mammals, as well as an extensive review of potential exposure pathways (e.g., ingestion or adsorption in agricultural workers using imidacloprid). There is no direct analysis of the likelihood of imidacloprid toxicity in humans, but the general discussion indicates a low risk, as for other vertebrates. Health Canada (2016) reviewed case reports of attempted suicides through ingestion of imidacloprid. Based on this work they identified that imidacloprid toxicity *"symptoms in humans consist of nausea, vomiting, headache, dizziness, abdominal pain, and diarrhea."* Of 56 attempted suicides, *"recovery was seen in all 56 patients reported."*

The on-plot risk to human health due to the application of imidacloprid under either of the action alternatives would only apply to the small number of people that handle and apply the chemicals. Required safety measures for applicators, including personal protective equipment (e.g., gloves, long sleeved shirts) are expected to prevent adverse effects during application (discussed further below).

While no mitigation for potential impacts to human health with implementation of Alternative 4 are addressed by the results of testing imidacloprid, Federal and State laws require various measures to be implemented to protect human health. These measures would mitigate potential significant adverse impacts. The following conditions imposed by the imidacloprid Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Registrations (USEPA 2013a and 2013b) would be protective of human health:

- The public would be notified prior to imidacloprid applications through signs, website postings, and e-mail to interested parties.
- All public access areas within one-quarter mile and all public boat launches within one-quarter mile radius of any bed scheduled for treatment with imidacloprid would be posted. Public access areas would be posted at 500-foot intervals at those access areas more than 500 feet wide.
- Signs would be posted at least 2 days prior to aerial treatment and will remain for at least 30 days after treatment. Signs shall say "Imidacloprid will be applied for burrowing shrimp control on [date] on commercial shellfish beds. Do not Fish, Crab or Clam within one-quarter mile of the treated area." The location of the treatment area would be included on the sign. The WGHOGA Integrated Pest Management (IPM) Coordinator would be responsible for posting, maintaining, and removing these signs.
- No bed would be treated with imidacloprid if it contains shellfish within 30 days of harvest.
- A 25-foot buffer zone would be maintained between the imidacloprid treatment area and the nearest shellfish to be harvested within 30 days when treatment is by hand.
- Imidacloprid would not be applied during Federal holiday weekends.

Under Alternative 4, WGHOGA proposes to also use a website in lieu of newspaper announcements for public notification of specific dates of proposed imidacloprid applications in Willapa Bay and Grays Harbor. The website would include a link for interested persons to request direct notification regarding proposed treatment dates and locations. The WGHOGA IPM Coordinator would send e-mail notifications to registered interested parties, as needed.

Washington State law requires that imidacloprid be used and applied only by certified applicators or persons under the direct supervision of a certified applicator.

To mitigate potential exposure for persons applying imidacloprid, applicators would be required to wear approved Personal Protective Equipment (PPE), and would be trained in pesticide applications. The following PPE would be required of all imidacloprid applicators and handlers, as required by the FIFRA labels (i.e., required pursuant to Federal law) and would mitigate potential significant impacts:

- Long-sleeved shirt and long pants;
- Chemical-resistant gloves made of any waterproof material such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene, polyvinylchloride (PVC) or Viton;
- Shoes and socks;
- Protective eyewear; and
- Dust mask when using Protector 0.5G, the granular formulation of imidacloprid.

Manufacturer's instructions must be followed for cleaning/maintaining PPE. If instructions for washables do not exist, detergent and hot water would be used. PPE should be kept and washed separately from other laundry.

Boats would also need to use a hopper, hopper loaders, and possibly a barge to hold additional chemical, equipment and personnel. Alternative 4 specifically excludes aerial (helicopter) applications of imidacloprid from the permit application, which would decrease the potential for drift compared to Alternative 3.

Response to Comments Related to Sediment Impacts

Ecology received numerous comments related to sediment impacts and concerns about the persistence of imidacloprid in sediments.

Under the proposed action, impacts to sediment and sediment porewater would be similar for Alternatives 3 and 4, although the extent of impacts would be greater in Alternative 3 due to greater acreage sprayed. Imidacloprid in on-plot sediment and sediment porewater would likely result in exposure to benthic invertebrates above the new EPA and Health Canada risk assessment endpoints. Exceeding these thresholds could result in mortality (acute toxicity) or sub-lethal effects (chronic toxicity). These effects would represent significant adverse impacts from imidacloprid application. Discussion of the toxic effects of imidacloprid in respect to the sediment and porewater concentrations documented in the field trials are further discussed in section 3.3.5 Animals.

Sediment Management Standards (SMS) benthic abundance criteria (WAC 173-204-420) was developed to assess sediment toxicity. Although the Puget Sound Marine Criterion in SMS was developed based on Puget Sound sampling only, and these embayments are not located in Puget Sound, Ecology has determined that benthic abundance criteria provided a reasonable metric during experimental spray monitoring. The criterion was considered, along with recent scientific literature, in developing the approach for interpreting the non-Puget Sound marine narrative criteria in Willapa Bay. Specifically, WAC 173-204-420 (3(c(iii))), benthic abundance, sets a statistically significant “fifty percent of reference mean abundance” criteria.

Given the risk assessments and new published peer-reviewed journal articles highlighting acute and chronic impacts to aquatic invertebrates, a more precise analysis of the Cedar River studies (i.e., 2011 field trials) can be concluded based on a weight of evidence approach. The north Willapa Bay-Cedar River sampling from 2011 experimental trials document significant acute and persistent on-plot benthic community unavoidable adverse impacts in high total organic carbon (TOC) areas. Fourteen and 28 day mean crustacean and polychaete abundance showed a more than 50 percent reduction in mean abundance. Mean abundances at control plots increased during the same time. All 2012 and 2014 monitoring occurred in sites containing low TOC levels in sediment. There are likely other shellfish beds in the 2012 and 2014 areas with higher TOC levels than those included in the monitoring studies. The current permit application specifically requests the ability to spray areas that are known to include high TOC sediments. Combined with the updated risk assessments and recent published peer-reviewed articles, Ecology is confident in the determination of the 2011 Cedar River study results.

At the North Willapa Bay experimental trial site (Cedar River) there was inadequate recovery of the benthic invertebrate population 14 days after treatment. Specifically, mean crustacean abundance showed an 86 percent decline after fourteen days, while there was little change in the control plot. After 28 days, while there was more than a 40 percent increase in crustaceans at the control plot, there was a 60 percent decrease in crustaceans on the treatment plot. Ostracods, noted as susceptible in the EPA (2017) risk assessment reflected this trend. After 28 days, six out of nine subgroups showed a more than 60 percent decrease compared to before treatment numbers.

This location failed, or exceeded, the minor adverse effects criteria in the Sediment Management Standards of WAC 173-204-415, as established by the department. If this test exceeded a minor effects threshold, it is above, or in exceedance, of the levels that can be allowed in a Sediment Impact Zone (SIZ) under the sediment management regulations. A SIZ must be authorized by Ecology such that compliance with the SIZ requirements can be met and compliance time periods are sufficient to meet the standards of this section WAC 173-204-420. This problem would repeat in areas of high TOC or areas with a low rate of tidal exchange (residence times) in the summer. Areas of high TOC have noted an extended duration of persistence in the sediment, increasing the period of sub-lethal (chronic) impacts which are likely to accumulative to toxic levels.

Field trials conducted in 2012 and 2014 confirm that imidacloprid does persist in the sediment after application (Hart Crowser 2013 and 2016) possibly serving as a source. Both the 2012 and 2014 results confirm that imidacloprid concentrations in the sediment decline, but remain above screening values after 14 days, and are generally undetectable or below screening values at 28 days. The 2012 results documented detectable concentrations of imidacloprid at 56 days for two of five sampled locations, both of which were below screening levels. Imidacloprid is known to bind to organic materials in sediments, which delays the rate of decline in imidacloprid concentrations compared to sediments low in organic materials (Grue and Grassley 2013). Similar results are seen for sediment porewater, with measurable concentrations of imidacloprid generally undetectable or falling below 2014 screening levels by 28 days or less at a majority of the sites tested, but with slower levels of decline at sites with higher organic levels in the sediments (e.g., the Cedar River test plots).

Based upon an updated review of best available science regarding neonicotinoid pesticides, Ecology has determined that under the proposed action, areas in Southern Willapa would be likely to exceed SMS standards if sprayed and that these areas would experience significant unavoidable adverse impacts. There is no known reasonable mitigation in the record to reduce these environmental impacts. This is consistent with Ecology's 2015 determination to exclude Southern Willapa Bay due to high TOC and poor circulation during the summer given our current knowledge. Ecology has concluded that under the proposed action, high TOC locations including the Cedar River and other high TOC areas throughout the bay, would be impacted and could not be sprayed without having significant unavoidable impacts due to the persistence of imidacloprid in high TOC sediments.

Please refer to Section 3.3.1, Sediment for further discussion of impacts to sediment. Additional discussion of persistence of imidacloprid in sediment can be found in section 1.7 Areas of Controversy and Uncertainty, and Issues to be Resolved.

Response to Comments Related to Impacts on Benthic Organisms

Ecology received numerous comments related to impacts on benthic organisms.

Sediment Management Standards (SMS) benthic abundance criteria (WAC 173-204-420) was developed to assess sediment toxicity. Although the Puget Sound Marine Criterion in SMS was developed based on Puget Sound sampling only, and these embayments are not located in Puget Sound, Ecology has determined that benthic abundance criteria provided a reasonable metric during experimental spray monitoring. The criterion was considered, along with recent scientific literature, in developing the approach for interpreting the non-Puget Sound marine narrative criteria in Willapa Bay. Specifically, WAC 173-204-420 (3(c(iii))), benthic abundance, sets a statistically significant "fifty percent of reference mean abundance" criteria.

For saltwater invertebrates, EPA (2017) found only a limited number of studies covering seven estuarine or marine species, five of which were crustaceans. Acute toxicity values ranged widely, from a low LC50 of 10 micrograms of active ingredient per liter (µg a.i./L is equal to ppb) for blue crab megalopae (a planktonic stage), to an LC50 of 361,000 µg a.i./L for brine shrimp. The blue crab study (Osterberg et al. 2012) is of particular interest given its possible relevance to imidacloprid effects on Dungeness crab in Grays Harbor and Willapa Bay, and so is reviewed separately below. EPA (2017), deemed the study "*qualitative*,", so EPA chose to use "*the lowest acceptable (quantitative) acute toxicity value of 33 µg a.i./L …for estimating risks to saltwater aquatic invertebrates*." The value of 33 µg a.i./L is the 96-hour LC50 for a species of mysid shrimp (*Americamysis bahia*). EPA notes that this value is "*42X less sensitive than that for freshwater invertebrates.*" EPA then applied a Level of Concern of 0.5 (i.e., a factor of safety) to this value, resulting in an acute toxicity standard for marine invertebrates of 16.5 µg a.i./L. (i.e., 33 µg a.i./L x 0.5 LOC = 16.5 µg a.i./L). Given selection of this toxicity standard by EPA (2017), Ecology has chosen to utilize 16.5 µg a.i./L as the imidacloprid acute toxicity criterion for marine invertebrates. However, given the limited number of marine studies, and known sensitivity of freshwater invertebrates such as ostracods for which marine species are also found, it is likely that as additional species are studied, more sensitive species will be documented. This would be likely to further lower the EPA acute marine benthic criteria. Surface water monitoring in 2014 reported an average concentration of imidacloprid of 796 ppb, nearly 50 times the EPA acute marine endpoint; although reports of up to 4200 ppb (250 times the EPA endpoint) have been reported (Hart-Crowser 2013).

For chronic toxicity of saltwater invertebrates, EPA (2017) again used data on mysid shrimp to develop a 28-day No Observable Adverse Effects Concentration (NOAEC) value of 0.163 µg a.i./L and a Lowest Observable Adverse Effects Concentration (LOAEC) of 0.326 µg a.i./L based on *"significant reductions in length and weight."* EPA (2017) includes only two chronic studies of imidacloprid effects on saltwater invertebrates. If a larger database had been available, it seems likely that lower values for chronic toxicity would have been noted for one or more invertebrate types, especially given the consistent pattern of wide variation in imidacloprid toxicity among species. See the literature review in SEIS Appendix A for further details.

In response to comments received during the public comment period which question benthic abundance monitoring results, and as part of Ecology's review of benthic monitoring data based upon new available literature, an examination of the previous benthic abundance monitoring has been conducted by Ecology and TerraStat, Inc. Benthic abundance monitoring was conducted during 2011, 2012, and 2014 as part of experimental applications of imidacloprid. During all three years, statistical power was low, requiring Ecology to make determinations based on best professional judgement.

A statistical review of monitoring results have identified a number of concerns with the proposed approach. Abundance values are highly variable. In order to obtain required statistical power to adequately measure variability, larger sample sizes (analysis of previous monitoring show up to 200 samples per plot are required to reach power) and more replication of control and treatment plots were advised (TerraStat, January 2, 2018). The current analytical approach led to a non-statistical evaluation of outcomes in 2014, suggesting that the approach is inadequate to evaluate the nature of the benthic community data (TerraStat 2018). Based upon this review, if the NPDES permit were to move forward, it is likely a new analytical approach to monitoring would need to be developed that is more robust to meet the power necessary to be able to make a statistical conclusion of "no negative effects."

The 2016 WGHOGA permit application requests authorization to spray in both north and south Willapa Bay, locations known to contain sediments with higher organic carbon levels. Field and laboratory studies have documented that imidacloprid levels in sediments decline more slowly over time as organic carbon levels increase (Grue and Grassley 2013). The risk of exposure of benthic organisms to toxic levels of imidacloprid in these sediments and sediment porewater is potentially higher than in sediments where imidacloprid dissipates more quickly. Only one field trial in Willapa Bay has been conducted in areas with high organic carbon to test this possibility, the 2011 test in Cedar River. Results in this area found impacts to benthic that exceeded Sediment Management Standard (SMS) criteria.

Specifically, mean crustacean abundance showed an 86 percent decline after fourteen days, while there was little change in the control plot. After 28 days, while there was more than a 40 percent increase in crustaceans at the control plot, there was a 60 percent decrease in crustaceans on the treatment plot. Ostracods, noted as susceptible in the EPA (2017) risk assessment reflected this trend. After 28 days, six out of nine subgroups showed a more than 60 percent decrease compared to before treatment numbers. Similar to the crustaceans, a 44 percent increase in polychaetes at the control plot after 14 days, was matched by a 72 percent decrease at the spray site. At 28 days, a 75 percent increase in polychaetes at the control site compares to a 55 percent decrease at the spray site. In conclusion, mortality was greater than 50 percent and did not recover to less than 50 percent in 14 days.

If this test exceeded a minor effects threshold, it is above, or in exceedance, of the levels that should be allowed in a SIZ under SMS. This problem will repeat in areas or treatment sites with high TOC or areas with a low rate of tidal exchange (i.e. high residence times) in the summer. Areas of high TOC have noted an extended duration of persistence in the sediment, increasing the period of sub-lethal (chronic) impacts which are likely to accumulative to toxic levels (see Sediments section above).

During evaluation of the original 2015 WGHOGA permit application, Ecology determined that these results exceeded the “minor adverse effects” standard of the SIZ regulations (TCP memo dated April 7, 2015). This location failed, or exceeded, the minor adverse effects criteria in the Sediment Management Standards of WAC173-204-415, as established by the department. Ultimately, Ecology in 2015 granted provisional approval to apply imidacloprid in north Willapa Bay, but removed south Willapa Bay from the permit. The provisional approval in north Willapa Bay was linked to a requirement to conduct additional field trials in this area as part of the permit’s monitoring and reporting plan. Based upon additional information reviewed for this SEIS, and comments received, Ecology has determined that imidacloprid application in Cedar River and Southern Willapa Bay, and other areas with high TOC, would exceed the SMS maximum biological effects criteria.

New information submitted by WGHOGA in 2016 showed an exceedance of the Sediment Management Standards (SMS) regulatory biological effects level as demonstrated by the documented rate of juvenile Dungeness crab mortality seen during the 2014 field trials of imidacloprid in Willapa Bay. Data collected at the 90 acre plot treated with imidacloprid in 2014 showed that 137 dead or affected (tetany) out of a total of 141 crab observed in and around the treatment area. That is a mortality rate for observed Dungeness crab that exceeds levels which cause more than a minor adverse effect in marine biological resources of the Sediment Management regulations (WAC 173-204-420).

While on-plot and directly off-plot impacts were defined by 2014 surveys, there is considerable uncertainty regarding the extent of off-plot impacts due to limited survey data taken 24 hours after application. Therefore, with the limited spatial information, Ecology can only determine impacts near and adjacent to the areas of spray. In these zones, impacts to crab would be unavoidable since imidacloprid drift cannot be controlled.

Please refer to SEIS Section 3.3.5, Animals for further discussion of impacts to sediment. Additional discussion of benthic invertebrates can be found in section 1.7 Areas of Controversy and Uncertainty, and Issues to be Resolved.

Response to Comments Related to Water Quality

Commenters were concerned about the pesticide, imidacloprid, being present in the waters of Willapa Bay and Grays Harbor at any level and worried about the toxicity associated with those levels. The Washington State Department of Ecology (Ecology) will consider in the proposed request for a National Pollutant Discharge Elimination System (NPDES) permit and Sediment Impact Zones (SIZ) authorization the on and off-plot imidacloprid levels in surface water and the related impact to aquatic life. Some of the on and off-plot imidacloprid water exposures will likely result in localized, short-term impacts (i.e., acute biological effects such as mortality) and uncertain long-term impacts (i.e., chronic biological effects such as tetany, delayed mortality from repeated exposure, and reduced prey abundance). Refer to Ecology's response to Uncertainties (next section) for further discussion about the data gaps.

There are no specific promulgated chemical criteria established in the Water Quality Standards for imidacloprid. EPA Risk Assessment (2017) endpoints are the current best available science and are relevant to the direct application of imidacloprid to marine sediment that experience tidal inundation twice a day. Notably, EPA (2017) establishes a chronic endpoint threshold for marine invertebrates. The endpoints are, at a minimum, a screening criteria to compare water quality data collected in the monitoring studies conducted by WGHOGA in Willapa Bay in 2012 and 2014 (Grue and Grassley 2013; Hart Crowser 2013 and 2016). The development of draft EPA Risk Assessment acute and chronic endpoints (see table below), as well as Health Canada's endpoints (PMRA 2016), provide highly vetted surface water criteria in order to determine potential impacts to marine aquatic life related to imidacloprid application.

Biological Effects Endpoints: **Saltwater Invertebrates-expressed as µg /L or ppb of imidacloprid (active ingredient[a])**		
	EPA 2017	**Health Canada (PMRA 2016)**

Acute Endpoint	16.5 µg a.i./L (Lowest EC50/2)	1.37 µg a.i./L (Acute HC5)
Chronic Endpoint	0.16 µg a.i./L (Lowest NOAEC)	0.33 µg a.i./L (Lowest NOAEC)

a.i., active ingredient

In summary, WGHOGA's 2014 imidacloprid applications measured directly on experimental spray plots on day one (i.e., Day 0 is the day of application) exceeded the EPA's higher acute endpoint by 17 to 97 times on all plots. The 2012 experimental data reported numerous exceedances as well. Surface water monitoring data from 2012 showed extensive distribution of imidacloprid off-plot at levels that exceed both the EPA (2017) and Health Canada (PMRA 2016) acute biological endpoint criteria.

Below are summaries from the SEIS section, 3.3.3 Surface Water-Affected Environment that detail the monitoring studies performed. The levels of imidacloprid found in surface water both on and off-plot are further described.

Site-specific studies have been conducted to assess the transport and persistence of imidacloprid in surface water. Studies were conducted in Willapa Bay in 2012 and 2014 (Grue and Grassley 2013; Hart Crowser 2013 and 2016) to quantify the concentrations of imidacloprid in the water column, sediment, and sediment porewater. The scope of these trials was to describe the SIZ that could be associated with the commercial use of imidacloprid for burrowing shrimp population control. A SIZ is the area where the applicable State sediment quality standards of WAC 173-204-320 through 173-204-340 are exceeded due to ongoing permitted or otherwise authorized wastewater, storm water, or nonpoint source discharges (WAC 173- 204-200). One of the studies was also designed to measure one of the degradation products of imidacloprid: imidaclopridolefin.

Results of the 2012 commercial-scale experimental trials conducted in Willapa Bay were described in the 2015 FEIS (Chapter 3, Section 3.2.3, pages 3-23 through 3-24). These trials documented that detectable concentrations of imidacloprid at more than ten times the EPA acute marine biologic criteria were observed at up to 1,575 feet from the edge of the sprayed plots, on the leading edge of the rising tide. Overall, imidacloprid was frequently detected off-site in drainage channels and areas covered by the rising tide, especially in those areas located closest to the treatment plots. Off-plot concentrations were highly variable, ranging from non-detection up to concentrations of 4,200 µg a.i./L. All remaining information on the 2012 trials is unchanged at the time of this writing, and the FEIS discussion is incorporated by reference in the SEIS.

Overall, the surface water data collected during the 2014 trials indicate a pattern of high on-plot and low off-plot concentrations during the first rising tide. However, these results were based on a single transect of surface water samples that may not be representative of off-plot drift. Ecology believes that the 2012 studies are more representative of actual off-plot transport. For the Cedar River sites, on plot locations had concentrations up to 1,600 ppb, with an average value of approximately half this amount. Imidacloprid was detected at considerable distances off-plot, but at low concentrations of 0.55 ppb to 0 ppb. Thus, although the 2014 data confirm a greater distance off-plot for movement of imidacloprid (up to 500 meters), the concentrations were much lower than those observed in the off-plot data from 2012. These varying results suggest that site-specific differences in how tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot.

Imidacloprid dissolves readily in surface water and moves off treated areas with incoming tides and in drainage channels. As the data above show, this will cause imidacloprid to impact nontreated areas through surface water conveyance, particularly as tide waters first pass over off-plot areas.

Response to Comments Related to Uncertainties

The current body of science regarding imidacloprid use in an estuarine intertidal habitat directly applied to the sediment surface has been reviewed and summarized in the SEIS. Various monitoring studies in Willapa Bay and Grays Harbor have been done to better understand the fate of imidacloprid and those results are summarized in the SEIS and the 2015 FEIS. The proposed use of imidacloprid in an estuarine environment is a unique registration of a pesticide in the United States; there is no other EPA registered use for imidacloprid in an estuary. Considering the concern for pollinators and aquatic insects due in part by neonicotinoid pesticides, the literature regarding imidacloprid aquatic toxicity is rapidly expanding on a global scale.

The SEIS and FEIS specifically summarizes that there are data gaps and uncertainties. These include:

- effects of imidacloprid to a broader range of, including sensitive, marine invertebrates at acute and chronic exposures;
- the long-term persistence of imidacloprid in marine sediments; and
- indirect effects to species or food chains (i.e., cascading trophic impacts) due to reductions in invertebrate numbers following imidacloprid exposure.

Also, stated in the SEIS, section 1.7 Areas of Uncertainty and Issues to be Resolved, were Ecology's assessment of uncertainties identified in Washington State Department of Agriculture's (WSDA) Toxicology Review (Appendix A) for insecticide registration of the granular and liquid forms of imidacloprid (Protector 0.5G and Protector 2F, respectively).

The effects of bioaccumulation (chemical concentration within an organism) and biomagnification (chemical magnification through the food web) in the food web is assumed to be negligible. Imidacloprid's log octanol/water coefficient (log K_{ow}) is 0.57, which below the threshold of five, indicates or assumes it is not likely to bioaccumulate. Because of this fact, EPA waived the need for bioconcentration studies (SERA 2005). There are no studies to date that have confirmed this assumption in marine or estuarine species. Ding et al. 2004 identified no bioaccumulation in the freshwater fish, *Danio rerio.* Ashauer et al. (2010) noted that the elimination time in studies with the freshwater amphipod, *Gammarus pulex* was particularly long

(11 days) for imidacloprid. This finding lead the authors to suggest their bioaccumulation model could lead to an underestimation of bioaccumulation potential when using a classical risk assessment method that does not consider toxicokinetics.

Although the EPA risk assessment (2017) does state, "i*midacloprid is unlikely to bioaccumulate in living tissue*," this should not be mistaken for cumulative or additive toxicity which may occur. Both Rondeau et al. (2014) and Tennekes and Sanchez-Bayo (2013) describe the molecular relationship of imidacloprid to insect nervous systems. The authors state that neonicotinoid insecticides (e.g. imidacloprid) "*bind virtually irreversibly*" to receptors in the insect's nervous system. Toxic effects can be "*reinforced with chronic exposure*". Review of the WGHOGA's 2012 imidacloprid experimental trials reported that, "*the Cedar River site had 2-5 ppb of imidacloprid bound to sediment at 56 days after treatment, which was the last date monitored.*" In 2014, monitoring for imidacloprid persistence was performed at 14 and 28 days post spray for whole sediment and porewater.

Ecology has determined that there are areas of high Total Organic Carbon (TOC) in southern Willapa Bay and the Cedar River area. Distribution of high TOC sediments is variable at bay-wide and plot scales. Therefore, it is uncertain which areas or shellfish beds within central Willapa Bay and Grays Harbor also contain areas of high TOC. Areas of high TOC have been shown to have persistence in sediments and have had significant unavoidable adverse impacts to invertebrates.

Although direct impacts to marine vertebrates, i.e. fish and/or marine mammals, from acute exposure to imidacloprid may be low, indirect impacts to marine vertebrates should be examined. Indirect impacts include impacts to prey resources which may be more susceptible to imidacloprid than vertebrates. The Risk Assessment states, "***the potential exists for risks to fish indirectly** through reductions in aquatic invertebrates that comprise their prey bas*e" (EPA bolded). Chronic impacts to invertebrates might migrate through the food chain to important ecological guilds of ecological and economic value such as forage fish, salmonids, and sturgeon. The chronic endpoint proposed by the EPA RA aims to address these impacts.

Chapter 1, Section 1.7 of the 2015 FEIS (pages 1-34 through 1-37) described areas of controversy and uncertainty about the use of imidacloprid for burrowing shrimp population control in the marine aquatic environment of Willapa Bay and Grays Harbor. This SEIS section updates those issues, and describes new information identified by Ecology during preparation of the SEIS.

Areas of Controversy

Imidacloprid is a neonicotinoid pesticide. There is controversy over the use of neonicotinoid pesticides in the environment. Much of this controversy is likely due to the widespread distribution (e.g., newspaper and magazine articles) of the results of studies examining the impacts of this class of pesticides on honey bees, other pollinators, and freshwater aquatic insects. Consequently, a number countries, states, and local municipalities have banned or significantly restricted the use of neonicotinoid pesticides. A segment of the public is also opposed to the use of chemical pesticides, particularly on food crops, including oysters. Conservation groups are often concerned with the use of pesticides which may have impacts to mammals, birds and fish, or the ecosystems on which these animals depend. Conversely, many oyster growers and public and business members of the communities in which they operate feel strongly that chemical control of burrowing shrimp is essential to the long-term operational and economic survival of the industry. Some growers report feeling they are being unfairly targeted, or that the public does not recognize that they have used chemical control of burrowing shrimp since at least the 1960s without, from their perspective, adverse human or environmental effects. For these and other reasons, consideration by Ecology of a potential permit to apply imidacloprid to commercial shellfish grounds in Willapa Bay and Grays Harbor will be controversial, as the Department learned when it reviewed and approved a 2015 permit (since terminated at the request of WGHOGA).

Another area of controversy involves whether enough scientific information is available to adequately address the potential effects of a proposed permit to apply imidacloprid to commercial shellfish grounds. Neonicotinoid pesticides, and imidacloprid specifically, have been the focus of hundreds of scientific studies, and more recently (e.g., EPA 2017) risk assessments based on reviews of those studies. The majority of data regarding the effects of imidacloprid have been obtained from dose-response studies performed within laboratory settings to determine toxicity over periods ranging from 24 hours to 28 days, or longer. Other published studies have focused on freshwater ecosystems, particularly potential impacts to sensitive freshwater insects. Elements of these studies may not be directly transferrable to aquatic invertebrate organisms in an estuarine environment due to how organisms are exposed to imidacloprid. In freshwater studies, imidacloprid enters the aquatic environment from runoff or less commonly, overspray. The proposed action would directly apply imidacloprid to sediments and benthic invertebrates. Tidal exchange and dilution would occur within a few hours of application, although some imidacloprid is likely to persist in sediments. A number of field studies of imidacloprid and its effects in these specific estuarine environments have been conducted, and they inform much of the analysis of effects in this SEIS. The information that has been gathered is limited and important data gaps remain regarding significant direct and indirect impacts from imidacloprid applications within an estuarine environment both on and off the treatment plot.

Previously, some commenters raised concerns about how eradication of burrowing shrimp could affect the ecosystems where these animals are present. However, the WGHOGA application for the permit is not a proposal to eradicate burrowing shrimp in Willapa Bay and Grays Harbor. The proposal is for the control of burrowing shrimp populations on a limited acreage of commercial shellfish beds. However, as imidacloprid will drift off-plot, the area impacted by applications would be greater than the treated plot. Not all of the tideland acres owned, leased, or currently farmed for commercial clams and oysters would be treated with imidacloprid over the term of the permit. Ghost shrimp populations in the majority of tidelands in Willapa Bay and Grays Harbor would not be treated with imidacloprid, and are expected to continue functioning normally as components of the ecosystems within these estuaries. Remaining mud shrimp populations are currently declining due to a parasitic isopod and cumulative impacts from imidacloprid applications are likely to increase this decline. This is an area of considerable uncertainty.

Areas of Uncertainty and Issues to be Resolved.

Washington State Department of Agriculture (WSDA) provided a Toxicology Review that accompanied the WSDA registration of the granular and liquid forms of imidacloprid (Protector 0.5G and Protector 2F, respectively) which listed areas of uncertainty based on WSDA's assessment of the preliminary nature of the environmental fate and effects data presented in the studies submitted with the application. This review is attached in Appendix A.

Following are additional areas of uncertainty that contribute to increased risk of additional adverse impacts occurring:

- The results of multi-year studies (> 2 years) are not yet available to quantify the degree to which imidacloprid accumulates in sediments, and if so, the "worst-case" scenario of such accumulation.
- Long-term data on sediment and sediment porewater concentrations of imidacloprid after treatment are still absent.
- Previous field trials with imidacloprid in Willapa Bay indicate that imidacloprid concentrations decrease following treatment, with concentrations in sediments falling below laboratory detection limits in most samples within 28 days. However, these data also demonstrate that imidacloprid remained at detectable levels in some samples on the last sampling date of the trials (28 days or 56 days), particularly in sediments with higher organic carbon levels (e.g., the 2011 Cedar River field trials).
- It is possible that imidacloprid residues may persist in some treatment areas until the following year when imidacloprid is again applied. Such a circumstance would constitute a cumulative effect, over time, such that imidacloprid concentrations could occur at higher levels than those expected where no residual imidacloprid remains.
    - To test for this possibility, Ecology would (if the permit is issued) require that WGHOGA, as part of its mandatory Monitoring Plan, conduct long-term persistence monitoring of imidacloprid in sediments. This sampling would continue through time to determine when no imidacloprid is detectable in sediment pore water or whole sediments, and to confirm whether a cumulative buildup of imidacloprid would occur over time.

Due to the preliminary nature of research data available at the time of this writing, there is uncertainty regarding whether imidacloprid may have potential long-term sediment toxicity effects on benthic and free-swimming invertebrate communities, the species that utilize them as food sources, and the ability of the Willapa Bay and Grays Harbor estuary ecosystems to maintain homeostasis, as a whole.

- The duration of persistence of imidacloprid toxicity in areas of high TOC, such as the 2011 Cedar River site, is unknown as monitoring occurred only for 28 days. At 28 days there was no recovery of benthic abundance. There is uncertainty as to whether or when recovery occurred.

- This SEIS includes a review of additional field studies of the effects of imidacloprid on invertebrate communities conducted in 2014. These studies confirmed previous work that showed that invertebrate communities on treatment and control plots were generally similar within 14 to 28 days after treatment, although statistical power remained weak. They also demonstrated that imidacloprid is carried for long distances off-plot, by rising tidewaters and are likely to pose some impact, particularly to sensitive species, or in those areas closest to the treatment plots that are most likely to experience high concentrations of imidacloprid. Modeling of data from field studies demonstrates that the transport of imidacloprid at acute concentrations is greater than previously predicted.
- This SEIS also includes results from new scientific studies, including studies of impacts to Dungeness crab. This work documents that Dungeness crab would be killed or immobilized on-plot, and there is uncertainty as to how far off-plot impact may occur. Modeling of off-plot concentrations and areal extent raises uncertainty regarding the impact to Dungeness crab from acute and chronic exposure. Additionally, toxicity and mortality to megalopae have not been adequately quantified.
    - As with potential sediment impacts, Ecology would (if the permit is issued) require that WGHOGA conduct additional and expanded monitoring of off-plot impacts to Dungeness crab and continue monitoring the effects of imidacloprid applications on invertebrates.

Uncertainty has been expressed as to whether the results of experimental trials using imidacloprid on treatment plots up to ten acres in size can be assumed to correlate directly when the spatial extent of the treatment area is increased under the proposed NPDES permit.

- The 2016 WGHOGA application requests authorization to treat up to 485 acres per year in Willapa Bay, and up to 15 acres per year in Grays Harbor. Given the reduced acreage, and the elimination of aerial spraying from helicopters from the 2016 WGHOGA application, treated plots are now expected to be 10 acres or less in size, consistent with most of the prior field studies. Dependent on the number of repeated applications, and overall ground where imidacloprid is applied, expanded monitoring would likely be required to evaluate transport off-plot.

Efficacy has fluctuated greatly, partly due to the many associated variables such as timing, sediment type, vegetative cover, formulation of imidacloprid, temperature, tidal inundation, and method of application. Efficacy information from 2014 experimental trials submitted by WGHOGA in the draft SIZ applications show highly variable and inconsistent results in controlling burrowing shrimp populations in Willapa Bay. Studies finalized in 2016 by WGHOGA on commercial scale application show anywhere from a reduction of over 90 percent of shrimp burrows to an increase of over 400 percent in the number of shrimp burrows. Also, in as little as three months, burrowing shrimp populations may have returned to or exceeded pre-spray levels. Earlier studies conducted by WGHOGA on smaller scale plots indicated a range of shrimp burrow reduction from 27 percent to 97 percent. Dr. Kim Patten summarized many years of field trials and lab studies ranging between 0 percent to over 95 percent efficacy. Dr. Patten reports that the more likely range is between 40 percent and 80 percent efficacy under better conditions (SIZ Application submitted by WGHOGA, February 13, 2017, and March 21, 2017 revised). A consequence of highly varied results is that spray plots may need to be treated the following year(s) which may lead to persistence in the sediments and potential build up.

Several commenters have provided peer reviewed journal articles documenting the development of imidacloprid resistance in target species from terrestrial applications. Also identified by commenters was a lack of long-term understanding of the spatial and temporal scale of impact to the estuarine ecosystem in Willapa Bay and Grays Harbor. They commented that the draft SEIS did not provide adequate analysis of cumulative or ecosystem perturbation and the significance of negative responses. It is not yet known whether the target species of burrowing shrimp may become resistant to the effects of imidacloprid over time. Pesticide use can result in target pest resistance, especially when treatment efficacy is low or variable. Typically, pest resistance results in increased frequency in pesticide usage and thus increase in adverse environmental impacts.

Other areas of uncertainty were identified during the original EIS scoping process, in subsequent meetings and communications with Ecology, and during preparation of the FEIS. These are listed below.

- Research on the effects of burrowing shrimp on commercial shellfish beds has been done where oysters are the primary crop. Field research data are lacking regarding how burrowing shrimp affect clams, and the threshold for damage to clam beds. For more information refer to Chapter 2, Section 2.8.3, page 2-34.
- The proposed permit would allow imidacloprid treatments from April to December. Some studies have documented seasonal or temperature related effects on imidacloprid toxicity, specifically that the pesticide has greater efficacy at higher temperatures. There is uncertainty whether imidacloprid treatments during periods of low water temperature would successfully reduce burrowing shrimp populations.
- The effects of imidacloprid on zooplankton species are largely unstudied.

Under the proposed action, imidacloprid would be applied on selected commercial shellfish beds under low tide conditions when large numbers of zooplankton would not be present (see FEIS Chapter 3, Section 3.2.5). However, those communities on the leading edge of the incoming tide could be exposed to imidacloprid during the first flood tide. Applications that would be done in standing water would likely impact zooplankton when toxicity levels exceed the EPA marine acute toxicity threshold.

The SEIS reviews two recent scientific studies that examined the effects of imidacloprid on crab megalopae (the last planktonic stage before settlement to the sediments). Both documented that imidacloprid can cause death or tetany at concentrations that are likely to exist on-plot immediately following treatment, and off-plot, particularly in those areas closest to the treatment plots that are most likely to experience high concentrations of imidacloprid. By extrapolation, impacts to other planktonic species appears likely. Given the abundance of zooplankton, there is uncertainty regarding effects bay wide; however they will extend off-plot within areas that exceed the EPA marine acute and chronic criteria.

Limited information in marine environments is available regarding the possible sub-lethal effects of imidacloprid on non-target aquatic organisms. Ultimately, burrowing shrimp are controlled through sub-lethal effects.

The SEIS reviews a number of studies that recorded sub-lethal effects, including tetany, reduced feeding, impaired movement, and behavioral changes. Laboratory studies document that these sub-lethal effects are reversed once imidacloprid has been removed. However, in the field we expect mortality based on predation and environmental stressors.

A wide variety of sub-lethal impacts, such as immune suppression, growth, reproduction, molting success, etc., are likely to occur due to exposure to imidacloprid, but they are very difficult to document or measure outside of laboratory conditions. This may remain an area of uncertainty into the future without the development of specific monitoring requirements.

Limited information is available regarding imidacloprid impacts to marine vegetation.

The results of field studies conducted during one season to evaluate uptake in eelgrass tissues showed limited uptake by eelgrass, and imidacloprid was undetectable after 14 days. Imidacloprid is an acetylcholinase inhibitor and plants do not have a biochemical pathway involving acetylcholinase. Therefore, it is unlikely that imidacloprid would adversely affect eelgrass or other marine vegetation (see FEIS Chapter 3, Section 3.2.4).

Limited field verification data are available at the time of this writing regarding the toxicity and persistence of imidacloprid degradation products.

Some laboratory studies have been conducted using marine waters. The results of these studies showed that the imidacloprid degradation products have toxicity levels that are equal to or less than the toxicity of the parent compound (SERA 2005) (see FEIS Chapter 3, Section 3.2.3). The persistence of a variety of the degradation products in surface water and sediments is currently unknown.

A limited number of field studies have been conducted in the estuarine environment to confirm the off-plot movement of imidacloprid following applications of the flowable and granular forms on commercial shellfish beds.

The SEIS evaluates field data from both 2012 and 2014 trials in Willapa Bay in which off-plot movement of imidacloprid was evaluated. These data showed a strong pattern of high on-plot and low off-plot concentrations during the first rising tide. Imidacloprid was detected at considerable distances off-plot, but at highly variable concentrations (e.g., 0.55 ppb to 1300 ppb). These varying results suggest that site-specific differences in how tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot. Consequently it is very difficult to determine off-plot areal extent, and pesticide concentration, without extensive monitoring. Currently we do not have extensive off-plot monitoring data, although modeling of existing off-plot data supports significant spread off-plot of imidacloprid at acute concentration levels.

It is not possible to quantify the total acreage of commercial shellfish beds to be treated with imidacloprid over the five-year term of a potential NPDES permit.

The maximum possible acreage is known. If the growers apply imidacloprid to every acre allowed under the permit, and every such acre is sprayed only once, then the maximum acreage to be treated under the potential permit would be 2,425 acres in Willapa Bay (485 acres *per year* times five years), and 75 acres in Grays Harbor (15 acres *per year* times five years).

It is uncertain what locations would be sprayed over a five year period, and whether repeated spray events would occur and/or how often. This would be determined annually with an Ecology approved annual operations plan if a permit is issued.

WGHOGA comments that the SEIS notes that there is some uncertainty about what controls burrowing shrimp populations, then lists several possible anthropogenic factors that may have led to increases in shrimp numbers over time. One potentially important anthropogenic effect is the significant decrease in Columbia River floods due to development of an extensive system of flood control dams. WGHOGA is aware of past work indicating that during large Columbia River floods, a large plume of freshwater or low salinity water traveled north along the coast, likely causing extensive periods of low salinity conditions in Willapa Bay and Grays Harbor. Such an event would be expected to negatively impact burrowing shrimp, as evidenced by their widespread absence or low population numbers in areas where freshwater rivers enter Willapa Bay and Grays Harbor. The timing of the onset of these diminished Columbia River flows (1930's- 1950's) corresponds well with observed increases in burrowing shrimp populations. WGHOGA requests that Ecology include some discussion of this anthropogenic impact in its discussion of factors that may have affected burrowing shrimp populations.

Several authors (e.g., Stevens 1929, Feldman et al. 2000, Sanford 2012), have hypothesized that human-related impacts may have contributed to changes in Willapa Bay which led to increased burrowing shrimp populations. These potentially include excessive harvest of native Olympia oysters during the 1900s, land use changes in the watersheds (e.g. logging, farming), disturbance associated with current shellfish farming (including chemical and physical efforts to reduce burrowing shrimp), and other human activities. Changes in climate and oceanic conditions may also have altered conditions in ways that are favorable for burrowing shrimp.

Response to Comments Related to SEPA

Comments addressed the SEPA process. This SEIS supplements the environmental review and analysis of alternatives in the 2015 FEIS. The FEIS is adopted and incorporated by reference in this SEIS, in accordance with WAC 197-11-630(3)(b). The 2016 application is evaluated as Alternative 4, in the context of additional research that has been performed, and additional literature that has been published on the environmental effects of imidacloprid since the 2015 FEIS was issued.

Washington State Environmental Policy Act (SEPA). The SEPA Rules (Chapter 197-11 WAC) that implement the State Environmental Policy Act (Chapter 43.21C RCW) require an EIS to describe and evaluate the proposal (or preferred alternative, if one exists) and reasonable alternative courses of action. Reasonable alternatives are actions that could feasibly attain or approximate the objectives of the proposal, but at a lower environmental cost or decreased level of environmental degradation. The word "reasonable" is intended to limit the number and range of alternatives, as well as the amount of detailed analysis for each alternative. The level of detail is to be tailored to the significance of environmental impacts, and one alternative may be used as a benchmark against which to compare the other alternatives. The EIS may indicate reasons for eliminating some alternatives from detailed study (WAC 197-11-440(5)).

WAC 197-11-794 defines "significant" as used in SEPA as "a reasonable likelihood of more than a moderate adverse impact on environmental quality… The severity of an impact should be weighted along with the likelihood of its occurrence. An impact may be significant if its chance of occurrence is not great, but the resulting environmental impact would be severe if it occurred." The determination that a proposed action will (or may) have a significant adverse impact involves context and intensity, and does not lend itself to a formula or quantifiable test. Context may vary with the physical setting. Intensity depends on the magnitude and duration of an impact.

WGHOGA believes the following should be emphasized:

Section 2.2 of the SEIS states the purpose and objective of the proposed action: to preserve, restore, and maintain the viability of clams and oysters on commercial shellfish beds. Off-bottom culture was not considered as an alternative in the SEIS because it would not meet the purpose and objectives of the proposed action.

WGHOGA commented that discussions included in the FEIS should be included in the SEIS. Ecology adopted the FEIS and it is referenced in the SEIS. The intent of the supplemental document is to discuss new information and the incorporation of information discussed in the FEIS should be limited.

Comment noted.

Response to Comments Related to the Endangered Species Act

Commenters identified concern that the Department of Ecology was not seeking ESA take provision coverage. The issuance of a NPDES permit by Ecology is not subject to Endangered Species Act (ESA) consultation with the National Marine Fisheries Service or the U.S. Fish and Wildlife Service. Case law from *Am. Forest & Paper Association v. EPA*, 137 F.3d 291, 299 (5th Cir. 1998) states EPA may not approve Louisiana's NPDES program on the condition that

Louisiana will undertake ESA consultation with the Services. And; *Oregon Natural Res. Council v. Hallock*, No. 02-1650-CO, 2006 WL 3463432 (D. Or. Nov. 29, 2006) states the State of Oregon's issuance of an NPDES permit is not a Federal agency action subject to the ESA's consultation provisions.

However, obtaining coverage under an NPDES Individual Permit does not exempt a permit holder from the "take" provisions of the ESA. "Take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in such conduct with respect to a species listed under ESA (16 U.S. C. Section 1532 [19]).

Commenters identified concerns for ESA listed salmon, green sturgeon, and southern resident orcas. Potential impacts to species listed under the ESA and mammals are addressed in SEIS Chapter 3, Section 3.3.5. The specific language is called out below. The SEIS does not discuss the southern resident orcas but identifies the marine mammals, harbor seals, and gray whales.

It is unlikely southern resident orcas would be exposed directly to imidacloprid. The timing of imidacloprid application precludes direct exposure of southern resident orcas. The resident population is highly unlikely to be in Willapa Bay or Grays Harbor during the spring, summer and fall because their range is the Salish Sea during that timeframe (Balcomb 1982, Osborne 1986, and Hauser et al. 2007). Also, the imidacloprid is unlikely to affect the orca's prey populations, adult salmon, because of low vertebrate acute toxicity and inability to bioaccumulate in fish (Ding et al. 2004). The EPA assessment (2017) concluded that direct effects of imidacloprid on vertebrates are unlikely EPA.

See language from SEIS Chapter 3, Section 3.3.5 further ESA-related discussion.

Response to Comments Related to Monitoring

Several commenters (WSDA, Audubon, NOAA) expressed concern about both the monitoring that has been conducted and about any proposed monitoring that may be conducted during proposed future pesticide application. Ecology has stated in the Draft SEIS that monitoring and environmental sampling is very difficult to conduct in a very dynamic and constantly changing situation like Willapa Bay and Grays Harbor. There are a significant number of variables that are difficult to control which make data collection and interpretations subject to a high degree of uncertainty. Ecology has clearly stated this in the EIS. Conclusions reached from interpretation of existing data rely on best professional judgement. Any further proposals for data collection and analysis will need to be reviewed with a critical approach, and it may be that an entirely new approach may need to be taken for environmental monitoring if any future pesticide application is considered. Future monitoring could include lab-based bioassays, in-situ bioassays (similar to the SEA Ring protocol used in Sinclair Inlet, WA) or different criteria for regulatory thresholds. Please see attached Terrastat correspondence for a statistical review of existing monitoring.

Response to Comments Related to Economics

Numerous comments addressed economics. Information regarding economic estimates has not been independently verified by the Department of Ecology. Information provided by other parties is provided below.

FEIS Chapter 2, Section 2.6 (pages 2-16 through 2-18) described the economic, employment, and tax base significance of the clam and oyster aquaculture industry in Pacific County, Grays Harbor County, Washington State, and the nation. Reviewers interested in these subjects are encouraged to review the 2015 FEIS section on these subjects (adopted in the SEIS by reference).

Section 2.8.5 of the SEIS, Alternatives Considered and Eliminated from Detailed Evaluation discusses off-bottom culture which is discussed in more detail in section 2.5.1, Oyster Culture Methods of the FEIS.

With regard to direct economic impacts to growers in Willapa Bay and Grays Harbor in the absence of burrowing shrimp population control, the FEIS cited the growers' estimate at that time that they would anticipate a 60 to 80 percent reduction in oyster production. The bay-wide loss of clams and oysters in Willapa Bay without pesticide treatments for burrowing shrimp population control was estimated at a higher level by the Washington State University Pacific County Extension Director – on the order of 80 to 90 percent.

Information provided with the 2016 WGHOGA NPDES permit application responds to a question from Ecology and others about the estimated economic consequences of not being able to control burrowing shrimp on commercial clam and oyster beds in Willapa Bay and Grays Harbor. WGHOGA members were surveyed and asked to project their bed losses over the next 5 years (2017 through 2022).[1] WGHOGA growers estimated cumulative losses of approximately 500 acres of seed or nursery ground, 575 acres of fattening beds, and more than 530 acres of clam beds by 2022 (Miller Nash Graham & Dunn, February 13, 2017). Based on growers' estimates of the dollar value of productivity per acre of these commercial shellfish beds, cumulative production losses by 2022 are projected to be just under $50 million without chemical control of burrowing shrimp populations on selected tideland acreage. Not included in this estimate are indirect economic impacts to the communities that surround Willapa Bay and Grays Harbor. For additional information on these subjects, the *Economic Analysis to Support Marine Spatial Planning in Washington* prepared for the Washington Coastal Marine Advisory Council (Cascade Economics, June 30, 2015) includes estimates of income and expenditures for WGHOGA as a whole in Pacific and Grays Harbor counties.[2]

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[1] Losses projected over the next 5 years do not include losses already experienced by WGHOGA's growers due to not being able to control burrowing shrimp over the past three years (2015-2017), and do not take into account the possibility that these growers may have to close farms due to increased burrowing shrimp activity. As with economic impact information published in the 2015 FEIS, information provided by WGHOGA with the 2016 application has not been independently verified by Ecology.

[2] http://www.msp.wa.gov/wp-content/uploads/2014/02/WMSP_2015_small.pdf.

Approval of the proposed NPDES permit, and subsequent use of imidacloprid to control burrowing shrimp could have negative economic consequences. For example, some tourists and recreationalists might choose to avoid Willapa Bay and Grays Harbor due to the use of chemical controls. Prices for shellfish from these estuaries could also fall due to negative perceptions about the use of imidacloprid.

In the interim since the FEIS was published, a number of shellfish producers, including Taylor Shellfish and Coast (Pacific Seafoods), have announced that they will not use imidacloprid to treat their commercial shellfish grounds in Willapa Bay. Taylor Shellfish has separately indicated it will continue the process of moving much of its shellfish production in Willapa Bay to off-bottom culture. Ecology contacted representatives of Taylor Shellfish to obtain information on their current operations, and more generally to seek their input on the feasibility of shifting much or most of the oyster culture in Willapa Bay and Grays Harbor to off-bottom production. The following points were derived from that discussion:[3]

- Burrowing shrimp are constraining production of ground-based oysters on Taylor Shellfish lands in Willapa Bay. Two 20-acre shellfish beds, one at Cedar River and one on North River, and another 50-acre bed near Goose Point can no longer be bottom-planted with clutched seed for shucked oyster meat production due to heavy populations of burrowing shrimp. A 30-acre bed at Stoney Point traditionally treated and used for bottom culture of oysters is currently threatened for continued bottom-culture use.
- Taylor Shellfish is developing custom equipment and their own methods of off-bottom oyster culture in Willapa Bay for beds lost to burrowing shrimp. These methods include line cultures with larger and longer posts and different types of anchors to prevent sinking in soft sediments, as well as harrowing of some bottom-culture beds, and a faster rotation to decrease loss of oysters due to the effects of burrowing shrimp populations. While some of the methods Taylor Shellfish is experimenting show promise, these methods are still in experimental stages.
- Bottom-cultured oysters grown for the shucked meat market have historically been and continue to be the predominant crop of the shellfish industry in Willapa Bay and Grays Harbor. Single-oyster production for the half-shell market is an entirely different, more specialized industry, requiring different farming, processing, and marketing approaches than shucked oyster meat production. It is an expensive process to convert from bottom culture to off-bottom systems of shellfish farming. Taylor Shellfish Farms' representative shared that in their opinion, it is not appropriate to compare single-oyster production for live sales to cluster production for shucked meat sales. "It is not apples to apples. They are entirely different products, culture systems, processing and markets."
- Taylor Shellfish does not believe it would be feasible for all of the growers in Willapa Bay and Grays Harbor to convert to off-bottom oyster culture to supply the half-shell market. It would be infeasible to cultivate enough single oyster seed stock in the appropriate nursery setting to provide stock for this many growers or this much tideland acreage. A significant shift to half-shell cultivation in Willapa Bay and Grays Harbor

[3] Bill Dewey, Director of Public Affairs, Taylor Shellfish, personal communication, July 28 and August 22, 2017.

would also result in saturation of the half-shell market, thus dropping prices, making it economically infeasible and unsustainable for growers. In addition, Willapa Bay and Grays Harbor contribute significantly to the entire U.S. shucked-meat industry. If shucked oysters were to be lost or significantly reduced in Washington, this would create a large void (up to 25 percent by some accounts) in the national supply of shucked oyster meats, and there would be secondary impacts to on-shore processing facilities, and related support services for this industry.

- Although Taylor Shellfish has chosen not to treat its shellfish beds in Willapa Bay with imidacloprid, the company believes that burrowing shrimp control is necessary to maintain a healthy and viable bottom-culture, shucked-meat oyster industry in Willapa Bay and Grays Harbor.

Willapa Bay is the largest producer of farmed oysters in the United States. Combined with Grays Harbor, this area along the southwest Washington coast produces approximately 25 percent of all oysters in the United States. Shellfish aquaculture is the largest private employer in Pacific County and a significant private employer in Grays Harbor County.

If a permit is issued there may be potential negative economic impacts to the local economy based on comments stating that people would limit their recreational opportunities and/or shellfishing opportunities base on the potential presence of imidacloprid. Additionally, consumers have stated that they would not purchase and/or consume shellfish from Willapa Bay even if the shellfish beds did not receive direct application of the pesticide.

Shellfish farmers from outside of Willapa Bay and Grays Harbor have stated that an imidacloprid permit would convey an unfair advantage to the potential permittees.

Response to Comments Related to Cumulative and Chronic (Sub-Lethal) Effects

Several comments addressed uncertainty involving cumulative, chronic, or sub-lethal long term impact from imidacloprid application to Willapa Bay. Ecology generally agrees that these uncertainties exist, and has stated that in the SEIS. There is research that is important to note regarding these concerns.

Although the EPA risk assessment does state, “imidacloprid is unlikely to bioaccumulate in living tissue,” this should not be mistaken for cumulative toxicity which may occur. Both Rondeau et al. (2014) and Tennekes and Sanchez-Bayo (2013) describe the molecular relationship of imidacloprid to insect nervous systems. The authors state that neonicotinoid insecticides (e.g. imidacloprid) “bind virtually irreversibly” to receptors in the insect’s nervous system. Toxic effects can be “reinforced with chronic exposure.” This may increase the impact of chronic exposure and lead to delayed mortality. For example, crabs not placed into tetany may migrate off-site, be exposed to chronic levels of imidacloprid in sediment porewater or in dilute surface water, and show delayed tetany and mortality which is not measured by day-after surveys.

Several comments addressed the EPAs Risk Assessment for Imidacloprid. Ecology views the EPA Risk Assessment currently as the best available science and will use the acute and chronic marine endpoint criteria from that document.

Several commenters raised concerns regarding cumulative impacts to mud shrimp in particular due to documented dwindling numbers in Willapa Bay and the impact of an invasive parasite to mud shrimp. Data presented by Dumbauld show a significant reduction in mud shrimp population recruitment to Willapa Bay. Since 2007, there have only been two years of recorded recruitment to WB. This species is listed as a species of concern in Oregon. (WDFW is responsible for listings of species of concern in WA State.) Chapman (pers. Comm.) has stated that they are "extinct" in many areas of their native range, mainly in California. The SEIS needs to have some language on the cumulative impact of invasive parasite and targeted, or non-targeted impacts of further reducing mud shrimp in Willapa Bay and Grays Harbor. The cumulative impacts are uncertain.

Several commenters have also stated that cumulative effects of eelgrass herbicides and imidacloprid spraying have not been evaluated. Ecology does not currently have information regarding potential additive synergistic toxicological effects between neonicotinoid pesticides and imazamox.

Response to Comments Related to Toxicity

Numerous commenters, including WGHOGA, referenced the Health Canada (2016) report reviewed in the SEIS, which extrapolate from toxicity levels actually observed in experimental trials using statistical modeling to guess what the lowest possible toxicity might be if more data were available. These results are projections of toxicity that are lower, and often much lower, than anything ever actually observed in scientific studies. These hypothetical toxicity levels are not an appropriate measure for evaluating the potential effects of imidacloprid treatments of the proposed WGHOGA permit. EPA (2017), very appropriately, bases its evaluation of imidacloprid toxicity on effects that have been observed in prior studies.

WGHOGA states that the use of the 16.5 ppb toxicity threshold in the SEIS leads to a significant overestimate of the actual effects to invertebrates that would occur under the proposed permit. This is the EPA toxicity threshold.

WGHOGA states that although the SEIS, in analyzing the modeling results, concludes that "[a]ctual toxicity to off-plot invertebrates is expected to be less," WGHOGA still feels that the entire modeling analysis should be eliminated. It is inaccurate, misleading, and unhelpful in assessing the potential effects of the proposed permit.

Ecology acknowledges WGOHGA's concern regarding modeling first presented in the Draft SEIS. As stated in the draft SEIS, "this modeling of imidacloprid off-plot is simple and a more complex model might yield different results." Ecology has determined to use Inverse Distance Weighting (IDW), which is a type of area-weighted averaging GIS tool that uses actual data calculated from monitoring, in this case surface water measurements from imidacloprid application from 2012.

IDW estimates concentrations between individual distinct data points to interpolate concentrations between these points. Area-weighted averaging is an established protocol for using individual data points to calculate proportional concentrations in areas between sampling points (SCUM II 2017). Results from using 2012 surface water monitoring collections show that on average, for every acre where imidacloprid was applied, the EPA acute surface water criteria was exceeded over an area more than 5 times the area sprayed. The off-plot area exceeding the EPA acute criteria by five times ranged from 5 to over 20 acres depending on site. In addition to using actual data from monitoring events, IDW can indirectly document as to how wind, tidal currents, and/or preferential flow channels at sites may affect the extent of off-plot imidacloprid concentrations at sites with SW samples.

This method provides a conservative estimate of off-plot distribution as it equally weights low detection values during interpolation, therefore lowering concentrations in areas where higher concentrations may be expected. For instance, lower concentrations of imidacloprid were estimated on the spray plots than directly off-plot because of adjacent low water SW concentrations in areas of the incoming tide lowered estimated on-plot concentrations. Additionally, IDW is estimated only to the farthest point where data was collected. For example, at the Palix site, surface water concentrations of 200 (shoreline) and 46 ppb (farthest east) exceeded the EPA criteria, however the modeling was cut off because no further data points were available. Toxicity to off-plot invertebrates may be lower depending upon tidal dilution, but the extent of this is unknown. As data was only collected at a single point as tidal inundation occurred and no surface water collections were collected after the day of spray, modeling of the extent of chronic impacts could not be performed. The extent and duration of chronic impacts on- and off-plot are unknown from the data collected.

WGHOGA comments that to avoid confusion by the public and reviewing agencies, WGHOGA suggests that the Final SEIS clearly state that 25-foot buffers will be required under the proposed permit. It is not necessary to insert this in every instance in the SEIS discussing that only ground-based methods will be used. It would be helpful to at least include this clarification in the Fact Sheet, and in Section 2.8.4 which summarizes WGHOGA's proposed permit (Alternative 4).

Comment noted and changes made.

Response to Comments Related to Kim Patten Ethics Concerns

A number of comments expressed ethics concerns related to Dr. Kim Patten's work. Comment noted.