

Eyes Over Puget Sound

[Field log](#)[Climate](#)[Water column](#)[Aerial photos](#)[Ferry monitoring](#)[Streams](#)

Surface Conditions Report June 8, 2015

Puyallup River at a record low flow

[Start here](#)

Up-to-date observations of visible water quality conditions in Puget Sound and the Strait of Juan de Fuca

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LONG-TERM MARINE MONITORING UNIT

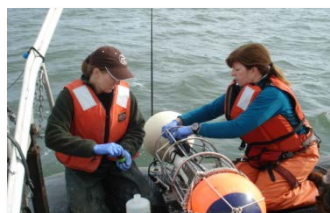
*Mya Keyzers
Laura Hermanson
Brooke McIntyre*



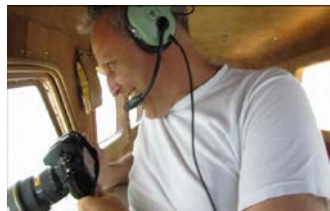
Skip Albertson



*Julia Bos
Suzan Pool*



*Dr. Christopher
Krembs*



Guests:
*Markus von Prause
Brandon Sackmann*



Personal field log

[p. 3](#)

Marine life in the Rocky Intertidal Zone.
Filter feeders and predators.

Climate conditions

[p. 5](#)

Rivers flows now have all dropped, especially the Skagit and Puyallup. Only the Fraser R. is running still slightly above normal. Air and ocean are warm and upwelling is back.

Water column

[p. 6](#)

Warm water in Puget Sound because of "the Blob". Temperatures are the highest on record since 1989. Oxygen is exhibiting new historical minima, an unusual condition given the time of year.

Aerial photography

[p. 10](#)

Large patches of jellyfish in finger inlets of South Sound.. Phytoplankton blooms in most places. Large Noctiluca bloom surfacing in Commencement Bay and around Port Madison. Rivers are flowing very low.

Ferry monitoring

[p. 35](#)

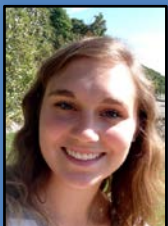
Puget Sound surface water is reaching >14 °C. High algal biomass in Elliott Bay and along the shoreline of Kingston.

Streams

[p. 37](#)

Record low flows for the Puyallup River on 6/4/2015 at river mile 6.6. Levels are below the regulatory minimum for in stream flows.

The Rocky Intertidal Part II - Filter Feeders



One way biologists classify organisms is by how they eat food. Here are some common filter feeders and predators in Puget Sound's rocky intertidal.

Brooke McIntyre

Olympia Oyster

(*Ostrea conchaphila*)

- Can filter about 1 gal. of water an hour!
- Predators = Crabs, sea stars, seabirds, humans



Butter Clam

(*Saxidomus gigantea*)

- Bury themselves 8-14 inches deep!
- Predators = sea stars, crabs, otters, humans



Breadcrumb Sponge

(*Halichondria panicea*)

- Attaches itself to rocks and can grow several feet across
- Predators = sea stars, snails, sea slugs



The Rocky Intertidal Part II - Predators



Brooke McIntyre

Tidepool Sculpin

(*Oligocottus maculatus*)

- Live up to 5 years
- Can breath air!
- Prey = crustaceans, worms



Moon snail

(*Euspira lewisii*)

- Grow up to 13cm in diameter
- Use a large muscular foot to move
- Lay eggs in large sand collars, shown here
- Prey = clams, snails



Sunflower Star

(*Pycnopodia helianthoides*)

- Grow up to 1m in diameter and move 5ft/min
- Pushes it's stomach outside it's mouth to eat prey!
- Prey = urchins, clams, snails

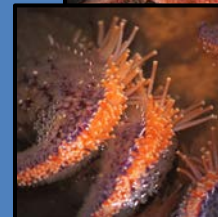


Photo Credits:

<http://www.pugetsound.edu/academics/academic-resources/slater-museum/exhibits/marine-panel/moon-snail/>; <http://www.alaskafloatsmyboat.com/beachcombing/2012/11/16/sunflower-seastars/>; <http://www.habitat.noaa.gov/images/oysters1.jpg>; <http://www.inaturalist.org/observations/1339582>; <http://northislandexplorer.com/molluscs/washingtonbutterclam.htm>

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Climate and natural influences, including weather, rivers, and the adjacent ocean, can affect our marine waters. Graphics are based on provisional data and are subject to change.

http://www.ecy.wa.gov/programs/eap/mar_wat/weather.html.

Summary:

Air temperatures were warmer than normal across Western Washington.

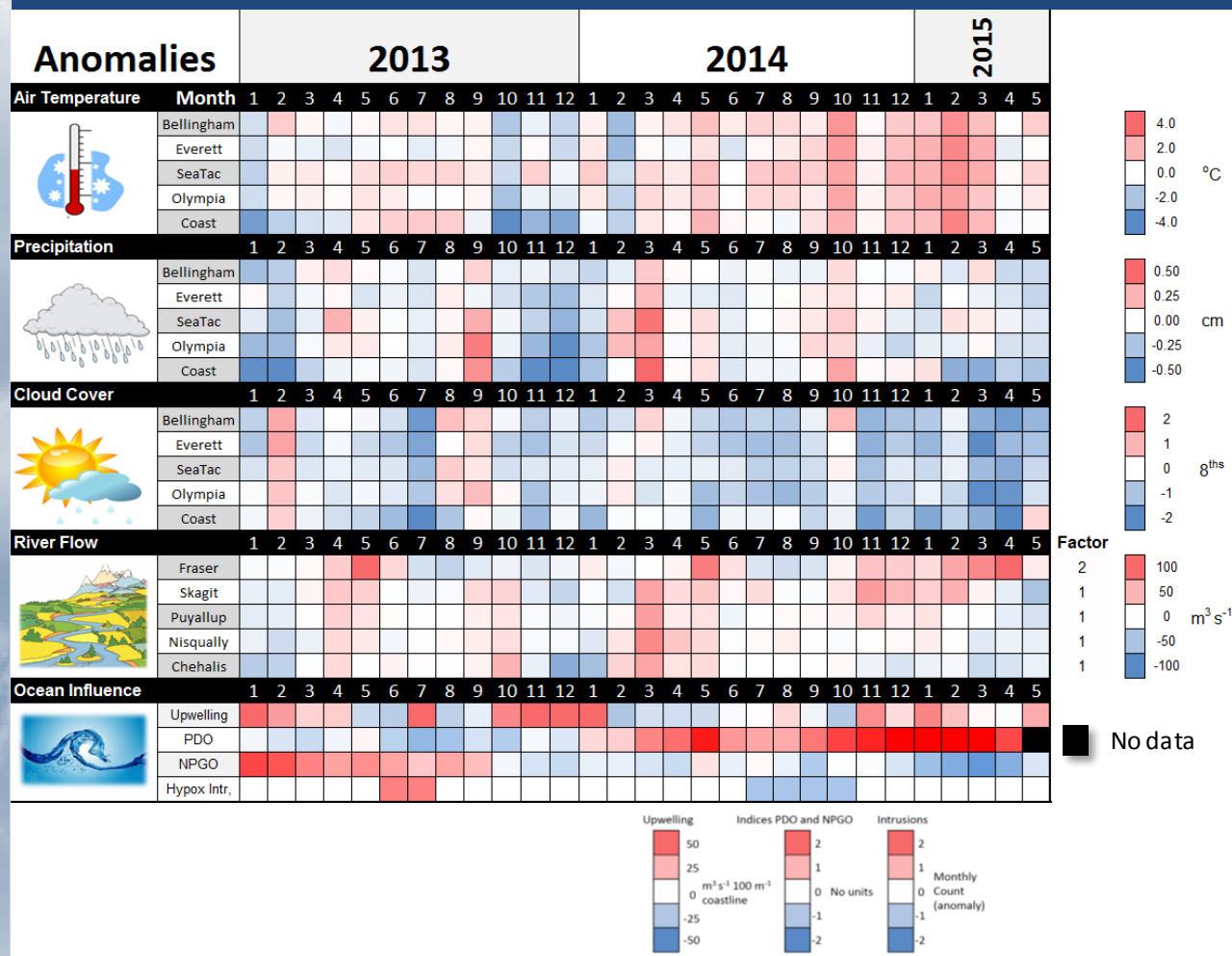
Precipitation was below normal in the Puget Sound region.

Sunshine has generally been above normal, except out on the coast.

River flows have all dropped, especially the Skagit and Puyallup. The Fraser is the only river running still (slightly) above normal.

PDO remains in the warm phase, and **upwelling** is now above normal.

Putting the puzzle-pieces of influencing factors together...



Our long-term marine monitoring stations in Washington

[Field log](#)[Weather](#)[Water column](#)[Aerial photos](#)[Ferry monitoring](#)[Streams](#)

- North Sound / San Juan Isl.
- Central Sound
- Whidbey Basin
- Hood Canal
- South Sound
- Grays Harbor & Willapa Bay

Stations:

ADM002

PTH005

ADM001

HCB010

HCB003

HCB007

HCB004

CSE001

OAK004

GYS004

GYS016

GYS008

WPA003

WPA004

WPA113

WPA001

WPA006

GRG002

BLL009

RSR837

SJF000

SJF001

SKG003

SJF002

SAR003

PSS019

ADM003

PSB003

ELB015

SIN001

EAP001

CMB003

CRR001

GOR001

NSQ002

DNA001

BUD005

Stations are sampled monthly by region using four independent flights. The float plane is equipped with a CTD package.

We use a chartered float plane and boat to access our monthly monitoring stations.

Start here

We communicate data and environmental marine conditions using:

1. Marine Water Condition Index (MWCI)
2. Eyes Over Puget Sound (EOPS)
3. Anomalies and source data

Physical conditions tracked in statistically historic context



Field log

Weather

Water column

Aerial photos

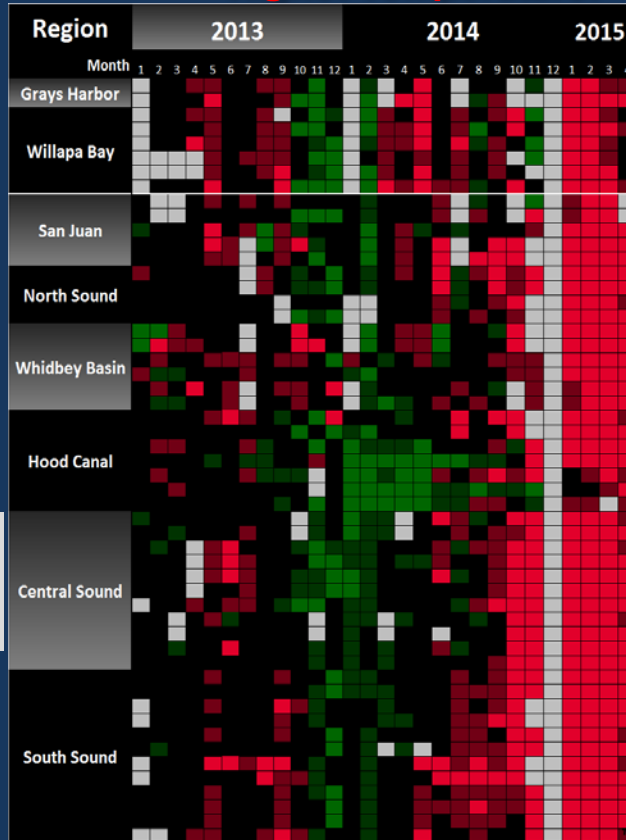
Ferry monitoring

Streams

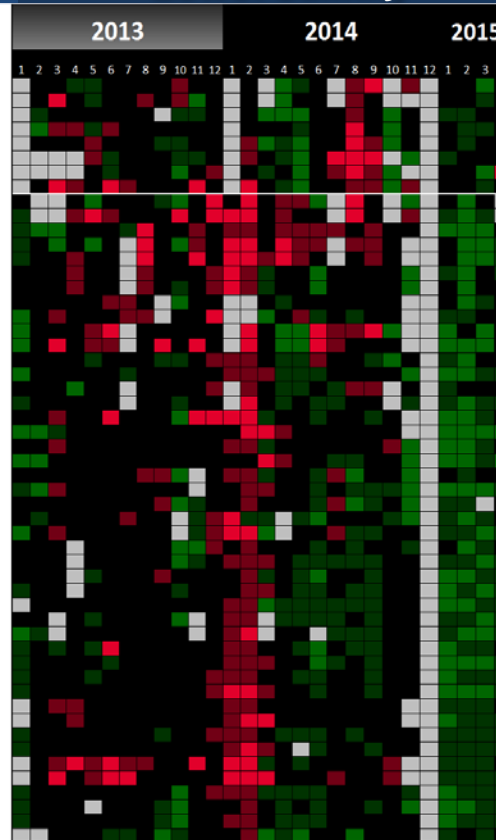


Conditions were dominated by warm water associated with the warm NE Pacific Ocean surface anomaly (“The Blob”). Starting in October, temperatures are the highest on record since 1989. Salinities and oxygen are lower in Puget Sound. Hood Canal has also reached new temperatures maxima.

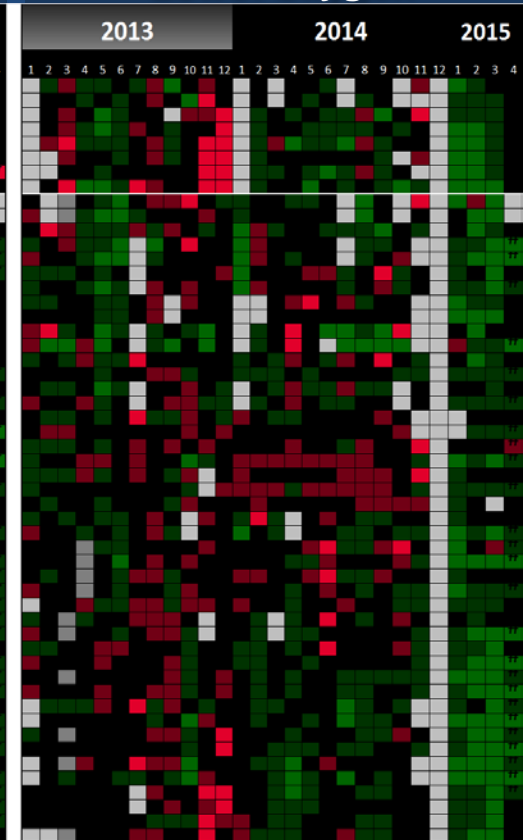
Higher Temperature!



Lower Salinity



Lower Oxygen



Red boxes show that the water measured is warmer than any of our measurements since 1989.

[Explore profiles at all stations](#)

■ = higher than expected (>IQR, n=13)
■ = higher than previous measurements

■ = expected (=IQR, n=13)
■ = no data

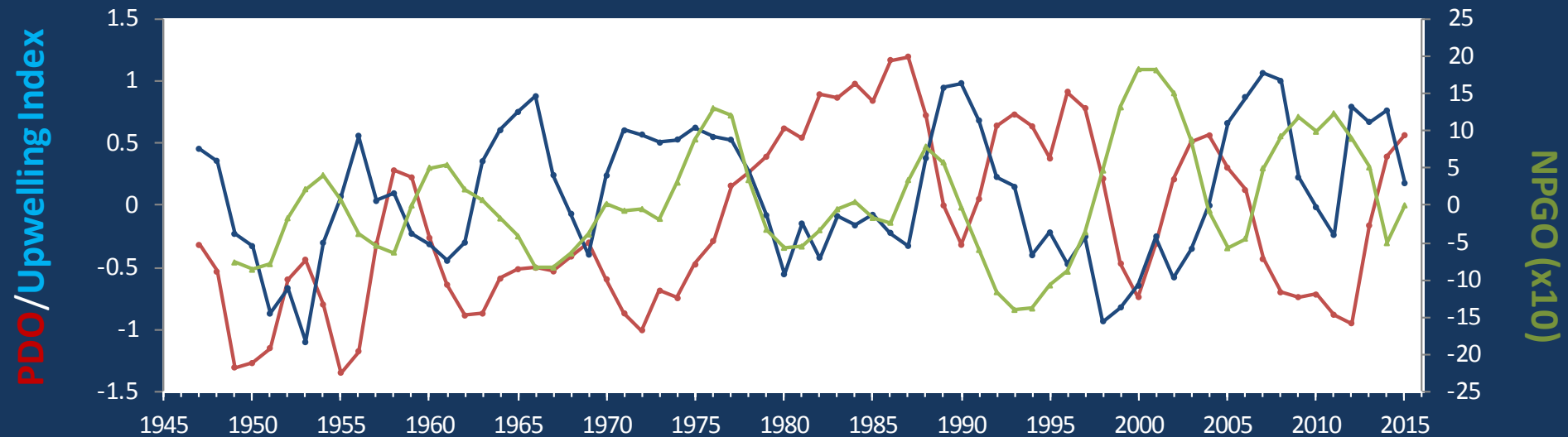
■ = lower than expected (>IQR, n=13)
■ = lower than previous measurements

The ocean affects water quality: Ocean Climate Indices

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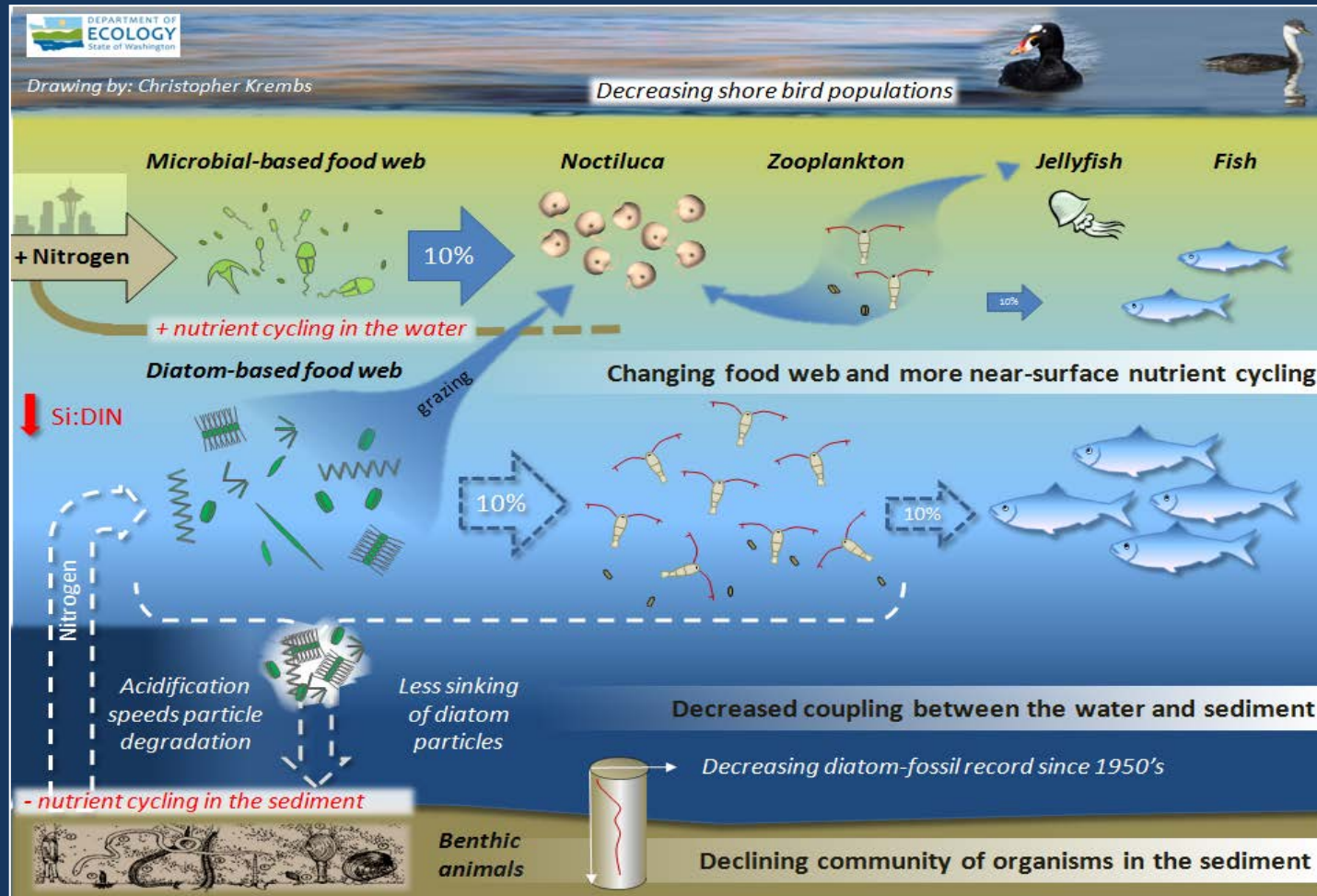
- a) Pacific Decadal Oscillation Index (**PDO, temperature**) [\(explanation\)](#)
- b) Upwelling Index (anomalies) (**Upwelling, low oxygen**) [\(explanation\)](#)
- c) North Pacific Gyre Oscillation Index (**NPGO, productivity**) [\(explanation\)](#)

Three-year running average of PDO, Upwelling, and NPGO indices scores



Ocean boundary conditions are no longer favorable for water quality in Puget Sound: (a) water is warming (PDO), (b) upwelling of low oxygen and high nutrient ocean water is again increasing (Upwelling Index), and (c) higher surface productivity along the coast (NPGO) is falling. Where are we heading next?

Hypothesis for combining a series of recent observations affecting energy and material transfer to higher trophic levels



Hypothesis!

Increases in nitrate concentrations could be caused by a top-down control on phytoplankton biomass.

Is *Noctiluca* a visible harbinger of a food web change?

Are changes in higher trophic levels part of a story of the low food web?

[Follow the experts](#)
[WebEx](#)

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Large patches of jellyfish in finger inlets of South Sound. Phytoplankton blooms in most places. Large Noctiluca bloom surfacing in Commencement Bay and around Port Madison. River discharge into Puget Sound is visibly very low.

Puyallup River at record low flows!



Macro-algae rafts in South Sound



[Click on numbers](#)

[Start here](#)



Mixing and Fronts:

Tidal eddy off Blake Island. Tidal fronts are nicely visible by different coloration of the water in response to blooms.



Jellyfish:

Sizable jellyfish patches present in southern inlets of South Sound (Budd and Eld Inlets).



Suspended sediment:

Very little amounts of suspended material associated with river plumes.



Visible blooms:

Green-brown: Wollochet Bay, surrounding Bainbridge Island

Red-brown: Eld Inlet

Green: Quartermaster Harbor, Henderson Inlet.

Noctiluca: Commencement Bay, Near Port Madison, Kingston

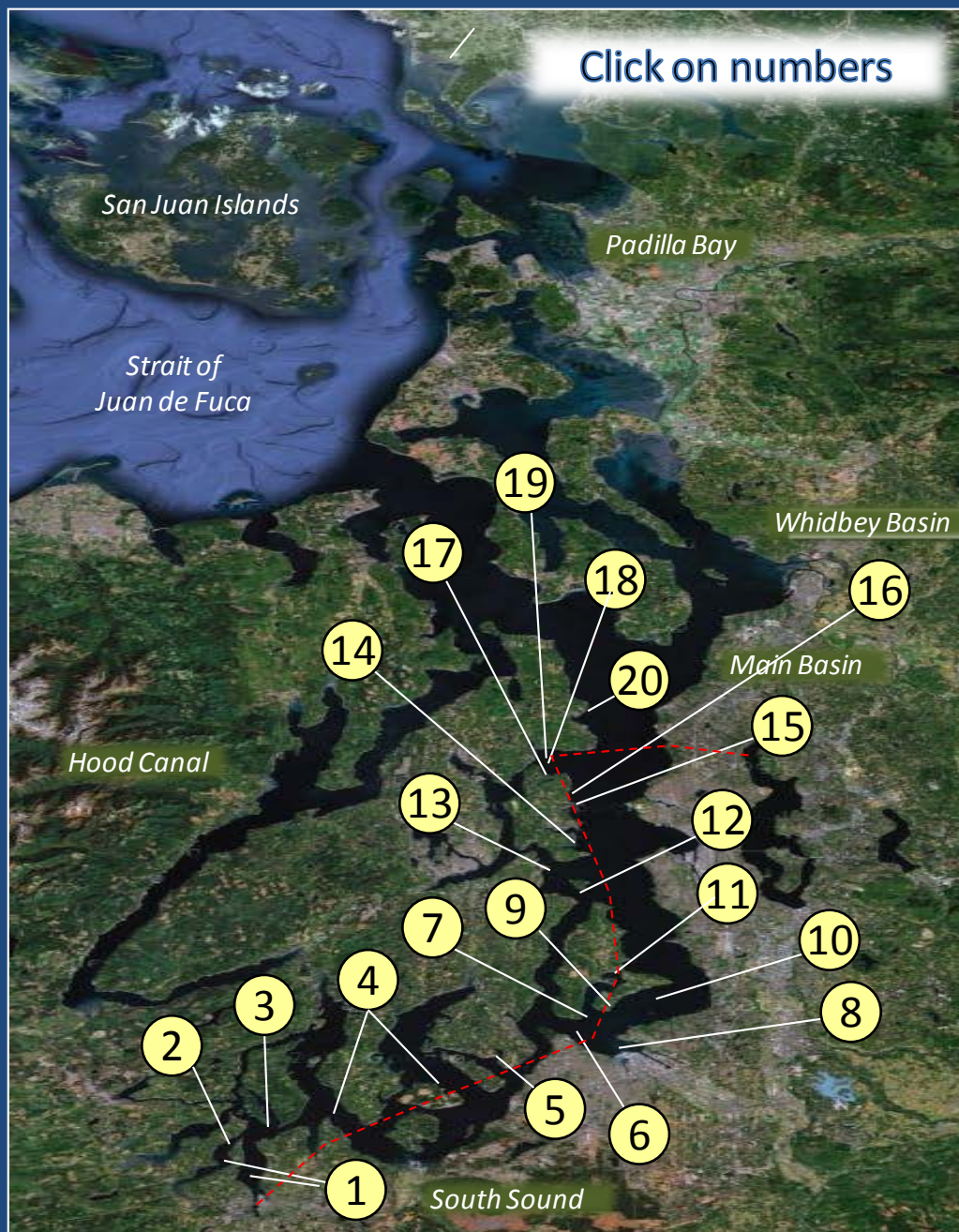


Debris:

Very abundant in South Sound, Commencement Bay and surrounding Bainbridge Island.



Click on numbers



Aerial photography and navigation guide

Date: 6-8-2015

Tide data (Seattle):

04:26 AM	5.2	L
09:26 AM	8.53	H
03:57 PM	0.09	L
11:02 PM	12.06	H

Flight Information:

Afternoon flight, photos 1-20

Broken ceiling, good visibility, locally windy and cloudy

--- Flight route

Observation Maps:

Central and North Sound

South Sound

Field log

Climate

Water column

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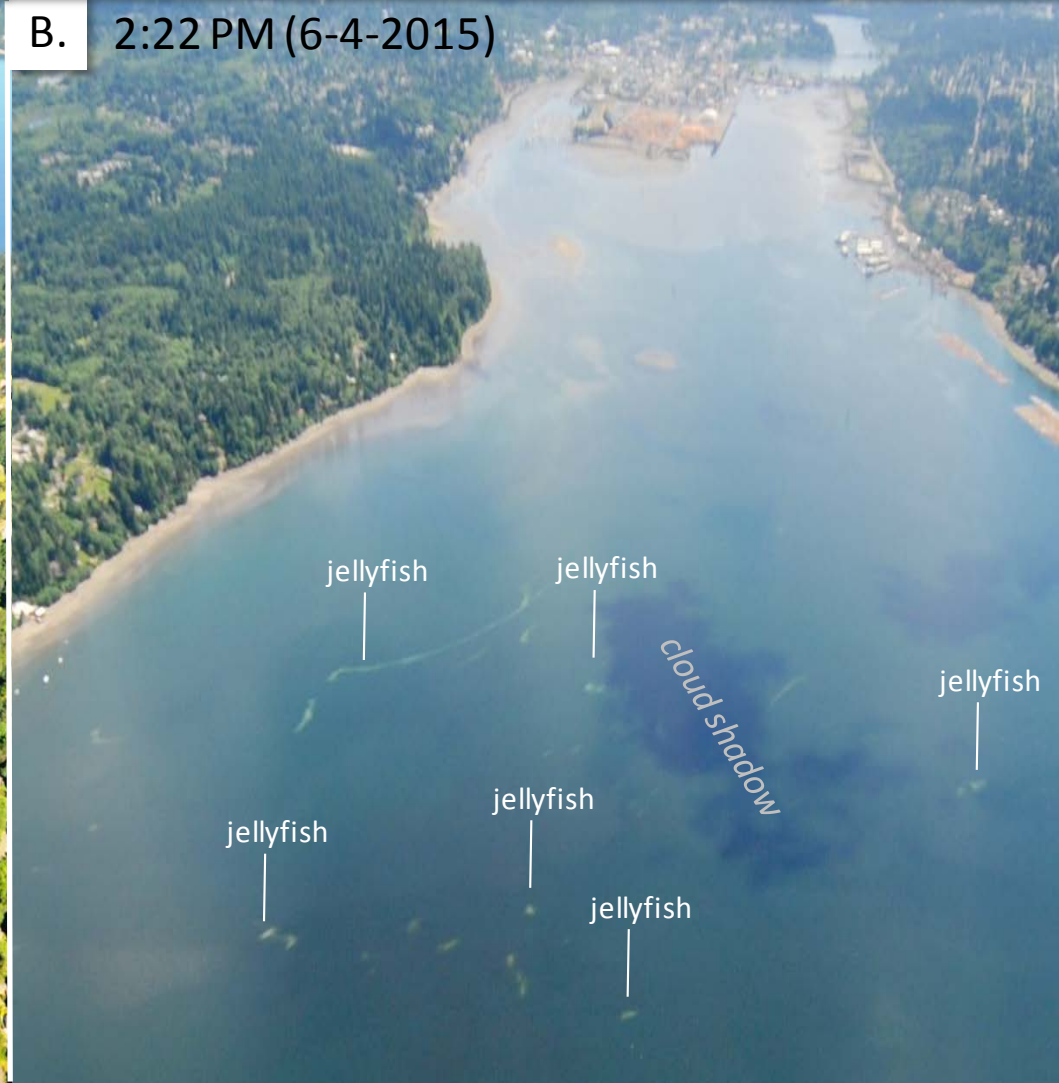
Ferry monitoring

Streams

A. 3:11 PM



B. 2:22 PM (6-4-2015)



*Large patches of jellyfish forming in finger inlets of South Sound.
Location: A. Eld Inlet; B. Budd Inlet on 6-4-2015 (South Sound).*

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Red-brown bloom.

Location: Eld Inlet (South Sound), 3:12 PM.



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Ribbons of organic material, tidal fronts and bloom highlighting dynamic in finger inlets of South Sound.
Location: Squaxin Island (South Sound), 3:14 PM.



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A.



B.



Large ribbons and patches of organic debris in many places of South Sound.
Location: A. North of McNeil Island, B. Nisqually Reach (South Sound), 3:16 PM.

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Brown bloom originating in Wollochet Bay.
Location: Wollochet, Tacoma Narrows, (South Sound), 3:22 PM.



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Large Noctiluca bloom surfacing and gathering in large quantities at tidal front.
Location: Commencement Bay (Central Sound), 3:32 PM.



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*Large Noctiluca bloom surfacing at entrance to Quartermaster Harbor.
Location: Vashon Island (Central Sound), 3:32 PM.*



Field log

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Sediment plume of Puyallup River with internal waves meandering into Bay and mixing with a bloom.
Location: Commencement Bay (Central Sound), 3:28 PM.

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*Large Noctiluca bloom surfacing and being washed on beaches near Piner Point.
Location: Vashon Island (Central Sound), 3:32 PM.*



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*Large Noctiluca bloom held back front off Maury Island Marine Park and Saltwater State Park.
Location: East of Vashon Island (Central Sound), 3:32 PM.*



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Algae bloom in Quartermaster Harbor.

Location: Quartermaster Harbor, Vashon Island (Central Sound), 3:33 PM.

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Large tidal eddy off Blake Island visible by bloom that mixes into the eddy.

Location: Blake Island, (Central Sound), 3:39 PM.



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*Large ribbons of organic debris (likely Noctiluca) lining bloom originating from Sinclair Inlet.
Location: Near Manchester, (Central Sound), 3:40 PM.*

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Bloom and organic debris (likely Noctiluca)

Location: Near Port Blakely, Bainbridge Island (Central Sound), 3:42 PM.

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Large Noctiluca bloom has surfaced near northeast Bainbridge Island across Discovery Park, Seattle.
Location: Bainbridge Island (Central Sound), 3:45 PM.

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Large Noctiluca bloom has surfaced near northeast Bainbridge Island.
Location: Bainbridge Island (Central Sound), 3:45 PM.

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Patches of Noctiluca bloom inside bay amongst boat docks.
Location: West Port Madison (Central Sound), 3:47 PM.



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Noctiluca bloom starting to surface and getting washed onto beaches.
Location: Port Madison (Central Sound), 3:47 PM.



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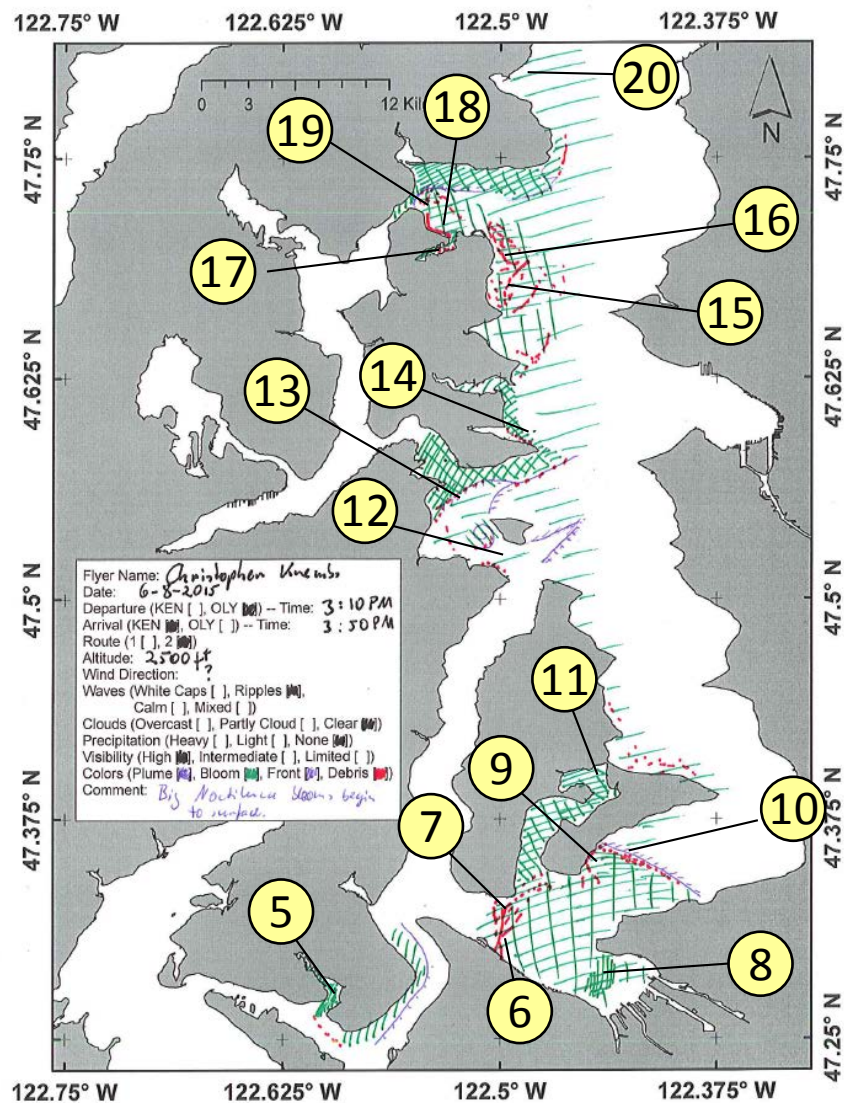


Much of the Noctiluca bloom is still under the surface.
Location: Port Madison (Central Sound), 3:47 PM.

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Noctiluca first emerges in red ribbons at surface on near Kingston on 6-4-2015.

Location: Kingston (South Sound), 2:30 PM.



Central Sound Date: 6-8-2015

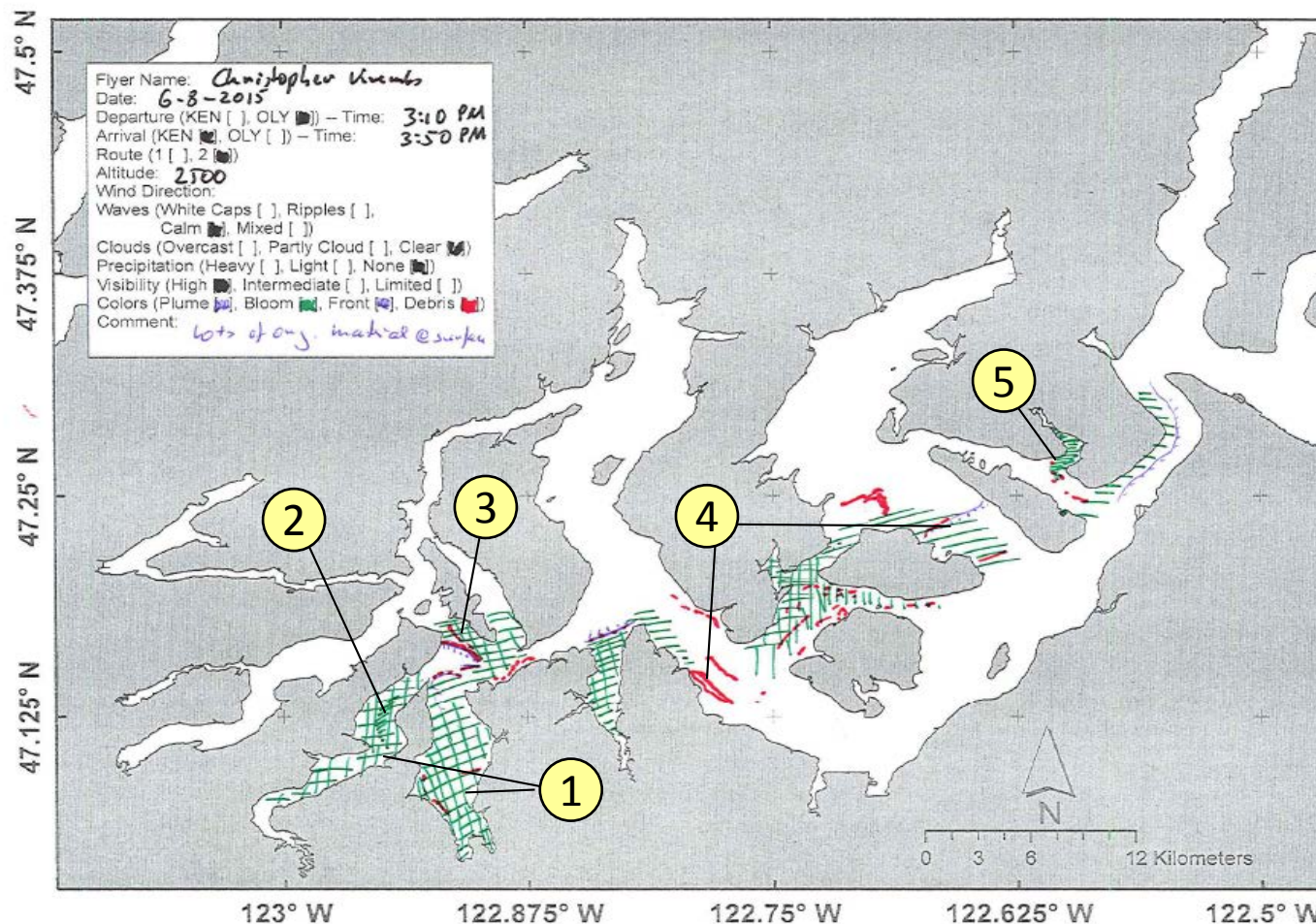
Numbers on map refer to picture numbers for spatial reference

Qualitative aerial observer map during transit










[Navigate](#)


Date: 6-8-2015

South Sound



Numbers on map refer to picture numbers for spatial reference

Plumes	
• Freshwater with sediment solid	
• Freshwater with sediment dispersed	
• Coastal erosion with sediment	
Blooms	
• Dispersed	
• Solid	
Debris	
• Dispersed	
• Solid	
Front	
• Distinct water mass boundaries	
• Several scattered	

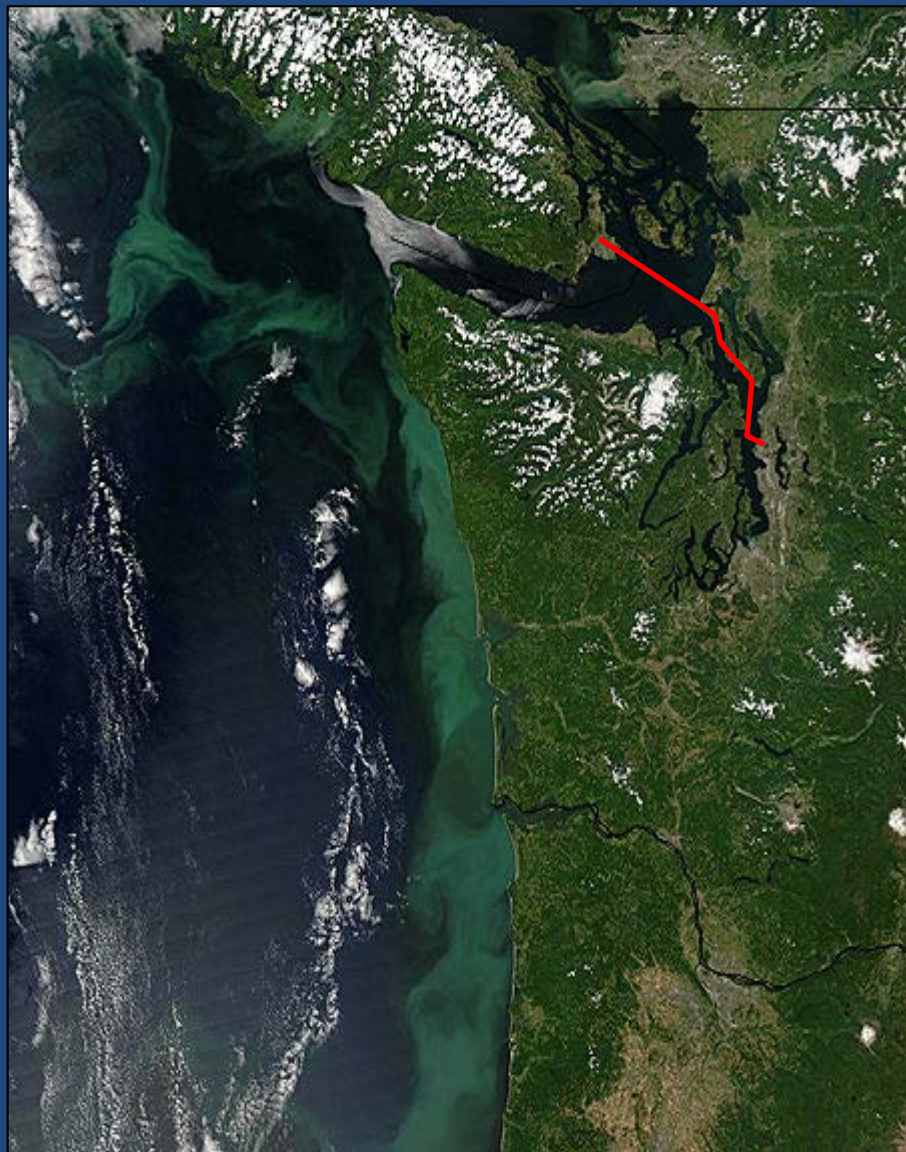
Comments:

Maps are produced by observers during and after flights. They are intended to give an approximate reconstruction of the surface conditions on scales that connect to and overlap with satellite images in the section that follows.

Debris:

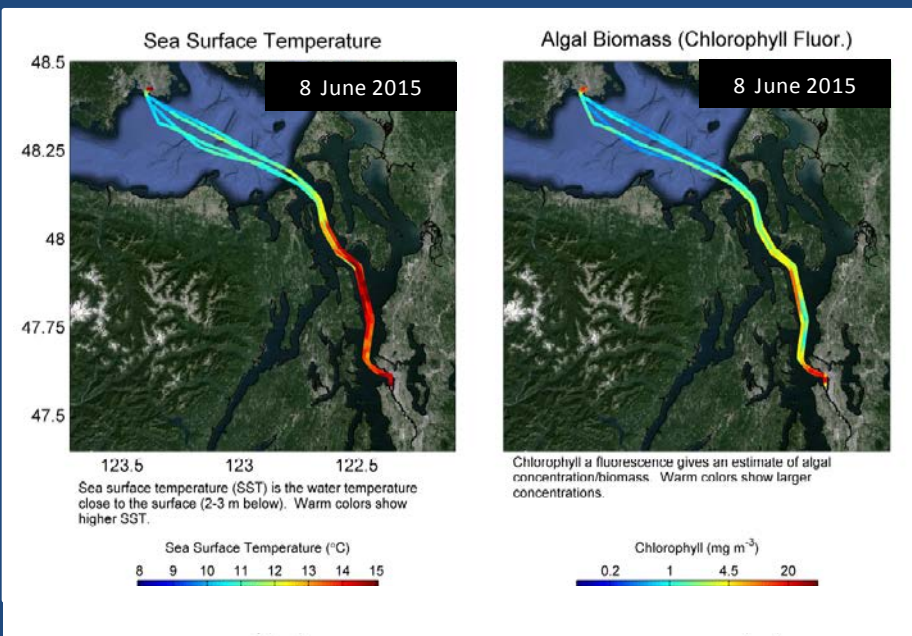
Debris can be distinguished into natural and anthropogenic debris floating at the surface *sensu* Moore and Allen (2000). The majority of organic debris in Puget Sound is natural and mixed with discarded man-made pieces of plastic, wood, etc. From the plane, we cannot differentiate the quality of debris at the surface and therefore, call it for reasons of practicality just “debris”.

S.L. Moore, M. J. Allen. 2000. Distribution of Anthropogenic and Natural Debris on the Mainland Shelf of the Southern California Bight. Marine Pollution Bulletin, 40(1): 83–88.



Brandon Sackmann

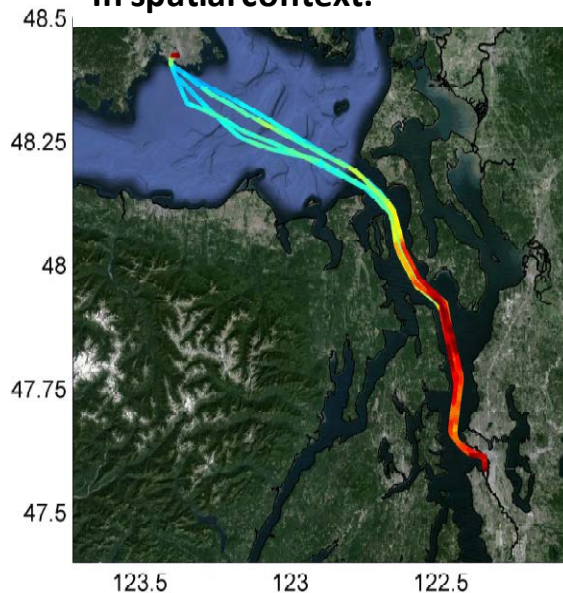
Contact: bsackmann@integral-corp.com



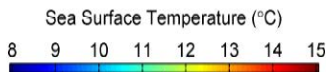
Current Conditions:

Puget Sound surface water is reaching >14 °C. High algal biomass in Elliott Bay and along the shoreline of Kingston.

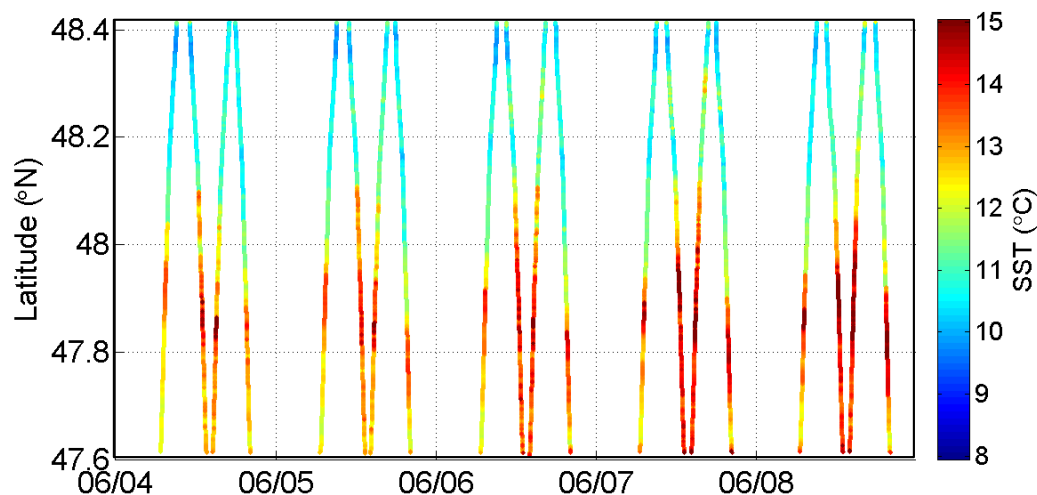
In spatial context:



Sea surface temperature (SST) is the water temperature close to the surface (2-3 m below). Warm colors show higher SST.



In temporal context:



Pockets of sea surface temperatures are now reaching $>15^{\circ}\text{C}$ near Kingston around the “Triple Junction” (Admiralty Reach, Whidbey Basin and Central Sound). Temperature are favorable for harmful algae species to bloom.



The *Victoria Clipper IV* carries sensors in its sea chest. The sensors allow us to get surface transects of temperature, chlorophyll, salinity, and other bio-optical measurements between Seattle and Victoria, BC twice per day.

Stream Flow on the Puyallup River

6-4-2015



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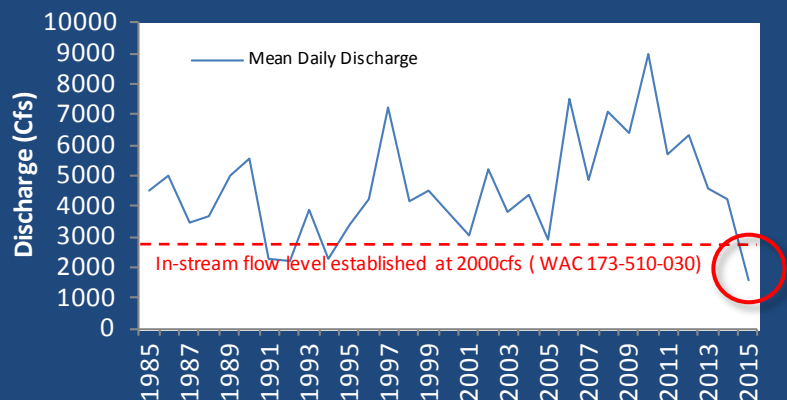
Record low flows of the Puyallup

On 6/4/2015 daily mean flow levels at the USGS flow gage ([12101500 \(Puyallup River at Puyallup\)](#)) on the lower Puyallup River at river mile 6.6. reached 1600 cfs. Levels are below the regulatory minimum for in-stream flows established for this Puyallup River site.

[\(Chapter 90.010, Revised Code of Washington\)](#)

Left: Aerial photo of the Puyallup River flowing into Commencement Bay on the record day of 6-4-2015

USGS Flow Gage 12101500 Puyallup River @ Puyallup, WA Mean Daily Discharge recorded for June 4th (30 year Period of Record)



The plot on the left indicates the observed mean daily discharge recorded since 1985 for the day of June 4th.

According to USGS historical flow data, this is the lowest discharge value recorded for the day of June 4th for the entire period of record (1914-2015).

Furthermore, the observed flow on 6/4/2015 (1600 cfs) is below the minimum mean flow observed for the months of May and June during the entire historical record as well.

Get data from Ecology's Marine Monitoring Programs



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Long-Term Monitoring Network

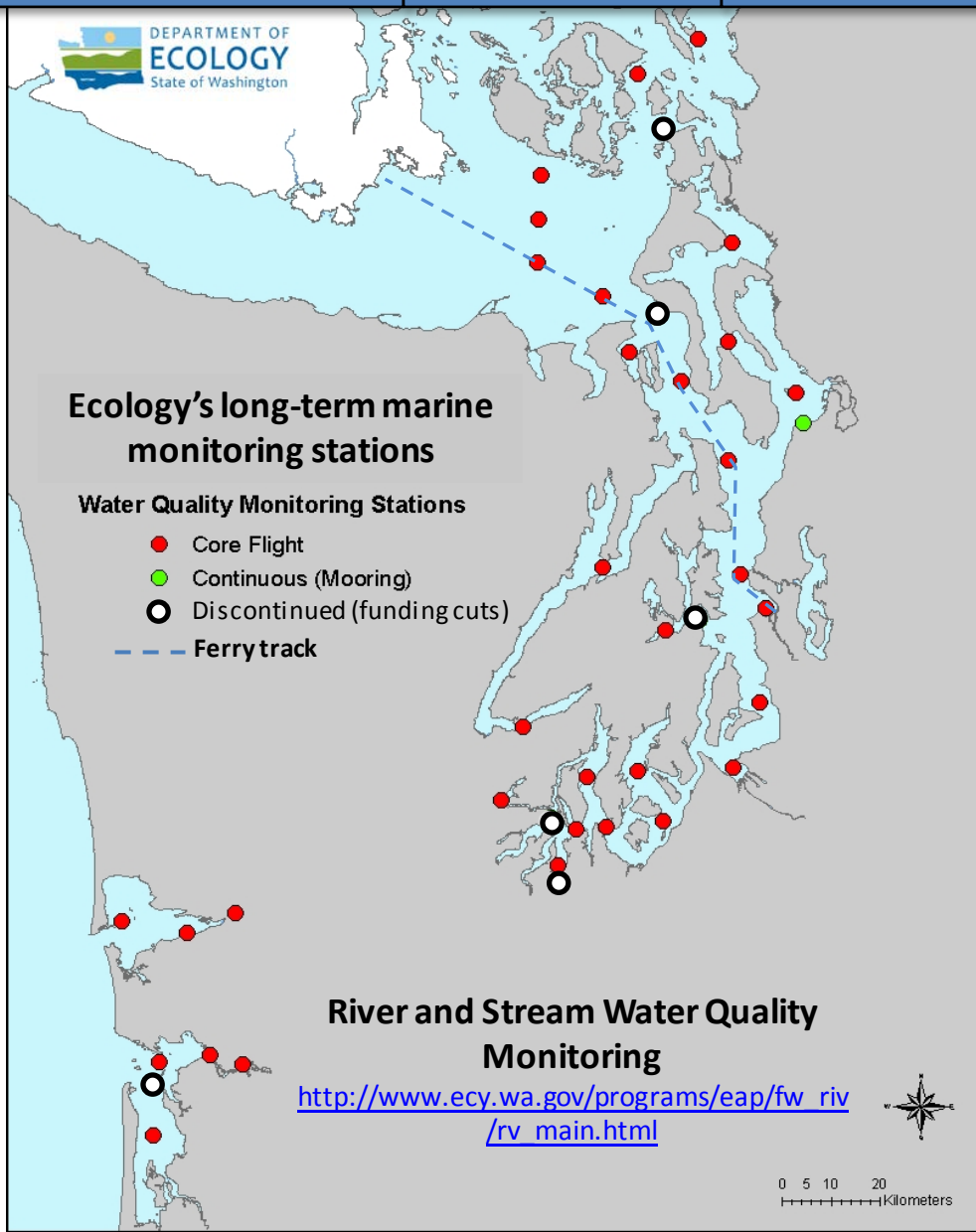


christopher.krembs@ecy.wa.gov



Access core monitoring data:

<http://www.ecy.wa.gov/apps/eap/marinewq/mwdataset.asp>



Real-Time Sensor Network



Suzan.Pool@ecy.wa.gov



Access mooring data:

ftp://www.ecy.wa.gov/eap/Mooring_Raw/Puget_Sound/

You may subscribe or unsubscribe to the Eyes Over Puget Sound email listserv by going to:

<http://listserv.wa.gov/cgi-bin/wa?A0=ECOLOGY-EYES-OVER-PUGET-SOUND>



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We are looking for feedback to improve our products.

Dr. Christopher Krembs

christopher.krembs@ecy.wa.gov

**Marine Monitoring Unit
Environmental Assessment Program
WA Department of Ecology**

