Vessel Activity Synopsis

Maritime activity in the Northern Puget Sound and Strait of Juan de Fuca

Spill Prevention, Preparedness, and Response Program

Washington State Department of Ecology

Northwest Regional Office

Shoreline, Washington

June 2021, Publication 21-08-008

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State of Washington

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Contact Information

Spill Prevention, Preparedness, and Response Program

P.O. Box 47600
Olympia, WA 98504-7600
Phone: 360-407-7455
Website[1]: Washington State Department of Ecology

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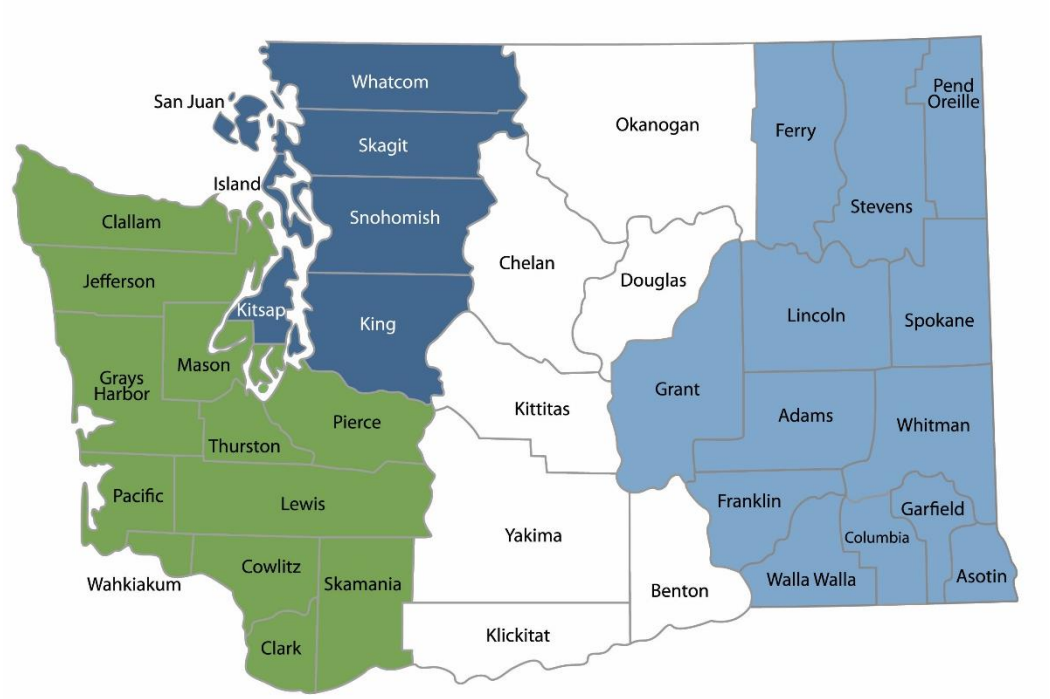

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Region	Counties served	Mailing Address	Phone
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Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	PO Box 330316 Shoreline WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
Headquarters	Across Washington	PO Box 46700 Olympia, WA 98504	360-407-6000

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- Department of Fisheries and Oceans Canada
- Jamestown S'Klallam Tribe
- NOAA Olympic Coast National Marine Sanctuary
- Pacific Pilotage Authority
- Swinomish Indian Tribal Community
- Transport Canada
- United States Coast Guard
- Washington Department of Fish and Wildlife
- Washington Sea Grant

Executive Summary

The Salish Sea, which includes the Strait of Juan de Fuca, the Strait of Georgia, and Puget Sound, is a large and diverse waterbody. A wide variety of commercial, tribal, First Nation, and recreational vessels operate on these waters.

In 2018, nearly 5,000 commercial vessels called on Washington and Canadian ports within the Salish Sea (Washington State Department of Ecology, 2019a). Half of all oil moved in Washington State in 2018, 10 billion gallons, was transported by vessels (Washington State Department of Ecology, 2019b). Commercial and private ferries provide transportation links for passengers, vessels, and cargo in the US and Canada.

The Salish Sea is home to numerous federally recognized tribes and First Nations with treaty reserved aboriginal fishing and hunting rights. Commercial fishing vessels catch multiple species of fin and shellfish. Each year, thousands of people enjoy recreational fishing and boating throughout the Salish Sea.

This synopsis combines multiple data sources and analysis methods to provide a holistic view of 2018 vessel activity in the Salish Sea, specifically the Strait of Juan de Fuca and northern Puget Sound, including Canadian waters.

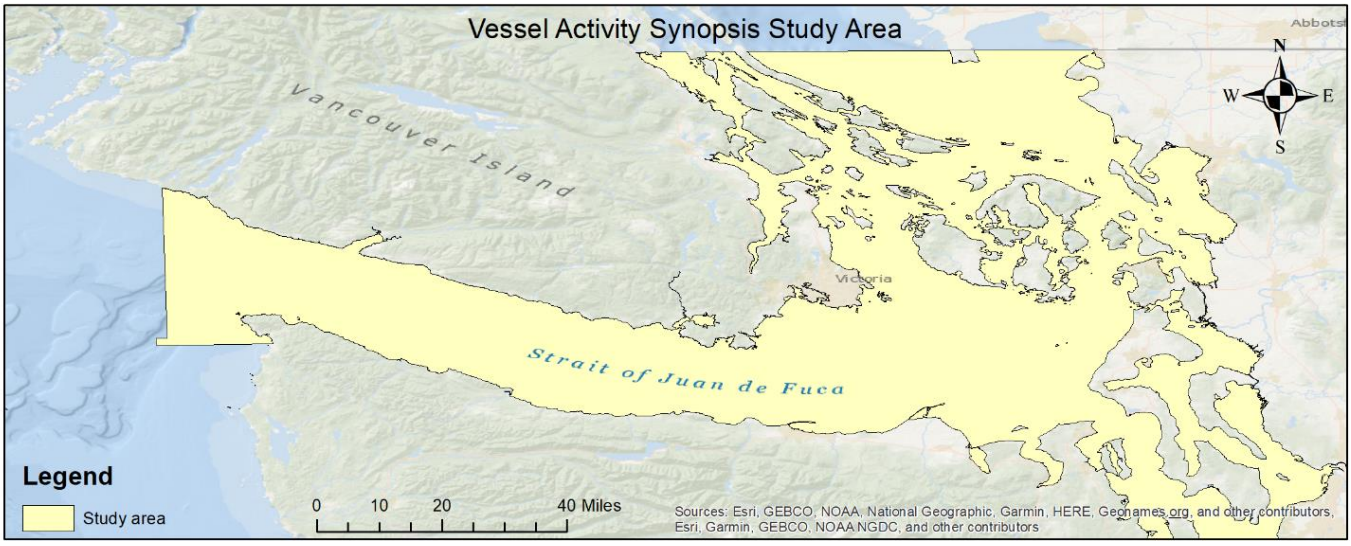

Figure 1: Map of project study area

Legislative direction

The 2019-21 biennium operating budget (Laws of 2019, ch 4, sec 302(26)) included a proviso directing the Washington State Department of Ecology (Ecology) to produce a synopsis of current maritime vessel activity for the appropriate committees of the Legislature by June 30, 2021. Section 302 (26) states the following:

> $100,000 of the Oil Spill Prevention Account—state appropriation is provided solely for the department to produce a synopsis of current maritime vessel activity, navigation lanes, and anchorages in the northern Puget Sound and the Strait of Juan de Fuca, including vessel transit in Canadian portions of transboundary waters. Consistent with RCW 43.372.030, the synopsis must compile key findings and baseline information on the spatial and temporal distribution of and intensity of current maritime vessel activity. The department may collect new information on vessel activity, including information on commercial and recreational fishing, where relevant to the synopsis. In producing the synopsis, the department must invite the participation of Canadian agencies and First Nations, and must coordinate with federal agencies, other state agencies, federally recognized Indian tribes, commercial and recreational vessel operators and organizations representing such operators, and other stakeholders. The department must provide a draft of the synopsis to the appropriate committees of the Legislature by June 30, 2021.

Methods

Ecology collected data and conducted analyses to evaluate commercial, recreational, and tribal fishing vessel activity in the study area in 2018, the latest year of data available at the time of the study.

The primary data source was vessel Automatic Identification System (AIS) data. AIS is a maritime navigation safety and communications tool. Vessels equipped with AIS broadcast information including their identity, type, position, course, speed, and navigational status. International and federal regulations require certain vessels, including large commercial ships, to be equipped with AIS.

Ecology used three primary methods to analyze AIS data:

- **Crossing lines**. Ecology implemented virtual lines in key locations in a Geographic Information System, and counted the number of AIS vessel tracks that intersected the lines. Crossing line counts were summarized for each vessel category.

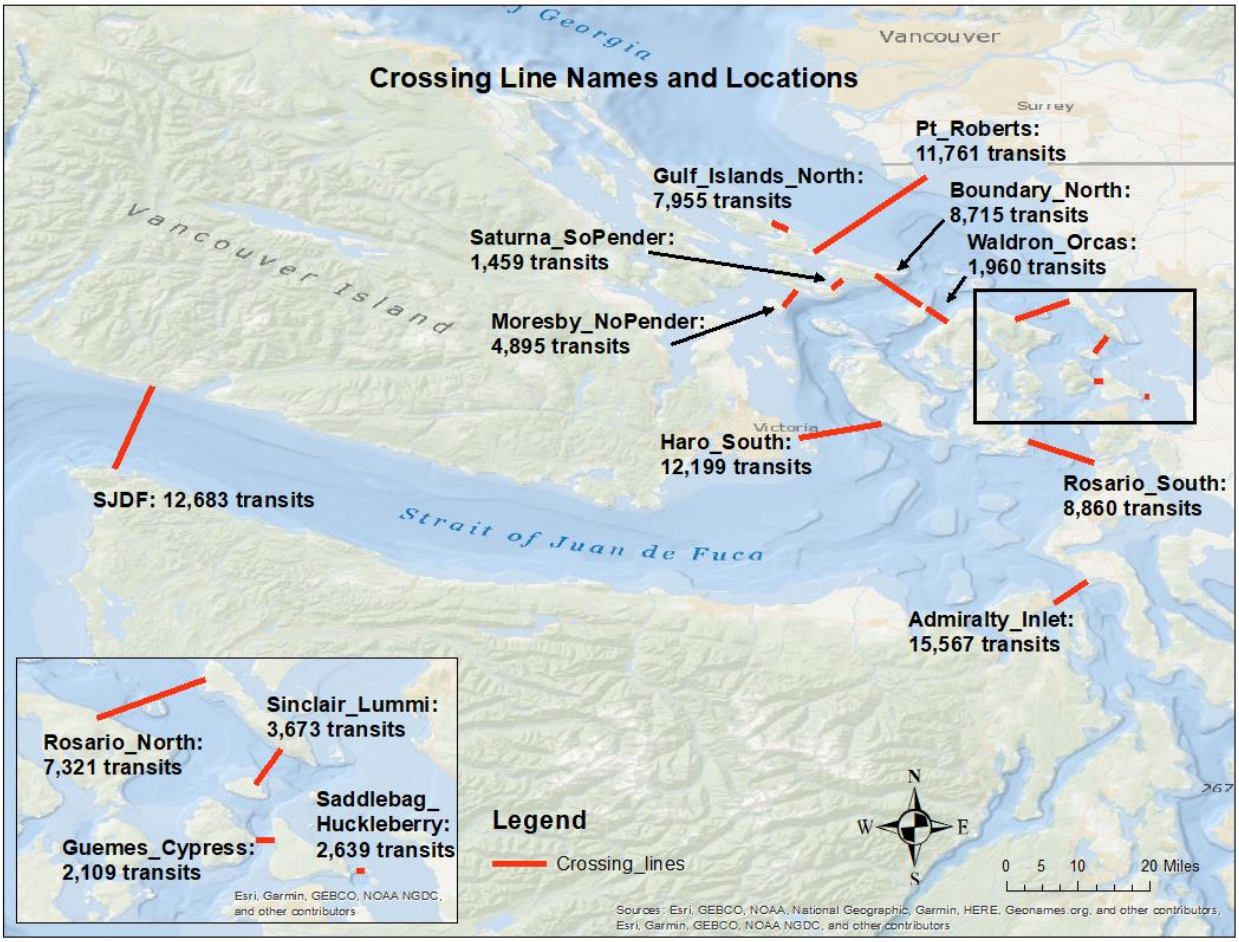

Figure 2: Map of crossing line names and locations

- **Operating hours** Ecology defined a one-nautical-mile grid across the study area. Analysis was conducted to determine the number of hours that each grid cell was occupied by a vessel in 2018. An example of the operating hour results for ships carrying bulk cargo, such as grain, is shown below.

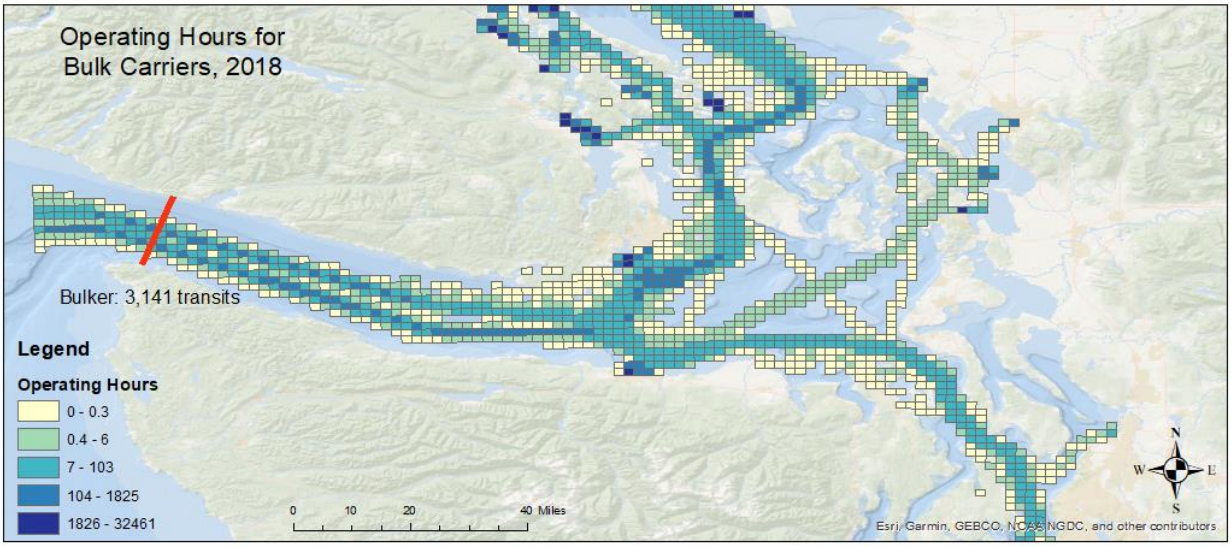

Figure 3: AIS Operating Hours for Bulk Carriers, 2018

- **Anchorage usage** Ecology identified anchorage locations, and counted AIS vessel tracks within anchorages. The number of vessels in each anchorage location was counted each minute for the year. Vessels present in anchorage locations for less than 60 minutes were excluded, to reduce the number of transiting vessels counted. Ecology generated summary statistics for each anchorage area and each quarter. Statistics include the amount of time an anchorage was vacant (0 vessels present) and occupied (at least one vessel present).

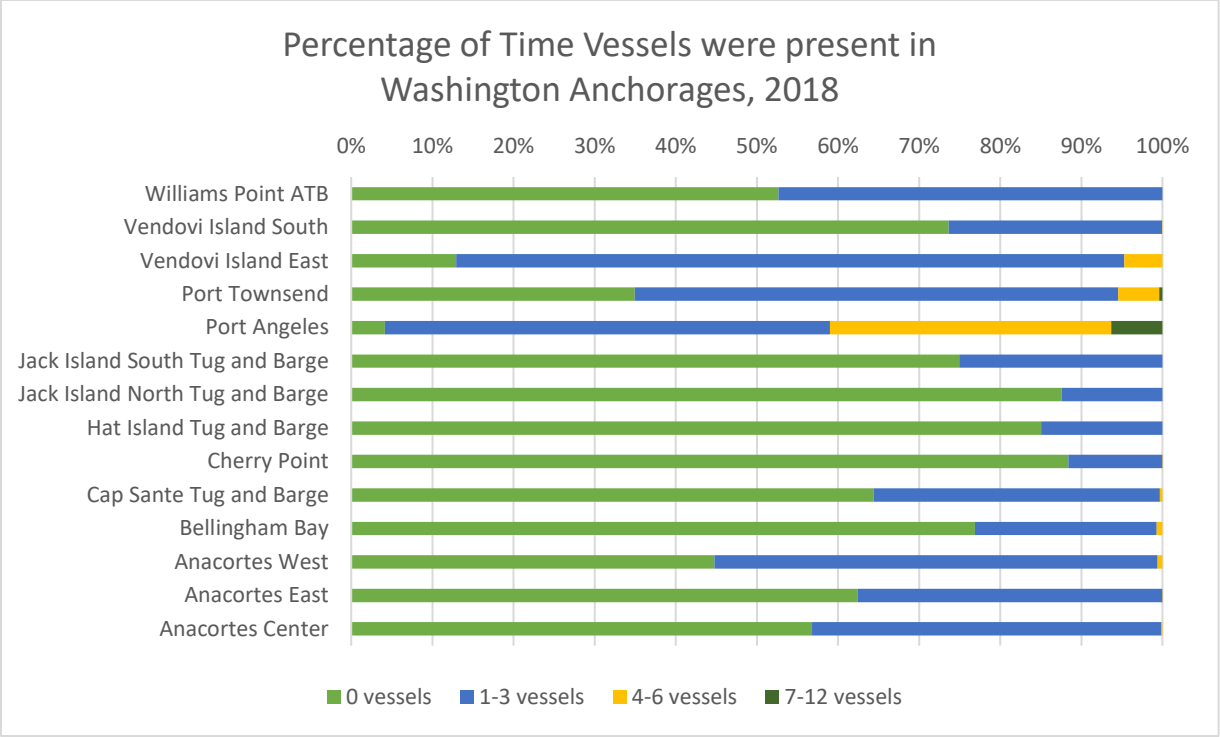

Figure 4: Number of vessels present in WA anchorages in 2018

Ecology used additional data sources for oil transfer activity, recreational boating activity, and commercial and recreational fishing activity in the study area.

Ecology received tribal fishing vessel data from two federally recognized tribes that fish within the study area, the Jamestown S'klallam Tribe and the Swinomish Tribe

Results

Across the study area, most vessel activities had minimal seasonal variation with the exception of fishing, passenger, and recreational vessels, which had greater activity in the spring and summer.

Tugs were the vessel type with the highest number of crossing line transits (22% of the total transits), followed by recreational vessels (21% of the total transits), and bulk carrier vessels (12% of the total transits).

Recreational vessels had the highest count of unique vessels (over 3,000). This is in contrast to tug vessels which had a similarly high transit count (21,948) but a relatively small number (approximately 300) of unique vessels.

Results by geographic area are summarized below, and discussed in detail in the synopsis. These results include information received by Ecology from the Jamestown S'klallam Tribe and the Swinomish Tribe. Other tribes may have usual and accustomed fishing rights within the areas described below.

Strait of Juan de Fuca: The crossing line analysis recorded 12,683 transits at the Strait of Juan de Fuca crossing line (25 percent bulk carriers, 16 percent container ships, 12 percent fishing vessels, and 9 percent tanker). Tanker transit counts were higher at the Strait of Juan de Fuca line (1,191 transits) than any other line in the study area.

An analysis of AIS operating hours showed the emergency response towing vessel (ERTV) in Neah Bay, fishing vessels spending time near the shoreline, and bulk carriers, container ships, tankers, car carriers, and cargo vessels spending time traveling along the traffic lanes.

Constance Bank, Victoria, and Port Angeles anchorages are located in the Strait of Juan de Fuca. The Port Angeles anchorage was the Washington anchorage with lowest vacancy (4%). The Port Angeles anchorage also had the highest oil transfer volume of all the Washington anchorages.

The Swinomish Tribe fishes for various species in the Eastern Strait of Juan de Fuca (Swinomish Tribe, 2021). The Jamestown S'Klallam Tribe fishing area includes the length of the Strait of Juan de Fuca (Jamestown S'Klallam Tribe, 2011).

Admiralty Inlet and Whidbey Island: The Admiralty Inlet crossing line had the highest count of vessel transits in the study area with 15,567 transits (27 percent tug, 26 percent recreational, 12 percent container ship, and 7 percent fishing vessel). Admiralty Inlet had more tug transits (4,168) and recreational vessel transits (4,076) than any other crossing line.

The AIS operating hours analysis showed Washington State Ferry traffic; Articulated Tug Barges (ATBs), tankers, container ships, car carriers, and bulk carriers spending time traveling through Admiralty Inlet; and container ships, car carriers, bulk carriers, and cargo vessels transiting to the port of Everett. Port Townsend anchorage is located near Admiralty Inlet and was vacant approximately 35 percent of the time.

The Jamestown S'Klallam Tribe fishing area includes Admiralty Inlet and Hood Canal (Jamestown S'Klallam Tribe, 2011).

Bellingham Bay, Rosario Strait and waters east: The crossing lines at Rosario South and Rosario North had the second and third highest tug transit counts in the study area (4,076 for Rosario South and 3,727 for Rosario North), exceeded only by the Admiralty Inlet line which saw 4,168 tug transits.

The AIS operating hours analysis showed ATBs and tankers spending time transiting Rosario Strait and at anchorages and terminals in Anacortes and Bellingham, as well as fishing vessels spending time in this area, particularly around Guemes Island.

There are several anchorages in this area including Bellingham Bay; Anacortes Center, East, West; Hat Island Tug and Barge; Jack Island North, South; Vendovi Island East, South; Cap Sante Tug and Barge; and Williams Point ATB. The Vendovi Island East anchorage had the second lowest vacancy for Washington anchorages at 13 percent. The 'Anchor - Vendovi Island' transfer location, which encompasses the Jack Island North, South; Vendovi Island East, South;

and Williams Point ATB anchorage locations, had the third highest oil transfer volumes with over 4 million gallons transferred there in 2018. The Anacortes/March Point anchorage had the second highest volume of oil transferred, with over 11 million gallons transferred there in 2018. The Bellingham anchorage had two transfers in 2018 totaling 295,000 gallons.

The Swinomish fishing fleet is primarily homeported on their reservation or across the Swinomish Channel in La Conner. The Swinomish Tribe fishes for various species in the vicinity of Rosario Strait, Guemes Channel, and Saddlebag (Swinomish Tribe, 2021).

San Juan Islands: 73 percent of the transits (1,439 transits) at the Waldron Orcas crossing line were recreational vessels.

The AIS operating hours analysis showed ferry routes through the Islands, time spent by cargo vessels transiting between Islands, and recreational, passenger and commercial fishing vessel activity throughout the Islands.

The Swinomish Tribe fishes for various species near the San Juan Islands (Swinomish Tribe, 2021). The Jamestown S'Klallam Tribe fishing area includes the San Juan Islands and portions of Rosario Strait, Haro Strait, and Boundary Pass (Jamestown S'Klallam Tribe, 2011).

Haro Strait/Boundary Pass: Recreational vessels made up a high percentage of Haro South transits (24 percent, 2,960 transits). Bulk carriers make up 21 percent (2,600 transits) and container ships make up 12 percent (1,427 transits) of Haro South crossing line transits.

The AIS operating hours analysis showed tankers, container ships, car carriers, cargo vessels, and bulk vessels and, to a lesser extent, ATBs transiting through Haro Strait/Boundary Pass.

The Swinomish Tribe fishes for various species in the vicinity of Haro Strait and Boundary Pass (Swinomish Tribe, 2021).

Point Roberts and Strait of Georgia: The Point Roberts line has the fourth highest crossing line count in the study area (23 percent bulk carriers, 22 percent tugs, and 12 percent container ships).

The AIS operating hours analysis showed bulk carriers, container ship, and tug activity near Roberts Bank.

The Cherry Point anchorage had the highest vacancy (period of time with 0 vessels present) of any of the Washington anchorages at 88 percent.

The Swinomish Tribe fishes for various species in the vicinity Cherry Point (Swinomish Tribe, 2021).

Southern Gulf Islands: The Gulf Island North crossing line had 7,955 transits, the Moresby North Pender line had 4,895 transits, and the Saturna South Pender line had 1,459 transits.

The AIS operating hours analysis showed tug activity throughout the Southern Gulf Islands, ATB activity to the west of Sidney; and cargo vessels operations from Sidney to Active Pass. The AIS operation hours analysis also showed vessel presence at anchorages such as bulk carriers presence Cowichan Bay, Ladysmith, and Plumper Sound anchorage locations; tank vessel presence at Plumper Sound anchorage; and cargo vessels presence Cowichan Bay and Ladysmith anchorages.

The anchorage analysis showed that the anchorages at the northern end of the Southern Gulf Islands (Houston Pass, Kuleet, Ladysmith, Trincomali) were each vacant at least 55 percent of the time in 2018 and the anchorages at the southern end of the Islands (Cowichan Bay, Long Harbor, Plumper Sound) were each vacant at least 45 percent of the time.

Conclusion

This synopsis combines multiple data sources and analysis methods to accomplish its goal of describing current maritime vessel activity, navigation lanes, and anchorages in the northern Puget Sound and the Strait of Juan de Fuca. It provides a holistic view of vessel activity by presenting information on vessel crossing line counts and operating hours for each vessel type, as well as information about anchorage usage and fishing and recreational vessel activity.

It can serve as both a foundational reference for understanding the areas and timeframes where vessel activities overlapped in 2018 and as a model for future work to build a deeper understanding of trends in vessel activities over time.

Introduction

Project approach

This synopsis describes commercial, tribal, and recreational vessel activities, oil transfers, and anchorage usage that occurred in 2018. Ecology reviewed existing data from a variety of sources and conducted new analyses of vessel Automatic Identification System (AIS) data.

Study area

Ecology defined the study area to include the Strait of Juan de Fuca, Puget Sound north of Admiralty Inlet, and the Southern Strait of Georgia. The study area is shown in yellow in the figure below.

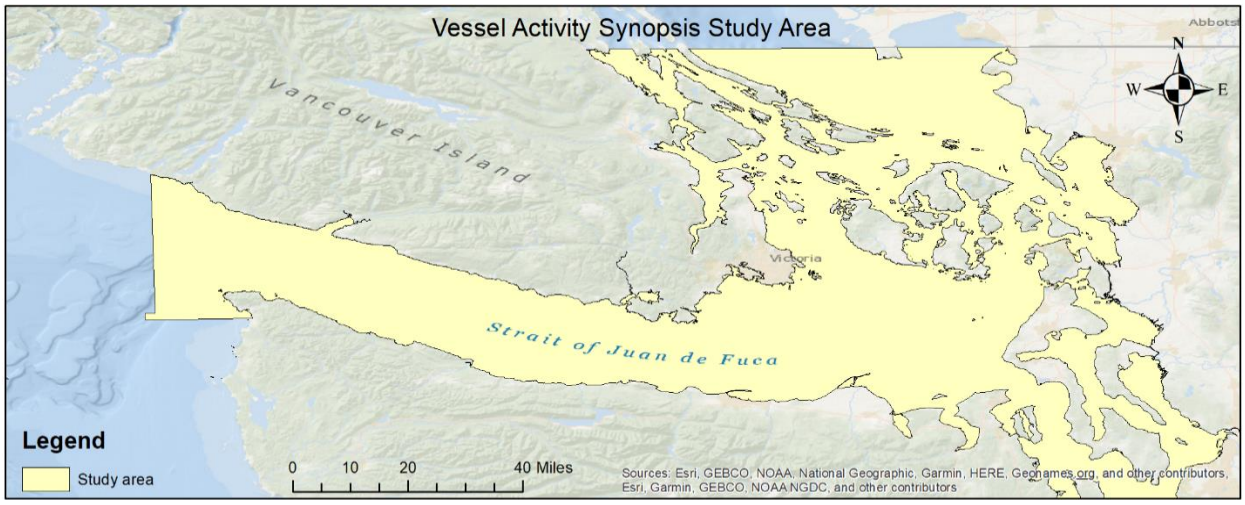

Figure 5: Map of project study area

Outreach and coordination

Laws of 2019, ch 4, sec 302(26) directed Ecology to "invite the participation of Canadian agencies and First Nations" and "coordinate with federal agencies, other state agencies, federally recognized Indian tribes, commercial and recreational vessel operators and organizations representing such operators, and other stakeholders" (Laws of 2019, ch 4, sec 302(26)).

- Ecology conducted extensive outreach with federally recognized tribes, First Nations, U.S. and Canadian agencies, and stakeholders. Project information was made available on a public-facing project webpage. Outreach events included two webinars and five Puget Sound Harbor Safety Committee meetings. The Recommendations Received by Ecology section of this report includes a discussion of the suggestions and recommendations that were out of scope for this project and not included in this analysis.

- Project Webinar 1: In April 2020, Ecology held an introductory webinar for federally recognized tribes, First Nations, and U.S. federal and state agencies, Canadian agencies, environmental organizations, local governments, the petroleum industry, and the shipping industry attended (see Appendix C for a full list of invited organizations). Twenty five people participated. Ecology reviewed the project timeline, data sources, and potential analysis methods. Participants recommended Ecology include additional vessel types and analysis methods in addition to counting vessel transits, and include oil transfer data. Ecology incorporated these recommendations into the analysis.
- Project Webinar 2: In May 2020, Ecology held a second webinar; 42 participants attended. This webinar included a presentation about project progress and example data. Feedback from this webinar included adding more vessels to the "ferry" category and adding more anchorages to the report. Ecology made both of these changes to the analysis.
- Puget Sound Harbor Safety Committee Presentations: Ecology gave five presentations during regular Harbor Safety Committee meetings in February, June, August, October, and December of 2020. The December meeting was co-hosted by the Canadian Pacific Marine Review Panel, with over 90 U.S. and Canadian participants. These presentations introduced the project and provided updates. Attendees included representatives from tribes, federal and state agencies, local governments, shipping industry associations, vessel operators, and environmental organizations.

Additionally, Ecology sent letters to 20 federally recognized tribes with fishing interests in or near the study area. Initial letters were sent to inform federally recognized tribes about the project and invite their participation in the webinars. The second letters included a request for data on the number of fishing permits or tribally-licensed fishing vessels that were active in 2018. Ecology also requested 2019 data due to the biennial nature of certain fisheries. Ecology received data from two federally recognized tribes, the Swinomish Tribe and the Jamestown S'Klallam Tribe.

Data and Methods

Overview

Ecology collected a variety of data and developed several methods to produce this synopsis. The primary data source was Automatic Identification System (AIS). U.S. Coast Guard Marine Event Permit information, Ecology Advance Notice of Transfer System data, fisheries data from Washington Department of Fish and Wildlife and Department of Fisheries and Oceans Canada, and recreational vessel data from Washington Sea Grant were also analyzed. In addition, Ecology requested data about fishing activity from federally recognized tribes in Washington and received data about recreational vessel ownership collected by Washington Sea Grant. 2018 was chosen as the time period for the analysis due to the availability of AIS data.

Data sources

Most data were either publicly available or obtained through public disclosure or Freedom of Information Act (FOIA), 5 U.S.C. § 552 requests. Tribal fishing information was provided by two federally recognized tribes. Table 1 shows the sources of data Ecology used to develop the synopsis, what vessel activity the data source was used to describe, and how data were analyzed. Analysis methods are described in detail in the remainder of this section.

Table 1: Data Sources Used for Different Vessel Activities

Vessel Activity	Analysis Method	Data Source
Vessel transits	AIS operating hours method & Crossing lines method	U.S. Coast Guard Automatic Identification System (AIS) data
Vessel presence in anchorage locations	Anchorage analysis method	U.S. Coast Guard AIS data
Oil transfers	Data export and review	Ecology Advanced Notice of Transfer System
Marine events	Data export and review	U.S. Coast Guard marine event permits
Washington Fisheries	Data export and review	Washington Department of Fish and Wildlife
Canadian Fisheries	Data export and review	Department of Fisheries and Oceans
Recreational boating	Data export and review	Washington Sea Grant
Tribal fishing	Data review	Jamestown S'Klallam Tribe and Swinomish Tribe

U.S. Coast Guard Automatic Identification System (AIS) data

Ecology analyzed Automatic Identification System (AIS) data to determine vessel operating hours within the study area, count the number of vessel transits in specific locations, and assess anchorage usage.

AIS is a maritime navigation safety and communications tool. Vessels equipped with AIS transmit information including their identity, type, position, course, speed, and navigational status. Vessels and shore stations receive and display this information, increasing situational awareness (U.S. Department of Homeland Security, 2020).

Vessels of certain sizes, types, and employments are required to carry AIS by federal regulations and international standards (U.S. Department of Homeland Security, 2021). Examples of ships that must carry AIS in US waters are commercial vessels longer than 65 feet, towing vessels longer than 26 feet, and passenger vessels capable of carrying more than 150 passengers.

Information transmitted by AIS comprises static vessel data (e.g., type of vessel and a unique, 9-digit identification number known as Maritime Mobile Service Identities, or MMSI); dynamic vessel data (e.g., vessels position, course, and speed); and voyage-related data (e.g., at anchor

or underway). Vessels carry either a Class A or Class B transmitter, depending on the vessel type and employment. Class A transmitters produce more power, transmit more frequently, and have additional capabilites compared to Class B transmitters. AIS data is sent through Very High Frequency (VHF) radio signals, and may be received by ship, land, or satellite based antennas.

In addition to its primary purpose of increasing navigational safety, AIS messages can be stored and analyzed, representing a rich source of data about vessel activities. Ecology recieved 2018 AIS data for the study area from the U.S. Coast Guard Navigation Center. The latest year of complete data that is available from the Coast Guard at the time of this analysis is 2018. The data included AIS signals from Class A and Class B transmitters, received by both land-based and satellite antennas. Data was received as Comma Separated Values (CSV) files, aggregated in 5-minute time intervals.

Ecology Advanced Notice of Transfer (ANT) system

Under authority of Revised Code of Washington (RCW) 88.46.165 and Washington Administrative Code (WAC) Chapter 173-184, the Spill Prevention Preparedness and Response (Spills) Program at Ecology requires advance notice of transfer (ANT) for over-water bulk oil transfers of more than 100 gallons from vessels and shore-based facilities that transfer to non-recreational vessels or facilities. ANT data contains the name of the deliverer and receiver as well as the transfer time, location, product, and volume. The ANT data was exported from the Spills Program Integrated Information System for 2018. The exported data was filtered to only include transfers at anchorage locations within the study area. The ANT data was reviewed for accuracy and completeness, and analyzed using R, a software environment for statistical computing and graphics.

U.S. Coast Guard marine event permits

The U.S. Coast Guard requires marine event permits for scheduled waterway events that could present extra or unusual safety hazards (U.S. Department of Homeland Security, 2018). Ecology received marine event permits in a combined PDF format from Coast Guard Sector Puget Sound. Information from each permit including the date, name, and location of the event was manually recorded into an Excel workbook. The quarter during which the event took place was identified, and events were grouped together based on proximity.

Tribal fishing data

The Jamestown S'Klallam Tribe and Swinomish Tribe each provided data on the number of registered fishing vessels their tribe had in 2018. The Swinomish Tribe provided data as responses to a questionnaire developed by Glosten Associates for use in a previous study. The full data submitted by the Swinomish Tribe is included in Appendix B.

Washington Department of Fish and Wildlife

The Washington Department of Fish and Wildlife (WDFW) maintains records on the number of commercial and recreational fishing licenses sold each year. Ecology received license statistics for 2018 from WDFW and aggregated it based on license type (e.g. temporary vs. annual).

Ecology also used information from WDFW's website and sport fishing pamphlets to determine commercial and recreational fishery seasons and locations (WDFW, n.d.; WDFW, 2017; WDFW, 2018).

Department of Fisheries and Oceans Canada (DFO)

DFO maintains public data on the number of commercial and recreational fishery licenses sold each year in Canada. Ecology downloaded commercial fisheries license statistics for the Pacific Region from DFO's website as an Excel workbook (Fisheries and Oceans Canada, n.d.). Ecology filtered data for 2018 and for license areas within the study area, and generated summary statistics of license types by area.

Washington Sea Grant

Washington Sea Grant provides data about the recreational boating fleet in Washington, including fleet size, values, age, geographic distribution across the state, and vessel characteristics (Barnett, n.d.). This data is derived from Washington Department of Licensing raw titling and registration information. Ecology accessed Washington Sea Grant's publicly available 2018 recreational boating fleet report and analyzed relevant information including vessel length and registered county.

Methods to prepare AIS data

AIS data processing

Ecology collected, processed, and analyzed AIS data as the primary source of information about commercial vessel traffic in the study area. The data was prepared for analysis using the following steps:

1. AIS data were imported into a Microsoft SQL Server 2016 database.
2. Erroneous and incomplete AIS messages were removed. This included AIS messages with missing MMSIs and messages that were clearly incomplete. AIS messages with data in the incorrect field, due to the use of special characters in the AIS raw data, were also corrected.
3. Data were transferred into a database table.
4. Data were separated into two tables, one for dynamic movement information (e.g., latitude, longitude, speed, course, heading, navigation status) and another for static vessel information (e.g., vessel name, IMO number, call sign, ship dimensions, flag).

AIS vessel categorization process

AIS data has inherent vessel categories (USCG, n.d.) but these vessel categories lack specificity. Ecology received requests from outreach event participants to break these categories into smaller, more detailed vessel types. Ecology developed a list of vessel categories based on preliminary analysis of AIS vessel categories, Washington Department of Ecology Vessel Entry and Transits data, and discussions with outreach event participants. Ecology's expanded list of vessel categories included: Articulated Tug Barge (ATB), Bulk Carrier, Car Carrier, Cargo,

Container Ship, Ferry, Fishing, Passenger, Recreational, Tanker, Tug, and Other. Vessels were assigned to categories using the following steps:

1. ATBs and Ferries were manually assigned to the appropriate vessel category. A list of active ATBs is maintained by Ecology. An ATB is a combination vessel that consists of a barge and a tug boat connected by mechanical equipment (Washington State Department of Ecology, 2017a). A list of ferries was compiled from the websites of public and private ferry operators (Washington State Department of Transportation, 2021; Black Ball Ferry Line, n.d.; Skagit County, 2021; BC Ferries, 2021; Clipper Vacations, 2021).
2. Vessels not on the lists of ATBs and ferries were assigned to a category based on their categorization in sources such as the Marine Exchange of Puget Sound, Chamber of Shipping of British Columbia, and Merchants Exchange of Portland, Oregon. If vessel information was available from more than one of these sources, the Marine Exchange information was used first, followed by the Chamber of Shipping information.
3. Vessels not categorized by the first two steps were cross-referenced with the United States Coast Guard Vessel Documentation System and the Canada Transportation Safety Board Marine Safety Information System (MARSIS) data. These vessels were assigned the category listed in these sources.
4. Remaining uncategorized vessels were sorted into study vessel categories based on the vessel type they transmitted over AIS.

The table below provides examples for the vessel types included in each category.

Table 2: Vessel Types included in Synopsis Vessel Categories

Synopsis Vessel Category	Example Vessel Types included in Vessel Category (from all sources)
ATB	Ecology list of active ATBs
Bulk Carrier	Bulk Carrier
Car Carrier	Ro/Ro, Vehicle Carrier
Cargo	General Cargo, Refrigerated Cargo
Container Ship	Container Ship
Ferry	BC Ferries, Black Ball Ferry, Guemes Island Ferry, San Juan Clipper, Victoria Clipper, WA State Ferries
Fishing	Fishing, Fish Factory, Fish Processor
Passenger	Passenger, Passenger Cruise, Passenger Ro/Ro
Recreational	Pleasure Craft, Sailing Vessel, Yacht
Tanker	Asphalt Tanker, Chemical Tanker, Crude Tanker, Liquefied Gas Tanker, Product Tanker
Tug	Barge Tow, Tug, Tug Tow, Towing Vessel
Other	Cable-Layer, Dredge, General, Hospital, Military, Research, Supply, Trawler

Using AIS data to create vessel tracks

Vessel tracks were created using a modified version of the Python AIS Track Builder 3.1 script available from MarineCadastre.gov. To simplify management and analysis of the AIS data, tracks were created for each unique MMSI for each 12-hour period. To create tracks, AIS points were grouped by MMSI and then separated into 12-hour blocks for the entire year. AIS points for each MMSI and 12-hour period were sorted by the date and time of the AIS message and a track was created connecting the points from earliest to latest time.

Methods to analyze AIS data

Crossing line method

Crossing lines are commonly used to measure vessel activity in a particular area. Crossing lines are implemented as virtual lines in Geographic Information Systems (GIS) or in AIS display tools. Crossing lines function by counting the number of vessels that transit across the line. The Marine Exchange of Puget Sound, an association that serves as an information clearinghouse for the maritime industry and waterway users, uses crossing lines to produce reports for the Puget Sound Harbor Safety Committee. The Marine Exchange provided Ecology the coordinates for these crossing lines. Ecology added other crossing lines based on input from outreach event participants, including lines to count vessel traffic entering and leaving the Gulf Islands and lines to count traffic transiting near Saddlebag Island[2]. The locations for the Gulf Island lines were chosen based on a review of AIS data and vessel traffic patterns. The Saddlebag Island line locations were determined based on a discussion with a Puget Sound pilot on common vessel routes through that area.

Ecology implemented the crossing lines in ArcGIS. Crossing line counts were calculated by counting the number of AIS vessel tracks that intersected with the crossing lines. The crossing line counts were summarized for each vessel category. Locations of each crossing line are shown in the figure below.

[2] Saddlebag Island is located east of Guemes Island, near Padilla Bay, WA

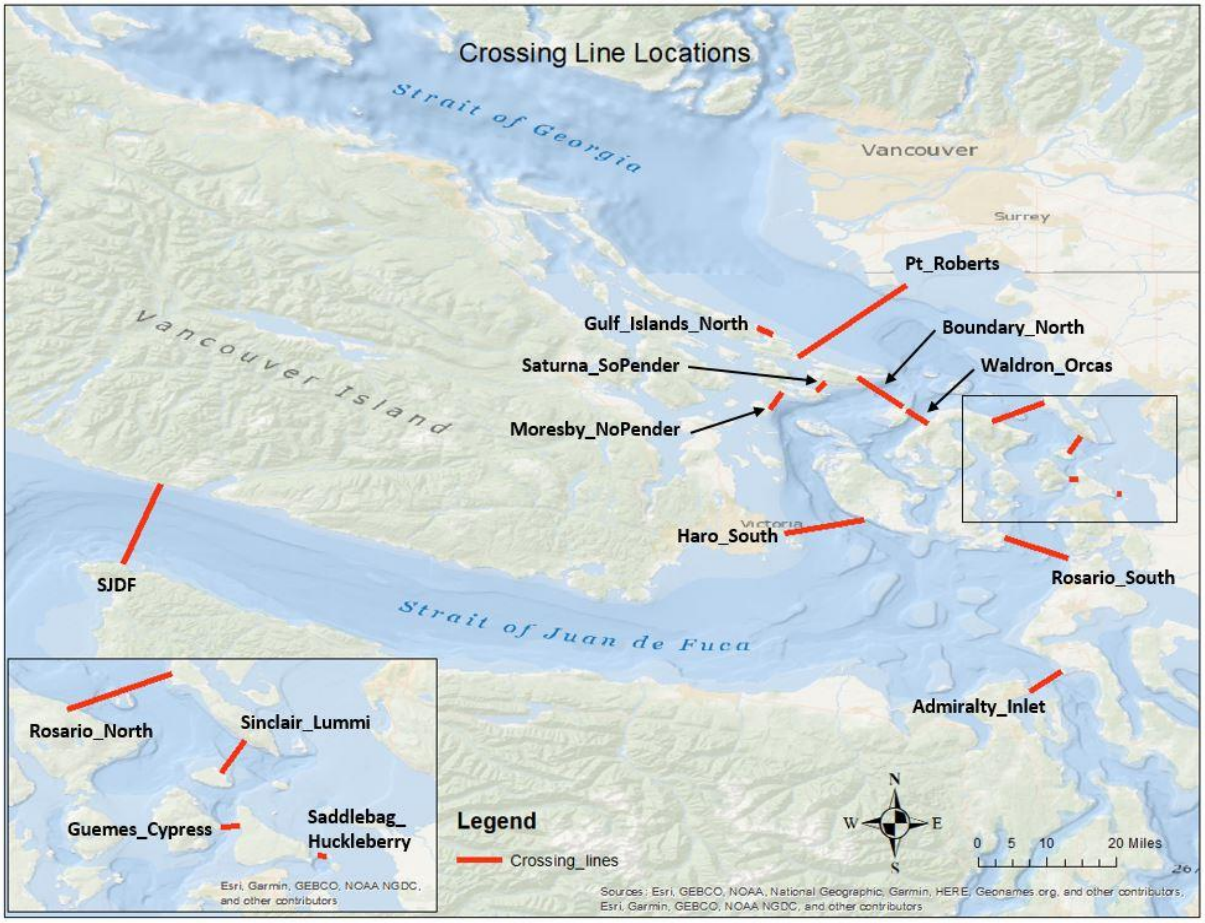

Figure 6: Map of crossing line locations

AIS operating hours method

This method was developed based on conversations with researchers from the National Oceanic and Atmospheric Administration (NOAA) (G. Galasso and J. Adams, personal communication, April 15, 2020). The operating hours method supplements crossing line data by providing a more complete picture of where vessels spent the most time. In this method, a one-nautical-mile grid was overlaid onto the study area and analysis was conducted to determine the number of hours that each grid cell was occupied by a vessel in 2018. This analysis was conducted using the following steps:

1. The five-minute aggregate AIS data received from the Coast Guard was interpolated into one-minute intervals along a defined track. This was necessary because the five-minute aggregate data did not accurately represent vessels traveling at higher speeds through the one nm grid.
2. The time that a vessel spent in each grid cell was determined by calculating the difference in the time stamp from when each AIS vessel track entered and left the grid cell.
3. The time spent in each grid cell was summarized by vessel category.

Data from this analysis was loaded into ArcGIS and a scaled color gradient was used to represent the number of operating hours in each grid cell. Creating a color gradient requires selecting a method for classifying data. Of the classification methods available in ArcGIS, the geometrical interval method was the most appropriate for the data. This method is useful for visualizing data which is skewed, instead of having a normal distribution. Since the majority of operating hours data points for each vessel type were near zero, meaning that most vessels were transiting through grid cells quickly, the geometric interval classification produced the most informative visual results. ArcGIS determines the color of each grid cell based on the classification of the cell.

Anchorage analysis method

To determine the number and percentage of time vessels were present in anchorage areas, Ecology:

1. Defined polygons in ArcGIS to encompass anchorages within the study area.
2. Counted AIS vessels tracks within these polygons each minute for the year, excluding vessel tracks that were in the anchorage less than 60 consecutive minutes.
3. Identified several anchorage locations where a visual inspection of the AIS tracks showed a high occurrence of vessels present outside the area encompassed by the standard anchorage polygon. For these anchorages, expanded anchorage areas were created to determine the number of vessels present in the area surrounding the anchorage.
4. Generated summary statistics for each anchorage area and each quarter, calculating the percentage of time that each anchorage had a vessel present there by a discrete number of vessels (e.g. 0, 1, 2, 3…). Transits by crew and supply vessels (e.g. Arrow Launch) were excluded from the anchorage statistics.

The list of anchorage areas included in the report was determined through reference material and based on input from outreach events. For Puget Sound, anchorages were compiled from the Puget Sound Harbor Safety Plan and the Code of Federal Regulations for Puget Sound Anchorages (Puget Sound Harbor Safety Committee, 2017; 33 CFR § 110.230). Emergency and explosive anchorages were excluded. Conversations with stakeholders resulted in the addition of Jack Island anchorages, which are not federally designated, but are in common usage. For British Columbia, designated anchorage locations were sourced from Pacific Pilotage Authority notices (Pacific Pilotage Authority, 2015). The anchorage locations used were reflective of the designations as they were in 2018. Table 3 lists the anchorages within the study area that were included in the analysis.

Table 3: Names and Locations of Study Area Anchorages

Anchorage Name	Location
Anacortes Center, East, West	Washington
Bellingham Bay	Washington
Cap Sante Tug and Barge	Washington
Cherry Point	Washington
Constance Bank 1, 2, 4, 5	British Columbia
Cowichan Bay A, B, C, D, E, F	British Columbia
Hat Island Tug and Barge	Washington
Houston Pass 1, 2, 3	British Columbia
Jack Island North, South	Washington
Ladysmith A, B, C, D, E, F	British Columbia
Long Harbour	British Columbia
Plumper Sound A, B, C, D, X	British Columbia
Port Angeles	Washington
Port Townsend	Washington
Vendovi Island East, South	Washington
Victoria A, B, C, D, E, F	British Columbia
Williams Point ATB	Washington

Limitations and data gaps

AIS data

While AIS data can provide a wealth of information regarding locations for commercial vessels, it fails to provide robust information about recreational and fishing vessels. Most non-towing vessels under 65 feet long are not required to have AIS transponders, meaning smaller recreational and fishing vessels often do not transmit AIS information. As a result, any recreational and fishing AIS data only includes a fraction of the true number of vessels. Because AIS data is the primary source for vessel locations and movements, much remains unknown about movements of small recreational and fishing vessels. While AIS data for fishing and recreational vessels has been included in the analysis, it should be noted that these results are not representative of the true amount of traffic with respect to these vessel types.

Because of these gaps with AIS data, Ecology has included additional data on registered recreational vessels in Washington and fishing license information. This data helps provide context on the popularity of these activities. However, this information is not able to be represented spatially or seasonally, unlike the AIS information.

Additionally, there can be inaccuracies present with AIS data due to temporary gaps in the AIS coverage, a vessel mistakenly categorized based on available data, or a vessel transmitting inaccurate information. Vessel owners self-identify their vessel types, meaning that the accuracy of this information is dependent upon vessel owners identifying and describing their vessel correctly. There are also several pieces of AIS data that may be unreliable due to a vessel operator failing to provide or update information about their vessel and transit. For example,

information such as “destination” or “status” may not be entered or updated correctly by vessel operators, making these sections of AIS data unreliable. Because of these known challenges, these fields have been largely excluded from the analysis.

Anchorage usage

The anchorage analysis considers vessels that had an AIS signal within the anchorage area for at least 60 minutes to be ‘present’ in that anchorage. In some cases, the count of vessels present within the anchorage may be higher than the actual count of vessels physically at anchor. Vessels broadcasting AIS within an anchorage polygon for over 60 minutes were counted in this analysis regardless of whether they were at anchor or conducting other activities such as escorting, bunkering, or fishing. Additionally, vessels anchored in neighboring locations could be counted twice if a vessel in the AIS data changed position by rotating around its anchor (e.g., due to changes in wind or current), and entered into the polygon encompassing a neighboring anchorage.

Current vessel activity

Because the legislative direction was to provide an understanding of “current maritime vessel activity,” this report describes a one-year snapshot of vessel activity. This report only provides information about vessel activities in 2018, and is not intended to be used to determine trends of vessel activity or intensity of vessel activity over multiple years. There are many factors that may alter the number of vessels within the study area, and the information included in this report for 2018 should not be used as a predictor for future years.

Tribal fishing activity

Ecology contacted 20 federally recognized tribes with a request for fishing vessel license or permit data and received data from two tribes for this synopsis, the Swinomish Tribe and the Jamestown S’Klallam Tribe. Inclusion of fishing data from other federally recognized tribes with usual and accustomed fishing rights within the study area would enhance future analysis work and provide greater understanding of interactions between tribal fishing vessels and other vessel activities.

Results

Crossing line results

Number of transits

The waterway areas with the most vessel activity, measured by number of crossing line transits, were:

- Admiralty Inlet – 15,567 transits
- Entrance to the Strait of Juan de Fuca – 12,683 transits
- Southern end of Haro Strait – 12,199 transits

- Point Roberts – 11,761 transits

Crossing line counts include transits in each direction (e.g., both north and south, or both east and west, depending on the orientation of the crossing line). The figure below shows the crossing line names and the number of transits across each line.

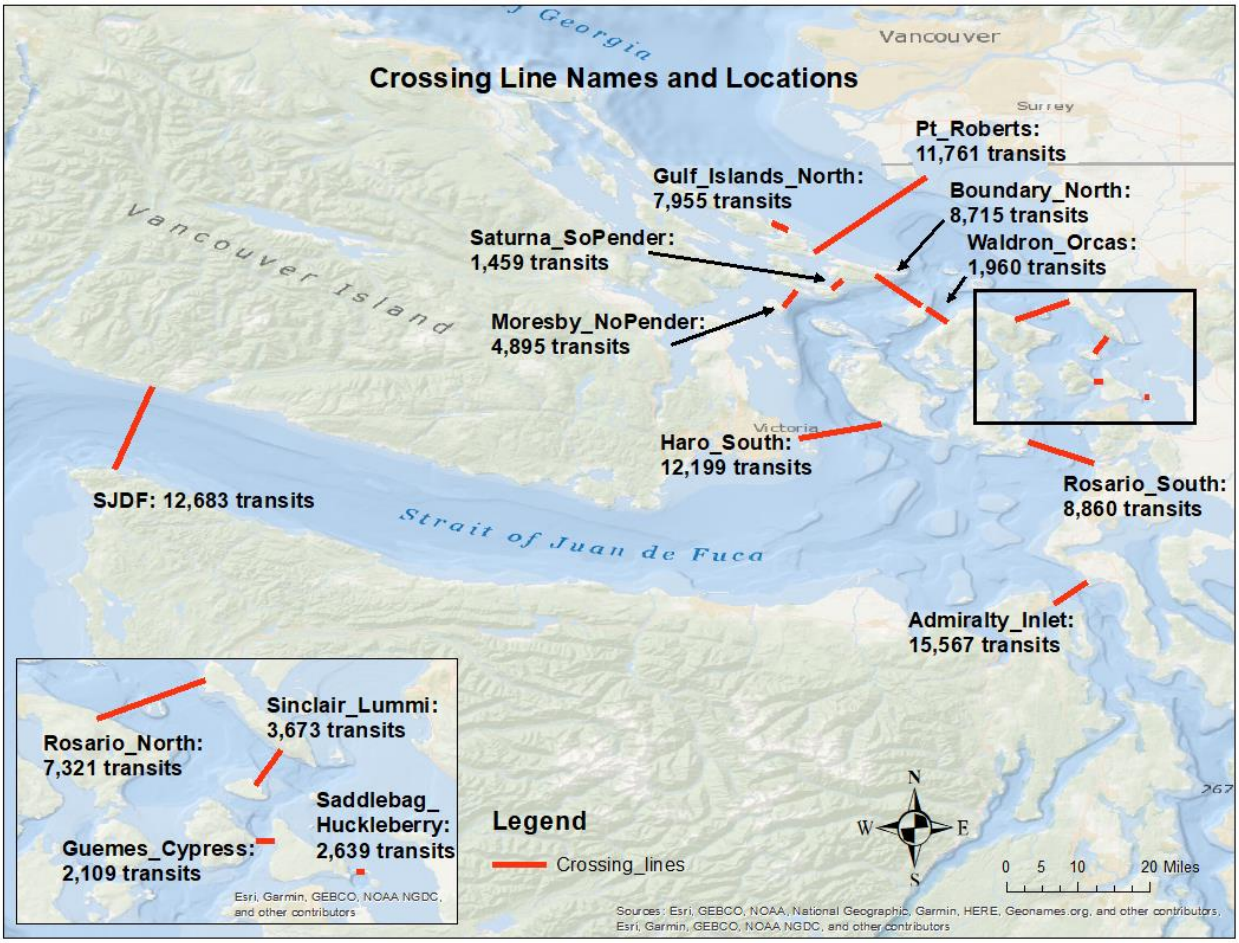

Figure 7: Map of crossing line locations with the number of vessel transits across each line

Transits by vessel type

Figure 8 shows crossing line counts color coded by vessel type. Figure 9 provides a closer look at the information in Figure 7 with a focus on crossing lines with the highest transit counts and their respective vessel types.

The Admiralty crossing line, the line with the highest overall transit counts, was primarily transited by tugs (27 percent), recreational vessels (26 percent), container ships (12 percent) and fishing vessels (7 percent).

Strait of Juan de Fuca line had the second highest counts. It is the primary route for vessels calling on U.S. and Canada from overseas. The majority of transits were by bulk carriers (25 percent), container ships (16 percent), fishing vessels (12 percent), and tankers (9 percent).

Transits through the southern end of Haro Strait were the third highest. Most transits there were recreational vessels (24 percent), bulk carriers (21 percent) and container ships (12 percent).

The Point Roberts line had the fourth highest total counts, with a majority of transits from bulk carriers (23 percent), tugs (22 percent), and container ships (12 percent).

Other notable results included the Gulf Island North crossing line, which is unique due to its high percentage of ferry transits (36 percent). The Gulf Island North line also had a high percentage of cargo vessel transits (18 percent), which includes the transits of the cargo-carrying Seaspan Ferries.

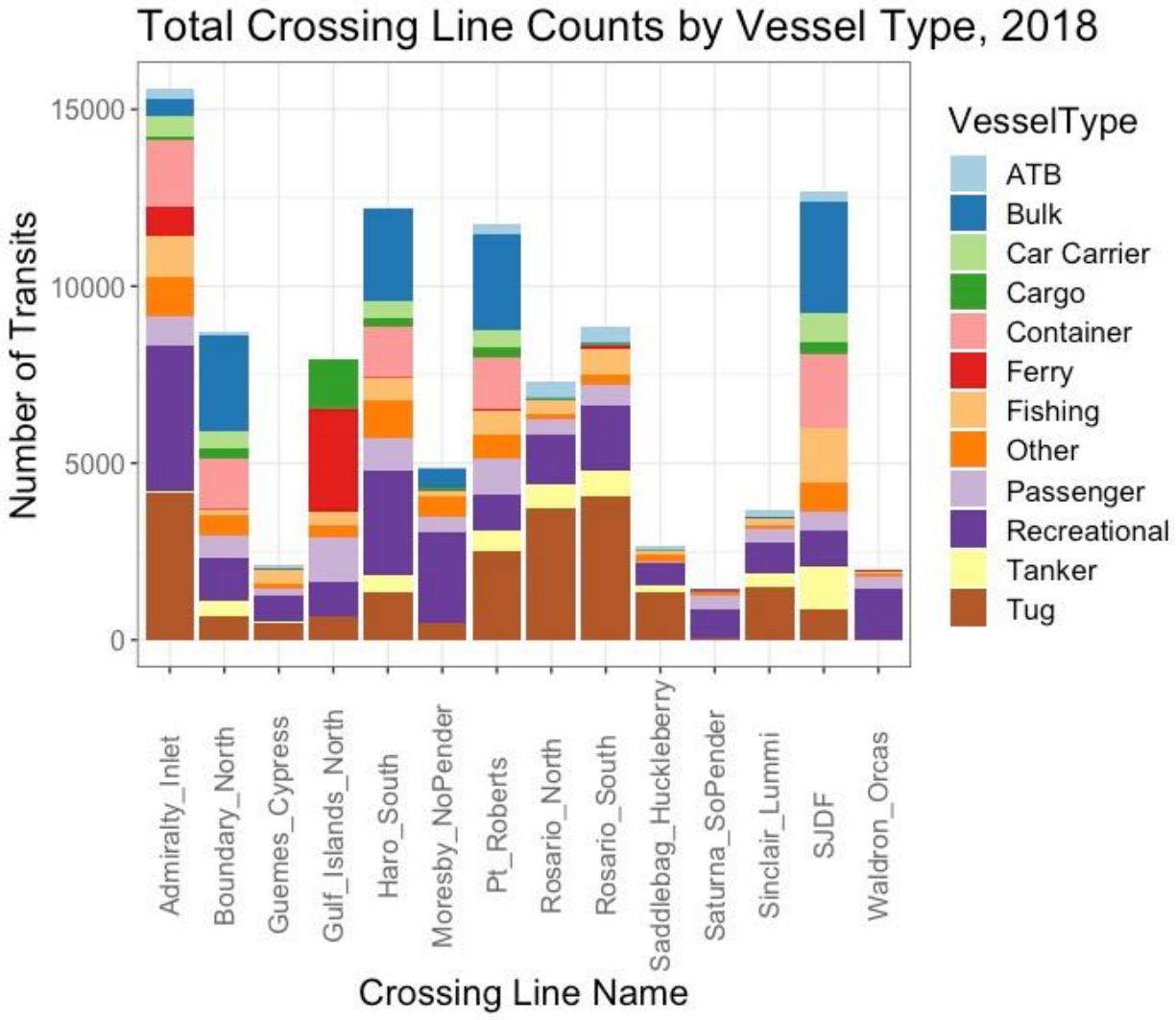

Figure 8: Transit counts for each crossing line, by vessel type

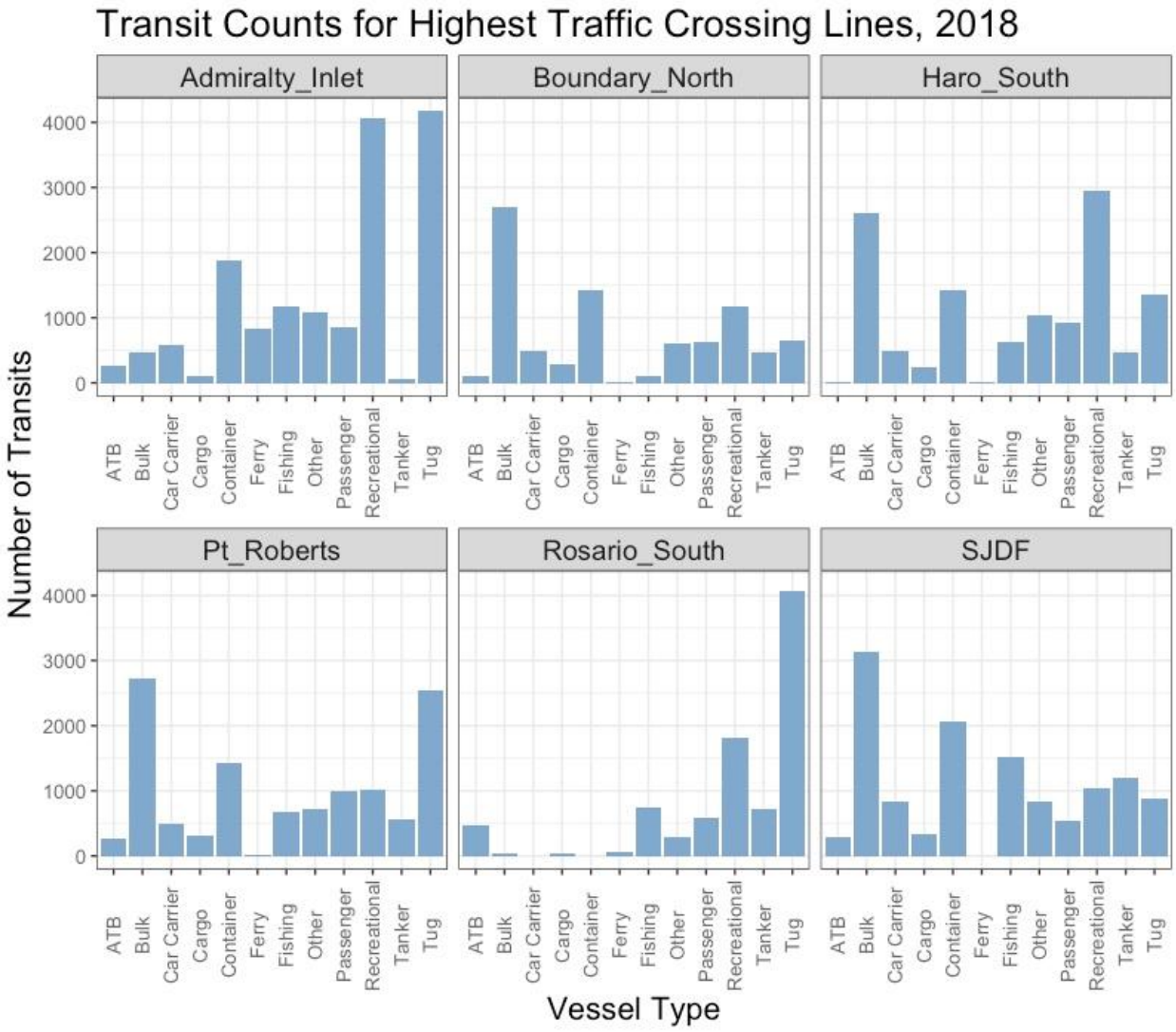

Figure 9: Transit counts for crossing lines with the most transits, by vessel type

Figure 10 shows the percentage of crossing line transits for each vessel type. Across the study area, the vessel types with the highest crossing line transits are tugs, with 22 percent of total study area transits, and recreational vessels, with 21 percent of transits. As described in the Limitations and Data Gaps section, many recreational vessels do not carry AIS. The crossing line data therefore represents a fraction of the true number of recreational vessels operating in the study area.

Tug crossing line counts are highest in Admiralty Inlet (4,168 transits), Rosario South (4,076 transits), Rosario North (3,727, transits), and Pt Roberts (2,532 transits).

Recreational vessel crossing line counts are highest in Admiralty Inlet (4,076 transits), Haro South (2,960 transits), and Moresby NoPender (2,553 transits). The highest bulk carrier transit counts were seen crossing the lines at SJDF (3,141 transits), Pt Roberts (2,715 transits), Boundary North (2,707 transits), and Haro South (2,600 transits).

Container ships (8 percent of study area transits) were primarily seen crossing the lines at the Strait of Juan de Fuca (2,070 transits), Admiralty Inlet (1,884 transits), Pt Roberts (1,437 transits), Boundary North (1,428 transits), and Haro South (1,427 transits).

Passenger vessels transits (8 percent of study area transits) were highest at the Gulf Islands North line (1,247 transits), followed by Point Roberts (995 transits), and Haro South (931 transits).

Tanker transit counts were highest at the Strait of Juan de Fuca line (1,191 transits), followed by Rosario South (726 transits), and Rosario North (666 transits).

Due to the location of these crossing lines, many ferry routes transits are not counted in this crossing line analysis. Ferry activity is best represented in the AIS operating hours portion of this synopsis.

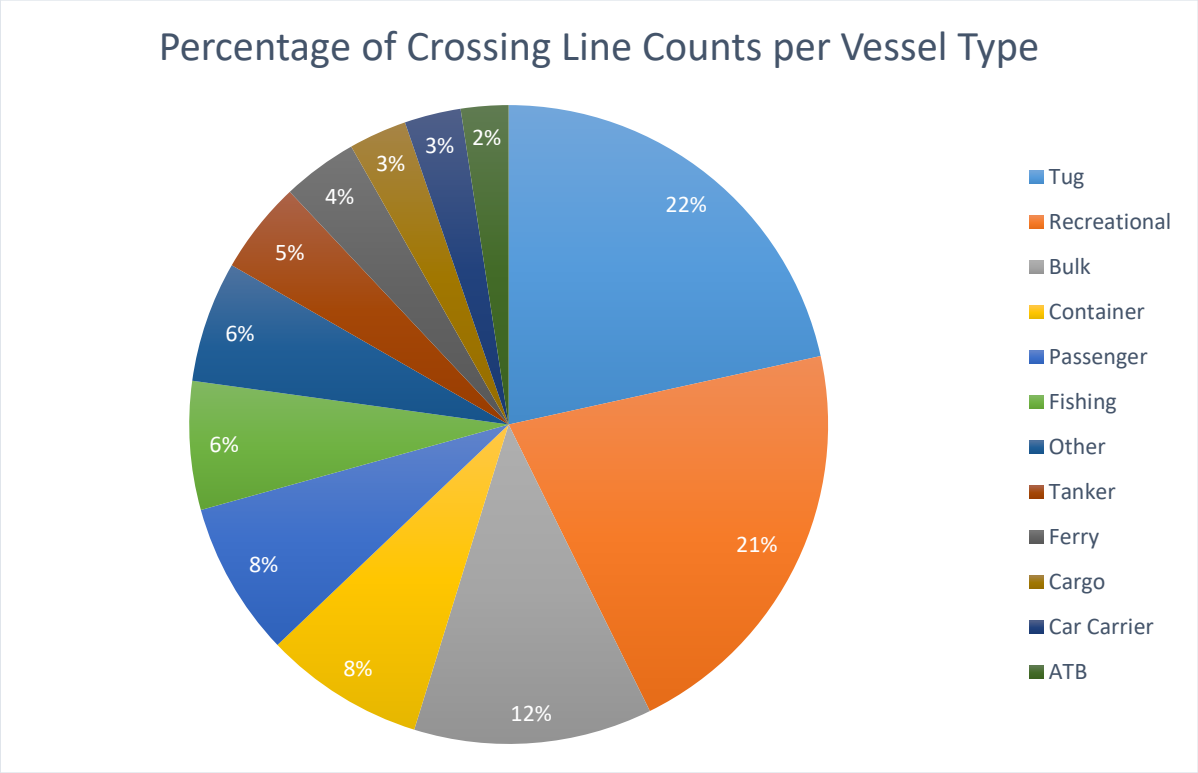

Figure 10: Percentage of crossing line counts per vessel type in the study area

Comparing the crossing line counts per vessel type to the number of unique vessels per vessel type provides insight into the relative number of transits for individual vessels of various types. Unique vessels were counted by summing the number of unique vessel identifiers (MMSI number) for each vessel type counted in the crossing line analysis. A summary of the unique vessels per vessel type is shown in Table 4.

Table 4: Unique vessels per vessel type counted in the crossing line analysis

Vessel Type	Unique vessels counted in Crossing Line Analysis (measured by count of MMSI)	Crossing Line transits
Recreational	3,071	21,530
Bulk Carrier	1,240	12,282
Fishing	624	6,618
Other	413	6,229
Tug	287	21,948
Container Ship	286	8,248
Tanker	268	4,763
Car Carrier	195	2,907
Cargo	136	2,993
Passenger	131	7,950
Ferry	38	3,879
ATB	14	2,449

Recreational vessel had the highest number of unique vessels (3,071) and the second highest number of crossing line counts (21,530). This indicates that recreational vessels are operated for a relatively small number of trips per vessel during a year, which aligns with the fact that most recreational boating takes place during the spring and summer months.

In contrast, tugs had only 287 unique vessels but the highest crossing line counts (21,948). This aligns with the operational nature of the tug industry which involves specialized, often resident, vessels conducting frequent waterway operations throughout the year.

Bulk carriers had the second highest number of individual vessels (1,240) and high crossing line transits (12,282). This indicates that bulk carriers are frequent visitors to the study area, but that the visits are often made by unique vessels. In contrast, container ships also had high crossing line transits (8,248) but only 286 individual vessels. The low count of individual container ships relative to the crossing line count is due to container ship consortiums use of liner service, using high capacity vessels on regular routes and fixed schedules.

Seasonal differences

Ecology reviewed crossing line counts by calendar quarter to identify differences between seasons. This analysis revealed most commercial vessel types have minimal seasonal variation in their transit counts (Figure 11).

Fishing, passenger, and recreational vessels did have seasonal differences. Fishing and passenger vessels had more transits in quarters two (April – June) and three (July – September).

The increase in fishing vessel transits likely reflects the timing of fisheries openings and favorable boating weather during the spring and summer. The increase in passenger vessels indicates cruise ship and whale watching season. Recreational vessel traffic shows a significant increase during quarter three, more than doubling the number of transits from quarter two, likely due to favorable boating weather in the late summer months.

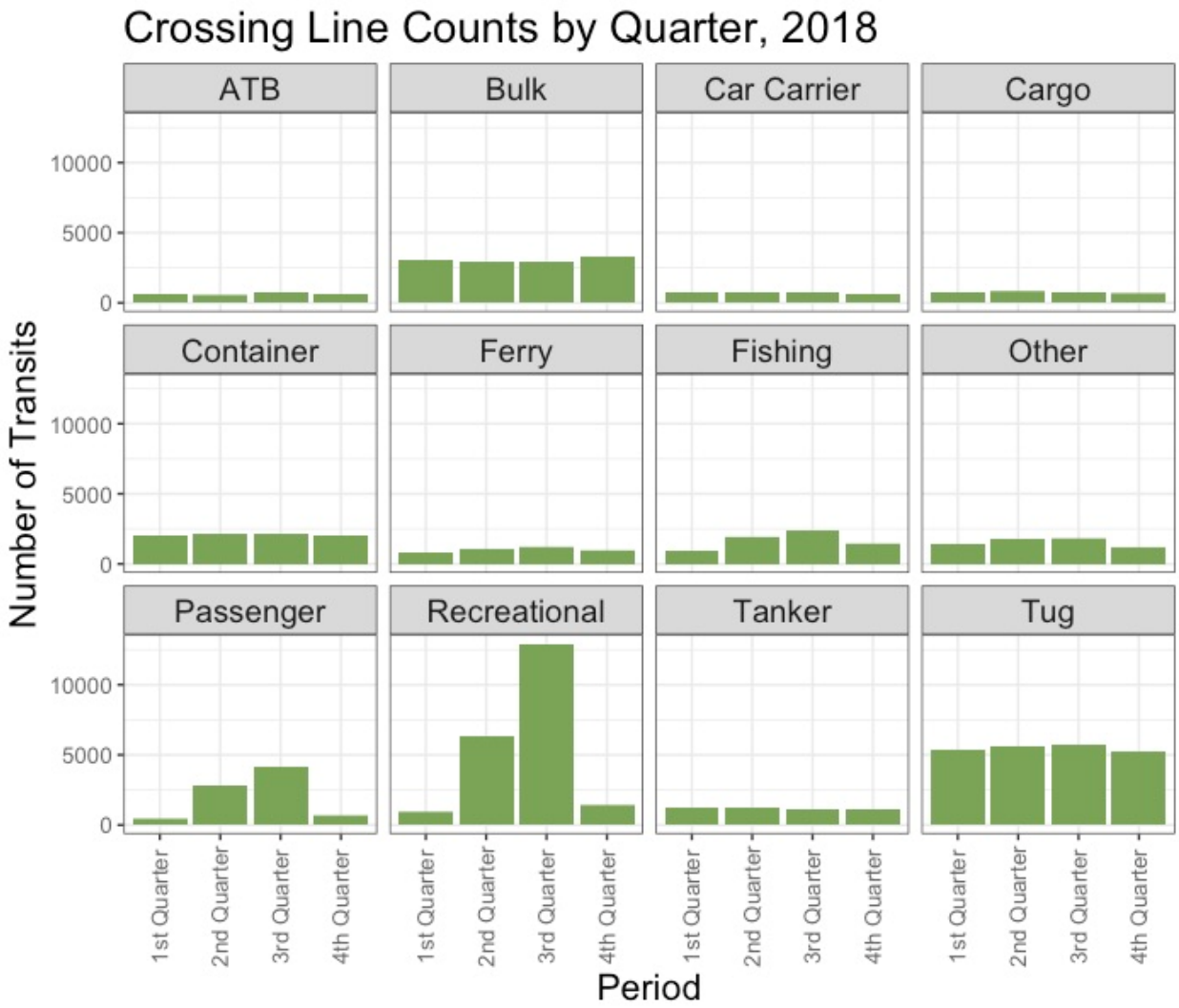

Figure 11: Transit counts for each vessel type, by quarter

AIS operating hours results

AIS operating hours results supplement the crossing line data by providing a more complete picture of where vessels spent time before and after transiting past a crossing line. It also captures vessels whose operation may not have resulted in a transit through a crossing line. Operating hours for each vessel type are displayed in Figures 13-24 below.

These visuals display the length of time that each vessel type was transmitting an AIS signal within each one nm grid cell in 2018. The scale for each figure is defined so that yellow grid cells show areas where vessels spent less time and darker green and blue grid cells show areas where vessels spent the most time, such as anchorage areas, terminals, or ports.

Each figure has a different scale due to the different number of total operating hours for each vessel type. For example, bulk vessels, which routinely anchor while waiting to load or discharge cargo, spent as long as 32,000 hours in one grid cell. Container ships, which do not typically anchor in the study area, spent up to 15,000 hours in a grid cell. Because of these differences in scale, the figures are not directly comparable and each figure should be interpreted as a standalone product. The transit counts for the Strait of Juan de Fuca crossing line are included on each figure to provide context to the number of transits represented there and to assist with consolidation of crossing line and AIS operating hours data. Due to the wide variety in the number of total operating hours and crossing line transits, vessel types are listed in alphabetical order.

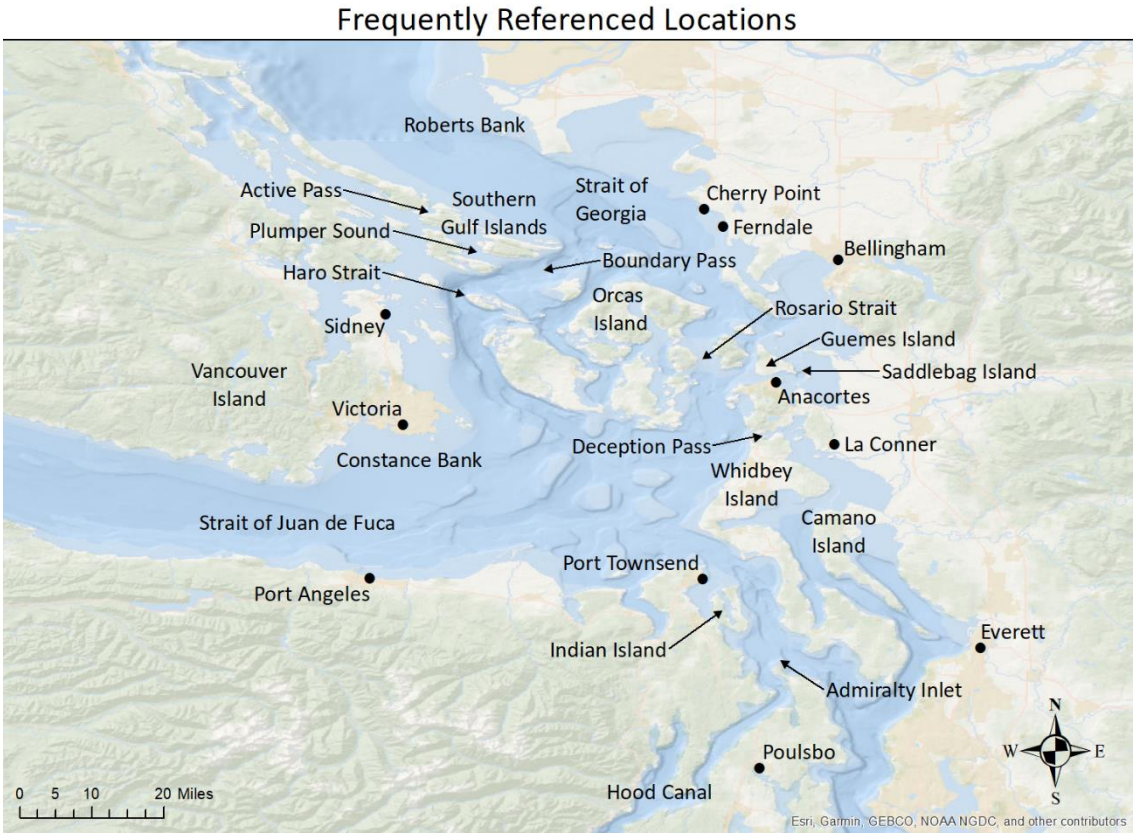

Figure 12: Locations frequently referenced in AIS operating hours results

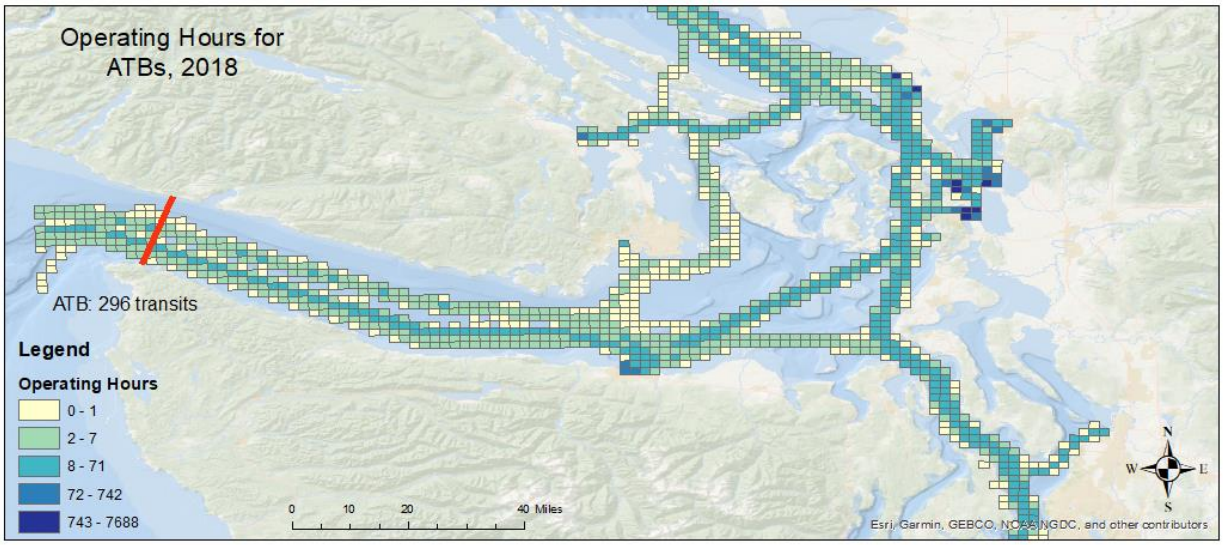

Figure 13: AIS Operating Hours for ATBs, 2018

ATBs: Figure 13 shows ATBs spending time traveling through the Strait of Juan de Fuca, Rosario Strait, the Strait of Georgia, and Admiralty Inlet and, to a lesser extent, Haro Strait/Boundary Pass.

The darker cells on the southern portion of the Strait of Juan de Fuca could represent ATBs making use of the nearshore recommended two-way route, potentially due to their slower transit speeds, weather conditions, or their destination.

The dark blue cells in the Anacortes and Bellingham areas represent additional time spent at refineries and anchorages in those areas.

The blue grid cells on the southeast side of Whidbey Island show transits to Everett.

There are blue grid cells near Sidney and to the west of Sidney which may represent ATBs delivering refined products to Vancouver Island.

This visual shows ATBs spending more time in Rosario Strait than Haro Strait. ATBs that are not required to take a BC pilot (operating on a pilotage waiver) may use Rosario Strait to transit from Cherry Point to BC, but ATBs that are required to take a BC pilot would need to transit from Cherry Point to Victoria to board the pilot before transiting to BC. The visual also shows the fairly steady ATB traffic travelling through the Strait of Georgia.

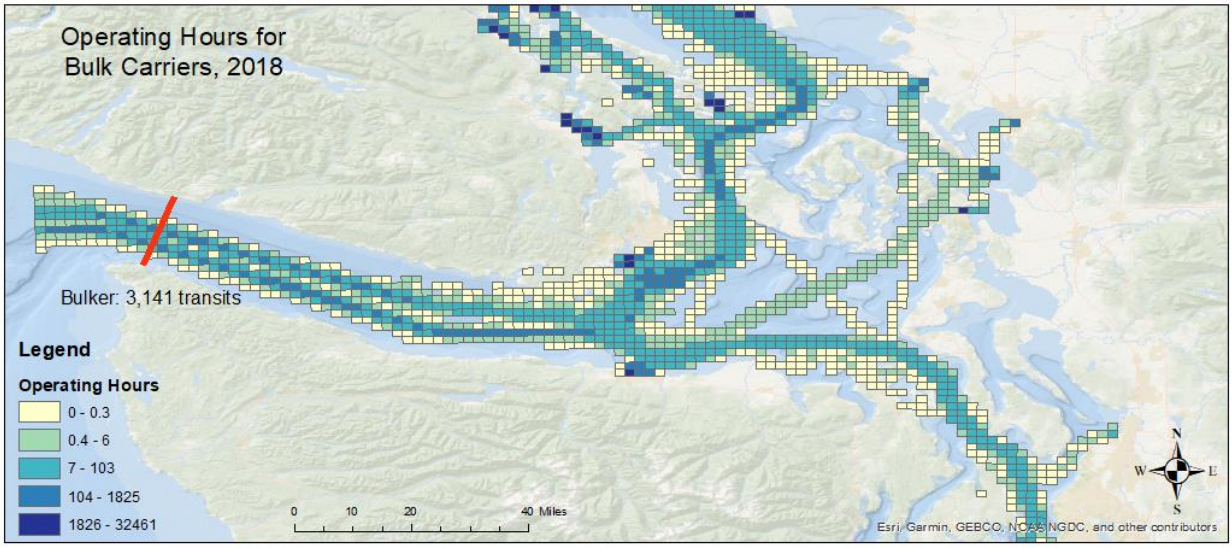

Figure 14: AIS Operating Hours for Bulk Carriers, 2018

Bulk Carrier Activity: Figure 14 shows bulk carriers spending time traveling in the traffic lanes through the Strait of Juan de Fuca, Haro Strait/Boundary Pass, Strait of Georgia, and Admiralty Inlet.

The cluster of blue and dark blue cells near Port Angeles and Victoria likely represent bulk carriers spending time dropping off or picking up a pilot.

Blue grid cells can be seen near the Constance Bank Anchorage which may represent bulk carriers making use of short-term anchorage there to align logistics and pilot times.

The green grid cells in Rosario Strait represent bulk carriers spending time (less than 6 hours in 2018) transiting through Rosario Strait to the Anacortes area, potentially to visit the cold storage facility in Bellingham or the aluminum smelter in Ferndale.

The green grid cells on the southeast side of Whidbey Island show transits and berth time at the Port of Everett.

The darkest blue color, where bulk carriers spent longer amounts of time, is seen near Roberts Bank where bulk carrier loading and unloading takes place and in several of the Southern Gulf Island anchorage locations such as Cowichan Bay, Ladysmith, and Plumper Sound.

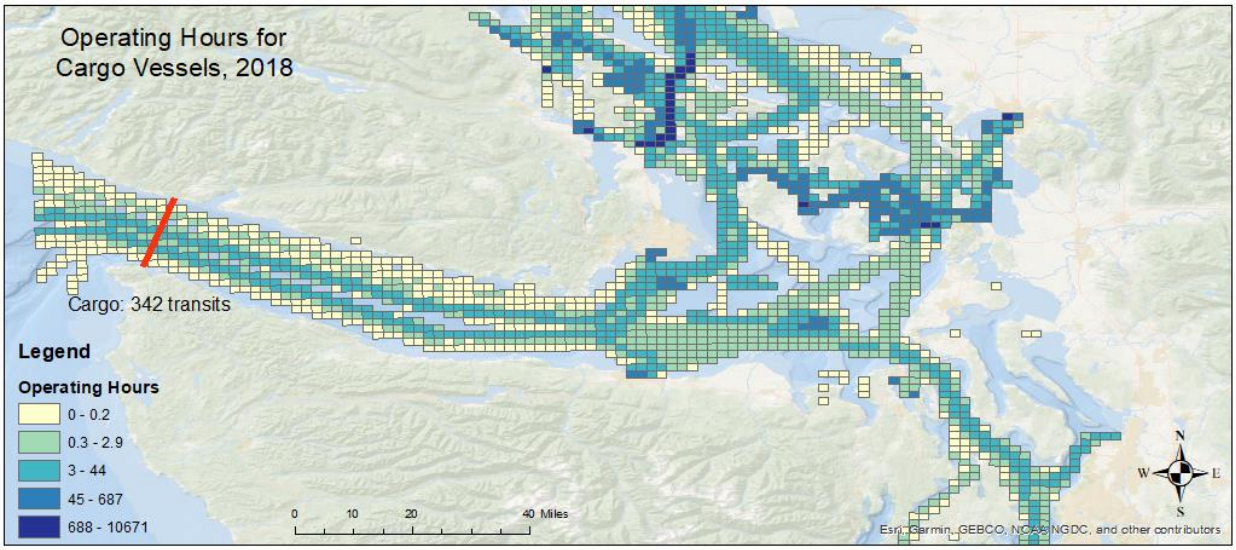

Figure 15: AIS Operating Hours for Cargo Vessels, 2018

Cargo Vessel Activity (General Cargo or Refrigerated Cargo): Figure 15 shows cargo vessels spending time traveling in the traffic lanes through the Strait of Juan de Fuca, Haro Strait/Boundary Pass, and to a lesser extent Admiralty Inlet and Rosario Strait.

The cluster of blue cells near Port Angeles and Victoria likely represent cargo vessels spending time dropping off or picking up a pilot.

Blue grid cells can be seen near the Constance Bank Anchorage which may represent cargo vessels making use of short-term anchorage there to align logistics and pilot times.

The green and blue grid cells on the southeast side of Whidbey Island show transits and berth time at the Port of Everett. The yellow cells near Whidbey and Camano Island could indicate a temporary gap in the AIS coverage or a vessel mistakenly categorized based on available data. The blue grid cells through the San Juan Island may represent transits of small cargo and landing craft vessels that are used to transport goods between the San Juan Islands and Anacortes.

The darker blue grid cells that run from Sidney to Active Pass likely represents transits of Seaspan Ferries vessels, which carry cargo between Vancouver Island and the Lower Mainland of British Columbia.

The blue cells near Cowichan Bay and Ladysmith anchorages likely represent vessels spending time at anchor in those locations. This visual also shows vessels spending time transiting through the Hood Canal.

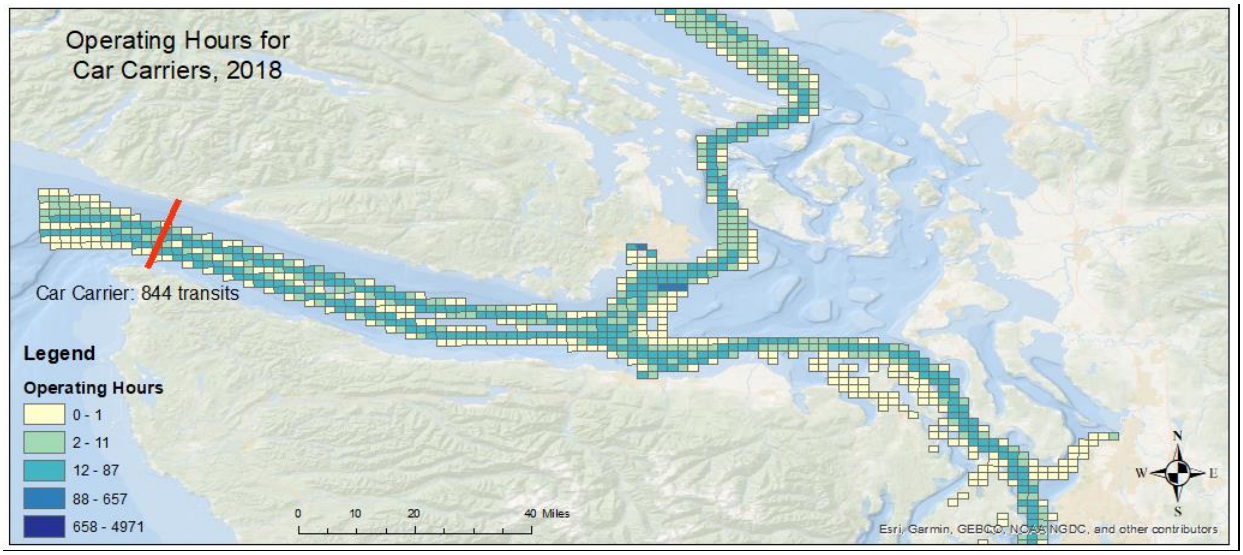

Figure 16: AIS Operating Hours for Car Carriers, 2018

Car Carriers Activity (Ro/Ro, Vehicle Carriers): Figure 16 shows car carriers spending time traveling in the traffic lanes through the Strait of Juan de Fuca, Haro Strait/Boundary Pass, and Admiralty Inlet.

The cluster of blue and dark blue cells near the Port Angeles and Victoria likely represent car carriers spending time dropping off or picking up a pilot.

Blue grid cells can be seen near the Constance Bank Anchorage which may represent car carriers making use of short-term anchorage there to align logistics and pilot times.

The green and blue grid cells on the southeast side of Whidbey Island show transits and berth time at the Port of Everett.

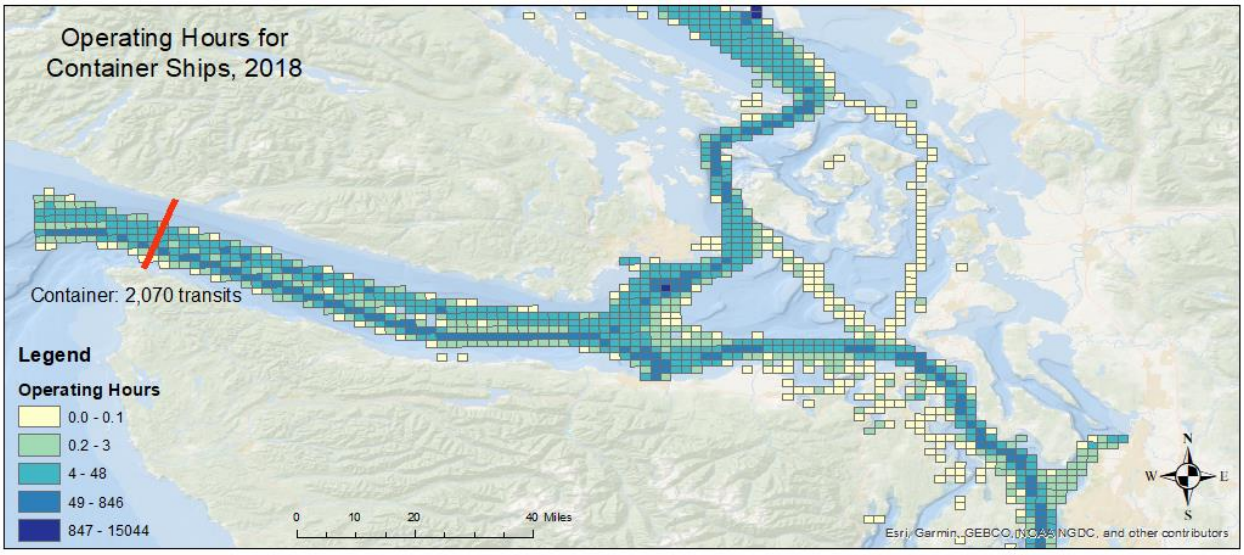

Figure 17: AIS Operating Hours for Container Ships, 2018

Container Ship Activity: Figure 17 shows container ships spending time traveling in the traffic lanes through the Strait of Juan de Fuca, Haro Strait/Boundary Pass, and Admiralty Inlet.

The cluster of blue cells near the Port Angeles and Victoria likely represent container ships spending time dropping off or picking up a pilot.

Blue grid cells can be seen near the Constance Bank Anchorage which may represent container ships making use of short-term anchorage there to align logistics and pilot times.

The inbound traffic lane in the Strait of Juan de Fuca is slightly darker than the outbound lane, which may be a result of these vessels moving at slightly slower speed on their inbound transit, potentially to align arrival and pilot times.

The green grid cells on the southeast side of Whidbey Island show transits and berth time at the Port of Everett.

The dark blue cell near Roberts Bank likely represent container ships conducting cargo operations at the container terminal at that location.

Some isolated yellow cells are present in unlikely locations such as near Orcas Island, Hood Canal, Deception Pass, and Poulsbo. The yellow cells in these locations could indicate a temporary gap in the AIS coverage or a vessel mistakenly categorized based on available data.

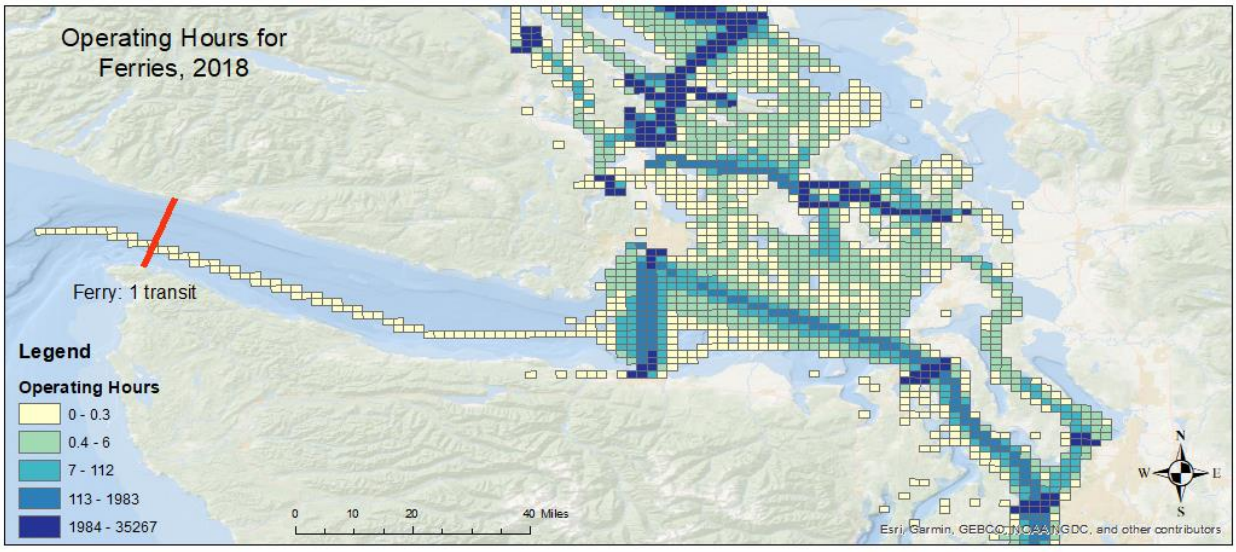

Figure 18: AIS Operating Hours for Ferries, 2018

Ferries (WA State Ferries, BC Ferries, Guemes Island Ferry, Black Ball Ferry, Victoria Clipper, San Juan Clipper): Figure 18 shows ferry routes within the study area. Some routes show greater variation than others, such as the wide blue grid cells between Port Angeles and Victoria. This may indicate more frequent variations in the track line taken by ferries, potentially due to inclement weather or other vessel traffic.

The green cells on the east side and Whidbey Island and through Deception Pass may represent passenger-only ferries taking an inclement weather route between Seattle and Victoria.

The yellow and green cells throughout the outside of ferry routes could be a result of vessels that provide both ferry and whale watching services continuing to broadcast their AIS as a ferry when conducting their whale watching operations.

The yellow transit through the Strait of Juan de Fuca may represent the SPIRIT OF BC ferry arriving from Europe.

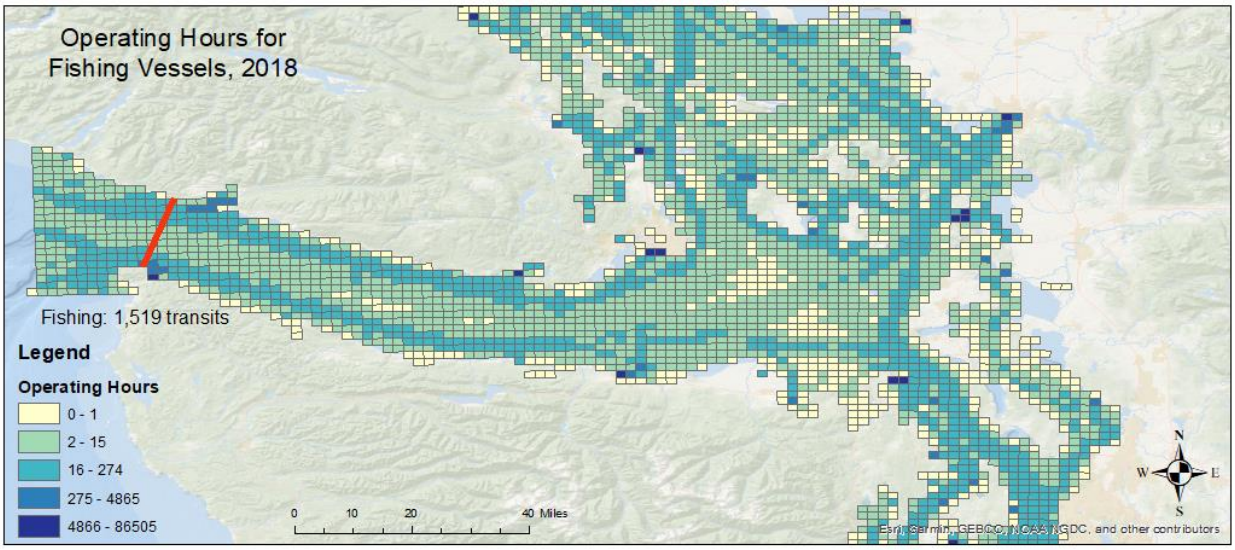

Figure 19: AIS Operating Hours for Fishing Vessels, 2018

Fishing vessels (Fishing, Fish Factory, Fish Processor): Figure 19 shows fishing vessel activity. In the Strait of Juan de Fuca the darker colors near shore indicate that fishing vessels are generally spending most of their time outside of the main vessel traffic lanes.

The higher operating hours near Admiralty Inlet and near the San Juan Islands may be due to higher vessel density in those regions.

Some of the dark blue cells indicate terminals and marinas where some vessels likely continued to transmit AIS even when moored.

Larger dark blue clusters can be seen near Victoria, Port Townsend (home to Port Townsend Boat Haven), near Anacortes (home to Trident Seafood and Curtis Wharf), and near Bellingham (home to Bellingham Cold Storage).

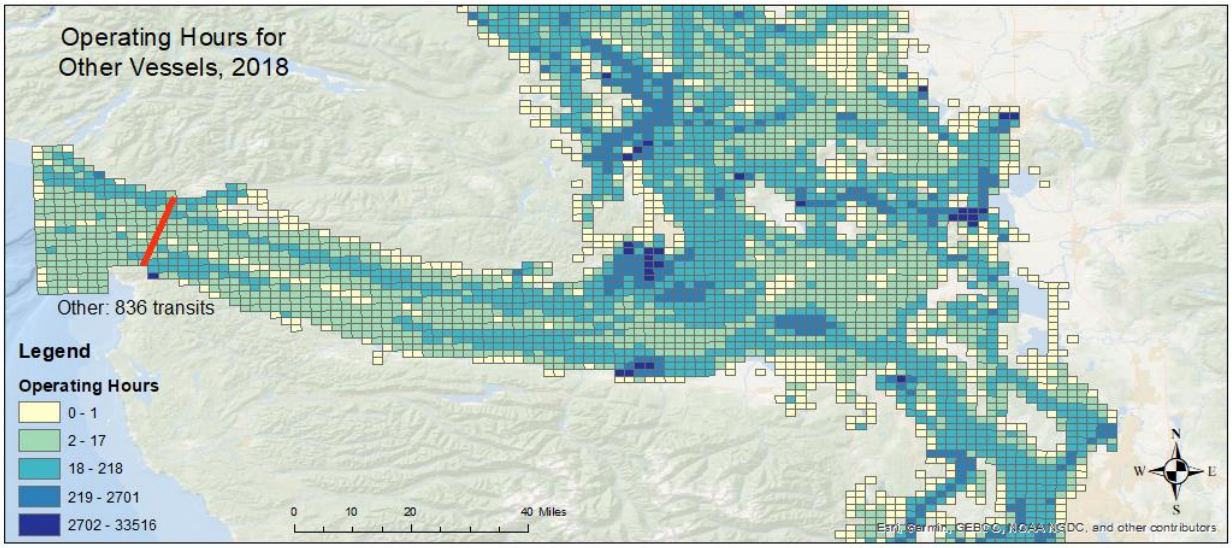

Figure 20: AIS Operating Hours for Other Vessels, 2018

Other (General, Cable-Layer, Supply, Research, Dredge, Hospital, Military, Trawler): Figure 20 shows activity for the vessel category of other. The clusters of dark blue cells align with port and anchorage locations. For example, the dark blue cells near Port Angeles may be the CABLE INNOVATOR, which changes port between Port Angeles and Victoria about once a month (Navy League of the US, 2020).

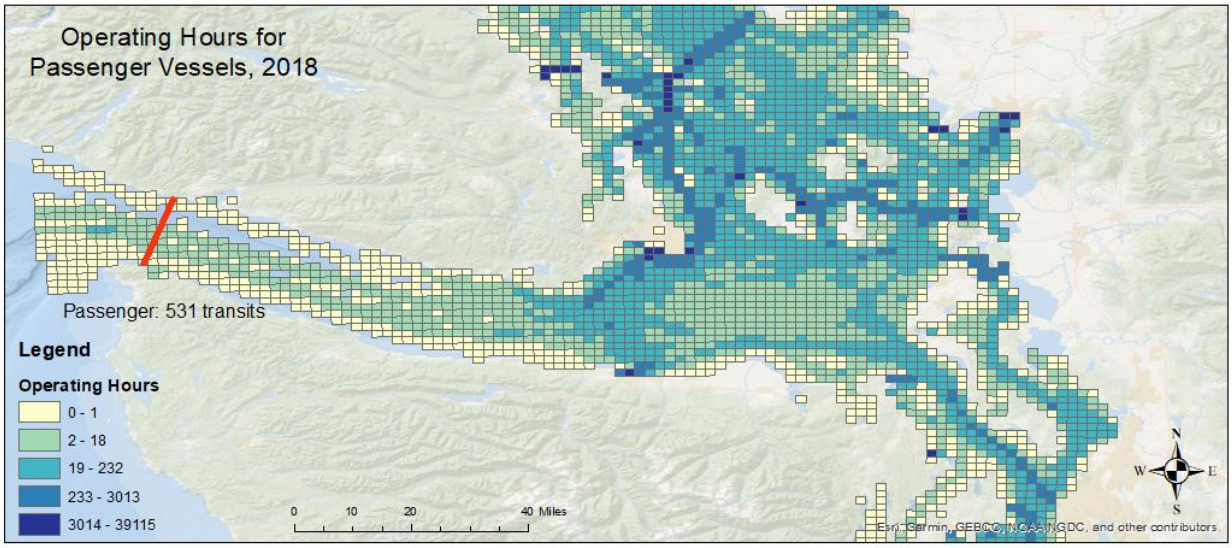

Figure 21: AIS Operating Hours for Passenger Vessels, 2018

Passenger vessels (Passenger, Passenger Cruise, Passenger Ro/Ro): Figure 21 shows passenger vessel activity. The blue cells through the San Juan Islands may be a result of small passenger cruise vessels and whale watching vessels.

The dark blue cells near Victoria may represent cruise ships moored there. The lighter cell colors in the Canadian portion of the study area may be due to differences in the Canadian and U.S. AIS carriage requirements. In 2018, Canadian AIS carriage requirements did not encompass as many passenger vessels as the U.S. requirement.

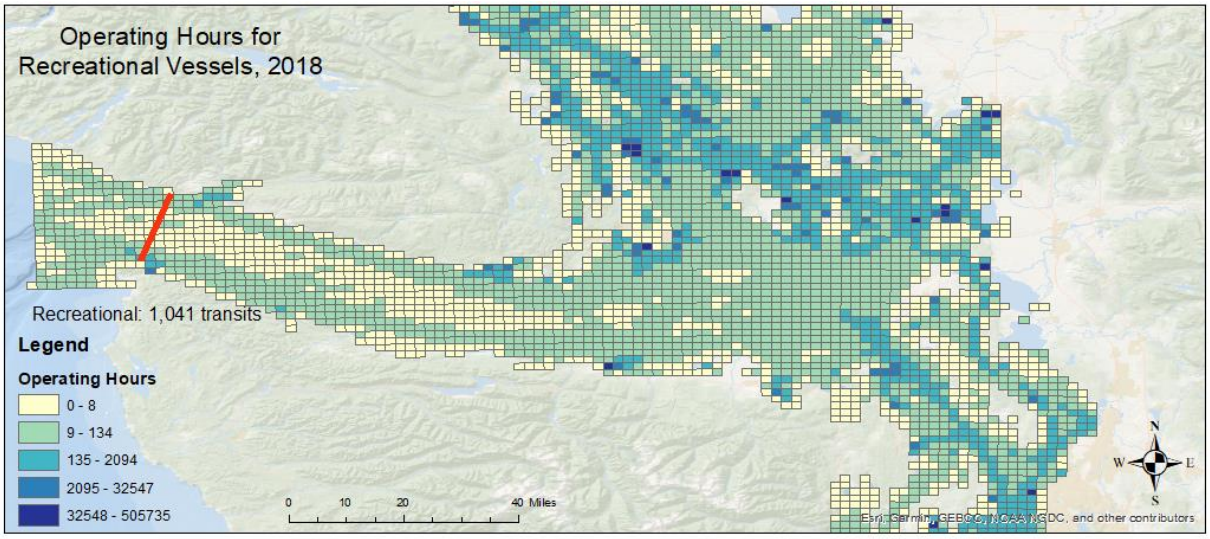

Figure 22: AIS Operating Hours for Recreational Vessels, 2018

Recreational vessels (Pleasure Craft, Sailing Vessel, Yacht): Figure 22 shows recreational vessel activity. The highest operating hours are in the vicinity of the San Juan Islands and near Seattle.

The dark blue grid cells are primarily marina locations where some vessels likely continued to transmit AIS when moored.

The lighter cell colors in the Canadian portion of the study area may be due to differences in the Canadian and U.S. AIS carriage requirements. In 2018, Canadian AIS carriage requirements did not encompass as many passenger vessels as the U.S. requirement.

As described in the Limitations and Data Gaps section, many recreational vessels do not carry AIS. The operating hours data therefore represents a fraction of the true number of recreational vessels operating in the study area.

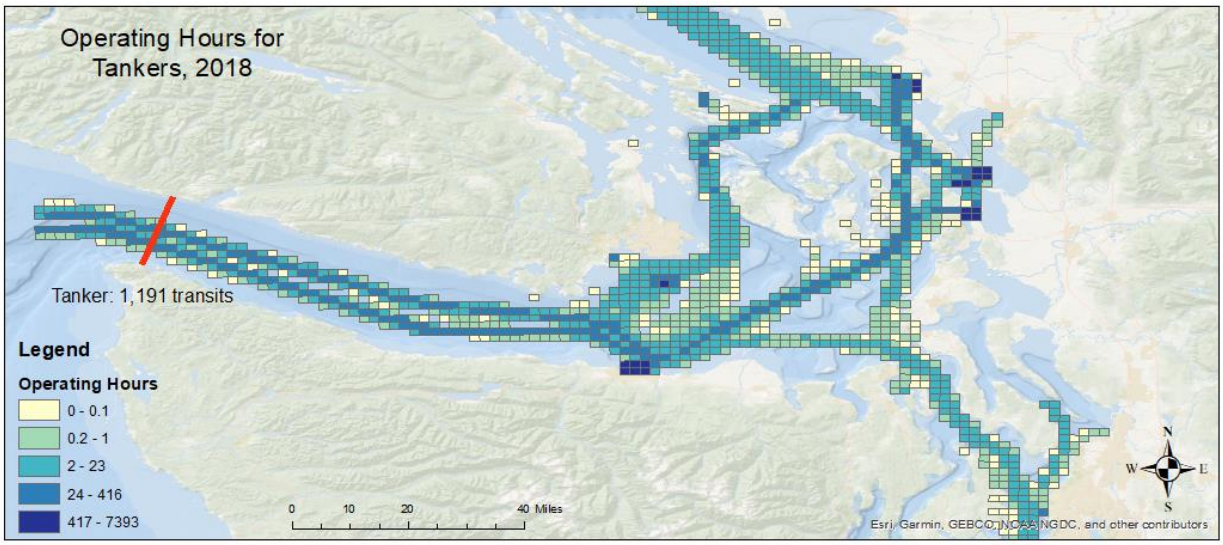

Figure 23: AIS Operating Hours for Tankers, 2018

Tankers (Chemical Tankers, Crude Tankers, Product Tankers, Liquefied Gas Tankers, and Asphalt Tankers): Figure 23 shows tankers spending time traveling in the traffic lanes through the Strait of Juan de Fuca, Haro Strait/Boundary Pass, Rosario Strait, Strait of Georgia, and Admiralty Inlet.

The cluster of blue cells near the Port Angeles and Victoria likely represent tankers spending time dropping off or picking up a pilot.

Blue grid cells can be seen near the Constance Bank Anchorage which may represent tankers making use of short-term anchorage there to align logistics and pilot times.

The blue cells near Port Angeles may also represent tankers also spend time anchored or bunkering at Port Angeles.

The dark blue cells in the Anacortes and Bellingham areas likely represent additional time spent at refineries and anchorages in those areas.

The blue grid cells between Whidbey and Camano Island suggest that in 2018 tankers spent some time (2-23 hours) there, and may represent a smaller tank vessel such as the GLOBAL PROVIDER.

The blue grid cell in Plumper Sound, B.C., suggests tanker anchorage activity in that area.

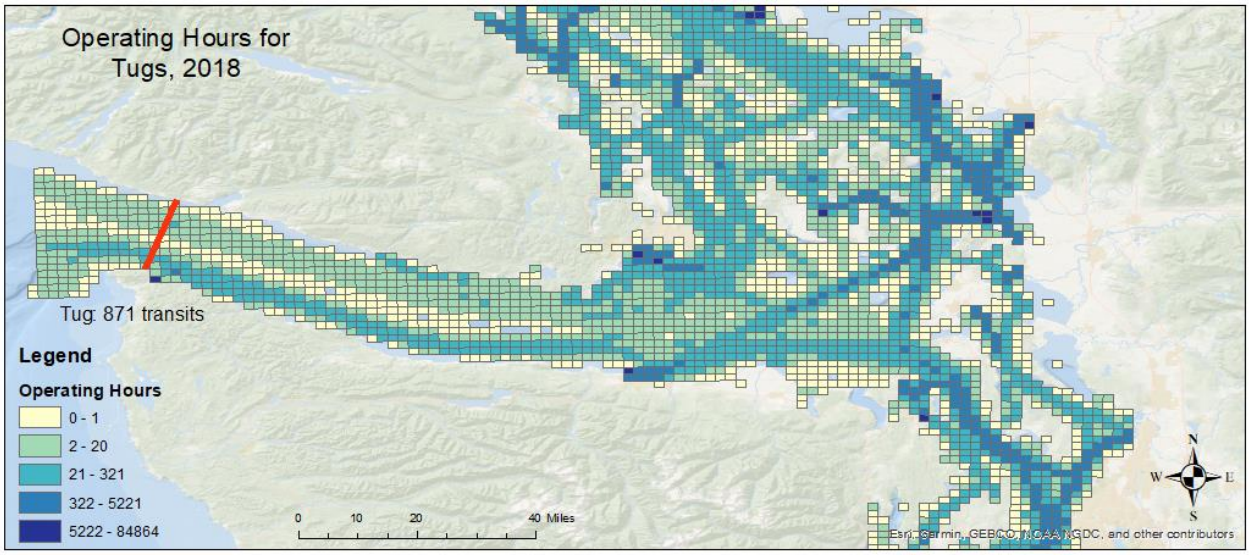

Figure 24: AIS Operating Hours for Tugs, 2018

Tugs (Tug, Tug Tow, Barge Tow, Towing Vessel): Figure 24 show tugs involved all manner of activities and shows their widespread activity throughout the area.

The dark blue cell at Neah Bay is representative of the designated Emergency Response Towing Vessel.

The cluster of blue cells near Port Angeles may be a result of assisting laden tankers as well as bunker barge activity.

Similar to ATBs, the darker cells on the southern portion of the Strait of Juan de Fuca could represent tugs making use of the inshore domestic lanes, potentially due to their slower transit speeds, weather conditions, or their destination.

The dark blue cells in the Anacortes and Bellingham areas likely represent additional time spent conducting escorts, towing oil barges, and conducting transfers in those areas.

The blue cells in the Gulf Islands likely represent tugs with chip barges and log storage that operate in that region.

The dark blue cells near Roberts Bank likely represents tugs engaged in berthing/unberthing large vessels at that location.

Washington anchorage and oil transfer analysis results

These anchorage results show the amount of time vessels were present (broadcasting an AIS signal for at least 60 minutes) within anchorage areas. Figure 25 shows the locations of the anchorages used in the analysis.

The anchorage analysis includes vessels broadcasting AIS within an anchorage polygon for over 60 minutes, regardless of whether they were at anchor or conducting other activities such as escorting, bunkering, or fishing. Vessels anchored in neighboring locations could potentially be counted twice if the vessel changed position by rotating around its anchor (e.g., due to changes in wind or current) and entered into the polygon encompassing a neighboring anchorage.

Advance notice of oil transfer data was added to this anchorage analysis to provide a more complete picture of vessel activities at anchorage locations. A total of 297 oil transfers took place at Washington State anchorages within the study area in 2018. Anchorage names shown in green in Figure 25 reflect locations that were also oil transfer locations in Washington State in 2018.

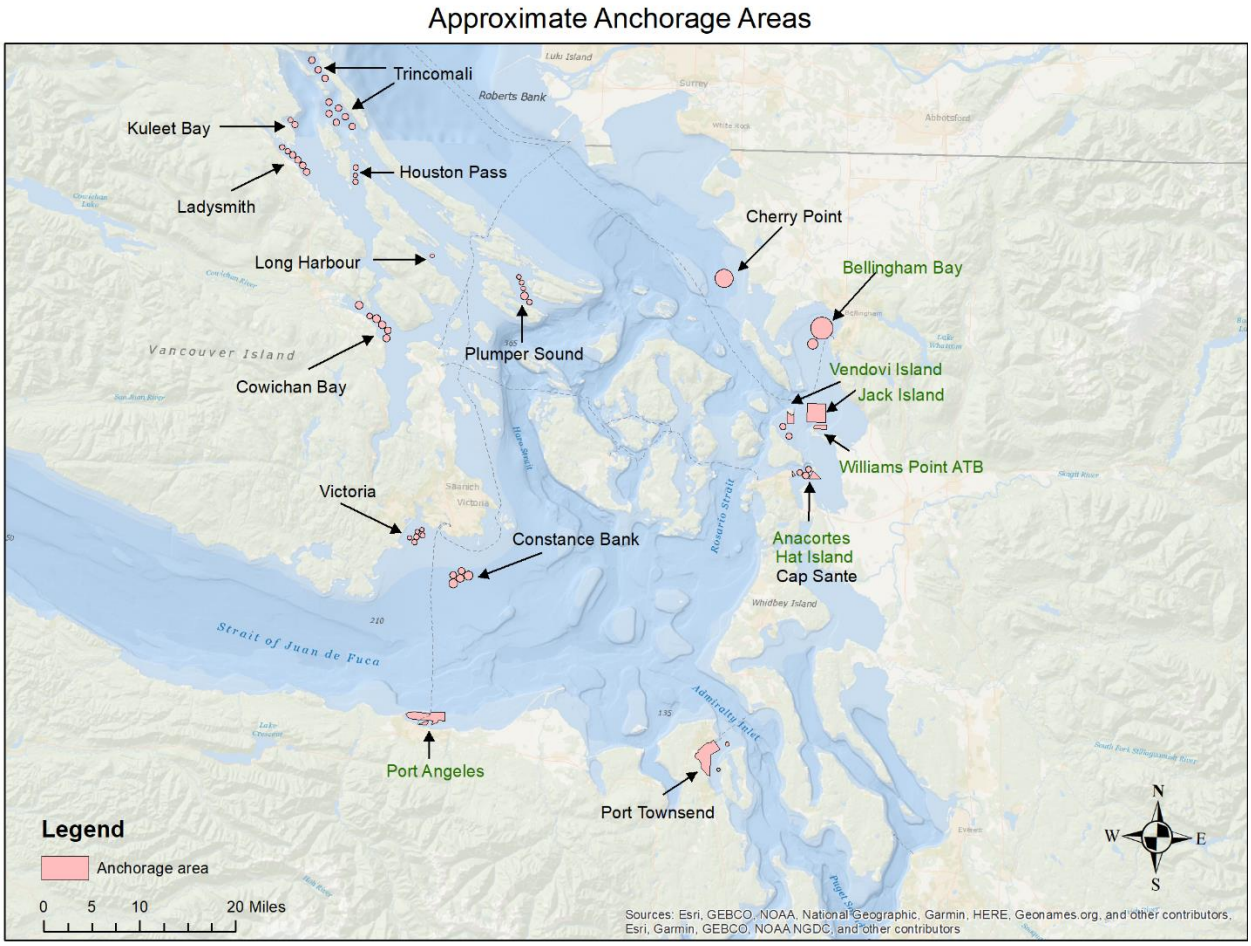

Figure 25: Approximate locations of anchorage areas

The Advance Notice of Oil Transfer (ANT) system has its own naming convention which consolidates several specific anchorage locations into a single ANT option. For example, the ANT system combines the Vendovi Island East and South, Jack Island North and South, and Williams Point ATB anchorage locations into a single 'Anchor - Vendovi Island' transfer location. The complete comparison between the specific anchorages and the corresponding ANT locations is shown in Table 5.

Table 5: Anchorage Names and their Corresponding ANT System Names

Detailed Anchorage Name	ANT Location
Port Angeles	Anchor- Port Angeles
Bellingham Bay	Anchor- Bellingham
Anacortes Center, East, West	Anchor - March Point/Anacortes
Hat Island Tug and Barge	
Jack Island North, South	Anchor - Vendovi Island
Vendovi Island East, South	
Williams Point ATB	

Figure 26 summarizes the percentage of time that vessels were present in Washington anchorages in 2018. The vertical Y-axis in Figure 26 shows the Washington anchorage locations and the horizontal X-axis depicts the percentage of the year that various vessel counts were present in each anchorage.

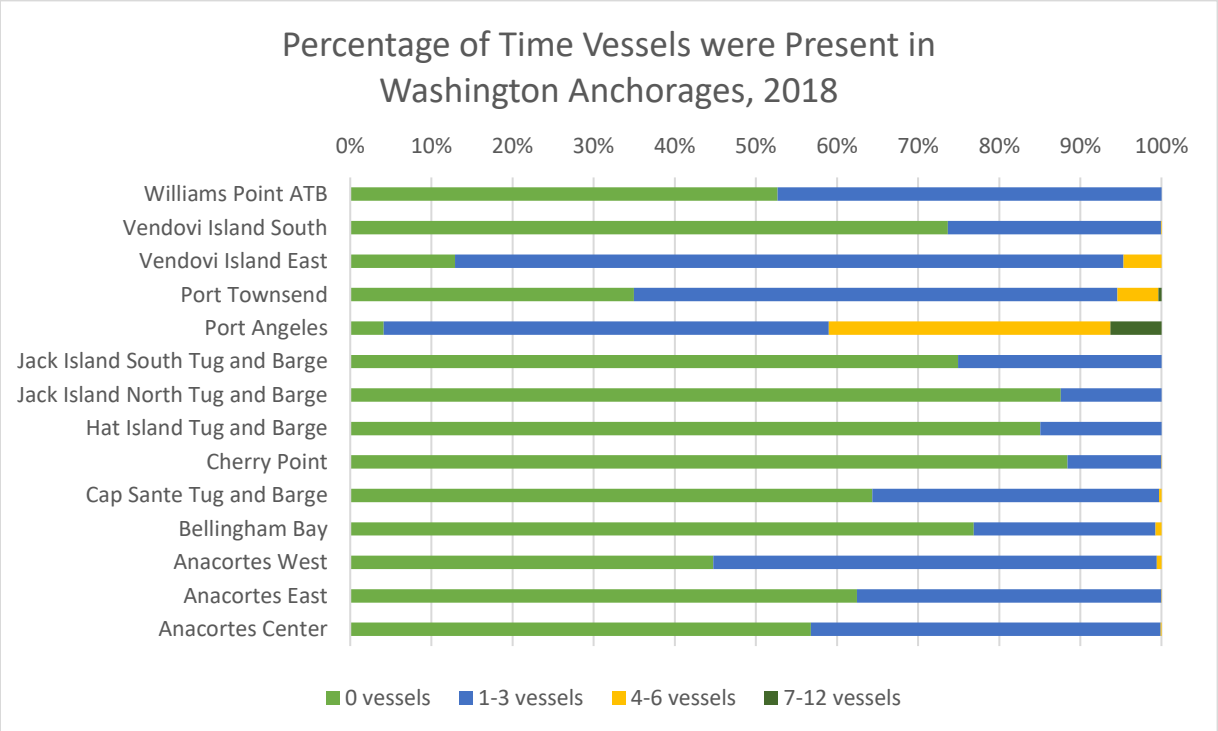

Figure 26: Number of vessels present (transmitting AIS for at least 60 minutes) in WA anchorages in 2018

Figure 27 shows the anchorage locations where oil transfers took place in 2018 on the horizontal X-axis and the quantity transferred there on the vertical Y-axis.

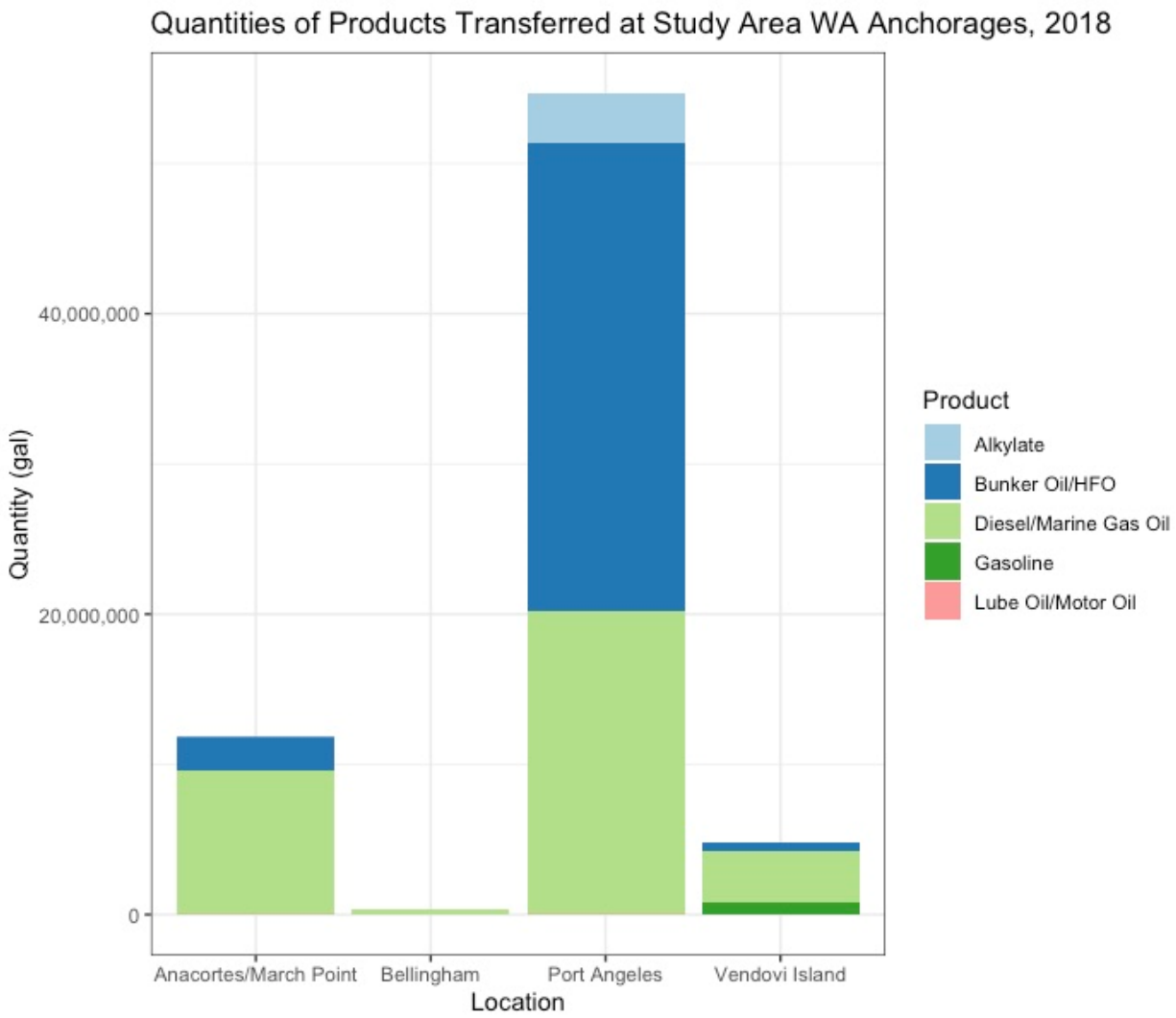

Figure 27: Quantities of regulated products transferred at WA anchorages in 2018

The Port Angeles anchorage is the Washington anchorage with lowest vacancy (period of time with zero vessels present); it was vacant 4 percent of the time in 2018. There was one vessel present 14 percent of the time, two vessels 20 percent of the time, and three vessels 21 percent of the time, as shown in Figure 26. Port Angeles is also the WA anchorage with the highest volume of oil transferred. Over 54 million gallons of oil were transferred there in 2018. Port Angeles' proximity to the Pacific make it a bunkering destination for vessels calling on other Pacific coast ports. The transfers at Port Angeles were primarily fueling transfers of diesel/marine gas oil and bunker oil/heavy fuel oil. The transfer of alkylate (a gasoline blending stock) in Port Angeles reflects a single lightering operation that took place at that location (NOAA, 2021).

The Vendovi Island East anchorage is the Washington anchorage with the second lowest vacancy (period of time with zero vessels present); it was vacant 13 percent of the time in 2018. The 'Anchor - Vendovi Island' transfer location, which encompasses the Jack Island North, South; Vendovi Island East, South; and Williams Point ATB anchorage locations, has the third

highest volume of oil transferred, with over 4 million gallons transferred there in 2018. These were primarily fuel transfers.

The Anacortes/March Point anchorage had the second highest volume of oil transferred, with over 11 million gallons transferred there in 2018. Transfers at the Anacortes/March Point anchorage were primarily diesel and marine gas oil to tankers and ATBs for use as fuel. These transfers comprised over 9 million gallons. The anchorage locations encompassed by the Anacortes/March Point anchorage transfer location the (Anacortes Center, East, West and Hat Island Tug and Barge) were vacant (zero vessels present) at least 40 percent of the time in 2018.

Lube oil/motor oil was occasionally transferred at the Port Angeles, Vendovi, and Anacortes/March Point anchorage locations however the volume was very small in comparison to the other products, less than 100,000 gallons across all of these locations for the entire year.

The Bellingham anchorage had two transfers in 2018 totaling 295,000 gallons. Both were fuel transfers, one to a fishing vessel and one to a fish processor. The Bellingham Bay anchorage was vacant (zero vessels present) 76 percent of the time in 2018.

Vessel presence outside of the standard anchorage area

A review of the AIS data shows that some anchorages had a high occurrence of vessels present outside the standard anchorage area encompassed by the anchorage polygon. For these anchorages, expanded anchorage areas were created to determine the number of vessels present in the area surrounding the anchorage. Additionally, combined areas were created that included results from both the standard and expanded anchorage areas.

Figure 28 shows the five anchorages that had at least one vessel present in the area outside of the standard anchorage for at least 5 percent of the time in 2018. The Vendovi East anchorage had the highest occurrence of vessels present in the area outside of the standard anchorage boundary. There was one vessel present there 35 percent of the time and two vessels present 7 percent of the time in 2018. When the vessels present in the Vendovi Island East standard and expanded anchorage areas are combined, the vacancy for the combined area is 8 percent (a decreases from the 13 percent vacancy in the standard area).

The other four anchorages included in this expanded anchorage area analysis recorded fewer vessels present outside the standard anchorage area than the Vendovi East anchorage. The area surrounding the Williams Point anchorage has one vessel present 13 percent of the time, the surroundings of Vendovi South had one vessel present 8 percent of the time; the area surrounding Jack Island South had one vessel present 7 percent of the time; and the area surrounding Jack Island North had one vessel present 5 percent of the time in 2018. When the vessels present in the Vendovi Island South standard and expanded anchorage areas are combined, the vacancy is 72 percent (a decrease from the 74 percent vacancy in the standard area). When the vessels present in the Williams Point ATB standard and expanded anchorage areas are combined, the vacancy for the combined area is 48 percent (a decreases from the 53 percent vacancy in the standard area). For Jack Island North the vacancy rate for the combined area is 84 percent (a decrease from the 88 percent vacancy in the standard area) and for Jack

Island South the combined area vacancy rate is 71 percent (a decrease from the 75 percent vacancy in the standard area).

This phenomenon of vessels present in areas outside of the expected anchorage area could be due to the lack of defined anchorage boundaries since these are all non-designated anchorages. Additional figures depicting the percentage of time vessels were present in the outside and combined areas for these anchorages can be found in Appendix D.

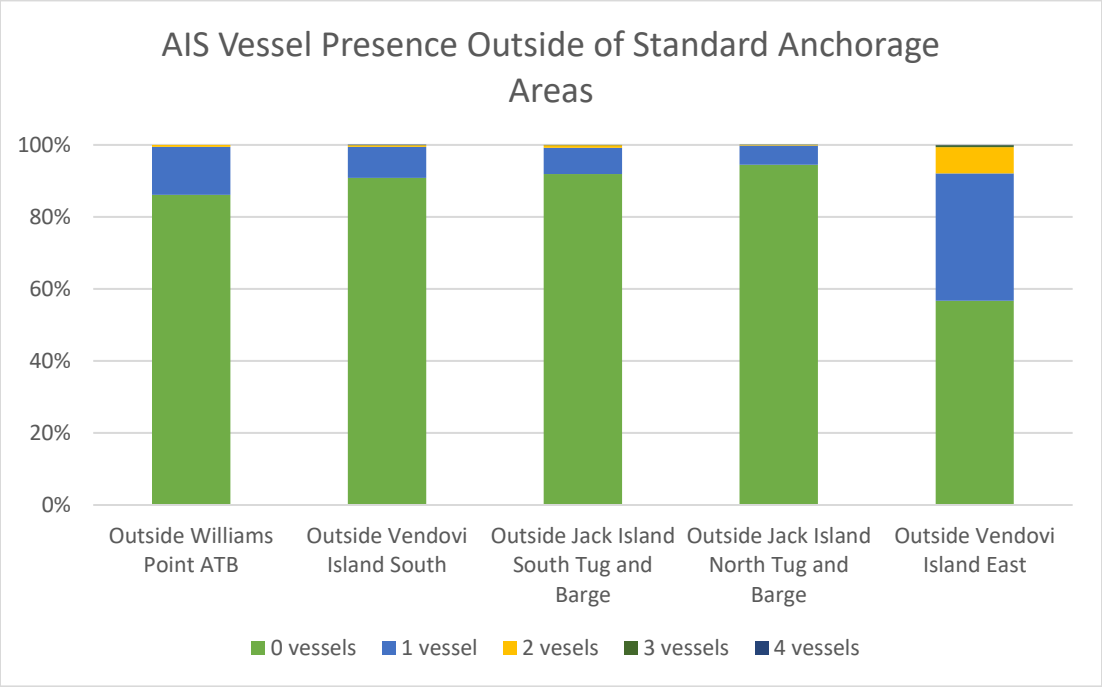

Figure 28: Number of vessels transmitting AIS outside standard anchorage areas for over 60 minutes in 2018

BC anchorage analysis results

Figures 29-31 show the BC anchorages included in the analysis and the percentage of time one or more vessels was present (broadcasting an AIS signal for at least 60 minutes) in 2018. This BC anchorage analysis displays the number of vessels present as either '0 vessels' or ' 1 or more vessels' since these locations are all designated as single vessel anchorages. Similar to the Washington anchorage analysis, these results include vessels broadcasting AIS within an anchorage polygon for over 60 minutes regardless of whether they were at anchor or conducting other activities such as escorting, bunkering, or fishing. Vessels anchored in neighboring locations could potentially be counted twice if the vessel changed position by rotating around its anchor (e.g., due to changes in wind or current) and entered into the polygon encompassing a neighboring anchorage.

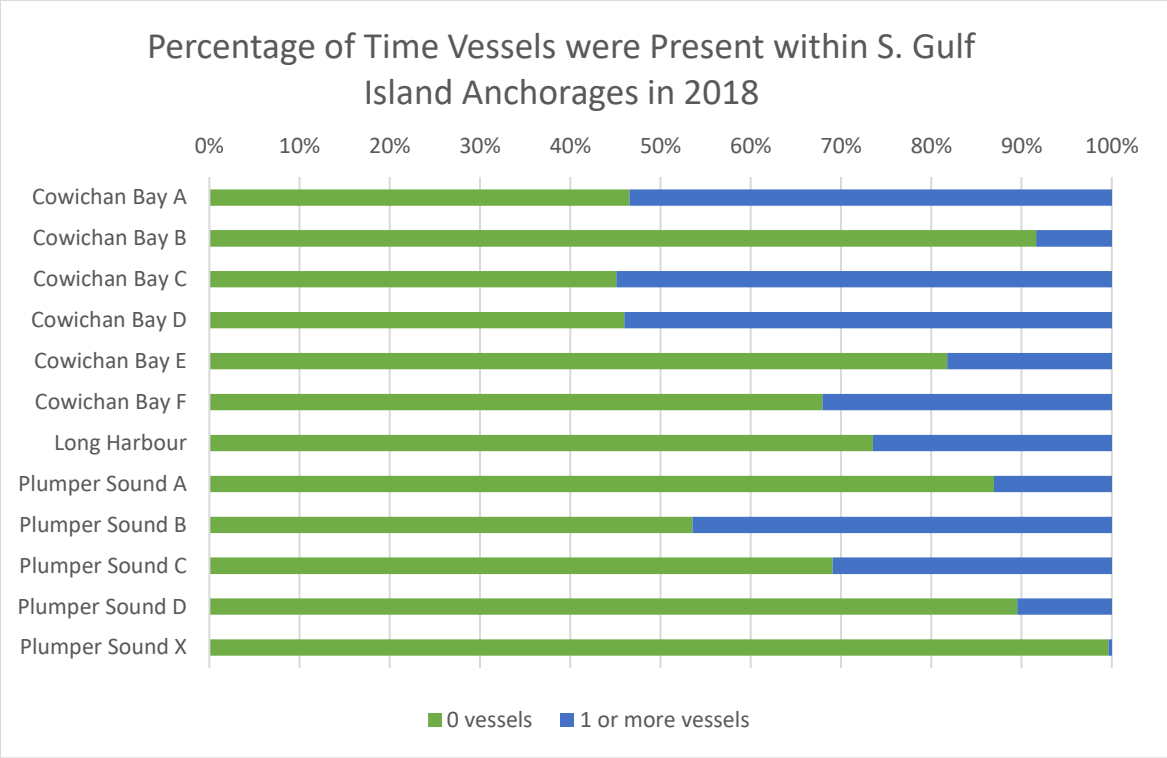

Figure 29: Number of vessels present (transmitting AIS for over 60 minutes) in Southern Gulf Island anchorages in 2018

The Southern Gulf Island anchorages that most often had a vessel present was Cowichan Bay C (vacant 45 percent of the time; a vessel present 55 percent of the time), Cowichan Bay D (vacant 46 percent of the time), and Cowichan A (vacant 46 percent of the time). Cowichan Bay B was vacant over 90 percent of the time, which may be because it is has a smaller swing circle and is primarily used for smaller vessels. The least used anchorage was Plumper Sound X (vacant 99.6 percent of the time) likely because it is reserved for emergency use.

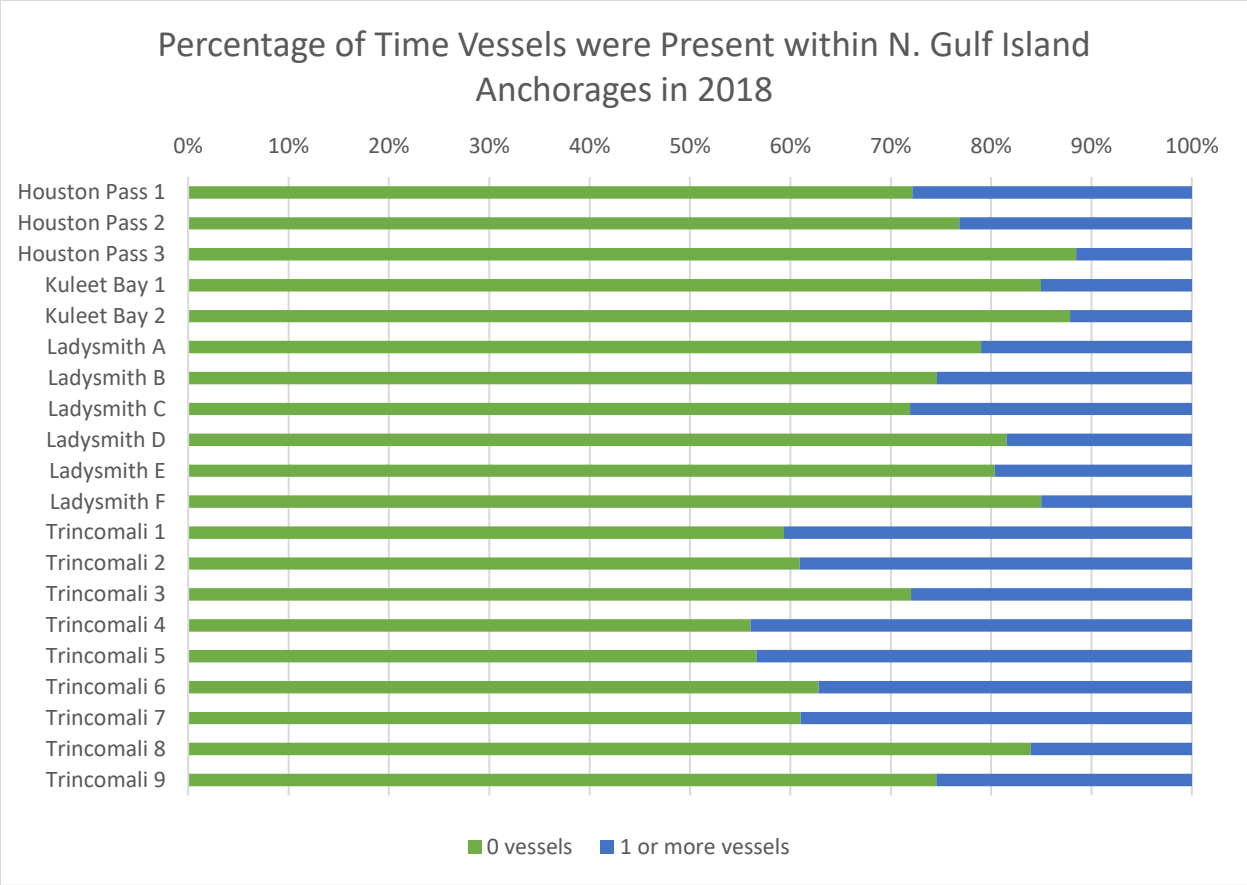

Figure 30: Number of vessels present (transmitting AIS for over 60 minutes) in Northern Gulf Island anchorages in 2018

The anchorages in Houston Pass, Ladysmith, and Trincomali were all vacant over 50 percent of the time in 2018 as shown in Figure 30. The Trincomali and Kuleet Bay anchorage are slightly outside the study area boundaries but are included in this analysis for completeness due to their proximity to study area anchorages.

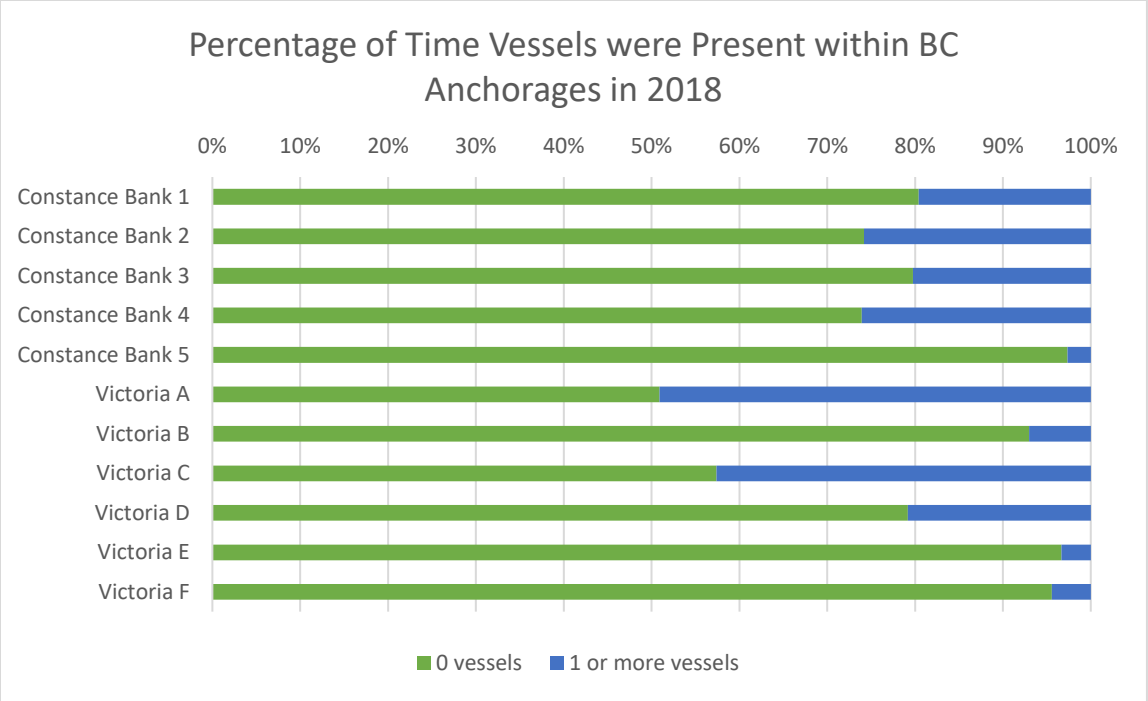

Figure 31: Number of vessels present (transmitting AIS for over 60 minutes) in B.C. anchorages in 2018

The BC anchorage that most often had a vessel present was Victoria A (vacant 51 percent of the time), as shown in Figure 31. The BC anchorages that least often had a vessel present were Constance Bank 5 and Victoria E (both vacant 97 percent of the time). As the easternmost anchorage, Constance Bank 5 is generally kept vacant in order to give vessels more operating room (K. Obermeyer and B. Young, personal communication, Jan. 12, 2021). The Department of National Defence, in the form of the Queen's Harbour Master, serves as the Port Authority for the Victoria anchorages (Royal Canadian Navy, 2021). The Victoria anchorages are used by cruise ships, particularly in heavy weather conditions and by other large vessels, particularly when other anchorages are full.

Tribal fishing

Tribes in Washington serve as co-managers of fisheries with the State of Washington. Tribes fish for subsistence and ceremonial purposes, as well as commercially (Northwest Indian Fisheries Commission, 2016). Tribal fishing vessels operate within the study area and may not be represented in AIS data. Opening and closing days and times for tribal fisheries may also be different from non-tribal fisheries. Two federally recognized tribes in Washington that fish within the study area provided data on the number of fishing licenses or fishing vessel registrations that were active for their tribe in 2018. This information can help provide an understanding of the number of additional vessels that could be operating within the study area.

The Jamestown S'Klallam Tribe had 20 vessel registrations in 2018 and 25 vessel registrations in 2019 (Jamestown S'Klallam Tribe, 2020). The Swinomish Tribe had 159 fishing vessels in 2018,

the majority of which were 20 – 30 feet in length (Swinomish Tribe, 2021). Additional data provided by the Swinomish, as well as a statement from the tribe on their fishing rights, are included in Appendix B.

Inclusion of fishing data from other federally recognized tribes with usual and accustomed fishing rights within the study area would enhance future analysis work and provide greater understanding of interactions between tribal fishing vessels and other vessel activities.

Recreational vessel activity

In 2018, there were 220,908 recreational vessels registered with Washington State (Washington Sea Grant, 2019). King, Pierce, and Snohomish counties had the highest number of registered vessels in western Washington (Figure 32).

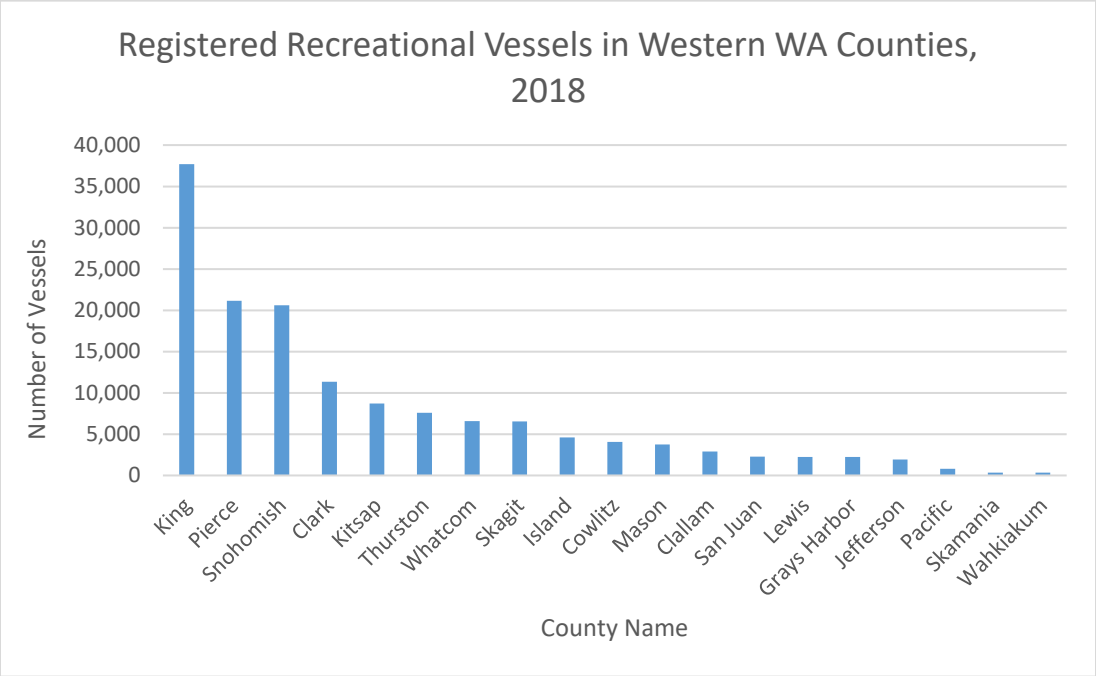

Figure 32: Number of registered recreational vessels in western Washington counties, 2018

Most of the recreational fleet consists of boats that are between 15 to 18 feet in length (Figure 33). Statewide, 93 percent of recreational vessels are less than or equal to 26 feet (Washington Sea Grant, 2019). About 63 percent of these vessels were registered in counties that border Puget Sound.

The U.S. Coast Guard's National Recreational Boating Safety Survey Final Report estimates that 16,155,000 boat outings took place in Washington in 2018, with outings defined as a boat leaving its dock or mooring and being operated on the water with people aboard. Of these boat outings, 63 percent were from motorized boats (Duffy et al., 2020).

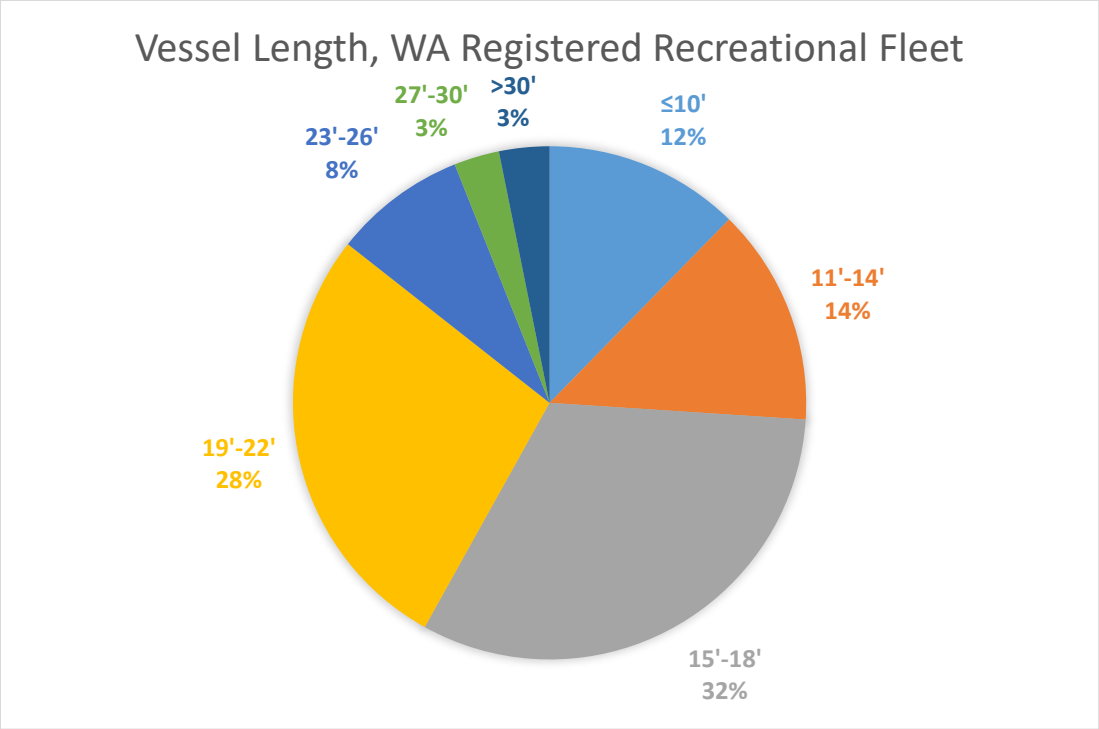

Figure 33: Registered recreational vessel lengths in Washington in 2018

Marine events

Seasonal marine events, such as sailing regattas or fishing derbies, provide additional information about recreational vessel activity. Ecology received marine event permit information from the U.S. Coast Guard through a Freedom of Information Act (FOIA), 5 U.S.C. § 552 request. In 2018, there were 63 permitted marine events that took place within the study area. The marine event permit information did not include the number of vessels participating in each event.

Figure 34 shows the location of each marine event. The majority of these events took place within Fidalgo Bay, due to the Fidalgo Bay Buoy Races, which were held on 24 separate days throughout the spring and summer. The majority of events occurred during Quarter 2 (32 events), followed by Quarter 3 (19 events).

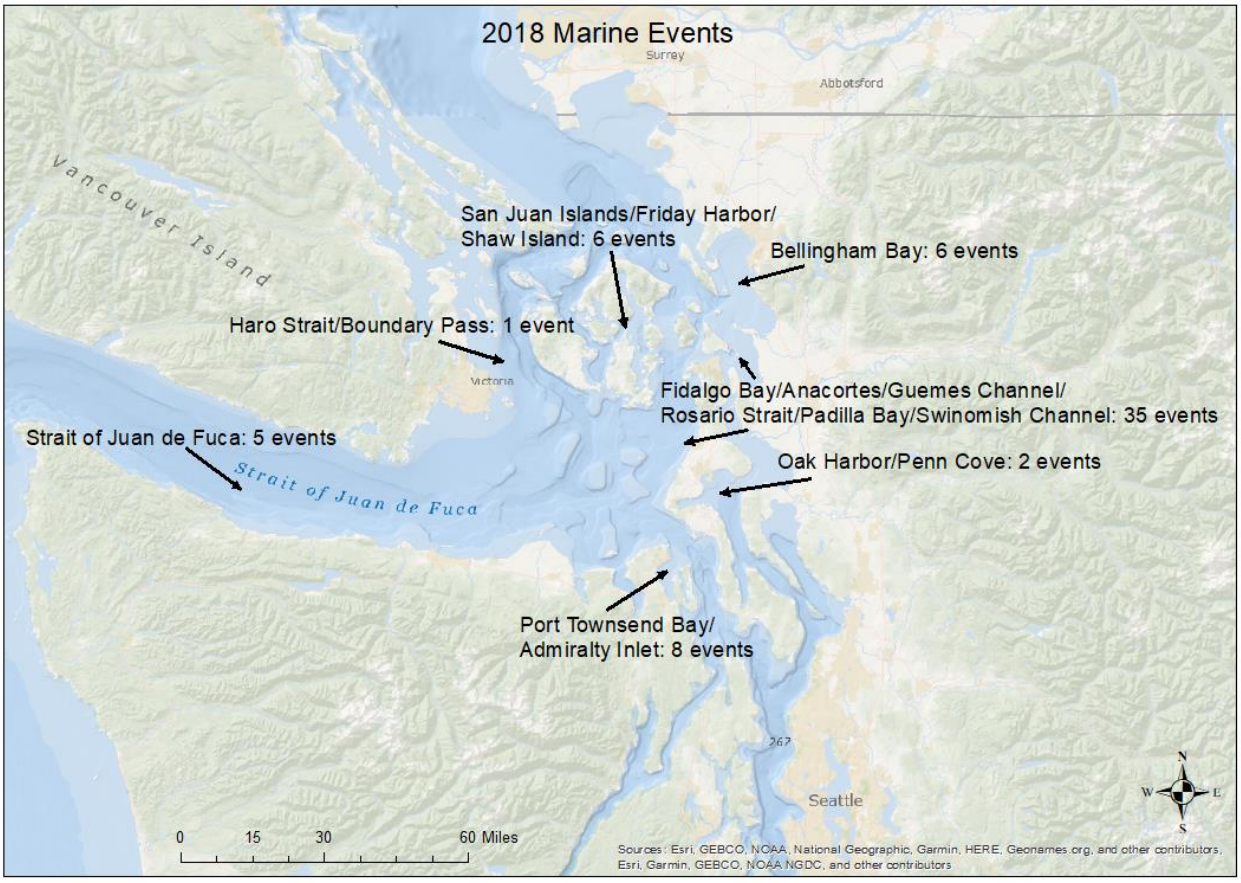

Figure 34: Map showing general locations of 2018 marine events

A side-by-side comparison of the recreational operating hours and the marine event permit locations shows that the areas where marine events took place frequently correspond with the darker grid cells that show higher operating hours. This is likely an indication of a desirable recreational boating location rather than a direct correlation; however, it does reinforce the higher level of recreational vessel use in these areas.

U.S. commercial and recreational fishing

U.S. commercial licenses and fisheries openings

Ecology collected data from the Washington Department of Fish and Wildlife (WDFW) regarding the number of commercial fishing licenses that could have been used to fish in the study area in 2018. According to WDFW, there were 1,674 commercial licenses issued in 2018 that could have potentially been used to fish in the Puget Sound and the Strait of Juan de Fuca. This number does not include charter or guide licenses (WDFW Public Disclosure Request). This license information supplements the fishing vessel crossing line and operating hours information and helps build a more complete understanding of commercial fishing vessel activity in the study area.

Major commercial fisheries that operate within the study area throughout the year are listed below. This information includes standard fisheries opening timeframes but does not necessarily reflect specific anomalies in fisheries opening timeframes that may have been present in 2018. The information below includes fishing areas and seasons, as well as general management measures that may influence fishing times and locations (e.g. quotas or license limits). This information informs a broader understanding of vessel activities within the study region. Areas and timeframes where commercial fisheries are open may have increased vessel activity.

- Commercial Puget Sound Herring Fishery: This fishery is open year-round in management areas within the Strait of Juan de Fuca and east of Whidbey Island. (Washington Department of Fish and Wildlife, 2020a).
- Commercial Puget Sound Smelt Fishery: This fishery is open the entire year in the Strait of Juan de Fuca and in the waters surrounding the San Juan Islands. From July 1 to April 15, the fishery is also open in the Strait of Georgia, and from November 1 to April 15, the fishery is open in waters near Port Townsend. The fishery has an annual quota of 60,000 pounds, and is closed once this quota is reached. Fishing is allowed from 6 a.m. to 10 p.m. Mondays through Thursdays (Washington Department of Fish and Wildlife, 2020b).
- Commercial Puget Sound Salmon Fishery: Commercial salmon fishing typically occurs from approximately July to August in waters near Point Roberts and the San Juan Islands. Fishing also occurs from approximately August to December in waters near Bellingham Bay (Pacific Salmon Commission, 2020; Washington Department of Fish and Wildlife, 2018b).
- Commercial Squid Fishery: This fishery is open year-round. In Puget Sound, commercial squid fishing is prohibited within ¼ mile of the shoreline of an incorporated town or city (Washington Department of Fish and Wildlife, 2020c).
- Commercial Puget Sound Scallop Fishery: The commercial dive fishery for pink and spiny scallops previously occurred from 1987 – 1998 and was restarted in 2016. Most of the harvest occurs in the area around the San Juan Islands. The Department of Health monitors shellfish areas for Paralytic Shellfish Poisoning, and must approve harvest areas (Washington Department of Fish and Wildlife, 2020d).
- Commercial Dungeness Crab Fishery: This fishery consists of both tribal and state vessels. The state commercial crab fishery in Puget Sound holds about 248 licenses (Washington Department of Fish and Wildlife, 2020e). Most of this fishery occurs north of Everett, with the bulk of the harvest near Blaine and Point Roberts. Other areas that have large commercial quantities of crab include Port Gardner and Port Susan, and Bellingham, Samish, Padilla, Skagit, and Dungeness Bays. Crabbers in Puget Sound often use smaller boats than crabbers on the coast (Washington Department of Fish and Wildlife, 2020f). All Puget Sound catch areas are generally open from October through April.

- Wild Stock Geoduck Clam Fishery: This fishery is jointly managed by tribes, WDFW, and Washington Department of Natural Resources (DNR, 2021). Geoduck tracts can be found in marine subtidal areas throughout Puget Sound and the Strait of Juan de Fuca. Commercial harvest occurs year-round in one management region at a time, and harvest areas are rotated within regions (DNR, 2008).
- Commercial Sea Urchin Fishery: Sea urchin harvest districts occur throughout Puget Sound and the Strait of Juan de Fuca (WDFW, 2021a). Harvest districts are closed when quotas are reached. Fishing generally starts in late summer or early fall and ends in February (Tulalip Tribes, 2017).
- Commercial Puget Sound Sea Cucumber Fishery: This fishery also has harvest districts that occur throughout Puget Sound and the Strait of Juan de Fuca (WDFW, 2021b). Districts close when quotas are reached.

The seasonality of the commercial fisheries openings (e.g. July – December for salmon, October- December for crab) does not perfectly align with the crossing line fishing vessel transit counts, which were highest in quarters 2 and 3 (April – September). This may be due to the fact that fishing effort is higher prior to October for salmon (K. Kiyohara, personal communication, December 30, 2020). The high number of fishing vessel transit counts in quarter 2 could also be due to salmon fishing vessels that winter in Seattle but return to Alaska for salmon season around May each year. Additionally, there are coastal fisheries that occur in April through June that may result in fishing vessel movement from Seattle or Everett to the Straits. There is some alignment between the locations of these commercial openings and the areas of higher fishing vessel operating hours.

U.S. recreational licenses and fisheries openings

Washington residents and non-residents need a license to fish recreationally in Washington waters. Table 6 summarizes the number of each type of recreational fishing license that were sold in 2018.

The number of licenses can help inform an understanding of the level of recreational fishing, which is one reason for recreational vessel trips. These trips are challenging to quantify since many of these vessels do not carry AIS. It is important to note, however, that the number of licenses sold do not represent the number of vessel trips. People fish from piers and shore, not just on recreational vessels. People can make multiple vessel trips while fishing under one license, or may purchase a license and never use it. One vessel may carry multiple people fishing on different licenses. A person may purchase multiple temporary licenses before deciding to purchase an annual license.

Table 6: Numbers of Recreational Fishing Licenses Sold in WA in 2018 (WDFW Public Disclosure Request)

License Type	Count of Licenses
Annual Combination Fishing License	220,859
1, 2, or 3 Day Temporary Fishing License	134,364
Annual Fish Washington Fishing License	31,555
Annual Saltwater Fishing License	40,668

Washington's marine waters are divided into Marine Areas, and regulations for each area differ in terms of species fished and retained, gear used, and opening dates. The study area includes portions of Marine Areas 4-8.

Recreational fisheries in the study area that have specific opening and closing dates are listed in Table 7. These fisheries may still be subject to emergency closures, exclusion zones, and other restrictions. Fishing for trout, steelhead, sturgeon, mackerel, herring, sand lance, smelt, tuna, anchovy, sardine, surfperch, wolf eel, cod, pollock, and hake occurs year-round in at least one of the Marine Areas within the study area. Fishing for rockfish also occurs year-round in Marine Area 4. Additional recreational fisheries that operate within the study area include crab, which begins in July, and spot prawn, which opens in May (K. Kiyohara, personal communication, Dec. 30, 2020).

Table 7: Approximate opening and closing periods for recreational fisheries (Washington Department of Fish and Wildlife, 2017, 2018a)

Marine Area	Time Period	Species
Marine Area 4: Neah Bay	May – September	Salmon
Marine Area 4: Neah Bay	April – October	Lingcod
Marine Area 4: Neah Bay	2nd Saturday in March, 3rd Saturday in October	Flatfish
Marine Area 5: Sekiu and Pillar Point	March – April, July – September	Salmon
Marine Area 5: Sekiu and Pillar Point	May – June	Lingcod
Marine Area 5: Sekiu and Pillar Point	May – September	Rockfish
Marine Area 5: Sekiu and Pillar Point	May – November	Cabezon
Marine Area 6: East Juan de Fuca Strait	March – April, July – September	Salmon
Marine Area 6: East Juan de Fuca Strait	May – June	Lingcod
Marine Area 6: East Juan de Fuca Strait	May – November	Cabezon
Marine Area 7: San Juan Islands	January – April, July – September	Salmon
Marine Area 7: San Juan Islands	May – June	Lingcod
Marine Area 7: San Juan Islands	May – November	Cabezon
Marine Area 8-1: Deception Pass, Hope Island, and Skagit Bay	November – April, August – September	Salmon
Marine Area 8-1: Deception Pass, Hope Island, and Skagit Bay	May – June	Lingcod
Marine Area 8-1: Deception Pass, Hope Island, and Skagit Bay	May – November	Cabezon

The seasonality of the recreational fisheries openings (primarily summer and early fall) aligns with the higher crossing line recreational vessel transit counts in quarters 2 and 3 (April – Sept).

Canadian commercial and recreational fishing

Commercial licenses and fisheries openings

There were 2,351 registered commercial sea and freshwater fishing vessels in the Pacific Region in 2018 (Fisheries and Oceans Canada, 2019a). These vessels contributed 191,227 metric tons of fishery landings in the Pacific Region, the majority of which were from groundfish fisheries (Fisheries and Oceans Canada, 2019a). Fishery landings report the weight of fish caught in a particular fishery. The commercial groundfish fishery has approximately 250 active vessels (Fisheries and Oceans Canada, 2019b).

Some additional popular commercial fisheries in the Pacific Region include salmon, herring, tuna, crab, prawn, and shrimp. Commercial salmon openings are dependent on local run timings (May-October) and can occur anywhere along the coast (Fisheries and Oceans Canada, 2021). The commercial crab fishery is limited entry, with 220 license eligibilities, as is the prawn and shrimp fishery, with 245 license eligibilities (Fisheries and Oceans Canada, 2020a and 2020b).

Recreational licenses and fisheries openings

Similar to Washington, recreational fishers must purchase a license in order to fish in Canadian waters. The license year runs from April 1 to March 31 of the following year. Table 8 shows the number of recreational licenses sold in the Pacific Region for the 2017-2018 and 2018-2019 seasons. These licenses could have been used to fish anywhere in Canada's Pacific Region.

Table 8: Recreational Fishing Licenses Sold in Canada's Pacific Region

Season	License Type	Licenses Sold
2017—2018	Annual and temporary resident licenses	296,086
2017—2018	Non-resident licenses	58,438
2018—2019	Annual and temporary resident licenses	284,725
2018—2019	Non-resident licenses	56,131

The number of resident licenses sold for the 2017 – 2018 season was the highest recorded by DFO in the available data, which dates back to the 1999 – 2000 season. The early 2000s saw higher numbers of non-resident licenses when compared to more recent years (Fisheries and Oceans Canada, 2020c).

Specific management areas are used to regulate fisheries in Canada. The study area includes portions of management areas 18, 19, 20, and 29 (see Figure 35).

Figure 35: Canada's Pacific Region Fishery Management Areas (Fisheries and Oceans Canada, 2017)

General opening and closing times for recreational fisheries in these management areas are listed below. These fisheries are subject to in-season management measures and closures (Fisheries and Oceans Canada, 2019c).

- April 1 – March 31: Fishing for cod, pollock, hake, greenling, herring, mackerel, anchovy, sand lance, sardine, perch, sablefish, sculpin, salmon shark, spiny dogfish, skate, smelt, sole, sturgeon, wolf eel, crab, and other species of finfish and shellfish.
- March 1 – 31: Fishing for halibut
- May 1 – September 30: Fishing for lingcod (Areas 18, 19, and 29-5) and rockfish
- April 1 – November 15: Fishing for lingcod (Area 20)
- August 16 – June 14: Fishing for smelt (Area 29)

Recreational salmon fishing also occurs in the study area, generally between May and December.

Similar to the U.S. recreational fisheries, the seasonality of the Canadian recreational fisheries openings (primarily summer and early fall) aligns with the higher crossing line recreational vessel transit counts in quarters 2 and 3 (April – Sept).

Results by geographic area

Each analysis method provided a unique view of vessel activities within the study area. Most vessel activities have only minimal seasonal variation with the exception of fishing (including Tribal fishing), passenger, and recreational vessels, which were greater in the second and third quarters. The following sections summarize insights from the different methods by geographic areas. The boundaries of these geographic areas are not strictly defined but are rather provided to provide a way to reference and summarize results throughout the study area

Strait of Juan de Fuca

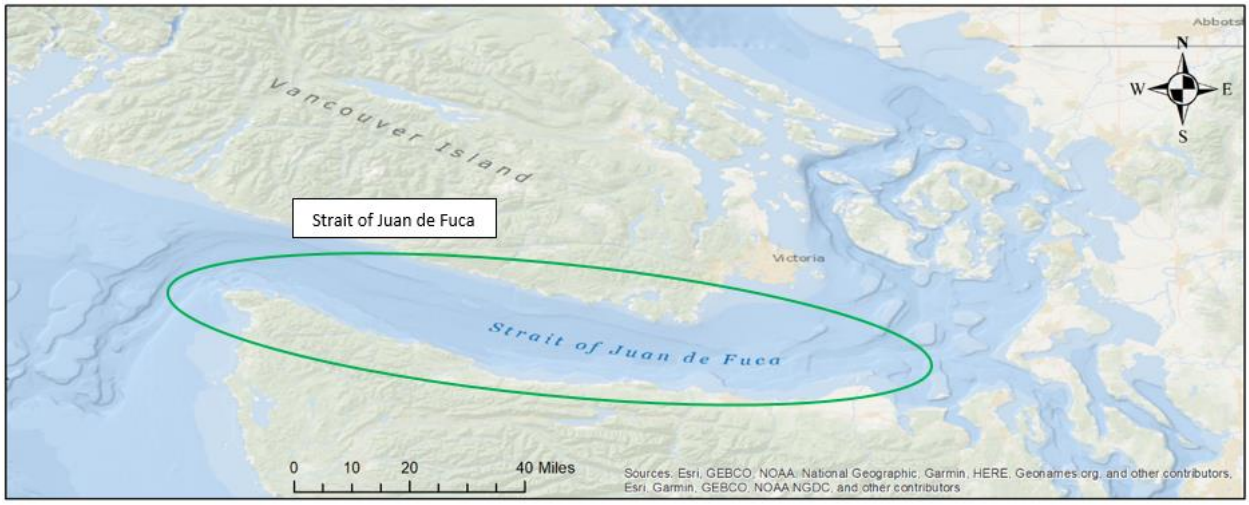

Figure 36: General location of the Strait of Juan de Fuca geographic area

The Strait of Juan de Fuca is the primary route for vessels calling on U.S. and Canada from overseas. The crossing line there recorded 12,683 transits. Bulk carriers made up 25 percent of the transits, container ships 16 percent, fishing vessels 12 percent, and tankers 9 percent. Tanker transit counts were higher at the Strait of Juan de Fuca line (1,191 transits) than any other line in the study area.

The AIS operating hours analysis shows the ERTV spending time in Neah Bay, fishing vessels spending time near the shoreline along the length of the Strait of Juan de Fuca, and regular ferry traffic to Victoria from Port Angeles and Seattle. It also shows bulk carriers, container ships, tankers, car carriers, and cargo vessels spending time traveling along the traffic lanes through the Strait of Juan de Fuca and picking up and dropping of maritime pilots near Port Angeles and Victoria.

Vessel activity was recorded at both the Constance Bank and Victoria anchorages in the anchorage analysis and the operating hours results. The Port Angeles anchorage was the Washington anchorage that most often had vessel present, compared to the other Washington anchorages in the study area. The Port Angeles anchorage receives frequent use from vessels bunkering or awaiting berth. It was vacant only 4 percent of the time, had one vessel present 14 percent of the time, two vessels 20 percent of the time, and three vessels 21 percent of the time. The Port Angeles anchorage also had the highest oil transfer volume of all the Washington

anchorages, as its proximity to the Pacific makes it a bunkering destination for vessels calling on other Pacific coast ports. Over 54 million gallons were transferred there in 2018, primarily fueling transfers of diesel/marine gas oil or bunker oil.

In addition to commercial vessel activity, the Strait of Juan de Fuca is also a location for commercial and recreational fisheries including the commercial herring and smelt fishery. This area may also see transits from fishing vessels leaving Puget Sound to fish on the outer coast. The Swinomish Tribe fishes for various species in the Eastern Strait of Juan de Fuca (Swinomish Tribe, 2021). The Jamestown S'Klallam Tribe fishing area includes the length of the Strait of Juan de Fuca (Jamestown S'Klallam Tribe, 2011). Other tribes may have usual and accustomed fishing rights within this area. Ecology received fishing data from two federally recognized tribes for this synopsis, the Swinomish Tribe and the Jamestown S'Klallam Tribe.

The Strait of Juan de Fuca was home to five marine events in 2018. AIS operating hours for recreational vessels are seen in the Strait of Juan de Fuca but are lower there than in other parts of the study area.

Admiralty Inlet and Whidbey Island

Figure 37: General location of the Admiralty Inlet and Whidbey Island geographic area

The Admiralty Inlet crossing line has the highest count of vessel transits in the study area. This line intersects the north and southbound vessel traffic lanes that serve as the primary commercial vessel traffic route between the ports of Everett, Seattle, Tacoma, and Olympia and Canadian ports and the Pacific Ocean via the Strait of Juan de Fuca. Tug (27 percent) and recreational (26 percent) traffic combined made up more than 50 percent of the transits crossing the Admiralty line, followed by container ships (12 percent) and fishing vessels (7 percent). Admiralty Inlet had more tug transits (4,168) and recreational vessel transits (4,076) than any other crossing line.

Vessel activity was recorded at the Port Townsend anchorage which saw moderate use and was vacant approximately 35 percent of the time and had 1-3 vessels present there approximately 60 percent of the time.

The AIS operating hours analysis shows regular ferry traffic between Clinton/Mukilteo, Port Townsend/Coupeville, and Kingston/Edmonds. It also shows ATBs, tankers, container ships, car carriers, and bulk carriers spending time traveling through Admiralty Inlet and container ships, car carriers, bulk carriers, and cargo vessels transiting to the port of Everett.

This area recorded higher fishing vessel operating hours than other parts of the study area. Commercial and recreational fisheries occur in this area including the commercial herring, smelt, squid, and crab fisheries. AIS operating hours for recreational vessels were higher in the area just south of Admiralty Inlet than in other parts of the study area.

The Jamestown S'Klallam Tribe fishing area includes Admiralty Inlet and Hood Canal (Jamestown S'Klallam Tribe, 2011). Other tribes may have usual and accustomed fishing rights within this area. Ecology received fishing data from two federally recognized tribes for this synopsis, the Swinomish Tribe and the Jamestown S'Klallam Tribe.

In 2018, eight marine events took place near Admiralty Inlet and two events near Oak Harbor.

Bellingham Bay, Rosario Strait and waters east

Figure 38: General location of the Bellingham Bay, Rosario Strait and waters east geographic area

The Rosario North and South crossing lines intersect the vessel traffic lanes used by vessels transiting to the maritime facilities in Bellingham, Ferndale, and Anacortes. The crossing line counts for Rosario North and South were similar, with the southern line recording higher overall counts, particularly for tug, recreational, passenger, and fishing vessels. Both Rosario lines had high tug transit counts: 4,076 for Rosario South and 3,727 for Rosario North. The only crossing line with higher tug transits was Admiralty Inlet at 4,168. The Sinclair Lummi, Saddlebag Huckleberry, and Guemes Cypress crossing lines show internal Rosario Strait transits. Out of these three lines, the Sinclair Lummi line had the highest tug, tanker, bulk vessel, ATB, passenger, and recreational vessel transit counts. Saddlebag Huckleberry had the highest cargo

and other vessel transit counts, and Guemes Cypress had the highest ferry and fishing vessel transit counts out of the three lines.

The AIS operating hours analysis shows ATBs and tankers spending time transiting Rosario and at anchorages and terminals in Anacortes and Bellingham, as well as fishing vessels spending time in this area, particularly near the Guemes line.

There are several anchorages and oil transfer locations in this part of the study area including Bellingham Bay; Anacortes Center, East, West; Hat Island Tug and Barge; Jack Island North, South; Vendovi Island East, South; Cap Sante Tug and Barge; and Williams Point ATB. The Vendovi Island East anchorage had the second lowest vacancy for Washington anchorages at 13 percent. The ANT data shows that the 'Anchor - Vendovi Island' transfer location, which encompasses the Jack Island North, South; Vendovi Island East, South; and Williams Point ATB anchorage locations, had the third highest oil transfer volumes with over 4 million gallons transferred there in 2018. The Anacortes/March Point anchorage had the second highest oil transfer volumes, with over 11 million gallons transferred there in 2018. The Bellingham anchorage had two oil transfers in 2018 totaling 295,000 gallons.

This area recorded higher fishing vessel operating hours than other parts of the study area. Commercial and recreational fisheries occur in this area including the commercial salmon and crab fisheries. AIS operating hours for recreational vessels in this area were higher than some other parts of the study area, particularly near Bellingham Bay and Anacortes.

The Swinomish fishing fleet is primarily homeported on their reservation or across the Swinomish Channel in La Conner. The Swinomish Tribe fishes for various species in the vicinity of Rosario Strait, Guemes Channel, and Saddlebag (Swinomish Tribe, 2021). Other tribes may have usual and accustomed fishing rights within this area. Ecology received fishing data from two federally recognized tribes for this synopsis, the Swinomish Tribe and the Jamestown S'Klallam Tribe.

Bellingham Bay was home to six marine events and Fidalgo Bay and the surrounding area had 35 marine events in 2018.

San Juan Islands

Figure 39: General location of the San Juan Islands geographic area

The AIS operating hours analysis shows ferry routes through the Islands and time spent by cargo vessels transiting between Islands, which likely represents transits of small cargo and landing craft vessels used to transport goods between the San Juan Islands and Anacortes.

Commercial fishing vessel activity can be seen in the AIS operating hours analysis throughout the Islands and particularly around San Juan Island. Several commercial fisheries take place near the Islands including the smelt, salmon, and scallop fisheries. Areas of high AIS operating hours are seen in the vicinity of the San Juan Islands for passenger vessels, which may be a result of small passenger cruise vessels and whale watching vessels operating there. AIS operating hours for recreational vessels in this area were higher than other parts of the study area. Of the 1,439 transits at the Waldron Orcas crossing line, 73 percent were recreational vessels.

The Swinomish Tribe fishes for various species near the San Juan Islands (Swinomish Tribe, 2021). The Jamestown S'Klallam Tribe fishing area includes the San Juan Islands and portions of Rosario Strait, Haro Strait, and Boundary Pass (Jamestown S'Klallam Tribe, 2011). Other tribes may have usual and accustomed fishing rights within this area. Ecology received fishing data from two federally recognized tribes for this synopsis, the Swinomish Tribe and the Jamestown S'Klallam Tribe.

The Islands were home to six marine events in 2018.

Haro Strait/Boundary Pass

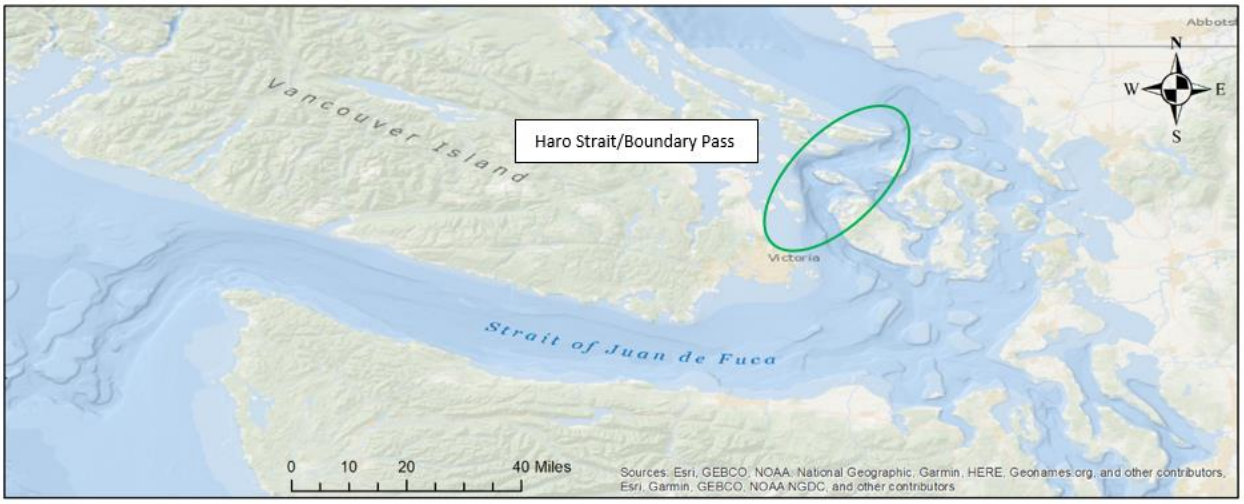

Figure 40: General location of the Haro Strait/Boundary Pass geographic area

The Haro South and the Boundary North crossing lines intersect the vessel traffic lanes that connect Canadian and U.S. ports and Canadian ports and the Pacific Ocean via the Strait of Juan de Fuca. Recreational vessels made up a high percentage of Haro South transits (24 percent, 2,960 transits). Bulk carriers make up 21 percent (2,600 transits) and containerships make up 12 percent (1,427 transits) of Haro South crossing line.

The AIS operating hours analysis shows tankers, container ships, car carriers, cargo vessels, and bulk carriers and, to a lesser extent, ATBs transiting through Haro Strait/Boundary Pass. AIS operating hours for passenger vessels in this area were higher than other parts of the study area. Recreational vessel hours were generally lower than other parts of the study area, but darker colors are seen in the area between the San Juan and Southern Gulf Islands.

The Swinomish Tribe fishes for various species in the vicinity of Haro Strait and Boundary Pass (Swinomish Tribe, 2021). Other tribes may have usual and accustomed fishing rights within this area. Ecology received fishing data from two federally recognized tribes for this synopsis, the Swinomish Tribe and the Jamestown S'Klallam Tribe.

Haro Strait/Boundary Pass were home to one marine event in 2018.

Point Roberts and Strait of Georgia

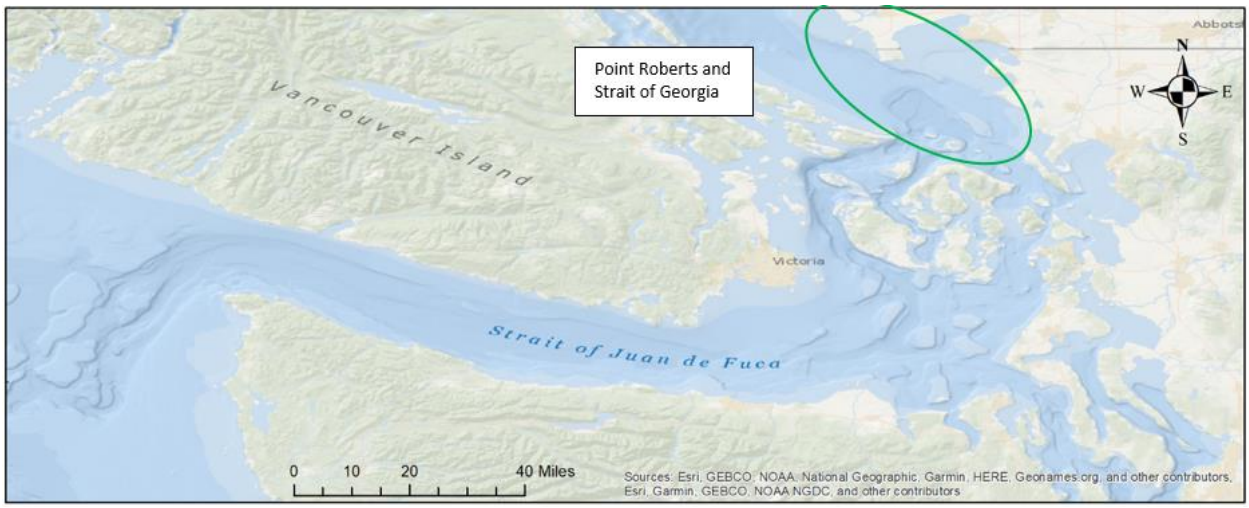

Figure 41: General location of the Point Roberts and Strait of Georgia geographic area

The Point Roberts line has the fourth highest crossing line count in the study area. This line intersects the north and southbound vessel traffic lanes that serve as the primary commercial vessel traffic route between Canadian ports and U.S. ports and between Canadian ports and the Pacific Ocean via the Strait of Juan de Fuca. The three vessel types with the highest transit counts through this line were bulk carriers (23 percent), tugs (22 percent), and containerships (12 percent).

The AIS operating hours analysis shows bulk carriers, container ship, and tug activity near Roberts Bank, likely a result of cargo operations and docking/undocking at that location. The Cherry Point anchorage had the most time vacant (88 percent) of any of the Washington anchorages.

The Swinomish Tribe fishes for various species in the vicinity Cherry Point (Swinomish Tribe, 2021). Other tribes may have usual and accustomed fishing rights within this area. Ecology received fishing data from two federally recognized tribes for this synopsis, the Swinomish Tribe and the Jamestown S'Klallam Tribe.

AIS operating hours for recreational vessels in this area were lower than other parts of the study area.

Southern Gulf Islands

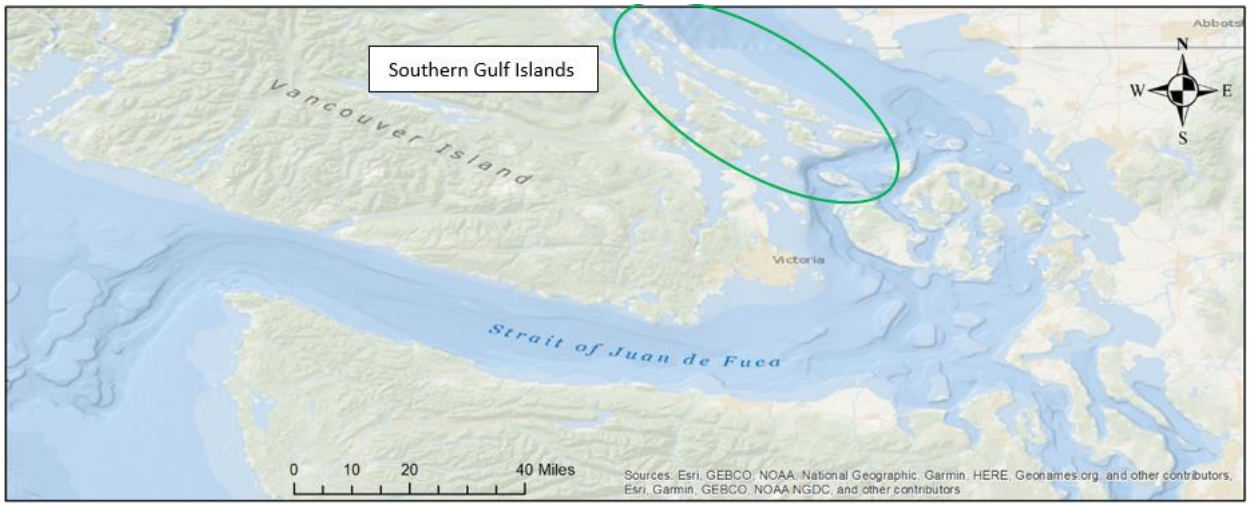

Figure 42: General location of the San Juan Islands geographic area

Transits through the Southern Gulf Islands are represented by the Gulf Islands North, Moresby North Pender, and Saturna South Pender lines. The Gulf Island North line crossed the route for the BC ferries sailing between Victoria and Metro Vancouver, which resulted in a high percentage of ferry transit at that line (36 percent). The Gulf Island North line also had a high percentage of cargo vessel transits (18 percent) which include the transits of the cargo-carrying Seaspan Ferries. Recreational vessels account for a high percentage of the transits at Moresby North Pender (2,553 transits, 52 percent) and at Saturna South Pender (831 transits, 57 percent). These high recreational vessel transit counts align with the AIS operating hours for recreational vessels, which were higher here than in other parts of the study area.

The AIS operating hours shows ATB activity to the west of Sidney, which may represent ATBs delivering refined products to Vancouver Island; cargo vessels (likely Seaspan Ferry vessels) transiting between Sidney to Active Pass; and tug activity, likely tugs with log or chip barges operating in that area.

The AIS operating hours analysis shows time spent by bulk carriers at several of the Southern Gulf Island anchorage locations such as Cowichan Bay, Ladysmith, and Plumper Sound. It also shows tank vessels spending time at anchor in Plumper Sound and cargo vessels spending time at anchor at Cowichan Bay and Ladysmith. The anchorage analysis shows that the anchorages at the northern end of the Southern Gulf Islands (Houston Pass, Kuleet, Ladysmith, Trincomali) were each vacant at least 55 percent of the time in 2018 and the anchorages at the southern end of the Islands (Cowichan Bay, Long Harbor, Plumper Sound) were each vacant at least 45 percent of the time.

Recommendations Received by Ecology

Ecology received several recommendations during the outreach and coordination process. When able, Ecology incorporated recommendations into this synopsis. Examples of recommendations that were incorporated into this work included putting ferries into a separate vessel category, adding additional crossing lines, including the AIS operating hours analysis method, including Ecology Advance Notice of Transfer Data in the analysis, and analyzing other anchorage locations such as Jack Island North and South.

Other recommendations largely involved additional risk assessments or analyses that were out of the scope of this synopsis. These recommendations represent additional areas of interest and provide the opportunity for future analyses. Recommendations received by Ecology that were out of scope for this synopsis included:

- Anchorages:
  - Improve understanding of trends in anchorage usage over time. Future research could involve studying anchorage occupancy trends using the analysis methods developed in this synopsis.
  - Conduct an anchorage occupancy analysis that includes all vessels present within an anchorage area, even those vessel present for very short timeframes. This synopsis counted a vessel as present within an anchorage area if a vessel transmitted an AIS signal within the anchorage area for at least 60 minutes. Future research could analyze anchorage use to include vessels present for shorter lengths of time.
  - Enhance the methodology to determine whether vessels that met this synopsis' definition of 'present' in an anchor were actually physically at anchor. Future analysis could investigate this question by cross-referencing the AIS anchorage analysis results with other vessel information. Ecology did not conduct this type of cross reference because the AIS navigational status of vessels is manually entered by vessel crews, which can introduce errors into the data.
- Spill risk:
  - Analyze changes in oil spill risk associated with changes in the size and capacity of vessels over time.
  - Research changes in oil spill risk associated with new technology in vessel propulsion.
- Other research topics:
  - Conduct a vessel activity synopsis or risk assessment for waters on Washington's outer coast.
  - Analyze vessels operating in the area without AIS. Understanding the number of vessels without AIS would be helpful since many of the analysis methods used in this synopsis are based on AIS data.

Conclusion

The purpose of this synopsis was to describe current maritime vessel activity, navigation lanes, and anchorages in the northern Puget Sound and the Strait of Juan de Fuca, including vessel transits in Canadian portions of transboundary waters. By presenting multiple data sources and analysis methods, the synopsis highlights areas and timeframes where vessel activities overlap.

Ecology incorporated several recommendations to enhance the synopsis, including the addition of a new analysis method for vessel operating hours and additional vessel categories.

The results of the crossing line analysis identified Admiralty Inlet and the entrance to the Strait of Juan de Fuca as the areas with the highest number of vessel transits. Crossing line results were similar across seasons for most types of vessels. Passenger, fishing, and recreational vessels had significant increases in transits during the summer and early fall. Across the study area, recreational vessels and tugs accounted for the largest share of vessel transits. Bulk carriers also represented a large percentage of transits in the study area, mostly in the Strait of Juan de Fuca, Point Roberts, and Haro Strait. ATBs had the least number of transits across the study area.

The AIS operating hours results demonstrated areas of vessel anchoring and heavily used transit routes for each vessel type. The vessel type with the highest number of total AIS operating hours in the study area was recreational vessels, with over 500,000 hours. Car carriers had the least number of total hours (~5,000 hours).

Analysis of anchorage areas determined that the Port Angeles and Vendovi Island East anchorages had the lowest vacancy rates. Port Angeles was the anchorage area with the lowest vacancy rate and the largest volume of oil transferred in 2018. Anacortes/March Point had the second highest volume of oil transferred, and Vendovi Island had the third highest volume of oil transferred.

Commercial fishing most often occurred during the summer and early fall, likely due to fishery openings and run timings. Marine events that may have provided an additional influx of recreational vessels most often occurred during quarters 2 and 3 (April – September). Fidalgo Bay and the nearby bays and channels had the most permitted marine events in 2018.

Two federally recognized tribes provided data on their fishing activities in 2018. The Swinomish Tribe had 159 fishing vessels in 2018, primarily homeported on their reservation or across the Swinomish Channel in La Conner. The Swinomish Tribe fishes throughout the study area including in the vicinity of Cherry Point, Haro Strait and Boundary Pass, the San Juan Islands, the Eastern Strait of Juan de Fuca, and in Rosario Strait, Guemes Channel, and Saddlebag (Swinomish Tribe, 2021). The Jamestown S'Klallam Tribe had 20 vessel registrations in 2018 (Jamestown S'Klallam Tribe, 2020). The Jamestown S'Klallam Tribe fishes throughout the study area including the length of the Strait of Juan de Fuca, Admiralty Inlet and Hood Canal, the San Juan Islands, and portions of Rosario Strait, Haro Strait, and Boundary Pass (Jamestown S'Klallam Tribe, 2011). Inclusion of fishing data from other federally recognized tribes with usual and accustomed fishing rights within the study area would enhance future analysis work and

provide greater understanding of interactions between tribal fishing vessels and other vessel activities.

Overall, recreational vessels and tugs were the vessel categories with the most widespread activity in the study area, based on the crossing line and AIS operating hours analyses. Tug activity was highest between Anacortes and Bellingham and from Admiralty Inlet to Everett and Seattle. Recreational vessel activity was highest around the San Juan Islands and Southern Gulf Islands, and between Admiralty Inlet and Seattle.

This synopsis combines multiple data sources and analysis methods to accomplish its goal of describing current maritime vessel activity, navigation lanes, and anchorages in the northern Puget Sound and the Strait of Juan de Fuca. It provides a holistic view of vessel activity by presenting information on vessel crossing line counts and operating hours for each vessel type, as well as information about anchorage usage and fishing and recreational vessel activity.

It can serve as both a foundational reference for understanding the areas and timeframes where vessel activities overlapped in 2018 and as a model for future work to build a deeper understanding of trends in vessel activities over time.

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Appendix A. 2018 Permitted Marine Events

Date of Event	Location of Event	Name of Event
2/3/18	Swinomish Channel	La Conner Race
2/24/18	Anacortes	Girts Rekevics Foul Weather Race
2/24/18	Port Townsend Bay	27th Annual Shipwright's Regatta
3/9 – 3/11/18	Eastern Strait of Juan de Fuca	Olympic Peninsula Salmon Derby
3/10/18	Bellingham Bay	Bellingham Bay Rough Water Race
3/10/18	Rosario Strait	Tri Strait I - Lawson Reef
3/14/18	Fidalgo Bay	Fidalgo Bay Buoy Races
3/21/18	Fidalgo Bay	Fidalgo Bay Buoy Races
3/24/18	Rosario Strait	Tri Straits II - Smith Island
3/28/18	Fidalgo Bay	Fidalgo Bay Buoy Races
4/4/18	Fidalgo Bay	Fidalgo Bay Buoy Races
4/7 – 4/8/18	Fidalgo Bay	Tulip Regatta
4/11/18	Fidalgo Bay	Fidalgo Bay Buoy Races
4/14/18	Port Townsend Bay	McCurdy Point Race
4/14 – 4/15/18	Haro Strait and Boundary Pass	Patos Island Classic Race
4/18/18	Fidalgo Bay	Fidalgo Bay Buoy Races
4/22/18	Bellingham Bay	Dan Harris Challenge
4/25/18	Fidalgo Bay	Fidalgo Bay Buoy Races
4/28 – 4/29/18	Puget Sound	Smith Island/Double Bluff Race
5/2/18	Fidalgo Bay	Fidalgo Bay Buoy Races
5/5/18	Port Townsend Bay	Port Townsend Yacht Club Parade
5/5/18	Rosario Strait	Tri Straits III – Salmon Bank
5/5 – 5/6/18	Puget Sound and Admiralty Inlet	2018 Race to the Straits
5/6/18	Friday Harbor	San Juan Opening Day Parade
5/9/18	Fidalgo Bay	Fidalgo Bay Buoy Races
5/10 – 5/13/18	Strait of Juan de Fuca	Oregon Offshore International Yacht Race
5/12/18	Penn Cove	27th Annual Penn Cove Water Festival
5/16/18	Fidalgo Bay	Fidalgo Bay Buoy Races
5/19 – 5/20/18	Saratoga Passage/Admiralty Inlet	Round Whidbey
5/23/18	Fidalgo Bay	Fidalgo Bay Buoy Races

Date of Event	Location of Event	Name of Event
5/26 – 5/28/18	Strait of Juan de Fuca	Swiftsure International Yacht Race
5/27/18	Bellingham Bay	Ski to Sea
5/30/18	Fidalgo Bay	Fidalgo Bay Buoy Races
6/2 – 6/3/18	Port Townsend Bay	34th Annual Classic Mariner's Regatta Series
6/6/18	Fidalgo Bay	Fidalgo Bay Buoy Races
6/11 – 6/13/18	Puget Sound	Seventy48
6/13/18	Fidalgo Bay	Fidalgo Bay Buoy Races
6/14 – 6/15/18	Strait of Juan de Fuca	Race to Alaska
6/16/18	Bellingham Bay	Makuakane Outrigger
6/20/18	Fidalgo Bay	Fidalgo Bay Buoy Races
6/23/18	Port Townsend Bay	Rat Island Race
6/27/18	Fidalgo Bay	Fidalgo Bay Buoy Races
7/1/18 & 7/4/18	Strait of Juan de Fuca	Victoria to Maui International Yacht Race
7/4/18	Fidalgo Bay	Fidalgo Bay Buoy Races
7/4/18	Friday Harbor	Friday Harbor Community Fireworks Display
7/7 – 7/8/18	Padilla Bay	Cheney Cup – Lummi Island Race
7/11/18	Fidalgo Bay	Fidalgo Bay Buoy Races
7/13 – 7/15/18	San Juan Islands	Bellingham Bay Salmon Derby
7/18/18	Fidalgo Bay	Fidalgo Bay Buoy Races
7/25/18	Fidalgo Bay	Fidalgo Bay Buoy Races
7/28/18	Fidalgo Bay and Guemes Channel	Round Guemes Race
8/1/18	Fidalgo Bay	Fidalgo Bay Buoy Races
8/4/18	Shaw Island	Round Shaw Race
8/8/18	Fidalgo Bay	Fidalgo Bay Buoy Races
8/11/18	Bellingham Bay	Bellingham Bay Classic
8/11/18	San Juan Channel	Shaw Island Classic
8/15/18	Fidalgo Bay	Fidalgo Bay Buoy Races
8/17 – 8/19/18	San Juan Islands	Northern Century
8/22/18	Fidalgo Bay	Fidalgo Bay Buoy Races
9/15/18	Bellingham Bay	Bellingham Traverse
9/15 – 9/16/18	Oak Harbor	Hydro for Heroes
10/6 – 10/7/18	Fidalgo Bay and Rosario Strait	S'Ale Fest
10/20/18	Guemes Channel and Rosario Strait	Lydia Shoal Race

Appendix B. Swinomish Tribe Statement and Fishing Data

Vessel Traffic Impacts Swinomish Treaty Fishing

By Lorraine Loomis
Fisheries Manager
Swinomish Indian Tribal Community
January 28, 2021

On behalf of the Swinomish Indian Tribal Community ("Swinomish"), I present the attached 2018 fisheries data concerning Swinomish treaty fishing in the norther portion of the Washington waters of the Salish Sea most affected by large vessel traffic. The data is presented in the form of a Response to a Questionnaire (the "Response") concerning tribal treaty fishers developed by Glosten Associates to assess impacts of vessel traffic on treaty fishing rights relating to the proposed Gateway Pacific coal terminal at Cherry Point. The area addressed by the Questionnaire (the "study area") is shown on the map on page 1 of the Response. The data presented points toward the conclusion that vessel traffic in the study area significantly interfere with the exercise of Swinomish treaty fishing rights.

Background

Swinomish is one of 15 tribes that have treaty-reserved fishing rights in the Washington waters of the Salish Sea. Each tribe's rights were recognized and secured by one of five treaties signed in 1854 or 1855. Each of these treaties secured tribal fishing rights in the tribes' "usual and accustomed grounds and stations" (U&A). For Swinomish, it was the 1855 Treaty of Point Elliott, which also set aside the Swinomish Reservation. Since 1974 the tribes have shared the fishery coequally with state fishers under the framework first established by the Boldt Decision.

The Swinomish Reservation is located on Fidalgo Island in Skagit County, with easy access to the waters of the study area to the north and west. Swinomish has a little over a thousand members, most of them living on or near the reservation. Swinomish currently fishes in the Washington waters from the Canadian border to a few miles south of the tip of Whidbey Island. The tribe is home to the second largest of the Salish Sea fishing fleets, second only to the Lummi fleet.

2018 Study area fishing data

The attached Response contains the Swinomish fishery data for 2018. As noted above, the questionnaire was used by Glosten Associates in its 2014 study of vessel traffic interference with the Lummi fishing fleet in the study area. Washington Department of Ecology participated in sponsoring the study. Using Lummi's 2013 fishing data, Glosten quantified considerable vessel traffic interference with Lummi treaty fishing, which would have been made worse if the Gateway project had proceeded.

Swinomish responded to the same questionnaire using 2013 data and presented its data to the U.S. Army Corps of Engineers as part of its opposition to the Gateway project, along with declarations from its tribal fishers concerning the impact vessel traffic on the treaty fishery. Swinomish data was not addressed in the Glosten report, however. This Response, using 2018 data, was prepared by Swinomish fisheries biologists at my direction, as was the 2013 response. The source of information used in the Response is the Northwest Indian Fisheries Commission treaty fishery database, TOCAS. This database is used by the state and tribal co-managers in making fisheries management decisions. Since the 2013 and 2018 data respond to the same questionnaire, a direct comparison between the two years is possible.

It must be noted that most of the data presented addresses Swinomish fishing *only for fishing activity in the study area, as shown on the map on page 1.* It does not include Swinomish data for its entire fishery, unless the response to a question so indicates. The study area is the area most likely to be affected by vessel traffic, and does not include, for instance, the waters of Skagit Bay and Saratoga Passage.

Swinomish does not fish alone in the study area. Treaty tribes fish throughout the entire Washington waters of the Salish Sea, and this is especially true of the study area. Swinomish shares the study area fishery, in whole or in part, with eight other treaty tribes: Jamestown S'Klallam, Lower Elwha, Lummi, Nooksack, Port Gamble S'Klallam, Suquamish, Tulalip and Upper Skagit. Vessel traffic affects all of the tribes, and the overall interference with treaty fishing is greater that the impact upon Swinomish alone.

With these points in mind, here are some pertinent observations based upon the data.

Key features of the Swinomish Treaty Fishery

Swinomish is a fishing community. The 2018 data shows that Swinomish remains a fishing community. Response Table 7, p. 4, shows that 207 Swinomish members registered for the 2018 crab fishery, the largest tribal fishery, and 130 fishers registered for the salmon fishery, the second largest. As to the main harvest, crab, over 20 percent of Swinomish tribal members registered to participate. Some of these fishers are engaged in fishing as a primary occupation. Others fish part-time for subsistence and supplementary income. But tribal fishing directly touches almost every Swinomish household.

The Swinomish fishing fleet is reservation-based. 95 percent of the fleet is based on the reservation or across the Swinomish Channel in LaConner. The remaining 5 percent is based in marinas in nearby Anacortes. Response #16, p. 6.

Swinomish fishes for every commercial species available in the study area. These fishery resources include salmon, crab, shrimp, halibut, clams, oysters, sea cucumbers, sea urchin, and geoduck. Response Table 2, p. 2.

Swinomish fishes throughout the study area. The only exception is the Strait of Juan de Fuca West area. Response Table 1, p. 1. Throughout the remaining areas, Swinomish fishes for all the

categories of fish, with the sole exception of geoduck, clams and oysters in the Haro Strait - Boundary Pass area. *Id.* Swinomish fishing is especially heavy in the Strait of Juan de Fuca East and Haro Strait – Boundary Pass Area, which experience heavy vessel traffic to and from Cherry Point, Anacortes and British Columbia. Response Table 4, p. 5.

The Swinomish fleet is dominated by small boats. This is true throughout the entire fishery. In 2018, 85 percent of Swinomish fishing boats were 30 feet in length or less. Of these boats, 40 percent were 20 feet or under. Response, Table 6, p. 4. This has important consequences for vessel traffic studies. Many studies have used data from automatic location devices required for large vessels. The Swinomish small boats are too small to be required to have such devices. As a result, the Swinomish fishing fleet is largely invisible to, and thus excluded from, studies that rely upon AIS or other electronic detection or reporting data.

Swinomish fishes throughout the year. In every year since 2002, Swinomish has recorded at least one commercial harvest landing in every month of the year. Response, Table 9, pp. 5-6. Throughout this period, as in 2018, the largest concentration of landings occurs in July through September, with lesser concentrations from March through May and in November. *Id.* This is also borne out by the days per month of fishing recorded in Response Table 10, p. 6. The pattern is similar throughout the period from 2002 to 2018. In 2018, Swinomish fishers recorded a landing of harvest in 202 days of the year, well over half the year. *Id.* This is likely to underestimate the days of fishing because a crab landing may, and often does, include harvest over two or more days. In 2018 Swinomish recorded 1,657 harvest landings. Response Table 8, p. 5. Crab accounted for 72 percent of the landings, followed by salmon at 13 percent. *Id.*

Fishing in the study area is important to Swinomish. The 2018 aggregate Swinomish commercial harvest in the study area was 1,435,446 pounds. Response Table 2, p. 3. That is a very significant portion of the overall Swinomish harvest. It equates to 9,000 pounds of harvest per fishing vessel and over 1400 pounds of harvest per Swinomish member. Response Table 6, p. 4.

Vessel traffic interference

The 2018 data documents the frequent and extensive use of the study area by Swinomish fishers, which especially coincides with the areas of extensive large vessel traffic. The result is a widespread and troublesome interference with the exercise of Swinomish treaty fishing rights throughout the study area.

A considerable disruption of Treaty fishing in the study area is baked in to the shipping pattern. The entire waters of the Washington portion of the Salish Sea are included in at least one tribe's usual and accustomed fishing areas. The designated shipping lanes and anchorages in that same area take up 27 percent of the same waters of the Salish Sea. Any consideration of the impact of vessel traffic upon treaty fishing must begin with a recognition that over a quarter of the fishing area reserved for the tribes is severely compromised and often functionally off-limits to treaty fishers. Further, as the Response shows, this disruption coincides with prime Swinomish fishing areas.

The threat of disruption inherent in the establishment of shipping lanes and anchorages is realized by the large amount of current vessel traffic and will be made worse by any vessel traffic increase, and especially by the presently increasing amount of ATB traffic. This disruption from the shipping lanes is augmented and spread to a wider area by the traffic outside the shipping lanes to and from the dockage facilities or anchoring and bunkering sites, and by the movement of tender boats and tugs accompanying or servicing the vessels. This problem is widespread throughout the study area waters but becomes more concentrated as the traffic approaches or departs from a dock or anchorage.

The previously mentioned Glosten report on vessel traffic interference with Lummi tribal fishing, based on 2013 data, documented the considerable traffic and interference with the Lummi fishing fleet in the study area. A comparison of the Lummi 2013 questionnaire response with the Response shows that Swinomish fishing has similar pattern to that of the Lummi fishing in 2013. The conclusions drawn by Glosten support similar conclusions concerning the Swinomish fishery today. The Response addresses one other aspect of vessel traffic interference with Swinomish fishing in the study area: gear loss. Response, #9, pp. 3-4. Areas in which loss of gear due to vessel traffic are spread throughout the study area: Lopez Island, Rosario Strait, Haro Strait, Vendovi Island, Anacortes, Cherry Point, Smith Island and Boundary Pass. *Id.*

In addition to the Response and its 2013 predecessor, Swinomish fishers have provided declarations documenting vessel traffic interference with fishing, at particular sites and also in the shipping lanes, as part of a Swinomish submission objecting to a particular permit or other governmental approval that would will increase vessel traffic on both sides of the border in the Salish Sea. Such declarations were submitted with regard to:

- Gateway Pacific Coal Terminal, Cherry Point
- TransMountain Pipeline expansion, British Columbia
- BP Cherry Point Dock, North Wing
- Tesoro CPUP Project, Anacortes
- Roberts Bank II Terminal, British Columbia

I myself have often submitted a declaration as well. The declarations document the current high level of vessel traffic in the study area or the adjacent Canadian waters, including gear loss, scrambles to lift gear or move to avoid large vessels, safety hazards, difficulty crossing shipping lanes to access a fishing area, and loss of opportunity by avoidance of shipping lanes and congested dock areas, and anchorages.

We are at a point where the current amount of vessel traffic interferes with Swinomish treaty fishing in important fishing areas. A baseline of current vessel traffic interference with treaty fishing rights should be established so that anticipated increases in vessel traffic can be evaluated.

Importance of Treaty fishing

The Response shows that the commercial treaty fishery in the study area is important to Swinomish. It is a large and important component of an activity that is a crucial part of the Swinomish economy. Since one in five Swinomish members participates in the commercial fishery, the livelihood of almost every Swinomish household depends on a tribal commercial fisher. The income generated by the Tribe's commercial fishery is diffused through the entire tribal community. A decline in tribal fishing would seriously affect the Tribe's economy and the Tribe as a whole.

The economic impact of the Tribe's commercial fisheries is very important, but it is not the only value of the Tribe's treaty fisheries, nor, in the end, is it the most important one. I want to turn now to the subsistence, cultural and spiritual aspects of the Tribe's fisheries.

Sharing the bounty of the sea is a deeply engrained spiritual and cultural tradition of the Coast Salish. One of our core values is the giving of a portion of the catch as a gift to our extended family, elders, those who are ill, and other in the community who cannot fish for themselves. Our people thrive as a community around the sharing of food, and the subsistence fishery (including the take-home component of the commercial fishery) sustains the circulation of fish and seafood throughout our community and ensures that the harvest ends up on the plates of every Swinomish member, even if they didn't obtain the harvest themselves.

Fishing is a central part of our culture and spirituality in other ways as well. Since time immemorial our people have conducted a first salmon ceremony and blessing of the fleet every spring. In this way we thank the Creator for blessing us with salmon and all of the other bounty from our rivers and the sea. We seek to ensure that our fish will always return to us, our fisheries will remain bountiful, and that our fishers will remain safe from harm in the coming year. This knowledge and lifeway has been passed down from generation to generation and sustains us today.

Feasting on the bounty of our rivers and the Salish Sea is a central feature of every Swinomish ceremony or gathering. It marks every important milestone in our peoples' lives – birth, naming, marriage, educational and other accomplishments, and even death – and is a feature of every important community event. These events and ceremonies are integral to our culture, and ceremonial food is an essential element.

The act of harvest of fish and shellfish is also very important to our culture and identity. I, like nearly every other Swinomish member I know, learned to fish from my family members, and I in turn taught my children, nephews and nieces, and many other younger relatives to fish. Learning how to fish from our elders and passing down that knowledge to our descendants is critical to maintaining our culture and identity as a people and the physical and spiritual wellbeing of our people.

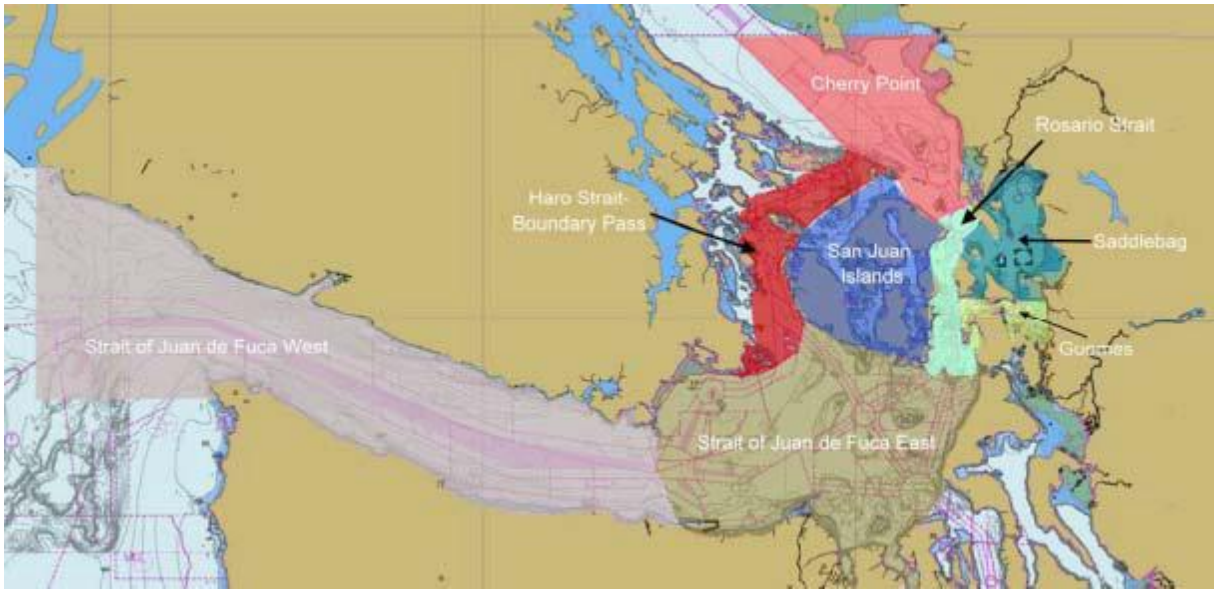
Thus, the act of fishing, the circulation of harvest in the community, and the central importance of fish and shellfish to Swinomish cultural and spiritual life confer upon our treaty fishing rights

a value that far transcends the commercial value of the fisheries. The fishery is the wellspring of our culture, and the treaty fishing right was intended to preserve our culture and lifeway. As a fisheries manager, I am always mindful of the need to preserve our treaty fishing rights and our historic fisheries in order to preserve our survival and maintain our identity as a tribe.

About the author

Lorraine Loomis (tribal name Ikatbix) was born, raised, and spent most of her life on the Swinomish Reservation. She has been the Swinomish Fisheries Manager since 1975. During her career she has served on many local, state, and international fish management organizations. Loomis has been a member of the Board of the Northwest Indian Fisheries Commission since 1978, serving as the Vice Chair for 30 years before becoming the Chair in 2014. She has been involved in the "North of Falcon" process, which annually sets salmon fisheries regimes for state and tribal fishers in Washington, and has served as the tribal co-chair (with the state) for many years. In addition, she has served on the Pacific Salmon Commission Fraser River Panel, which manages the Fraser River salmon run on both sides of the border, since 1985, at times serving as Chair of the U.S. section of that Panel.

Questionnaire



Fisheries

1. What fisheries do the Swinomish fishermen participate in?
Sockeye, pink, Chinook, Coho, chum, steelhead, crab, shrimp, halibut, clams, oysters, sea cucumber, sea urchin, geoduck.

2. Referring to the map above, please identify what types of fish that Swinomish generally fish for in each area and check the corresponding boxes in Table 1, below. Also, please use a star to indicate the area where the most fishing takes place within each fishery.

Table 1. Swinomish fishing locations

Fishery	Strait of Juan de Fuca West	Strait of Juan de Fuca East	Haro Strait/ Boundary Pass	Rosario Strait	Saddlebag	Guemes Channel	Cherry Point	San Juan Islands
Salmon		X	X	X	X	X	X	X
Halibut		X	X	X	X	X	X	X
Dungeness Crab		X	X	X	X	X	X	X
Geoduck, Clams, and Oysters		X		X	X	X	X	X
Sea Urchins and Sea Cucumbers		X	X	X	X	X	X	X
Shrimp		X	X	X	X	X	X	X
Other								
Total		**X**	**X**	**X**	**X**	**X**	**X**	**X**

Note: If the "Other" row is filled out, please include the list of species that would apply to this group.

3. Please complete Table 2 with the volume in pounds of the annual Swinomish fishery harvest for *each* fishery in each of the last three years (2016, 2017, 2018).

Table 2. Swinomish harvest volumes in the questionnaire catch areas.

Fishery	2016	2017	2018
Salmon	102,424	411,037	762,737
Halibut	24,388	20,524	4,887
Dungeness Crab	509,726	531,669	556,878
Geoduck, Clams, and Oysters	25,220	0	32,674
Sea Urchins and Sea Cucumbers	31,120	34,118	14,926
Shrimp	55,091	63,557	63,344
Other*	0	0	0
Total	**747,969**	**1,060,905**	**1,435,446**

The catch numbers in this table and associated values in all following tables are only for the catch areas in the questionnaire map above. They do not include Skagit Bay/River, for example. *Bycatch of dogfish and skates occurs during the halibut fishery, but as this does not occur in a separate directed fishery, those species are not being included in "other".

4. Please fill out the cells in Table 3 to indicate what portion (percent of total pounds) of each fishery is commercial versus subsistence or ceremonial.

Table 3. Swinomish Commercial, Subsistence, and Ceremonial Volumes, 2018

Fishery	Commercial	Subsistence/Ceremonial	Total Harvest
Salmon	98.8%	1.2%	100%
Halibut	99.3%	0.7%	100%
Dungeness Crab	100.0%	0.0%	100%

Fishery	Commercial	Subsistence/Ceremonial	Total Harvest
Geoduck, Clams, and Oysters	100.0%	0.0%	100%
Sea Urchins and Sea Cucumbers	100.0%	0.0%	100%
Shrimp	99.3%	0.7%	100%
Other			
Total			**100%**

Note: The sum of the two center columns should total 100 percent

5. Using the map on page 2, please estimate the percentage of time spent in each area during these fishing trips in the following table.

Table 4. ***Swinomish Fishing Time Estimates.***

Fishery	Strait of Juan de Fuca West	Strait of Juan de Fuca East	Haro Strait/ Boundary Pass	Rosario Strait	Saddlebag	Guemes Channel	Cherry Point	San Juan Islands
Salmon		10	20	15	20	5	5	25
Halibut		60	20	3		2	5	10
Dungeness Crab		10	5	5	40	5	15	20
Geoduck, Clams, and Oysters		50	5	5	5	5	5	25
Sea Urchins and Sea Cucumbers		30	5	5	5	5	5	45
Shrimp		45	15	5	5	5	5	20
Other								

Note: If the "Other" row is filled out, please include the list of species that would apply to this group.

Gear

6. We would like to learn more about reef net fisheries. Generally speaking, in which areas (as identified by the map on page 2) are the Swinomish reef net sites that are used today?
Swinomish does not fish any reef nets.

a. How many vessels are typically at a reef net site?
N/A

b. What is the level of activity at these sites, as measured in days per year?
N/A

7. What is the primary gear used by tribal fishermen for halibut fishing?
Set-lines.

8. What portion of the total annual Swinomish salmon harvests are caught using each gear type? Please fill out the shaded areas of Table 5 (the total column should equal 100 percent).

Table 5. Swinomish Harvest Data by Gear Type in the Questionnaire Catch Areas, 2018.

Fishery	Percent of Total Harvest					
	Drift Gillnet	Set Gillnet	Seine	Reef Net	Other	Total
Chinook	44.11%	0.00%	55.89%	0.00%	0.00%	**100.00%**
Chum	21.23%	0.00%	78.77%	0.00%	0.00%	**100.00%**
Coho	21.67%	0.00%	78.33%	0.00%	0.00%	**100.00%**
Pink	50.00%	0.00%	50.00%	0.00%	0.00%	**100.00%**
Sockeye	25.50%	0.00%	74.50%	0.00%	0.00%	**100.00%**

9. Please provide any data that the tribe has on volume of gear lost by type, location, and year.
The Swinomish Tribe does not have long-term data on gear loss. However, gear is susceptible to loss from damage to buoys or nets by recreational, commercial, ferry, shipping, and other vessel traffic, as well as theft.

a. Is gear loss due to vessel traffic more common in some areas over others? Please explain in detail.
Crab pots commonly placed near Lopez Island are particularly vulnerable to vessel traffic, as they are in or near shipping lanes and ferry routes. Other locations near shipping lanes in Haro Strait and Rosario Strait are also particularly susceptible to gear loss, as are locations near the high traffic vessel/barge anchoring and bunkering areas in the vicinity of Vendovi Island, and near the Anacortes and Cherry Point refineries and their associated oil tanker traffic.

b. Are certain types of gear more likely to be interfered with by vessel traffic than others? Please explain in detail.
Crab and shrimp pots are likely to be interfered with by vessel traffic because of the proximity of fishing locations to shipping lanes, and because the gear is unattended for periods of time. Some halibut fishing grounds (such as Smith Island) are in or near shipping lanes, making halibut gear vulnerable in these locations. Salmon gear placed in locations with heavy vessel traffic or near shipping lanes, such as Haro Strait, Rosario Strait, and Boundary Pass, are also vulnerable.

Vessel Activity

10. What is the breakdown of Swinomish fishing vessels (seiners, gill netters, skiffs) by vessel type and size (length overall)? Please fill out the shaded areas of Table 6.

Table 6. Swinomish Fishing Vessels by Size, 2018.

Vessel Type	5-20 ft	20-30 ft	30-40 ft	40-50 ft	50-60 ft	60+ ft	Total
Seiners							
Gillnetters							
Skiffs							
Total	**54**	**81**	**20**		**1**	**3**	**159**

Swinomish doesn't register boats by vessel type, so only the total number of boats in each size class are reported here. The 3 boats 50+ feet in length are all purse seiners.

11. What is the total number of Swinomish tribal vessels in each fishery, and how many actually participated in each fishery in 2018? Please fill out the shaded areas of Table 7.

Table 7. Number of Swinomish fishers and boats by species, 2018.

Fishery	Registered Fishers	Active Boats
Salmon	130	41
Halibut	70	14
Dungeness Crab	207	68
Geoduck, Clams, and Oysters	18 (+98 diggers)	33 (+10 clams)
Sea Urchins and Sea Cucumbers	16	6
Shrimp	101	27
Other	0	0
Total	**640**	**199**

Swinomish does not keep track of vessel type and participation in most fisheries. Instead, I've listed the number of individual fishers that sold catch in each of the fisheries during 2018, as a rough estimate of the number of active boats. However, in some cases multiple fishers on a single boat may report their catch separately. Individual fishers/boats may participate in more than one fishery type.

12. Is the number of participants in 2019 expected to be higher or lower than in 2018?
The number of participants varies year to year depending on the harvestable number of fish available and the number of days a fishery is open.

13. What is the estimated number of vessel traffic days that Swinomish vessels are fishing in Puget Sound waters? Please estimate the average numbers of trips that Swinomish vessels made by type and fishery in 2018, as well as the typical duration of each trip (one trip equals two transits). This estimate may be expressed in a range; for example, 20-25 trips, 8-12 hours each.

Table 8. Swinomish Vessel Trips, 2018.

Fishery	Total Tickets		Gillnetters		Skiffs	
	Annual Trips	Length of Trips	Annual Trips	Length of Trips	Annual Trips	Length of Trips
Salmon	216					
Halibut	29					
Dungeness Crab	1,199					

Fishery	Total Tickets		Gillnetters		Skiffs	
	Annual Trips	Length of Trips	Annual Trips	Length of Trips	Annual Trips	Length of Trips
Geoduck, Clams, and Oysters	92					
Sea Urchins and Sea Cucumbers	16					
Shrimp	105					
Other	0					
Total	**1,657**					

Swinomish does not track the participation of vessels in individual fisheries or trip lengths. Instead, I have reported the number of tickets, by species, for 2018. The number of tickets can reasonably be considered a proxy for the number of vessel trips. The length of trips is highly variable depending on the location fished, launch point, delivery point, and duration of the fishery.

14. Please estimate the average annual (by month), number of Swinomish fishing vessel trips (one trip equals two transits) for 2002 through 2018.

Table 9. Number of tickets by year and month, 2002-2018.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Jan	19	78	22	13	15	15	7	96	66	43	41	73	135	154	184	82	71
Feb	24	47	41	31	6	43	22	93	92	61	41	58	104	178	129	78	70
Mar	24	30	49	34	26	49	91	85	118	75	101	101	171	221	84	70	98
Apr	7	11	47	33	51	79	91	110	42	61	62	57	52	85	62	53	40
May	15	3	5	19	19	21	29	23	23	33	47	213	178	97	50	45	49
Jun	17	69	52	95	96	33	4	2	147	1	24	31	62	212	20	42	1
Jul	458	371	229	528	353	376	271	437	249	302	359	376	303	137	264	233	202
Aug	190	219	249	170	278	345	299	99	200	294	216	221	171	180	140	349	377
Sep	189	251	356	256	277	138	141	137	221	46	141	145	238	135	259	243	170
Oct	107	52	210	240	221	257	198	273	176	143	143	72	186	231	216	255	118
Nov	75	25	56	16	23	27	31	111	185	194	79	117	55	201	87	108	446
Dec	147	22	35	11	13	19	31	67	84	73	74	74	119	181	108	140	15

As in # 13 above, the number of tickets roughly equals the number of vessel trips, so are used as a proxy.

Table 10. Number of days that a landing occurred by year and month 2002-2018.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Jan	17	22	17	12	10	9	4	26	21	18	21	25	28	30	28	25	25
Feb	15	23	16	10	5	20	10	26	26	20	16	17	24	27	26	20	10
Mar	19	17	20	19	17	20	25	26	29	16	21	18	29	30	12	17	23
Apr	3	7	16	8	17	7	22	20	9	21	19	10	15	8	5	3	5
May	5	1	2	5	8	7	12	5	4	7	3	18	14	11	6	7	17
Jun	5	4	2	3	7	2	4	1	4	1	1	5	4	6	11	9	1
Jul	15	12	10	30	26	16	24	12	12	12	11	13	7	5	10	9	8
Aug	17	18	23	30	31	28	17	9	22	22	24	30	27	23	12	17	24
Sep	14	16	28	27	25	17	10	21	10	12	13	23	23	15	10	27	25
Oct	13	19	29	28	30	23	28	23	24	23	29	20	28	20	16	21	24
Nov	15	17	22	10	12	18	17	26	27	27	24	22	19	29	19	23	29
Dec	28	15	20	10	9	10	18	25	22	23	27	26	26	29	27	30	11

15. Do shellfish harvesters typically travel to and from their harvesting areas using vessels? If so, please describe.
Vessel trips are required for crab, shrimp, and geoduck fisheries, but not as frequently for clam fisheries.

16. Where are most Swinomish fishing vessels moored?
95 percent in La Conner, 5 percent Anacortes

17. Where are Swinomish fish delivered? Please fill out the shaded areas of Table 11. If more than one location applies, specify the percentages delivered to each.

Table 11. Swinomish Delivery Locations, 2018

Fishery	**Delivery Location**
Salmon	Mt Vernon (70%), La Conner (25%), Bellingham (2%), Blaine (1%), Vancouver B.C. (1%), Olga (1%), Other(<1%)
Halibut	La Conner (52%), Mt. Vernon (38%), Friday Harbor (7%), Anacortes (3%)
Dungeness Crab	Mt. Vernon (86%), La Conner (12%), Other (<1%)
Geoduck, Clams, and Oysters	Mt. Vernon (61%), La Conner (32%), Kent (6%), Seattle (1%)
Sea Urchins and Sea Cucumbers	La Conner (100%)
Shrimp	Mt. Vernon (56%), La Conner (27%), Anacortes (16%), Friday Harbor (1%)
Other	

Percentages are based on the total number of tickets for each fishery and may not add up exactly to 100 percent because of rounding.

Fishery Management

18. Are tribal fisheries managed in terms of access days and times? If so, how?
Yes. Fisheries are opened during specific days, times and areas. The fishing schedules for some fisheries are set preseason, while other fisheries are planned only days ahead of time via conference call with other tribal and co-managers.

19. Are the tribe's scheduled opening and closure days the same as those for non-tribal fishermen?
Not typically.

20. How are Swinomish (and other Indian) fishing vessels identified so that they can be distinguished from non-Indian fishing vessels?
Swinomish vessels are identified with their ID number WN - _ _ _ - SWN. The three spaces between the WN and the SWN are filled by numbers.

Appendix C. List of Entities Invited to Project Webinars

U.S. tribes

- Hoh Tribe
- Jamestown S'Klallam Tribe
- Lower Elwha Klallam Tribe
- Lummi Nation
- Makah Tribe
- Muckleshoot Tribe
- Nooksack Tribe
- Port Gamble S'Klallam Tribe
- Puyallup Tribe
- Quileute Tribe
- Quinault Nation
- Samish Tribe
- Sauk-Suiattle Tribe
- Skokomish Tribe
- Snohomish Tribe
- Squaxin Island Tribe
- Stillaguamish Tribe
- Suquamish Tribe
- Swinomish Tribe
- Tulalip Tribes
- Upper Skagit Tribe
- Yakama Nation

Canadian First Nations

- Beecher Bay First Nation
- Cowichan Tribes
- Ditidaht First Nation
- Esquimalt Nation
- Malahat Nation
- Musqueam Nation
- Pacheedaht Nation
- Songhees Nation
- Tsawout First Nation

U.S. and Canadian Organizations

- ACGI Shipping
- All Aboard Sailing
- American Waterways Operators
- Andeavor Anacortes Refinery
- Argosy Cruises
- Associated Petroleum
- BC Chamber of Shipping
- BC Coast Pilots
- BC Ferries
- BC Ministry of the Environment and Climate Change Strategy
- BC Whale Tours
- Bluewater
- BP Cherry Point
- BP Shipping
- Canadian Association of Petroleum Producers
- Canadian Coast Guard
- Cascade Marine Agencies
- Centerline Logistics
- Center for Whale Research
- Chevron
- City of Anacortes
- City of Bellingham
- City of Everett
- City of Port Angeles
- City of Port Townsend
- City of Vancouver Canada

- City of Victoria
- Clallam County
- Clear Seas Centre for Responsible Marine Shipping
- Council of Marine Carriers
- Crowley Petroleum
- Deer Harbor Charters
- Department of Fisheries and Oceans Canada
- Environment and Climate Change Canada
- Environmental Protection Agency
- Evergreen Shipping
- ExxonMobil
- Fishing Vessel Owners' Association
- Five Star Whale Watching
- Foss Maritime
- Friends of the Earth
- Friends of the San Juans
- General Steamship Corp
- Global Affairs Canada
- Global Diving and Salvage
- Greater Victoria Harbour Authority
- Gulf Marine Contractors
- Highliner and R&R Charters
- Holland America
- Hyundai America
- Inchcape
- Indigenous Advisory and Monitoring Committee
- Island Adventures Whale Watching
- Island County
- Island Tug and Barge
- Jefferson County
- Kitsap County
- King County
- Marine Exchange of Puget Sound
- Masco Petroleum
- Maxum Petroleum
- Maya's Legacy
- Moran Shipping Agencies
- NOAA Emergency Response Division
- NOAA National Marine Sanctuaries
- Northern Gateway
- Northwest Indian Fisheries Commission
- Northwest Marine Trade Association
- Northwest Seaport Alliance
- Norton Lily Shipping Agents
- NRC Environmental Services
- NuStar Energy
- Ocean Ecoventures
- Orca Spirit Adventures Group
- Outer Island Excursions
- Pacific Merchant Shipping Association
- Pacific Northwest Waterways Association
- Pacific States Marine Fisheries Commission
- Philips 66 Ferndale Refinery
- Polar Tankers
- Port of Anacortes
- Port of Bellingham
- Port of Everett
- Port of Friday Harbor
- Port of Port Angeles
- Port of Port Townsend
- Port of Skagit County
- Port of Vancouver
- Province of BC
- Puget Sound Anglers
- Puget Sound Express
- Puget Soundkeeper
- Puget Sound Partnership
- Puget Sound Pilots
- Recreational Boating Association of Washington
- Reisner Distributor
- Salt Spring Adventures Co.
- San Juan County
- San Juan Cruises
- San Juan Excursions
- San Juan Island Outfitters

- San Juan Safaris
- SeaDoc Society
- SeaSpan
- Seattle Yacht Club
- Shell Puget Sound Refinery
- Shell Shipping
- Sidney Whale Watching
- Skagit County
- Snohomish County
- Sound Marine and Industrial Services
- Southport Agencies
- Spirit of Orca Whale and Wildlife Tours
- Springtide Charters
- SSA Marine
- Stand Earth
- Steveston Seabreeze Adventures
- Talon Ships
- The Nature Conservancy
- The Whale Museum
- Town of Friday Harbor
- Transmarine Navigation Corporation
- Transport Canada
- Transversal Shipping Company
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- U.S. Navy
- U.S. Oil
- Vancouver Whale Watch
- Washington Department of Fish and Wildlife
- Washington Environmental Council
- Washington Public Ports Association
- Washington Sea Grant
- Washington State Department of Natural Resources
- Washington State Ferries
- Washington State Maritime Cooperative
- Washington State Parks
- Washington State Recreation and Conservation Office
- Western Prince Whale Watching
- Western States Petroleum Association
- Whatcom County
- Wild Whales Vancouver
- Wilhelmsen

Appendix D. Standard, Expanded, and Combined Anchorage Figures for Vendovi Island East and South, Williams Point ATB, and Jack Island North and South Anchorages

A review of the AIS data shows that some anchorages had a high occurrence of vessels present outside the standard anchorage area encompassed by the anchorage polygon. For these anchorages, expanded anchorage areas were created to determine the number of vessels present in the area surrounding the anchorage. These additional figures depict the percentage of time vessels were present in the outside and combined areas for the five anchorages that had at least one vessel present in the area outside of the standard anchorage for at least 5 percent of the time in 2018.

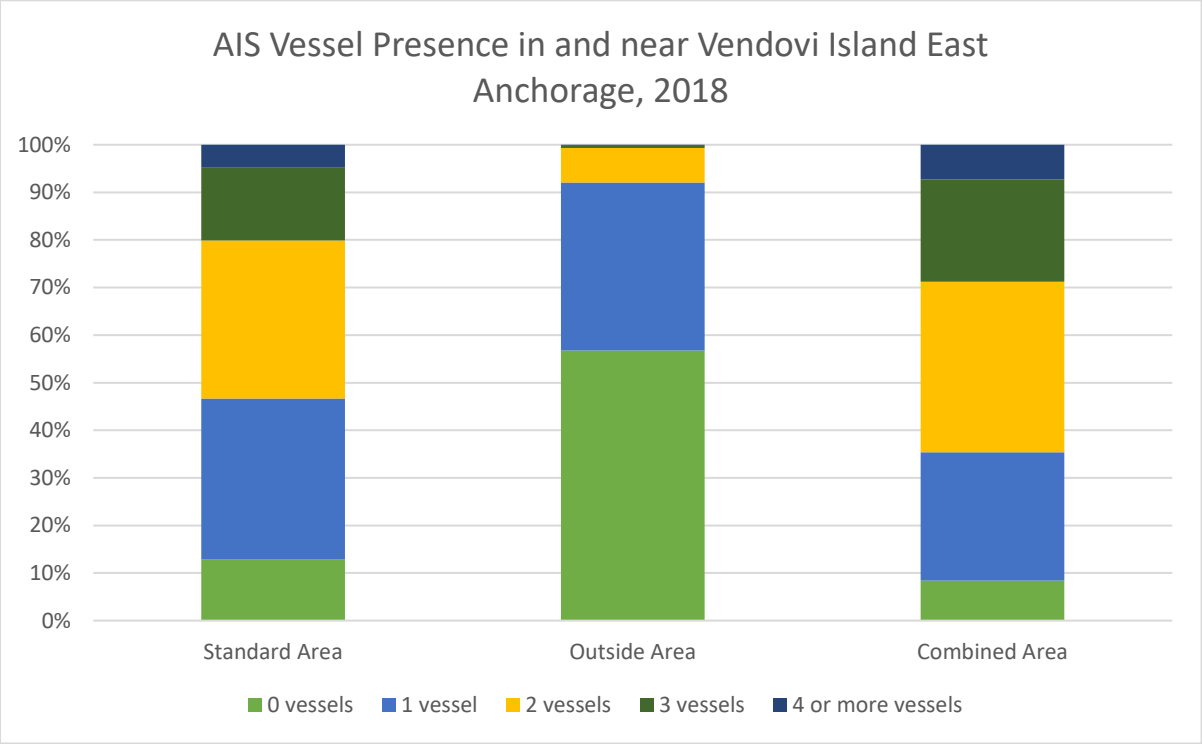


Figure 43: Number of vessels present (transmitting AIS for over 60 minutes) in and outside Vendovi Island East Anchorage in 2018

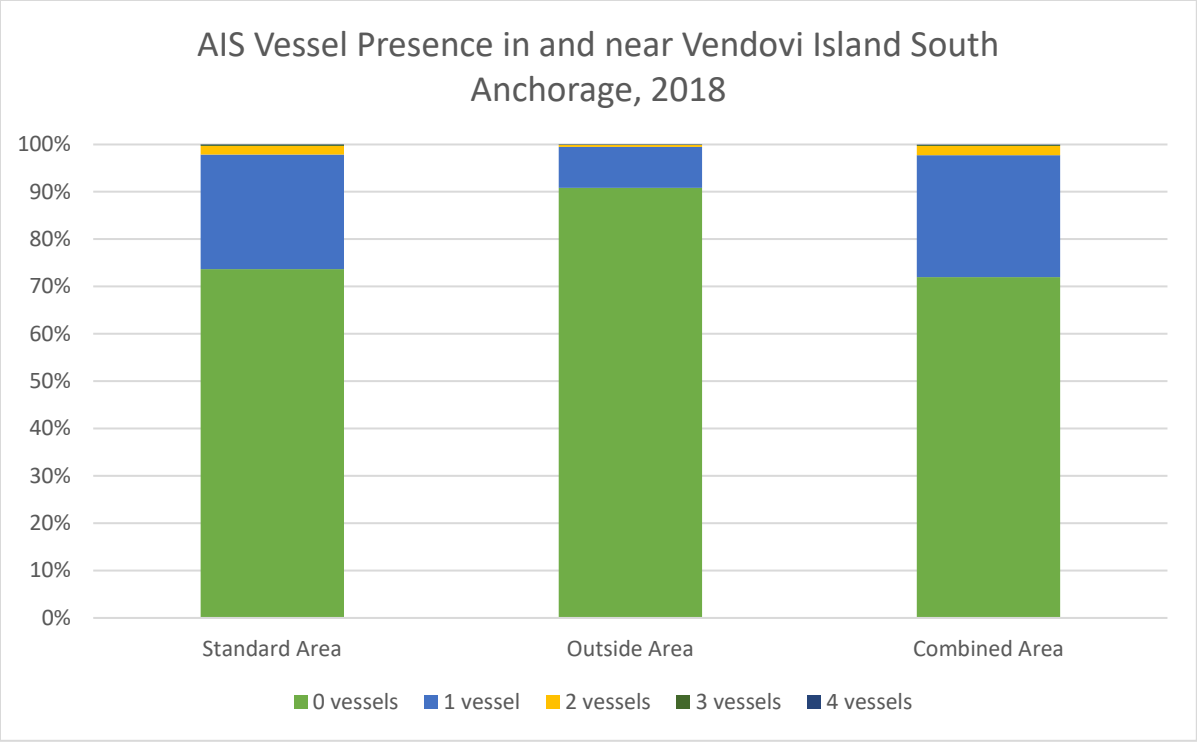


Figure 44: Number of vessels present (transmitting AIS for over 60 minutes) in and outside Vendovi Island South Anchorage in 2018

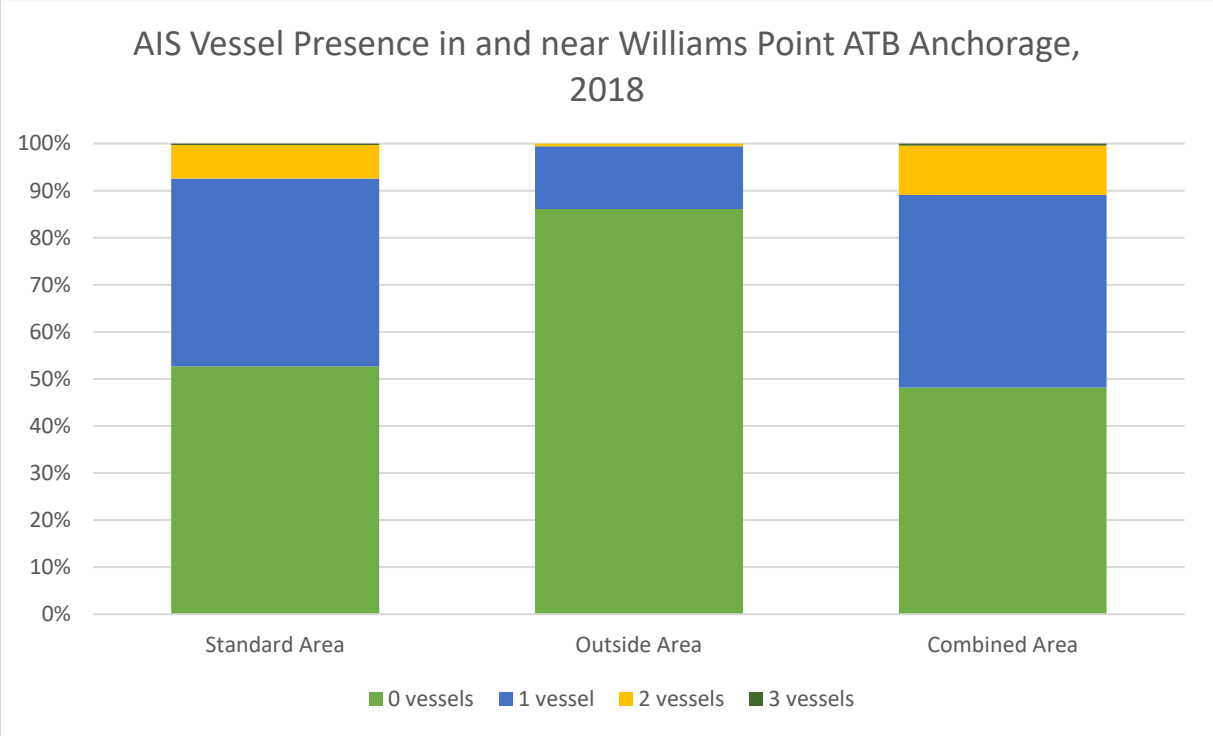


Figure 45: Number of vessels present (transmitting AIS for over 60 minutes) in and outside Williams Point ATB Anchorage in 2018

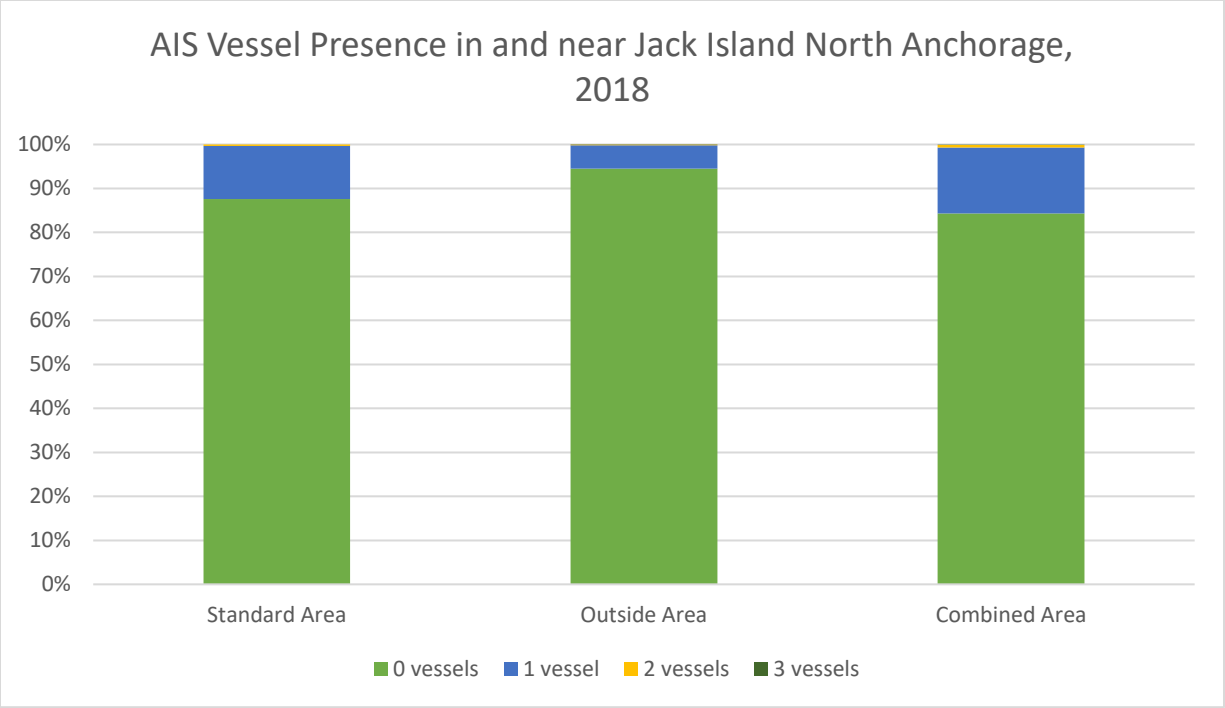


Figure 46: Number of vessels present (transmitting AIS for over 60 minutes) in and outside Jack Island North Anchorage in 2018

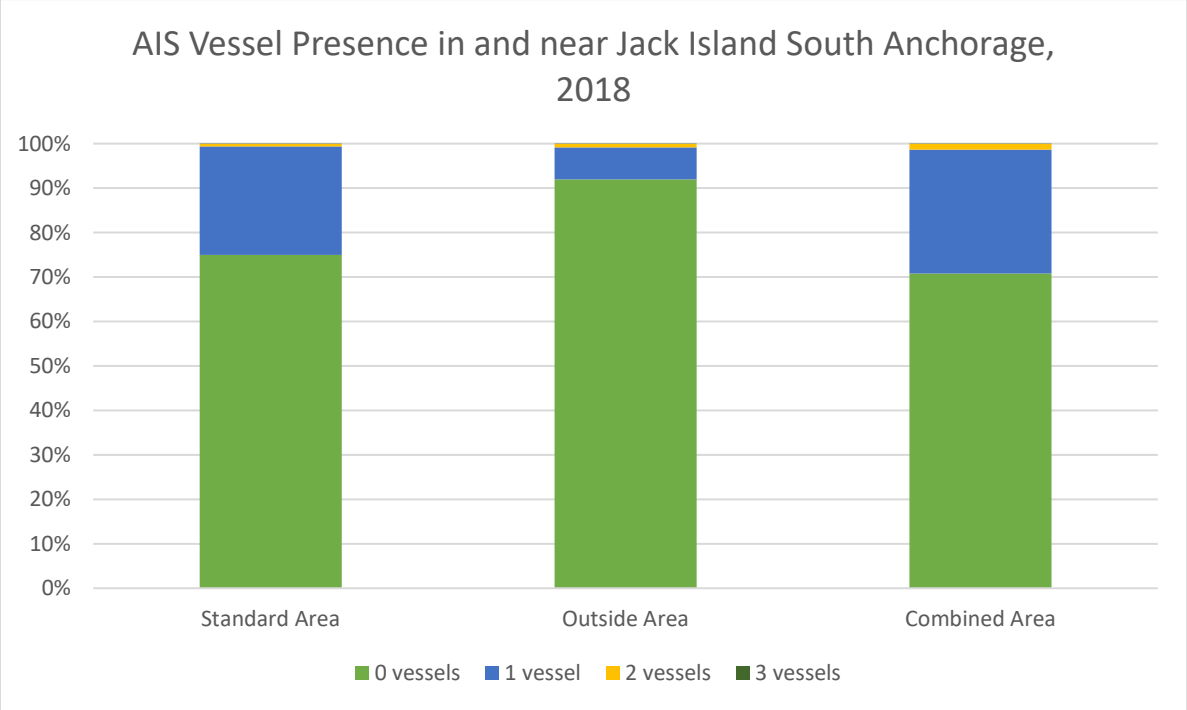


Figure 47: Number of vessels present (transmitting AIS for over 60 minutes) in and outside Jack Island South Anchorage in 2018

Appendix E. Crossing Line Data

Crossing Line	ATB	Bulk	Car Carrier	Cargo	Container Ship	Ferry	Fishing	Other	Passenger	Recreational	Tanker	Tug	Total
Admiralty Inlet	268	464	593	110	1884	828	1167	1087	861	4076	61	4168	15567
Boundary North	106	2707	493	293	1428	23	113	613	631	1184	471	653	8715
Guemes Cypress	97	11	0	26	0	8	386	154	162	724	53	488	2109
Gulf Islands North	4	0	0	1444	0	2869	406	333	1247	966	0	686	7955
Haro South	21	2600	488	247	1427	23	634	1038	931	2960	472	1358	12199
Moresby NoPender	82	491	0	99	0	10	165	549	457	2553	0	489	4895
Pt Roberts	276	2715	489	318	1437	22	681	716	995	1019	561	2532	11761
Rosario North	484	22	0	29	1	0	419	141	424	1408	666	3727	7321
Rosario South	481	32	0	46	1	68	745	284	596	1805	726	4076	8860
Saddlebag Huckleberry	118	5	0	28	0	0	88	213	29	630	203	1325	2639
Saturna SoPender	0	76	0	2	0	14	11	122	345	831	2	56	1459
Sinclair Lummi	216	18	0	7	0	1	200	67	411	894	357	1502	3673
SJDF	296	3141	844	342	2070	1	1519	836	531	1041	1191	871	12683
Waldron Orcas	0	0	0	2	0	12	84	76	330	1439	0	17	1960
Total	2449	12282	2907	2993	8248	3879	6618	6229	7950	21530	4763	21948	101796