Publication No. 16-03-071

DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound

Surface Conditions Report, March 16, 2016

Critter of the Month

Start here

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

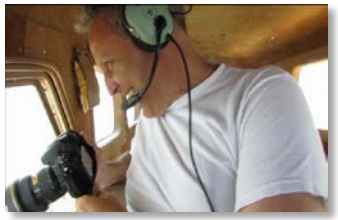
Marine conditions from 3-16-2016 at a glance

LONG-TERM MARINE MONITORING UNIT

Dany Burgess
Angela Eagleston

Skip Albertson

Dr. Christopher Krembs (Editor)



Julia Bos
Suzan Pool

Jim Shedd

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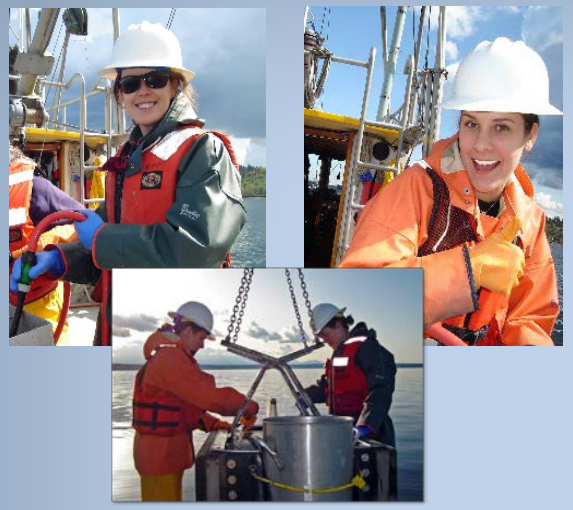
Eyes Under Puget Sound 3-16-2016

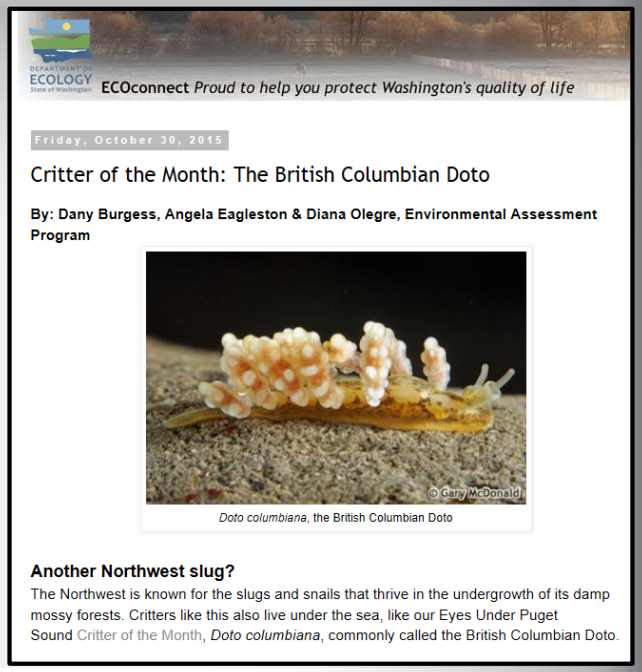


Dany Burgess & Angela Eagleston
Marine Sediment Monitoring Team

Critter of the Month

As benthic invertebrate taxonomists with the Marine Sediment Monitoring Team, we are excited to highlight the fascinating critters inhabiting the sediments of Puget Sound!

Learn about a different species each month on Ecology's EcoConnect blog and other social media sites.



ECOconnect *Proud to help you protect Washington's quality of life*

Friday, October 30, 2015

Critter of the Month: The British Columbian Doto

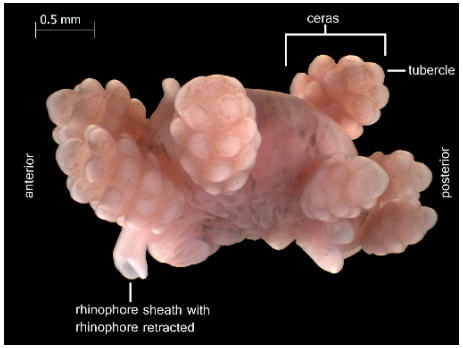
By: Dany Burgess, Angela Eagleston & Diana Olegre, Environmental Assessment Program

Doto columbiana, the British Columbian Doto

Another Northwest slug?

The Northwest is known for the slugs and snails that thrive in the undergrowth of its damp mossy forests. Critters like this also live under the sea, like our Eyes Under Puget Sound Critter of the Month, *Doto columbiana*, commonly called the British Columbian Doto.

Read here



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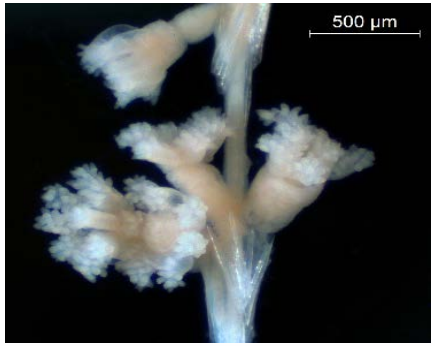


Read here

Read here

Natural Influences leading to 3-16-2016

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, page 26.

Putting the puzzle pieces of influencing factors together…

Summary for February 2016:

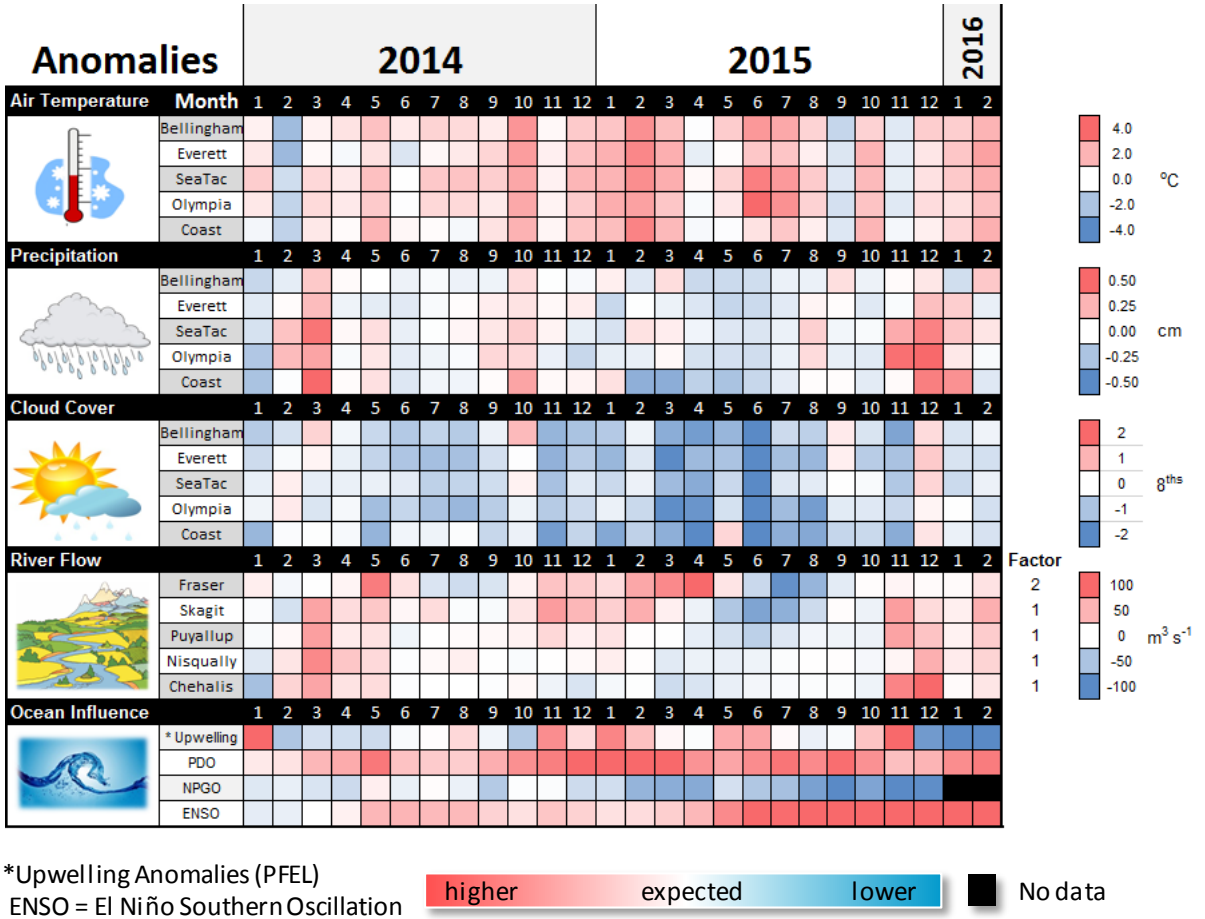
Air temperatures remained above normal in the Puget Sound lowlands.

Precipitation levels were above normal overall.

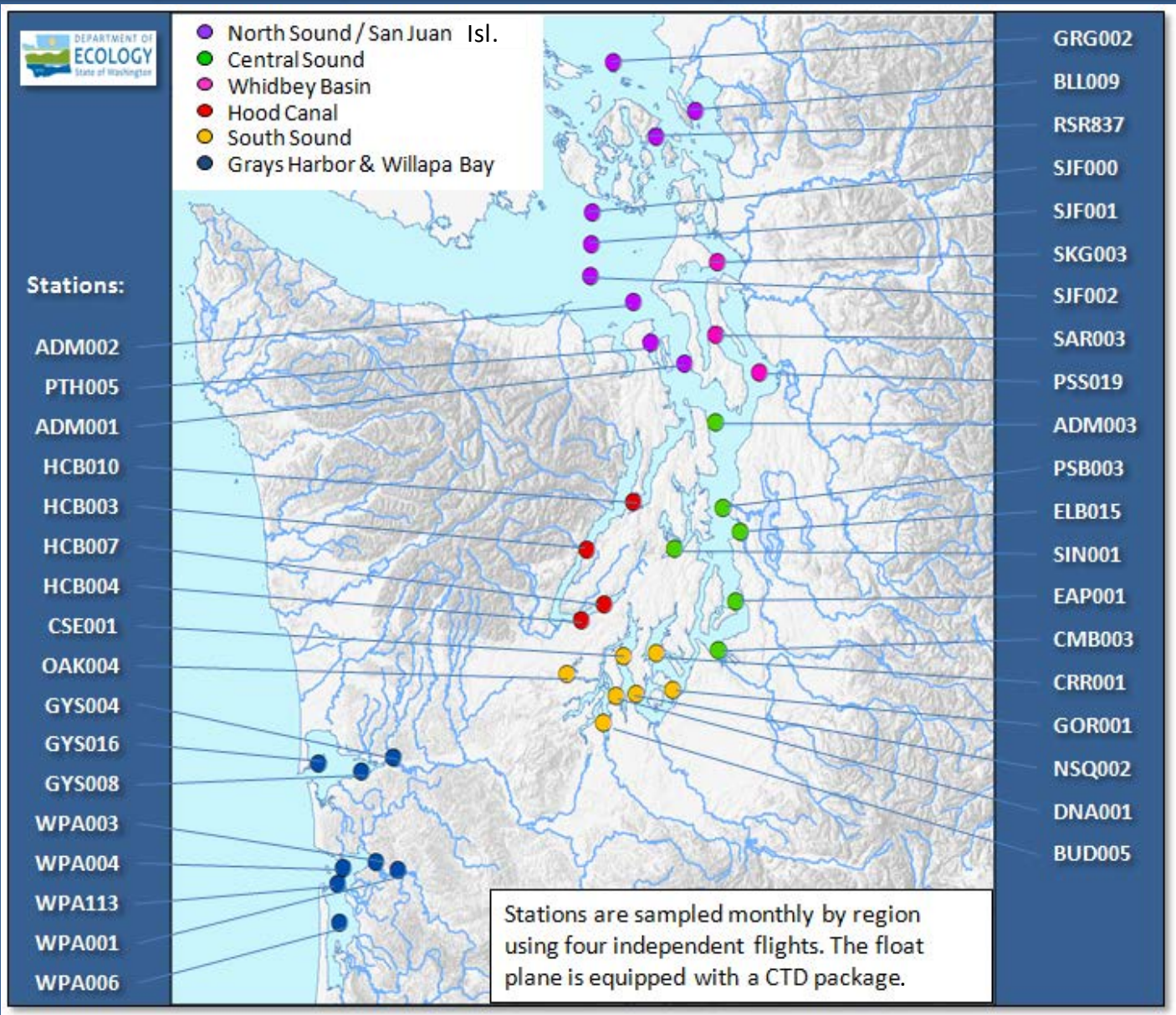
Sunshine levels were generally above normal, but alternated with cloudy periods.

River flows continued above normal.

Downwelling was strong, and ENSO and PDO remained in their warm phase (El Niño).



Our long-term marine monitoring stations in Washington



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

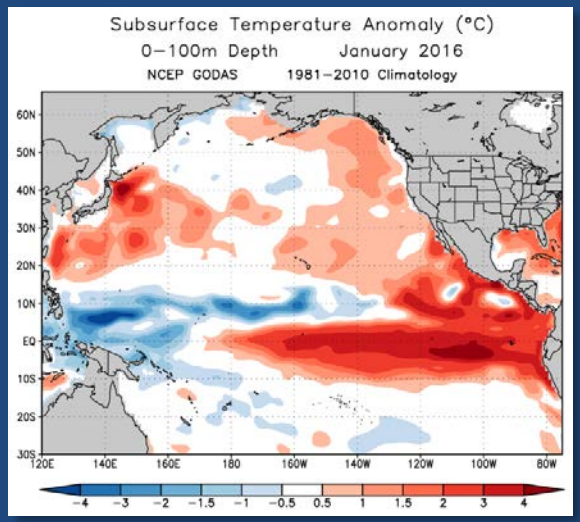
Start here

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**

Are Puget Sound conditions normalizing?

Year 2015 was a record breaker for water temperature in Puget Sound and for global temperatures. Premature melting of the snowpack in early summer caused initially fresh conditions. This year looks better. The winter brought record-breaking rain and, as a result, estuarine circulation has increased to renew the water within Puget Sound. **Yet, water temperatures are still high!**

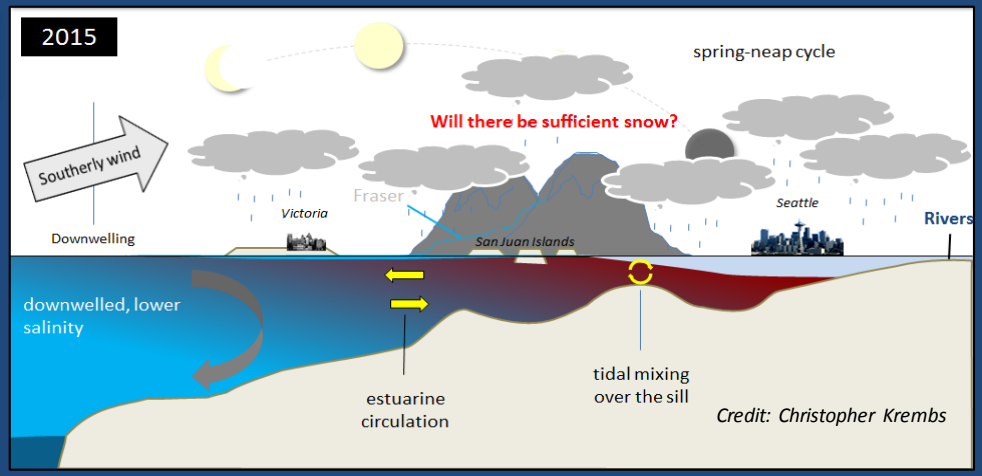


AOOS
Alaska Ocean Observing System

Alaska "Blob" Tracker

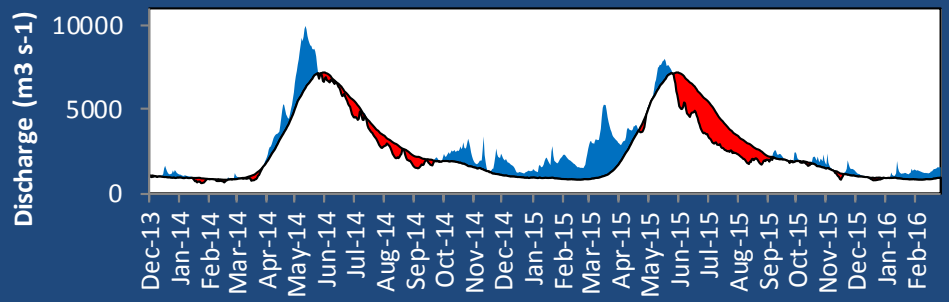
As of January 2016 (left), the Blob below the surface is still alive!

Read here



Rivers are flowing higher and increasing water exchange. This is an opportunity to bring cooler ocean water into Puget Sound.

The Fraser River is the largest freshwater source for the Salish Sea, significantly affecting estuarine circulation.



Government of Canada

In winter and spring 2015, the Fraser River and other rivers discharged prematurely. Very low summer flows followed and inhibited the renewal of water in Puget Sound. Rivers are now normal or running higher, but not like last year. Estuarine circulation is as expected.

Source: http://wateroffice.ec.gc.ca/index_e.html

Physical conditions tracked in historical context

The rain continues. With record high precipitation, salinity is notably lower than normal. **Temperatures** remain high in Puget Sound. Record warm water from last year persists much longer in Hood Canal. Oxygen in Puget Sound is mostly expected. Conditions are comparable, but less pronounced at the Coast.

Still higher temperature in P. Sound

Salinity below normal

Expected Oxygen

[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

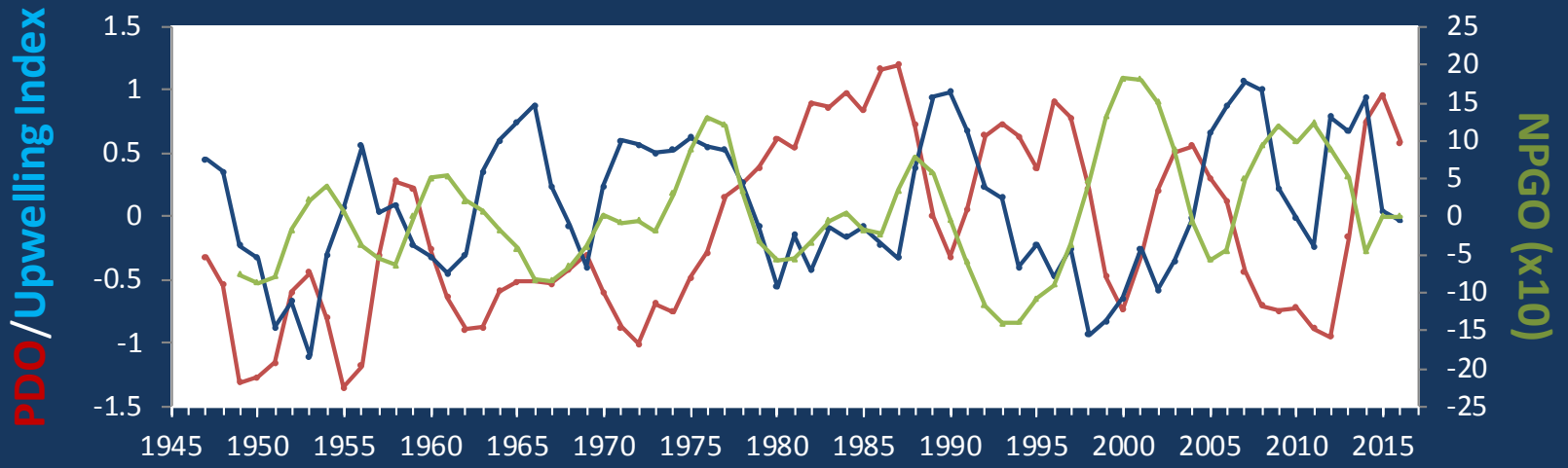
The ocean affects water quality: Ocean Climate Indices

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 in transition: (a) water is still warm (PDO), (b) upwelling of low oxygen and high nutrient ocean water are normal (Upwelling Index anomaly), and (c) surface productivity along the coast normalizing (NPGO).

Summary: Aerial photography 3-16-2016

Jellyfish still aggregate in patches in Budd, Eld, Henderson, and Sinclair Inlets. Phytoplankton blooms in Hood Canal and Henderson Inlet. Water in South Sound generally green. Many places in Central Sound with nearshore suspended sediments.

Start here

Patches of underwater mussel beds, Dana Passage

Beautiful Cutts Island State Park

Front

Mixing and Fronts:
Tidal fronts at Alki Beach.

Jellyfish:
Some patches persist in Budd, Eld, Henderson, and Sinclair Inlets.

Plume

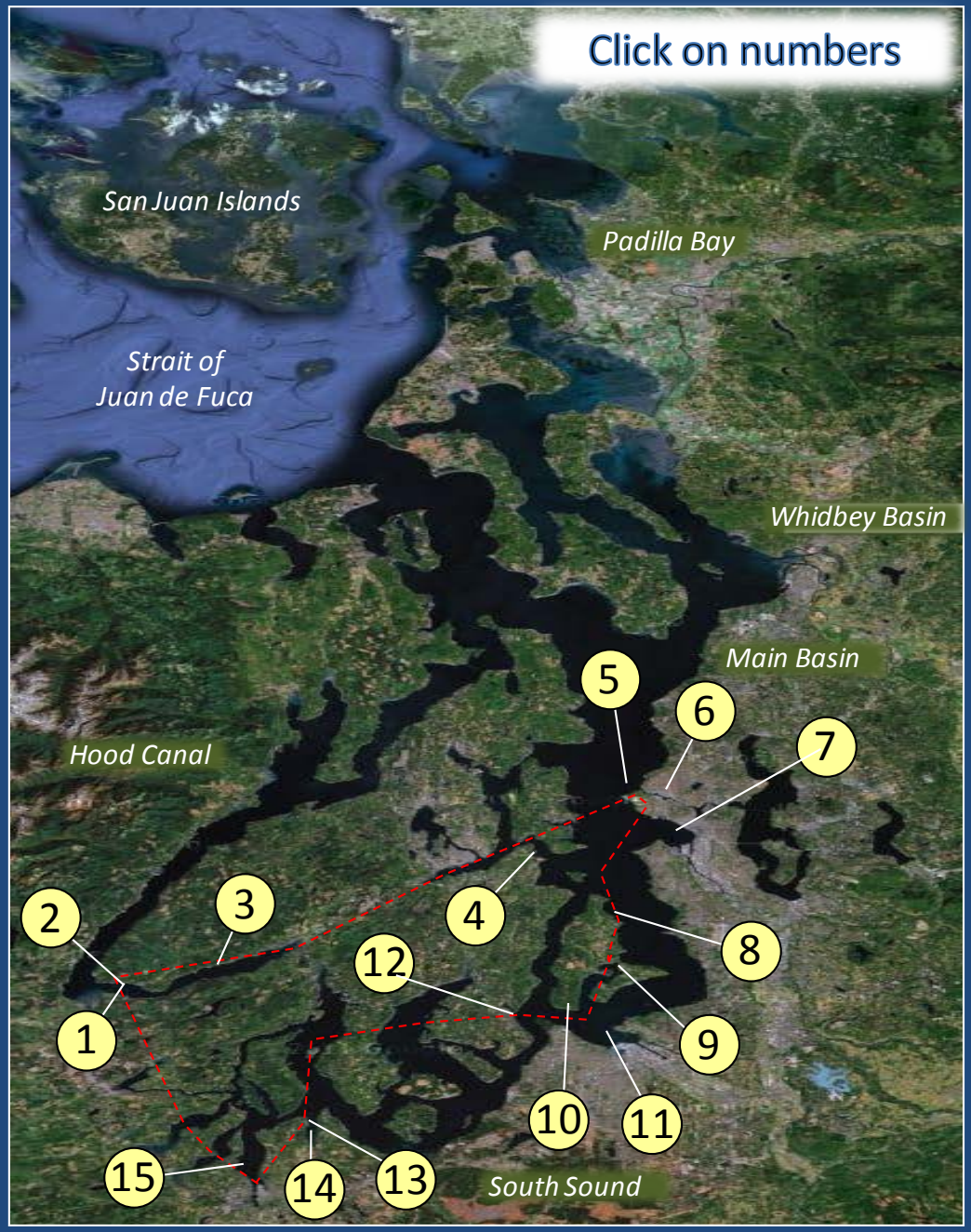
Suspended sediment:
Many places with suspended sediment near sandy spits and wave exposed beaches. Sediment loads from rivers visible, but small given the amount of rain we are receiving.

Bloom

Visible blooms:
Hood Canal intense green with pockets of red-brown blooms. Henderson Inlet with red-brown bloom near Chapman Bay. Budd, Eld, and Totten Inlets have greenish water.

Debris

Debris:
Very little organic debris in the water.



Aerial photography and navigation guide

Date: 3-16-2016

Tide data (Seattle):

Time	Pred	High/Low
12:44 AM	10.1	H
06:11 AM	6.58	L
11:25 AM	9.98	H
06:21 PM	0.64	L

Flight Information:

Broken ceiling with lots of cloud reflections on water

Flight route

Observation Maps:

Central Sound

South Sound

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Aerial photography 3-16-2016

Phytoplankton bloom in green and red-brown colors and in full swing.

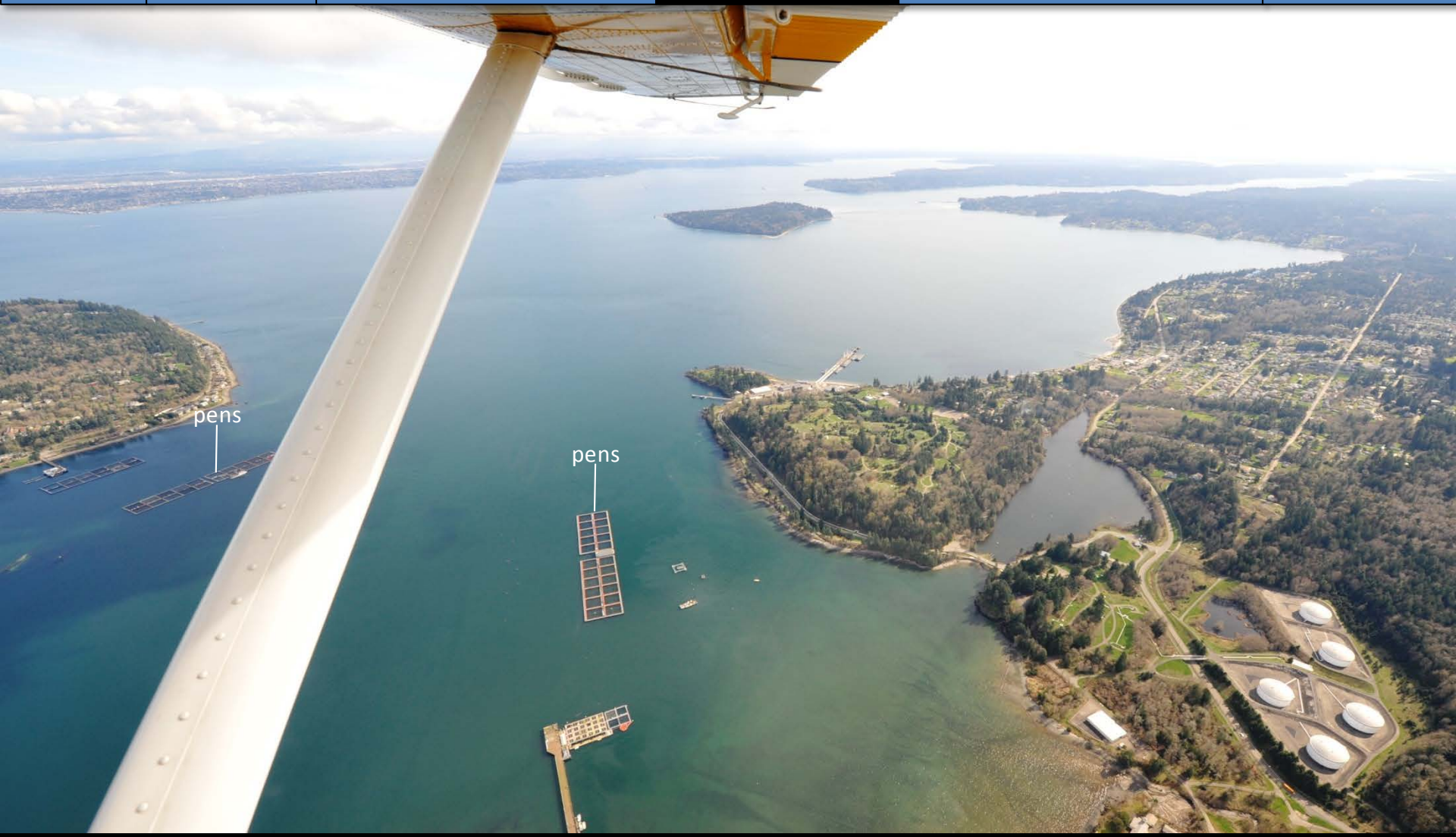
Location: Hood Canal near Union (South Sound), 2:21 PM.

Phytoplankton bloom in full swing next to water from the Skokomish River. Shadow of cloud dark.

Location: Hood Canal near Union (South Sound), 2:21 PM.

Aerial photography 3-16-2016

Phytoplankton bloom in green-brown color with clouds and their reflections.
Location: Hood Canal near Union (South Sound), 2:26 PM.



Clear water around fish pens.

Location: Clam Bay, Manchester (Central Sound), 2:38 PM.

Suspended fine sediments lining all beaches around Discovery Park.
Location: Seattle (Central Sound), 2:42 PM.

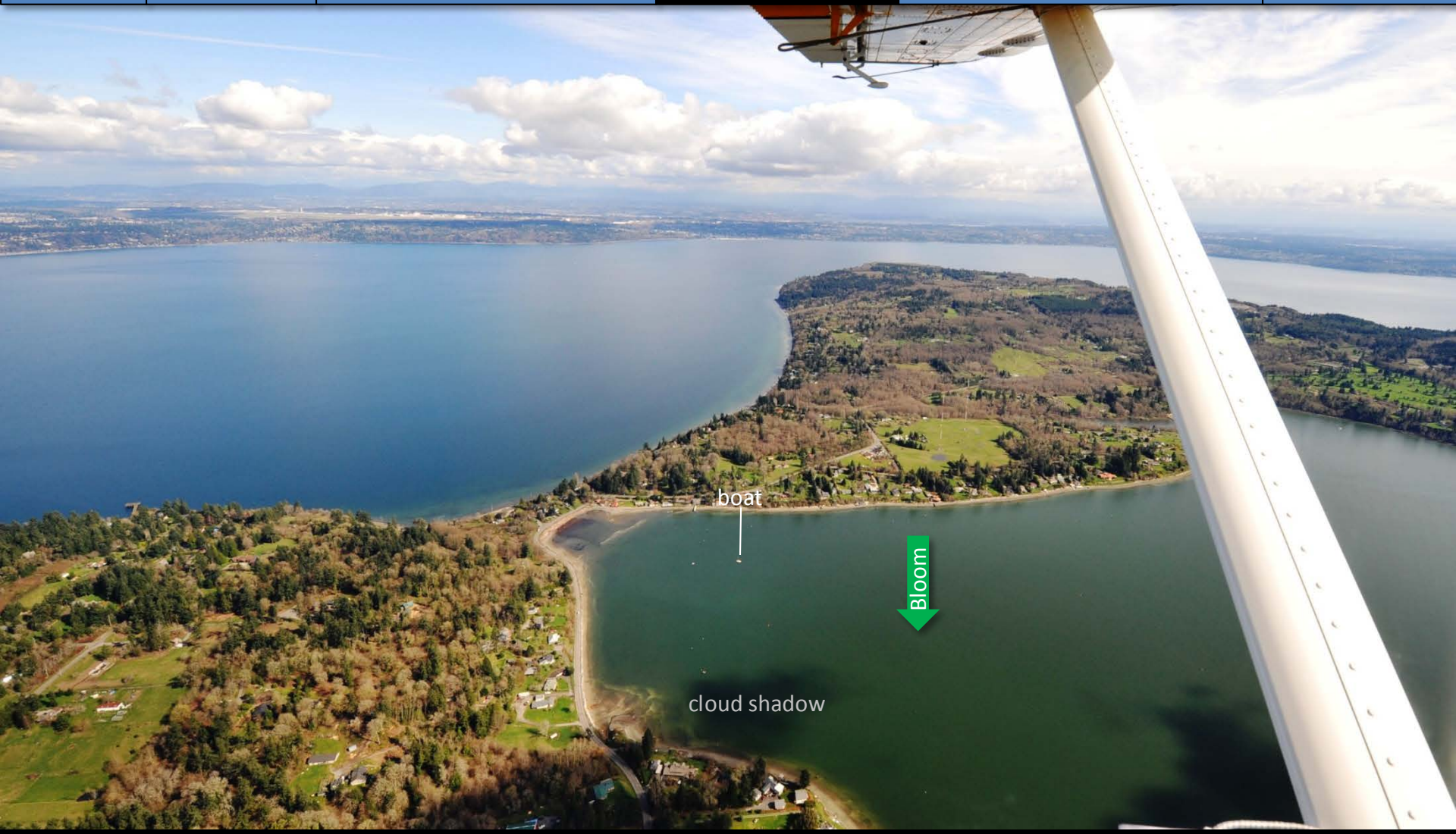
Multiple isolated plumes of suspended sediment near NW Dock and Dock 3 & 4.
Location: Salmon Bay (Seattle), 2:44 PM.

Water of the Duwamish River surprisingly low in sediment and barely visible.

Location: Seattle (Central Sound), 2:46 PM.

Large ribbon of suspended sediments along eastern Vashon Island beaches.
Location: Chautauqua, Vashon Island (Central Sound), 2:51 PM.

Aerial photography 3-16-2016



Phytoplankton staining water greenish and shades from clouds.

Location: Portage, Vashon Island (Central Sound), 2:54 PM.

Aerial photography 3-16-2016

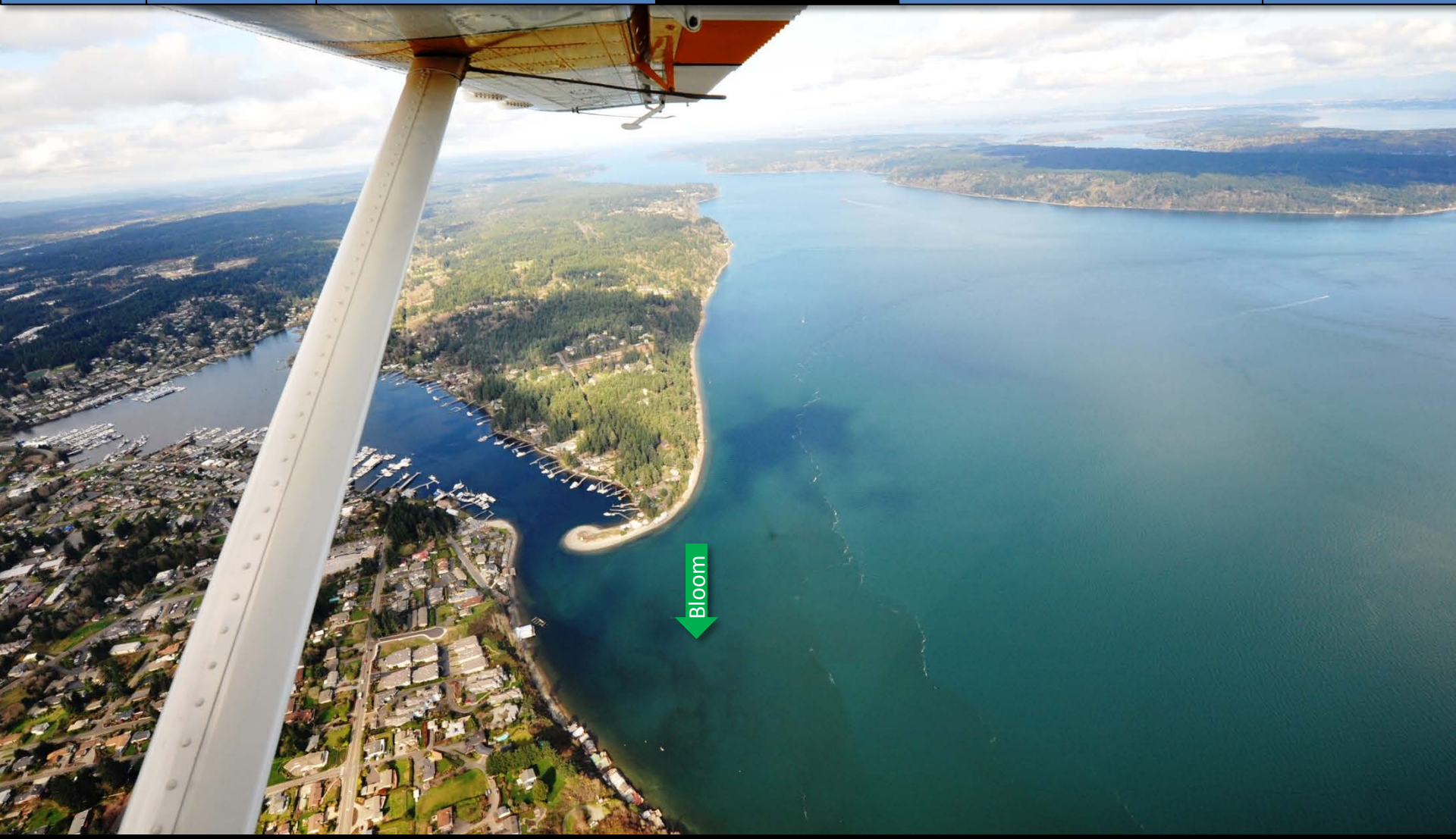
Large patch of suspended sediments along eastern Vashon Island beaches.

Location: Neill Point, Vashon Island (Central Sound), 2:57 PM.

Aerial photography 3-16-2016

Commencement Bay in dramatic cloud setting. Puyallup River plume barely visible despite recent heavy rain.

Location: Commencement Bay, Tacoma (Central Sound), 2:57 PM.



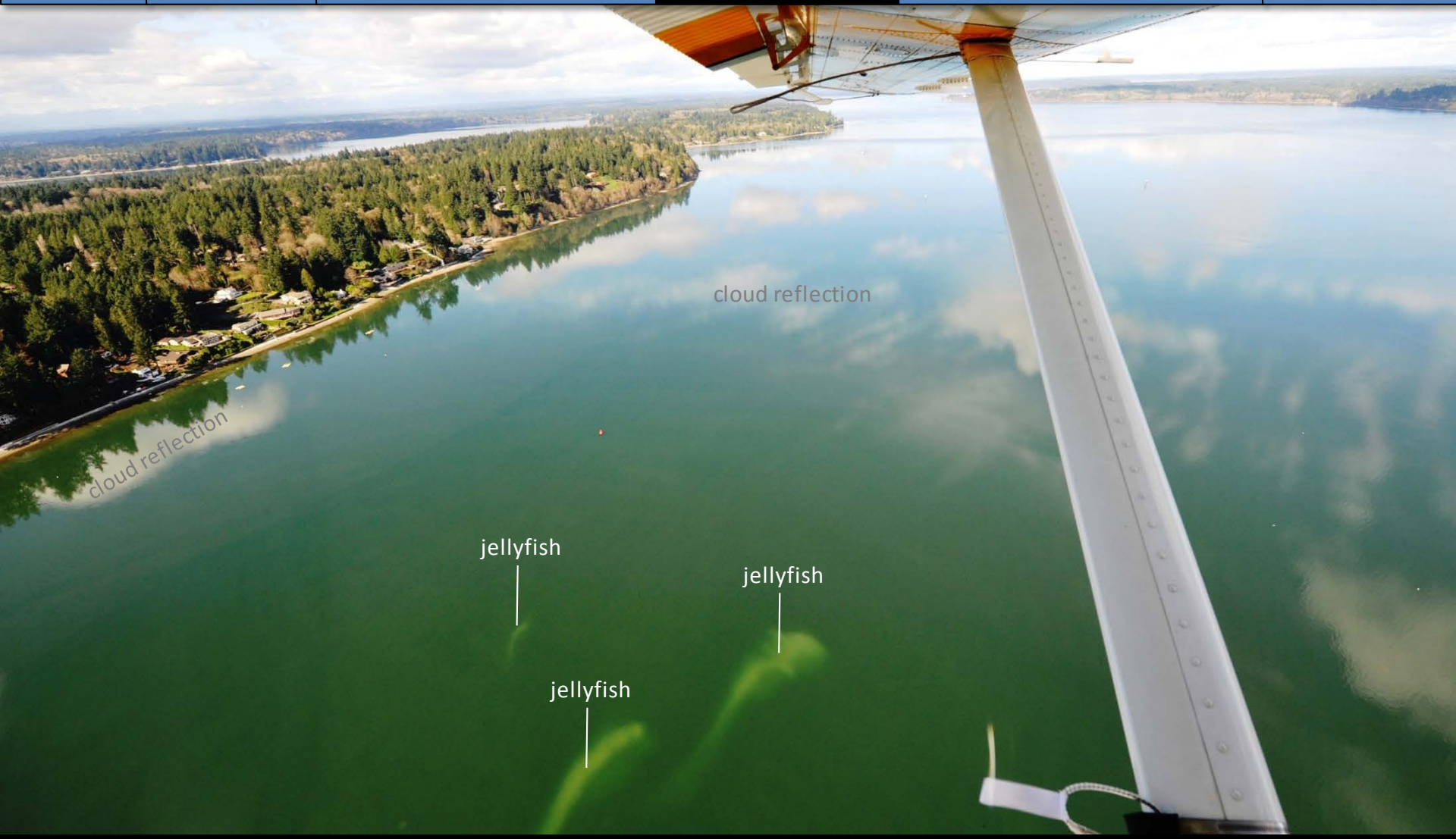
Red-brown bloom originating from Gig Harbor flowing into the Tacoma Narrows.
Location: Gig Harbor (Central Sound), 3:00 PM.

Aerial photography 3-16-2016

Jellyfish patches and green water stained by phytoplankton bloom.
Location: Henderson Inlet (South Sound), 3:12 PM.

Red-brown bloom confined to Woodard Bay.
Location: Henderson Inlet (South Sound), 3:12 PM.

Aerial photography 3-16-2016

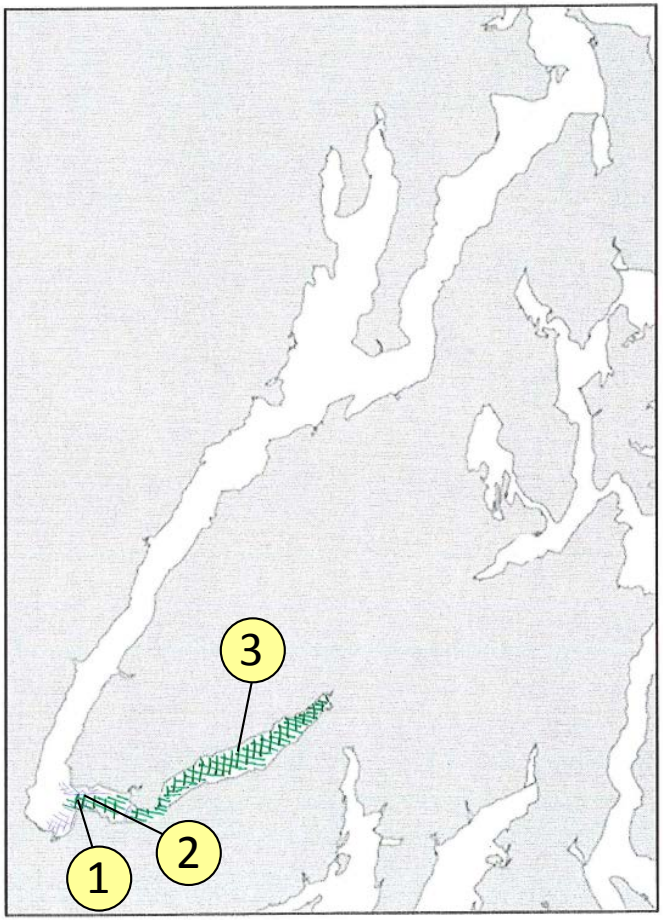


Jellyfish patches in green water discolored by a spring bloom.

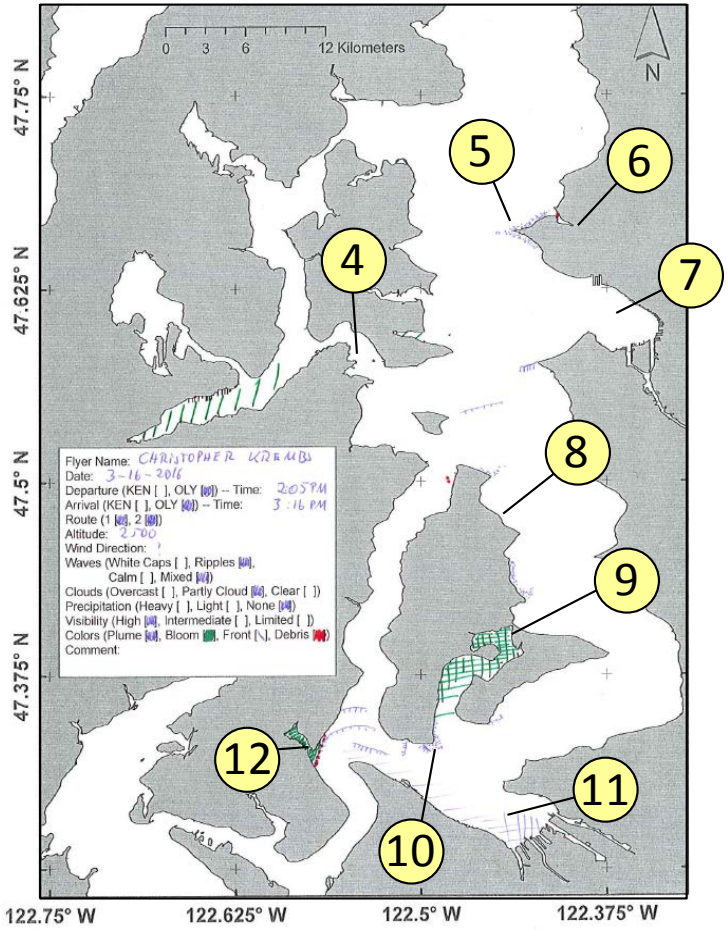
Location: Budd Inlet (South Sound), 3:16 PM.

Date: 3-16-2016

Hood Canal



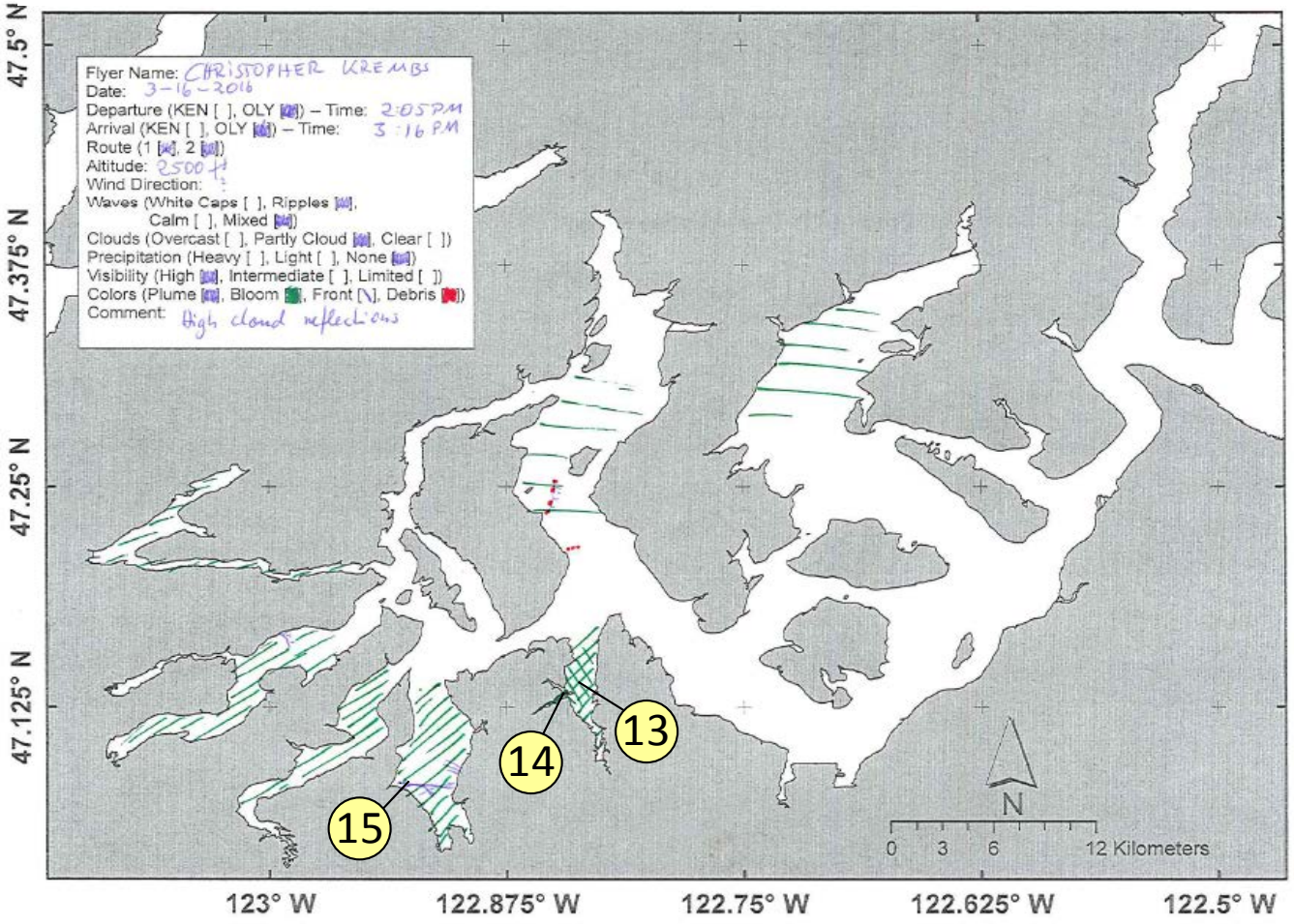
Central Sound



Numbers on map refer to picture numbers for spatial reference

Date: 3-16-2016

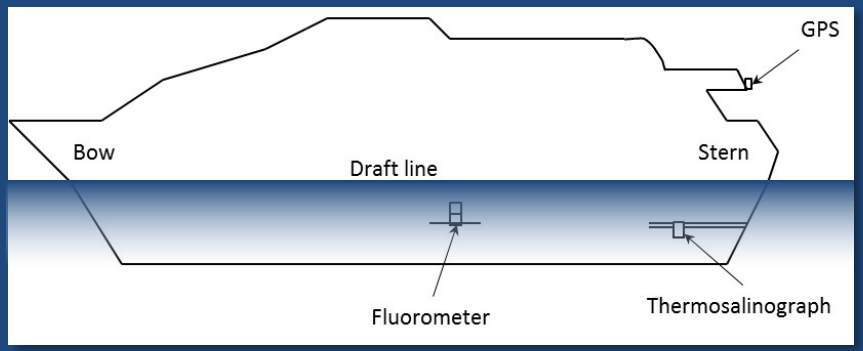
South Sound



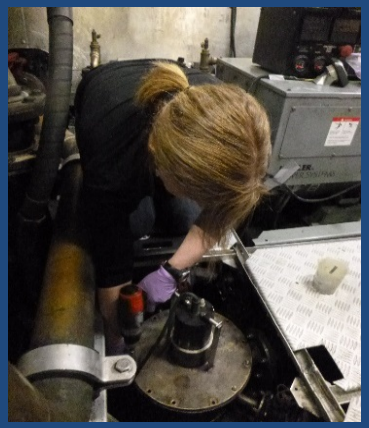
Numbers on map refer to picture numbers for spatial reference

Continuous monitoring 3-16-2016

Summary of *Victoria Clipper IV* ferry data:
The vessel was dry-docked for annual maintenance over the past few weeks. This included reinstalling our thermosalinograph, one of two sensor packages on the ferry. Here, we summarize what we do with our fluorometer to keep it in top working order.



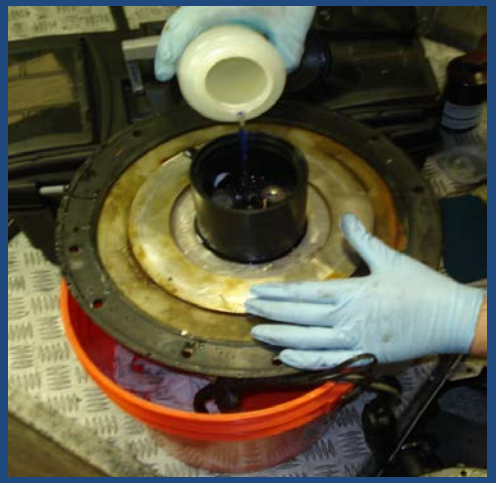
The fluorometer takes measurements as seawater flows through the vessel's sea chest.



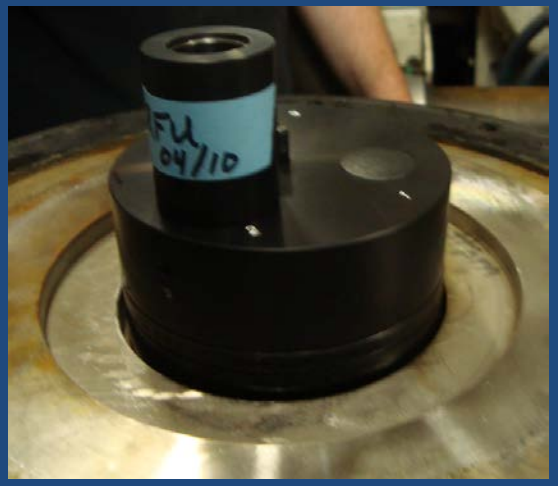
The instrument package is installed directly in the sea chest. After closing valves and draining the water, we unscrew nuts and bolts to remove the cover for servicing.

The fluorometer sensor package has three optical lenses that emit light to measure seawater properties (turbidity, colored dissolved material (CDOM) and phytoplankton pigments.

Continuous monitoring 3-16-2016



The sensor is inverted over a bucket. We use several test liquids to check that our sensor is operating properly. These include deionized water, ambient seawater, and liquid standards.



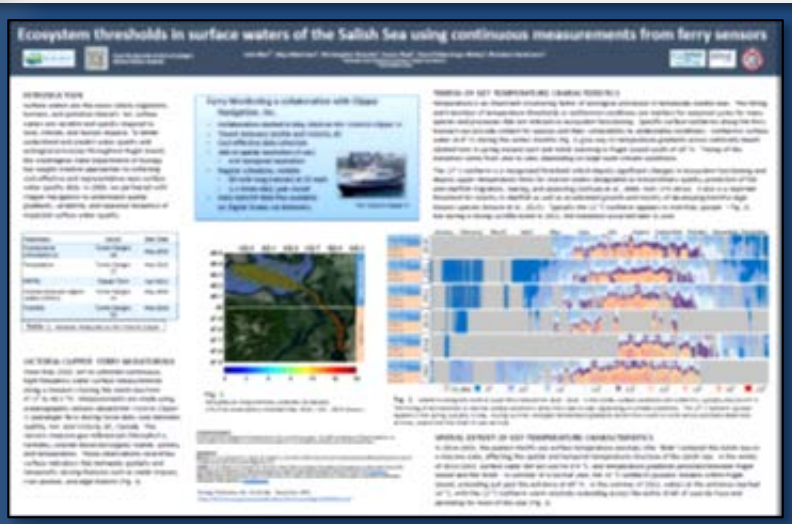
We also check measurements of solid secondary standards. When our servicing is complete, we reinstall the instrument in the sea chest.

Logger's date-time stamp (PST)	Fluorometer's date-time stamp (PST)		Chlorophyll fluorescence (RFU)	Turbidity (RFU)	CDOM (RFU)	Depth (m)	Temperature (°C)
02/18/2016 06:19:18.077	Date	Time	Chlorophyl	Turbidity	CDOM	Depth	Temp C
02/18/2016 06:19:24.648	2/18/16	6:16:57	141.60	84.40	50.80	9.99	11.18
02/18/2016 06:19:29.649	2/18/16	6:17:02	106.40	60.44	3.60	9.99	11.18
02/18/2016 06:19:34.648	2/18/16	6:17:07	100.92	60.68	5.92	10.07	11.18
02/18/2016 06:19:39.648	2/18/16	6:17:12	96.56	60.56	4.72	9.99	11.18
02/18/2016 06:19:44.649	2/18/16	6:17:17	90.48	60.60	4.36	9.99	11.18
02/18/2016 06:19:49.650	2/18/16	6:17:22	92.88	60.32	4.92	9.99	11.18

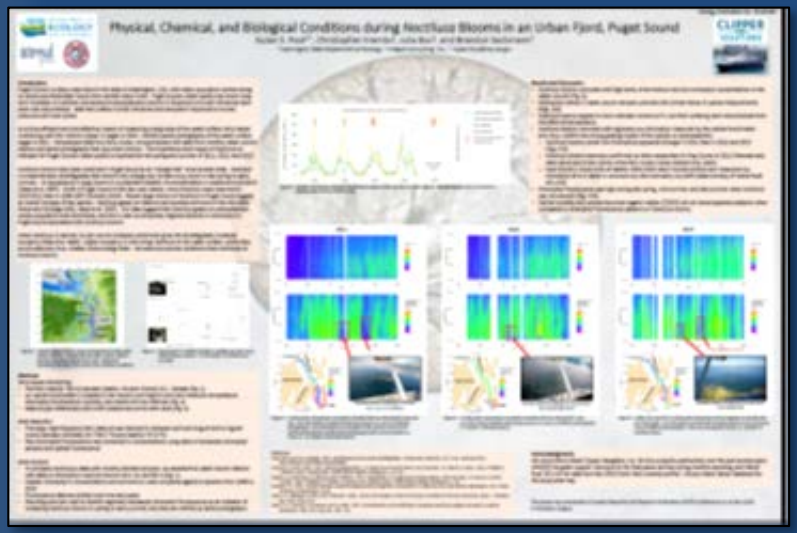
We use raw data output to test and routinely verify the instrument's performance.

Continuous monitoring 3-16-2016

Check out our posters that we presented at the Coastal and Estuarine Research Federation conference in Portland, Oregon during November 2015.

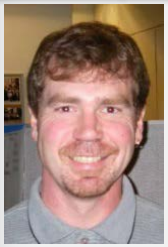


Bos, J., S. Albertson, C. Krembs, S. Pool, C. Falkenhayn Maloy, and B. Sackmann. 2015. Ecosystem Thresholds in Surface Waters of the Salish Sea using Continuous Measurements from Ferry Sensors. Poster presented at Coastal Estuarine and Research Federation 2015 Conference, Portland, Oregon. Washington State Department of Ecology Publication No. 15-03-041. https://fortress.wa.gov/ecy/publications/documents/1503041.pdf



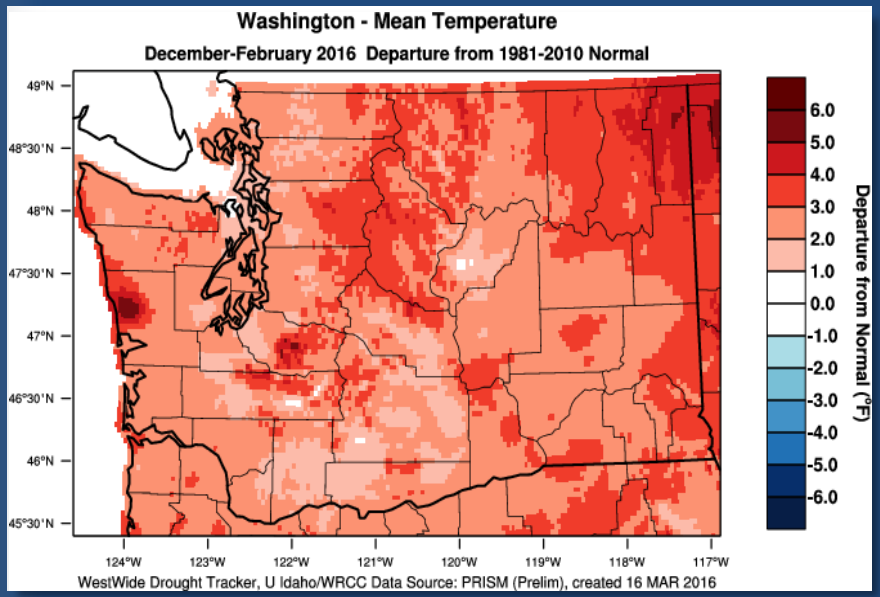
Pool, S.S., C. Krembs, J. Bos, and B. Sackmann. 2015. Physical, Chemical, and Biological Conditions during *Noctiluca* Blooms in an Urban Fjord, Puget Sound. Poster presented at Coastal Estuarine and Research Federation 2015 Conference, Portland, Oregon. Washington State Department of Ecology Publication No. 15-03-040. https://fortress.wa.gov/ecy/publications/documents/1503040.pdf

Wet and warm weather keep rivers flowing

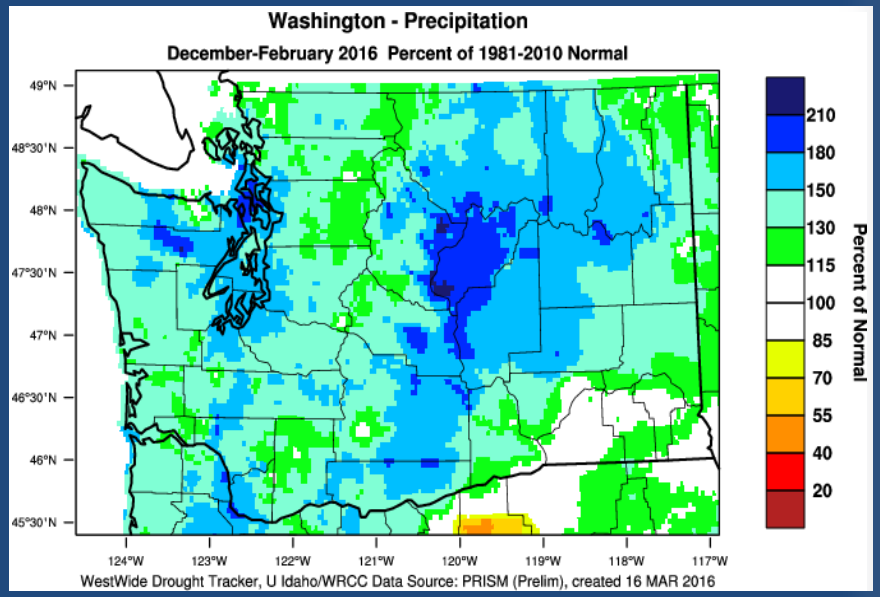


Jim Shedd, Ecology

Puget Sound Basin streamflows remained higher than normal in February. Many mountain streams reported much above normal flows (>90th percentile) responding to high snow fall and warm air. Despite warmer temperatures, snow water equivalence remains higher than normal, which is good news for snowpack.

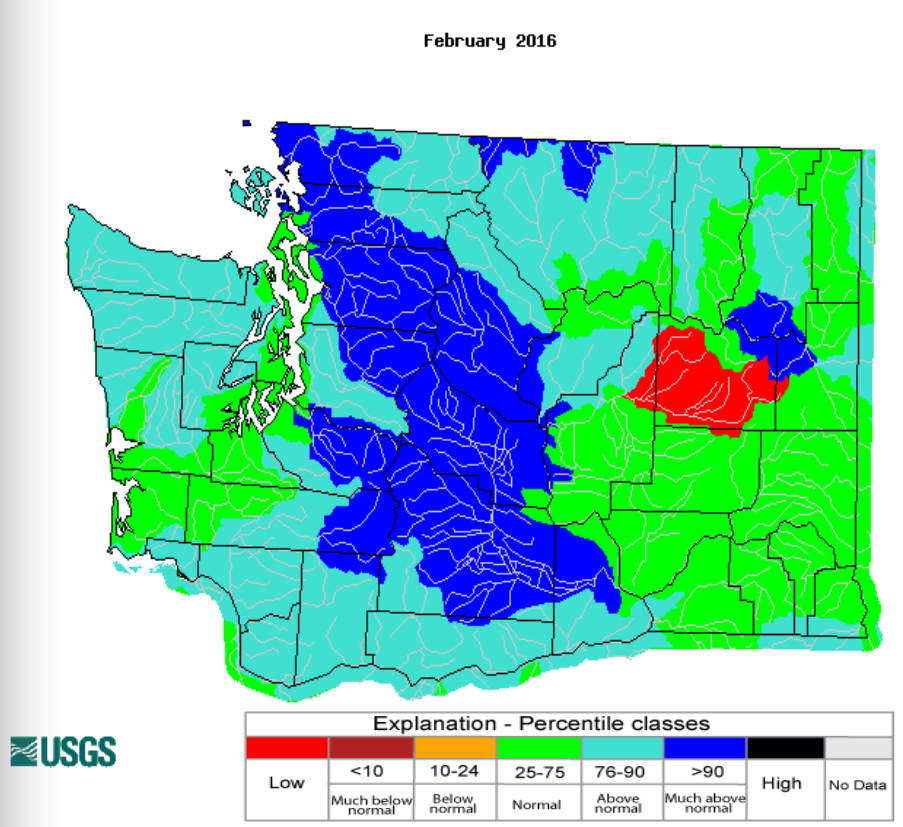


Temperatures were significantly higher than normal across Washington State from December through February. **This 3-month period is known as the meteorological winter.**



Precipitation was much higher from December through February reporting 150% of normal over 3 months in Puget Sound. **Seattle set an all-time record for rainfall from January through February with 25.5 inches of precipitation.**

Wet and warm weather keep rivers flowing



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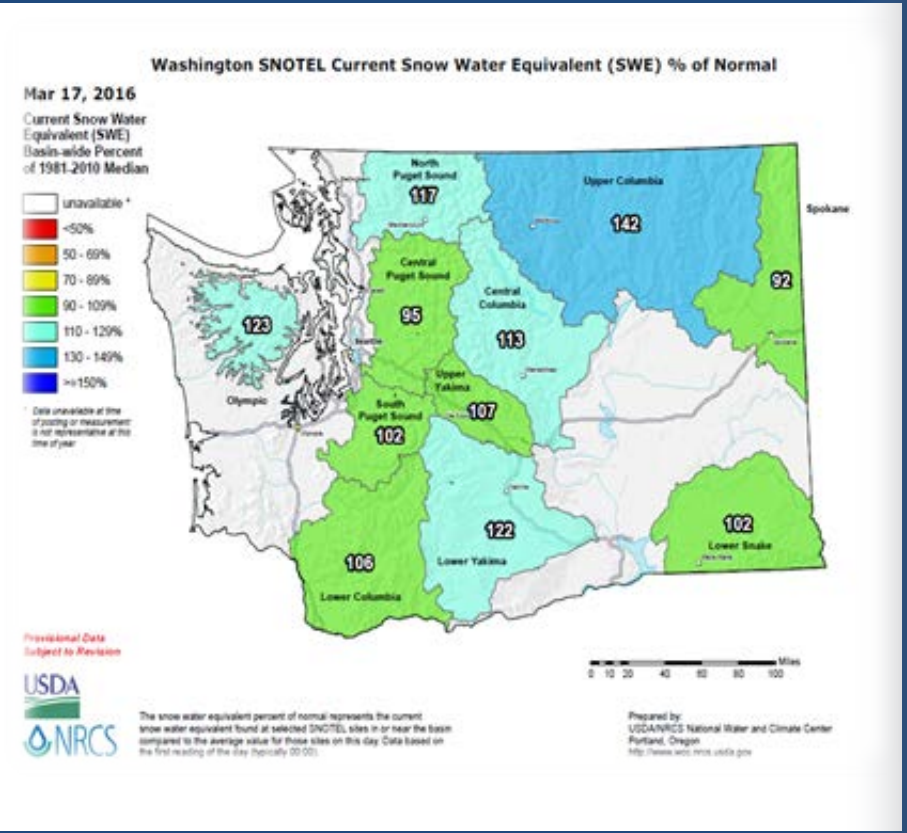


Snow Water Equivalence remains higher than normal in the Puget Sound Basin, good news for retaining snowpack.

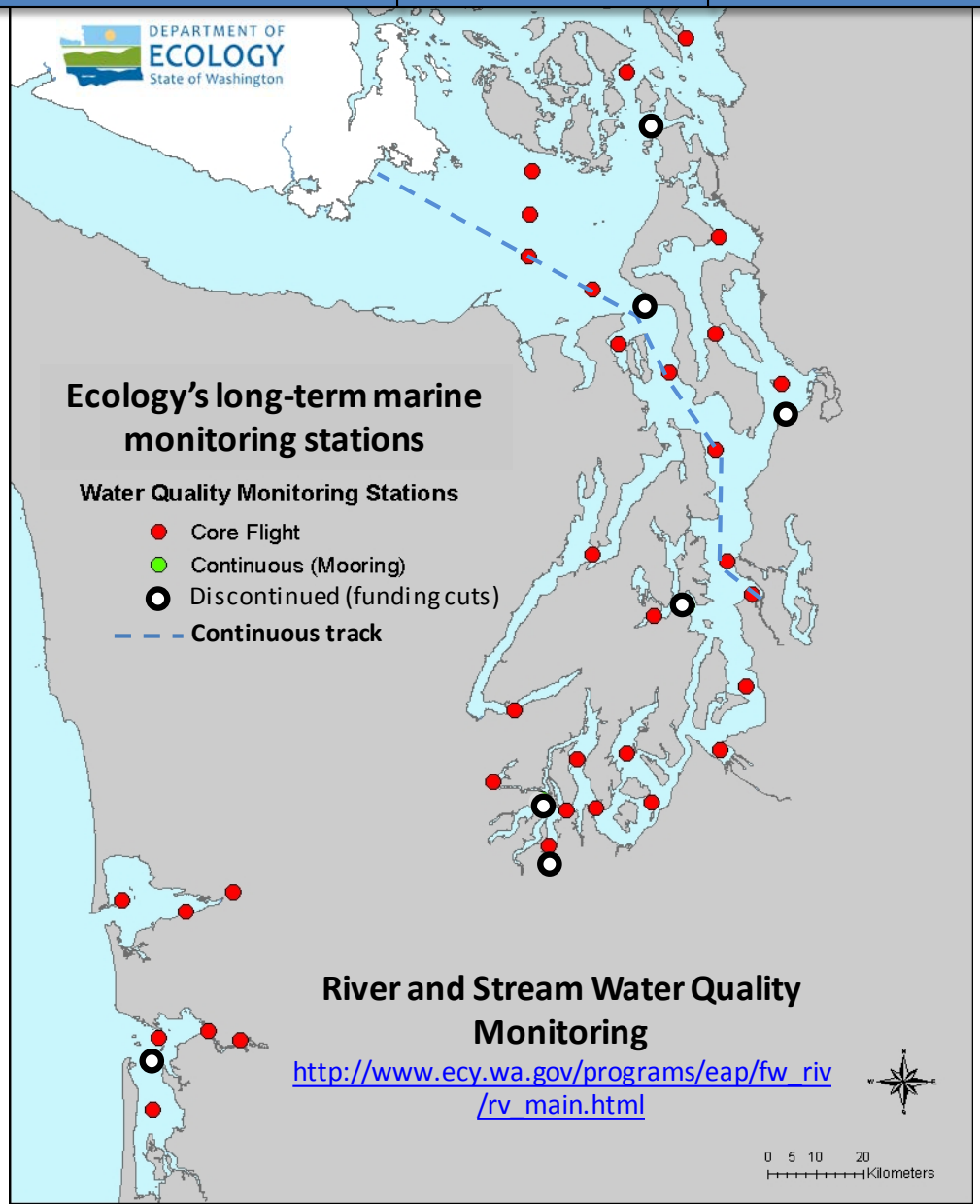
Get data from Ecology's Marine Monitoring Programs

Field log	Climate	Water column	Aerial photos	Continuous monitoring	Streams

Long–Term Monitoring Network

christopher.krembs@ecy.wa.gov

Access core monitoring data:
https://fortress.wa.gov/ecy/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

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

Many thanks to our business partners: Clipper Navigation, Swantown Marina, and Kenmore Air.