



Eyes Over Puget Sound

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

Surface Conditions Report, February 8, 2016

Warm air at
the coast and
at altitude

[Start here](#)

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

Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams

LONG-TERM MARINE MONITORING UNIT

*Mya Keyzers
Laura Hermanson*



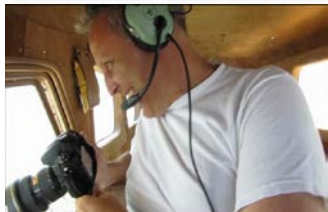
Skip Albertson



*Julia Bos
Suzan Pool*



*Dr. Christopher
Krembs*



*Jim Shedd
Don Watt*



Personal field log

[p.3](#)

Ecology's R/V *Skookum*, a 26-ft Almar gets the job done when conditions are foggy or windy.

Climate conditions

[p. 4](#)

Air temperatures were above normal for January and accompanied with strong temperature inversions and cold, sunny days. El Niño conditions prevail.

Water column

[p. 5](#)

Winter showers bring change! With recent precipitation, salinity is remarkably lower but temperatures are still at record-breaking highs in Puget Sound. At the Coast, water is fresher.

Aerial photography

[p. 9](#)

Jellyfish still aggregate in patches in finger inlets of South Sound. First signs of increasing phytoplankton in coastal bays that mix with boggy waters.

Continuous monitoring

[p. 31](#)

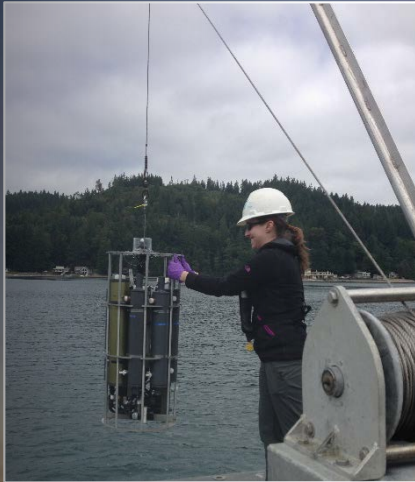
Near-surface water on the ferry route remains cool and well mixed. Turbidity was higher in the Strait of Juan de Fuca than Puget Sound.

Streams

[p. 34](#)

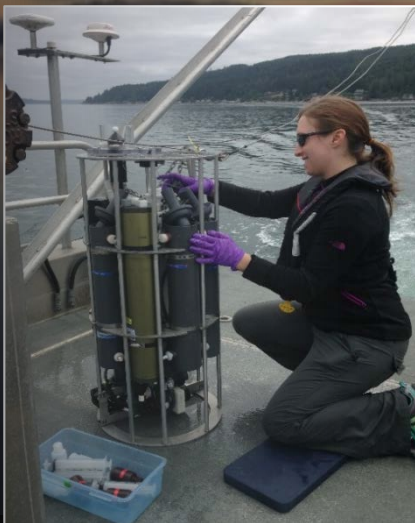
While we're losing a bit of snowpack to this warm weather, our snowpack is still in much better shape than it was at this time last year. But rivers have responded to warmer conditions.

It's a boat, it's a plane, it's... whatever it takes to get data!



What are we doing on a boat? Using a floatplane makes sense when your job is to collect water quality samples from the Canadian border to the most southern inlets in Puget Sound and to cover a lot of ground in a short period of time.

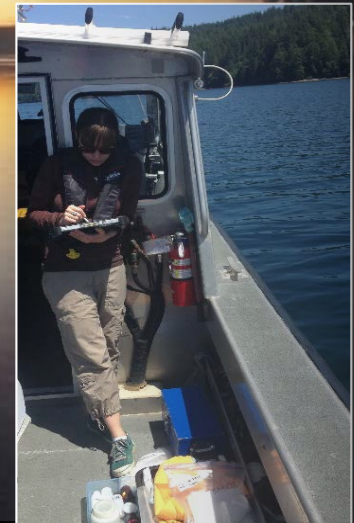
But sometimes Pacific Northwest weather precludes the use of a plane. That's when Ecology's R/V *Skookum*, a 26-ft Almar, comes into play. It gets the job done when conditions are too foggy or windy for the floatplane.



Laura collecting water samples from the CTD.



Using the boat works well to sample Hood Canal, Central Sound, and Coastal Bay stations.



Mya taking field notes.



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 January 2016:

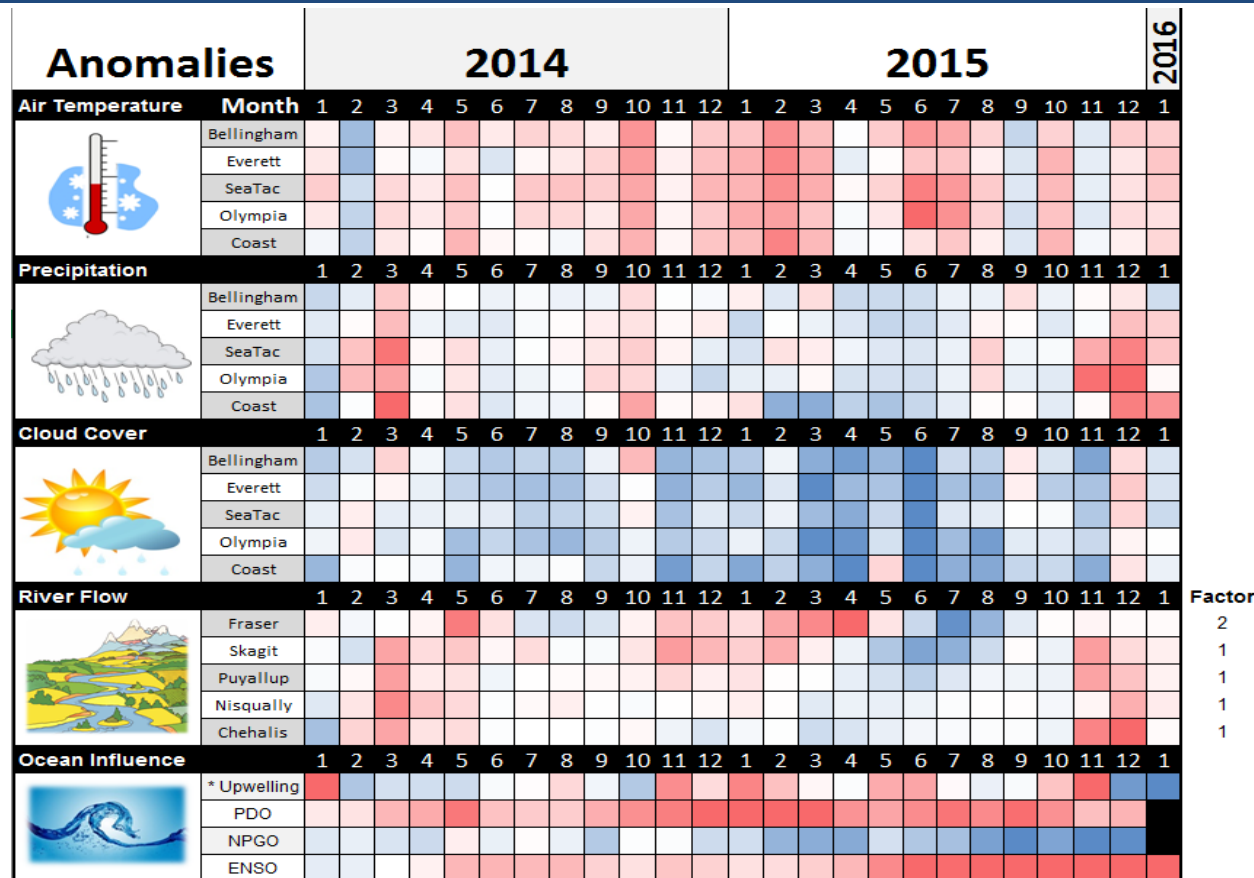
Air temperatures were above normal in the Puget Sound lowlands. The month began, however, with strong temperature inversions and cold, sunny days.

Precipitation levels were above normal, except to the north.

Sunshine levels were generally above normal.

River flows were slightly above normal.

Downwelling was strong and ENSO remained in the warm phase (El Niño).



*Upwelling Anomalies (PFEL)
 ENSO = El Niño Southern Oscillation

higher expected lower No data

Our long-term marine monitoring stations in Washington



Field log

Climate

Water column

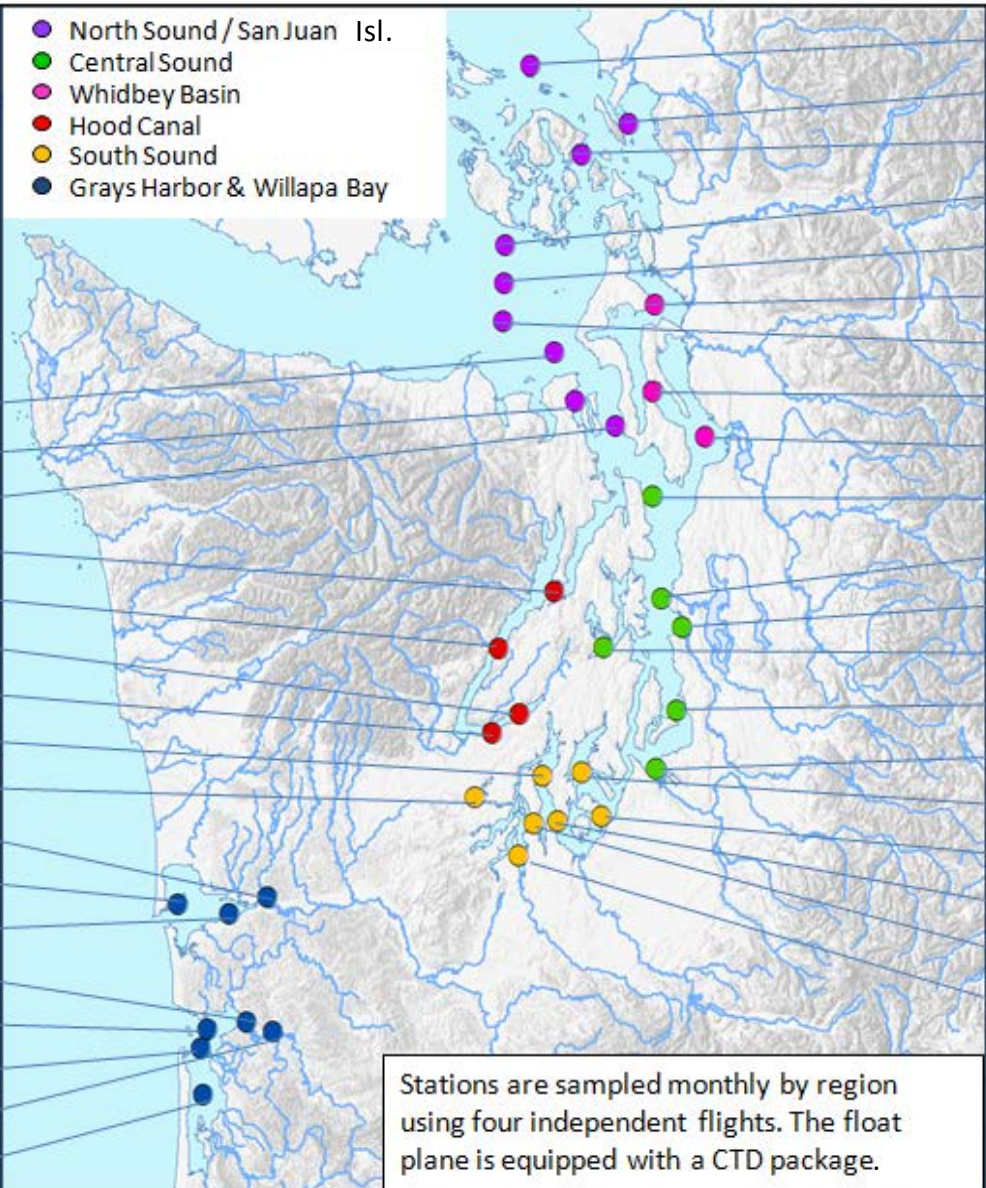
Aerial photos

Continuous 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.

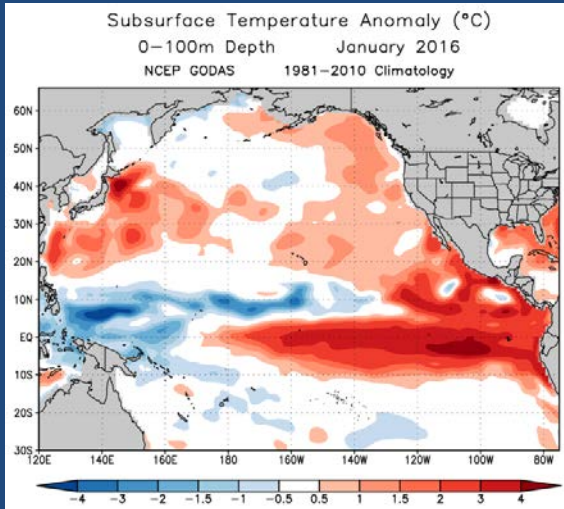
We use a chartered floatplane and boat to access our monthly monitoring stations.

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

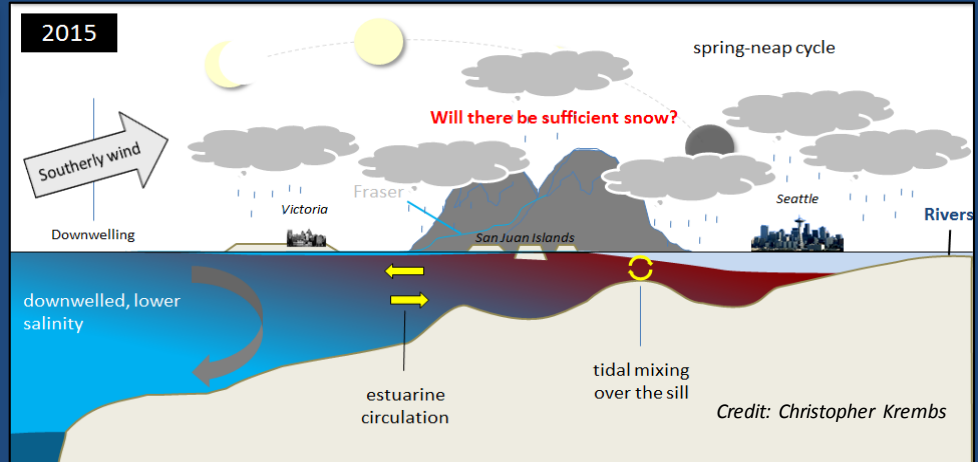
Year 2015 was a record breaker for water temperature in Puget Sound and for global temperatures. Premature melting of the snowpack in early summer caused initially fresh conditions. In July, unusually high salinities started appearing in response to drought and generally very low river flows. Fortunately, the winter brought a lot of rain and, as a result, estuarine circulation has increased to renew the water within Puget Sound. **Yet, water temperatures are still high!**



Alaska "Blob" Tracker

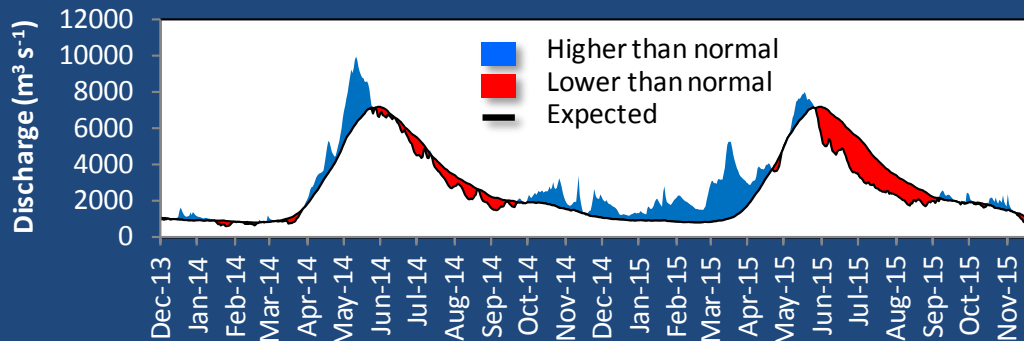
As of January 2016 (left), the Blob below the surface is still alive!

[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.



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 normalizing or running higher. Estuarine circulation is expected to rebound.

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

Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams

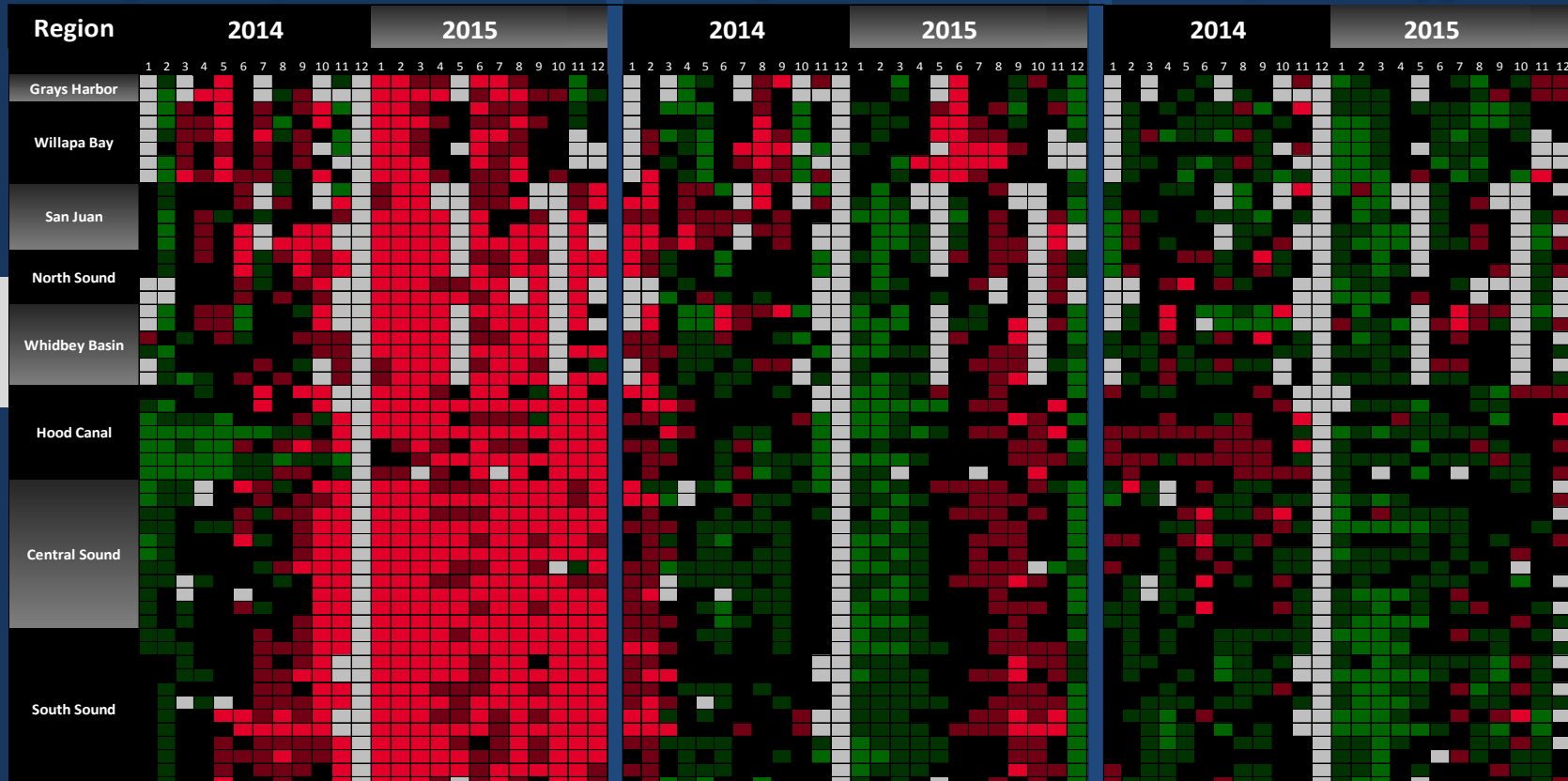


Winter showers bring change! With recent precipitation, salinity is remarkably lower than normal. In Puget Sound, **temperatures** are still at record-breaking **highs but not at the coast**. Oxygen is mostly expected everywhere. (Color observations fall outside 50% of our historical observations)

Still higher temperature in P. Sound

Salinity now below normal

Expected Oxygen



[Explore profiles at all stations](#)

■ = higher than expected (>IQR, n=13)
 ■ = expected (=IQR, n=13)
 ■ = lower than expected (<IQR, n=13)
■ = higher than previous measurements
 ■ = no data
 ■ = lower than previous measurements

The ocean affects water quality: Ocean Climate Indices



Field log

Climate

Water column

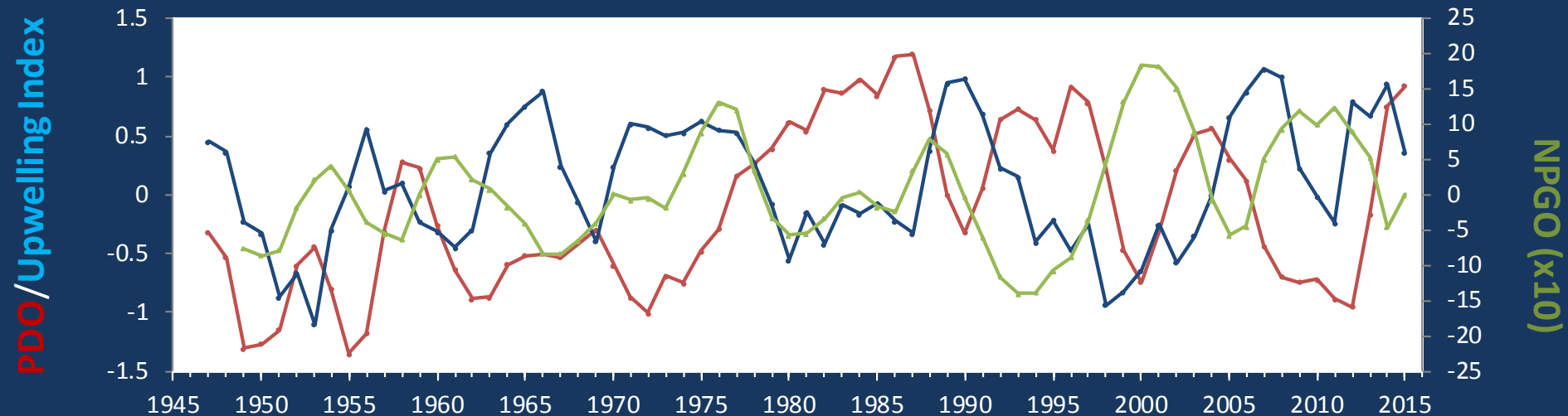
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Continuous monitoring

Streams

- 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 warm (PDO), (b) upwelling of low oxygen and high nutrient ocean water are higher (Upwelling Index anomaly), and (c) lower surface productivity along the coast (NPGO).



Jellyfish still aggregate in patches in finger inlets of South Sound. First signs of increasing phytoplankton in coastal bays that mix with boggy waters.

Start here

Very warm air (72 °F) flowed inland at an altitude of 2000 feet while near the water surface, cold air flowed toward the coast at 20 kts. This warm air reached the higher snow-covered elevations in the Puget Sound region.



Reading 72 °F on our outside cabin thermometer at an altitude of 2500 feet during our flight returning from the coast.



Mixing and Fronts:

Tidal fronts nicely visible in Grays Harbor.



Jellyfish:

Patches persist in Budd, Eld, and Totten Inlets.



Suspended sediment:

High sediment loads from rivers, winds, high tide, and large waves create a lot of suspended sediment near the coast.



Visible blooms:

Murky water with tint of red in Grays Harbor and near Naselle River estuary.

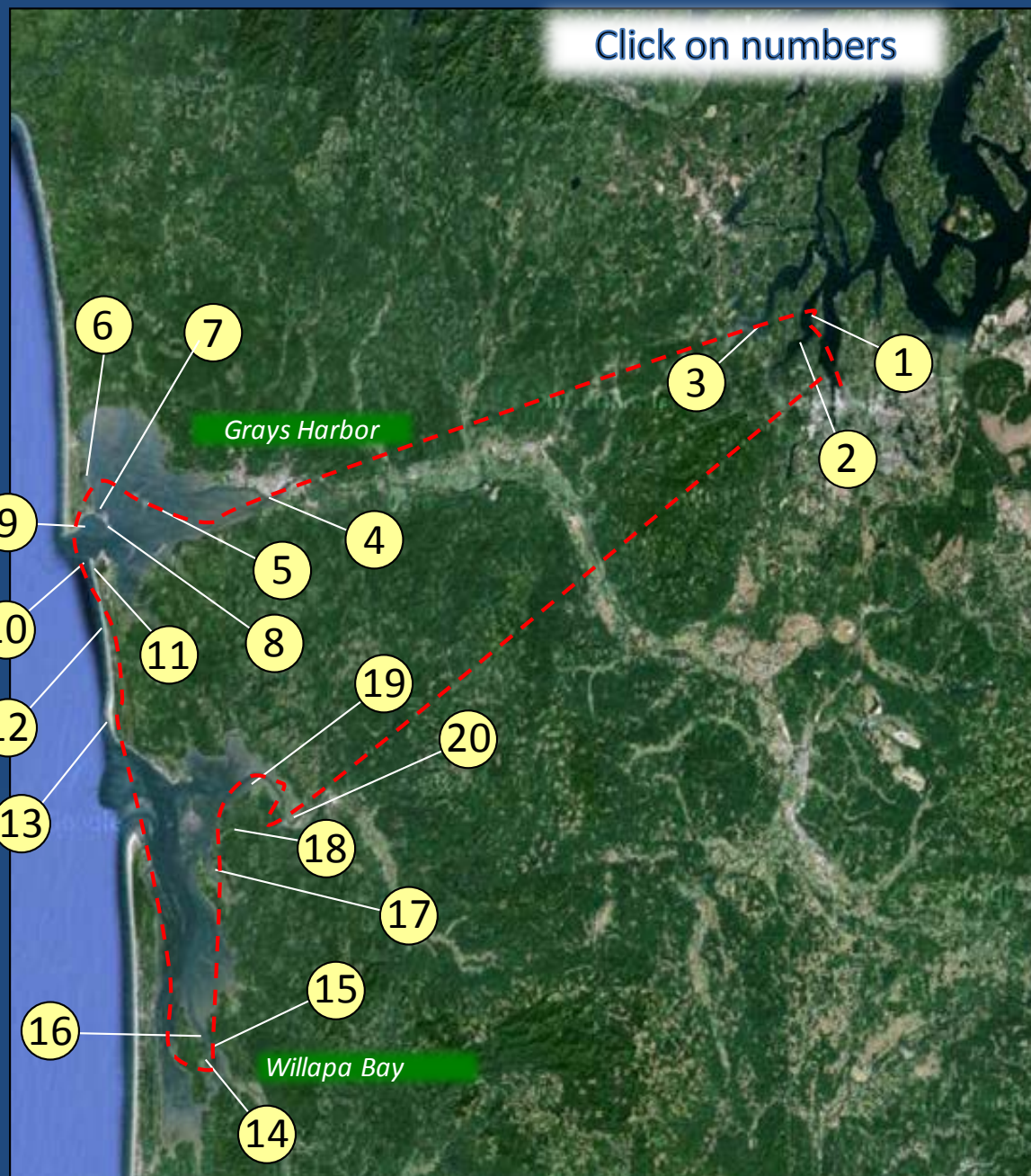


Debris:

Occasional floating organic debris near coastal beaches.



Click on numbers



Aerial photography and navigation guide

Date: 2-8-2016

Tide data (Nahcotta, Willapa Bay):

	Pred	High/Low
01:30 AM	9.78	H
07:06 AM	2.6	L
01:00 PM	11.74	H
07:44 PM	-1.08	L

Flight Information:

Good visibility, sunny warm air, layered system with opposite wind directions (ground - cold air flowing west; 2500 ft – warm air flowing east)

--- Flight route



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



Low hanging clouds flow into Eld Inlet, cold air near the ground flow to the west (see smoke).

Location: Eld Inlet (South Sound), 9:43 AM.



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



*Jellyfish patches are still present in Budd, Eld, and Totten Inlets.
Location: Eld Inlet (South Sound), 9:51 AM.*



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



Jellyfish patches are still present in Budd, Eld, and Totten Inlets.

Location: Eld Inlet (South Sound), 9:52 AM.



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



Brown-colored Chehalis River plume with bright brown pockets; a bloom of phytoplankton?
Location: Rennie Island (Grays Harbor), 10:14 AM.

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

Large number of seals hauled out on a sand bank in the middle of the bay.

Location: Grays Harbor, 10:40 AM.

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

*Brown-colored water of Duck Lake stained by humus flow into coastal bays.
Location: Ocean Shores (Grays Harbor), 10:46 AM.*



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



*Brown-colored water of Duck Lake stained by humus flow into coastal bays.
Location: Ocean Shores (Grays Harbor), 10:46 AM.*

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

suspended sediments

Large waves suspend sediment at entrance to Grays Harbor.
Location: Oyhut Recreation Wildlife Area (Ocean Shores), 10:47 AM.



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



*Incoming tide at the entrance to Grays Harbor. Colors indicate three different water masses.
Location: Westhaven State Park (Westport), 10:48 AM.*

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

*Large waves break on the high-energy beaches with a backwash all the way to the dunes.
Location: Westhaven State Park (Westport), 10:48 AM.*



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



*Large waves break on the high-energy beaches. Brown-colored diatom blooms near beach.
Location: Near Grayland (Washington Coast), 10:52 AM.*



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams

A.



Challenging to tell apart! Plume of boggy water or diatom bloom?

Location: A. North Cove, B. Stackpole Slough, Leadbetter Point State Park (Washington Coast), 10:54 AM.



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



Reddish sediment or beginning red-brown algal bloom.

Location: Long Island Slough, Willapa National Wildlife Refuge (Willapa Bay), 11:59 AM.

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

Sediment-rich Naselle River water (1) meeting Long Island Slough (2).
Location: Stanley Point, Naselle River (Willapa Bay), 11:59 AM.



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams



*Sediment-rich Naselle River water (1) meeting Long Island Slough water with red-brown bloom (2).
Location: Paradise Point, Long Island (Willapa Bay), 11:59 AM.*

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

High tide is flooding mudflats.

Location: Near Bay Center (Willapa Bay), 12:05 PM.

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

Niawiakum River banks flooded by high tide.

Location: Niawiakum River Natural Area Preserve (Willapa Bay), 12:06 PM.

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

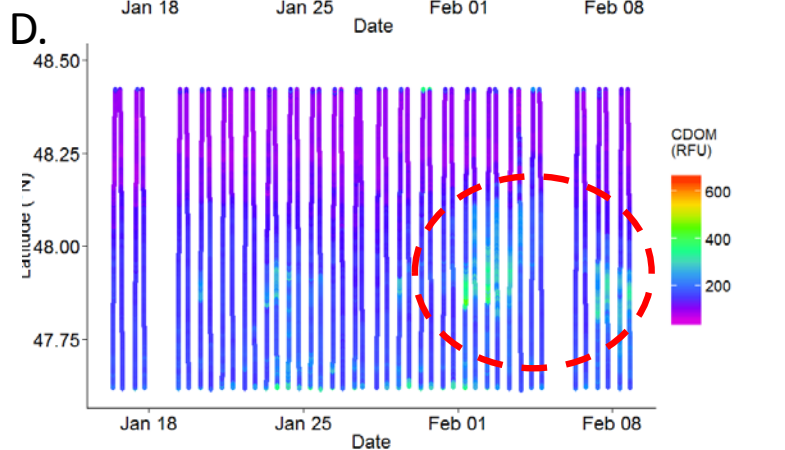
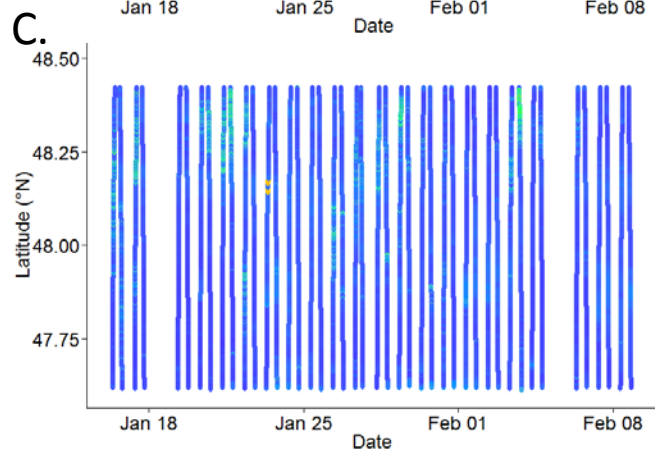
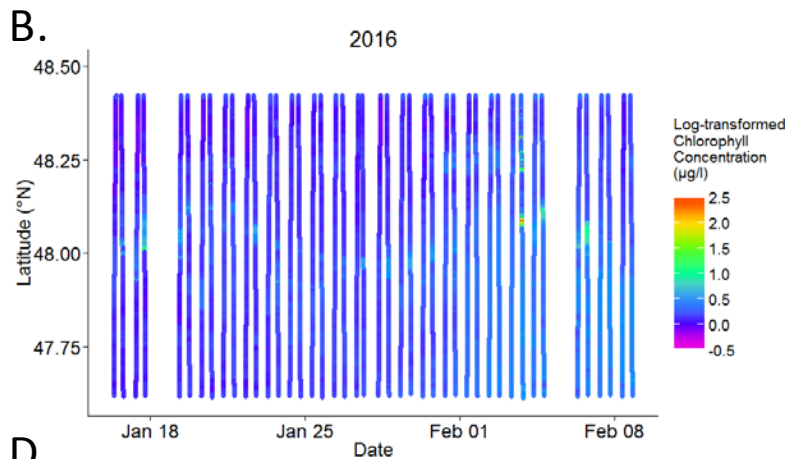
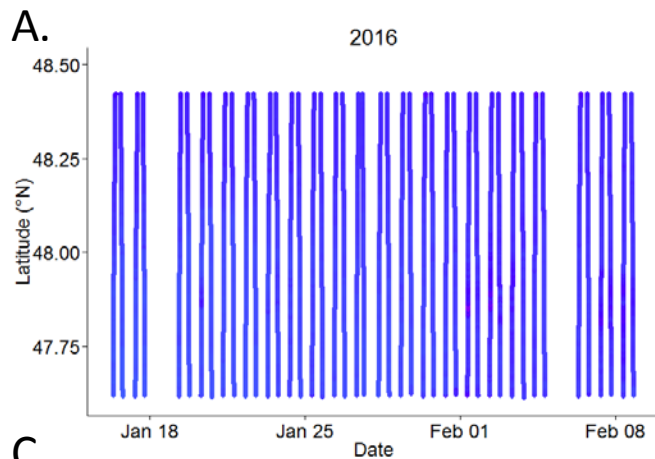
*Dikes keeping high tide off the fields. Willapa River in the background.
Location: Range Point (Willapa Bay), 12:09 PM.*

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

*Dikes keeping high tide off the fields. In the background, Willapa River and flooded mudflats.
Location: South Bend (Willapa Bay), 12:09 PM.*

Summary of *Victoria Clipper IV* ferry data:

Near-surface water on the ferry route remains cool and well mixed. Turbidity was higher in the Strait of Juan de Fuca than Puget Sound. Early February had an increase of colored dissolved organic matter (CDOM) in Whidbey Basin.

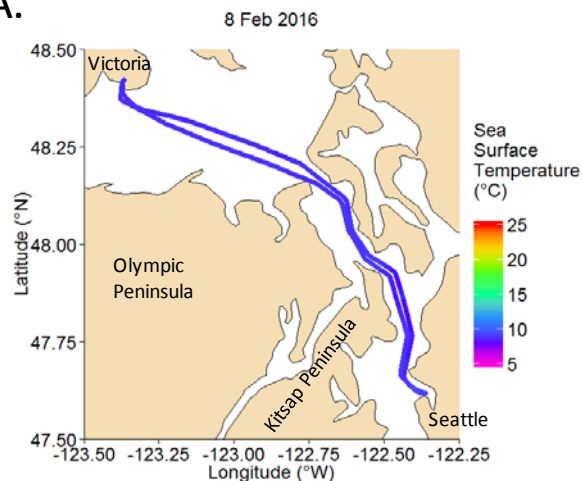


The *Victoria Clipper IV* carries sensors in its sea chest. The sensors allow us to plot over time transects of:

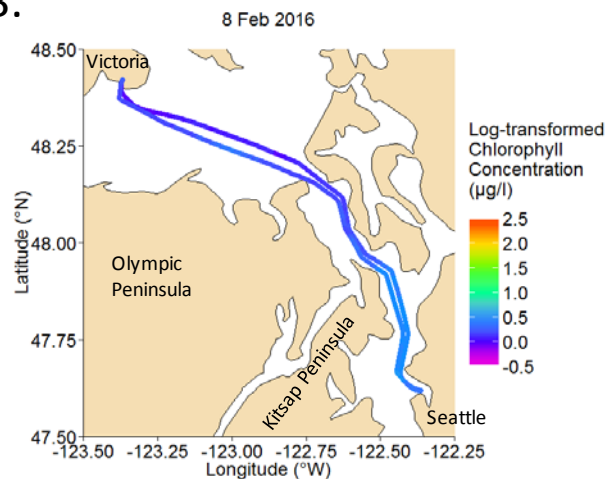
- A. Temperature
- B. Chlorophyll
- C. Turbidity
- D. CDOM

Over time, we see the dynamic of these variables in surface water between Seattle and Victoria, BC.

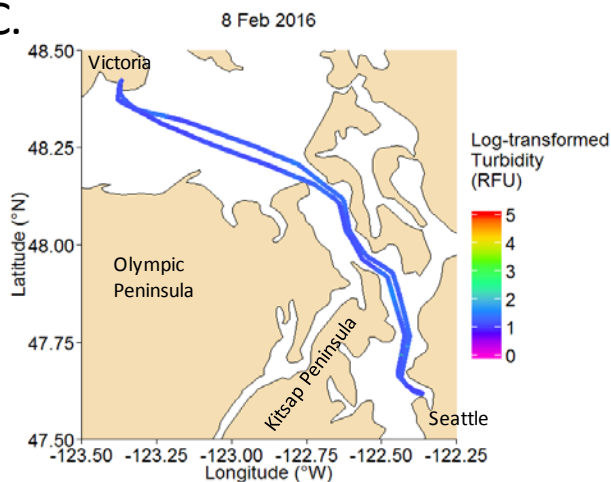
A.



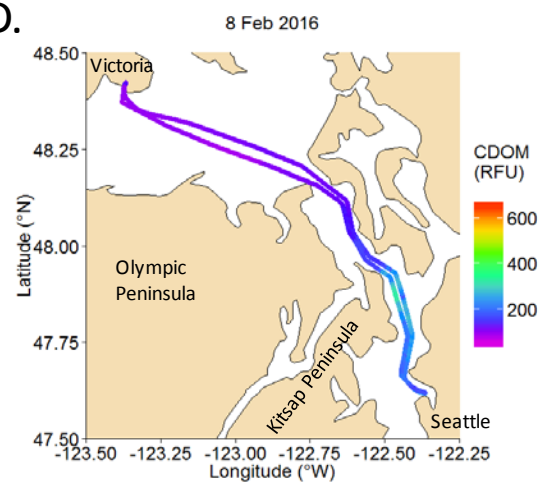
B.



C.



D.



Figures show daily sensor data installed on the ferry which measure near-surface water at 5-sec intervals while the *Victoria Clipper IV* transits between Seattle and Victoria, BC.

A. Sea Surface Temperature:

Water was isothermal in Puget Sound and the Strait of Juan de Fuca.

B. Chlorophyll:

Concentrations were low, particularly in the Strait.

C. Turbidity:

Turbidity was low on entire route.

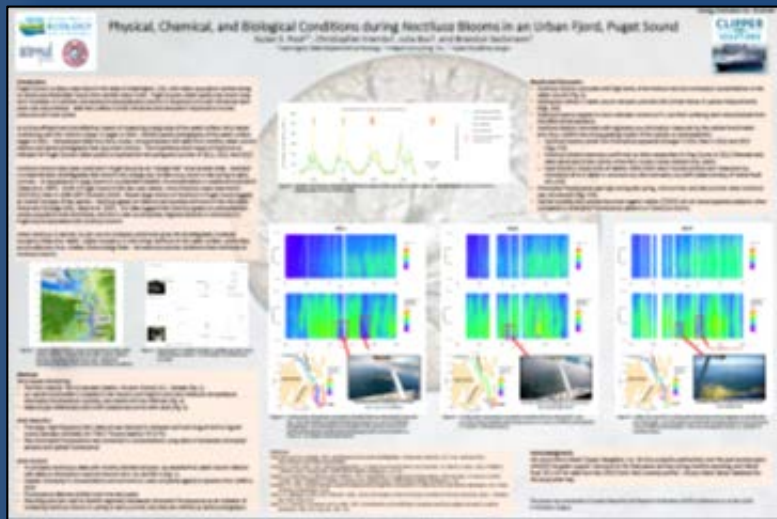
D. Colored Dissolved Organic Matter (CDOM):

Particulates in the water were abundant in Central Basin and nearly absent in the Strait.

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>



*Don Watt,
Ecology*

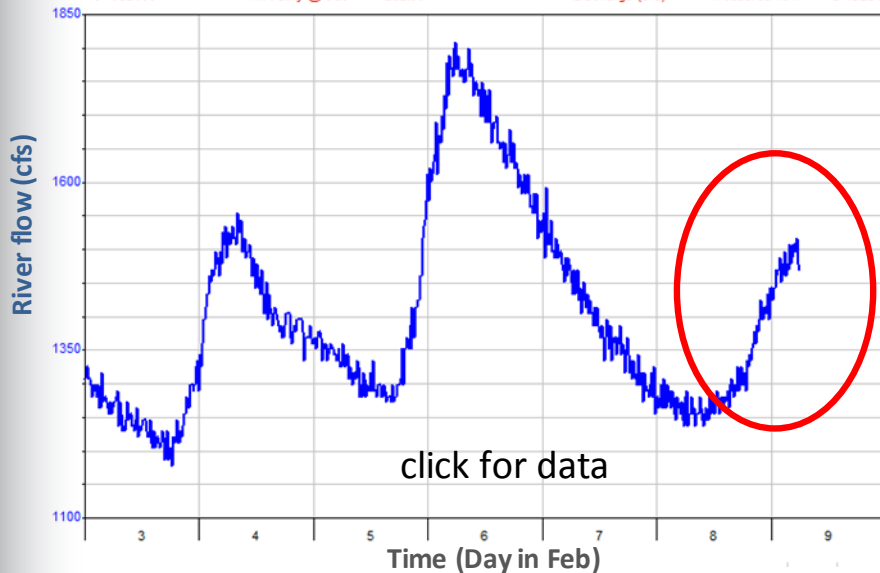
Warm temperatures, clear skies, and abundant sunshine brought snowmelt runoff and increased flows to streams flowing off of the foothills of the Cascade and Olympic Mountains on February 8th and 9th. Temperatures between 2000 and 4000 feet in elevation warmed into the 60s on Monday and Tuesday, and remained in the low to mid 50s Monday night.

Washington State Dept. of Ecology

HYPLOT V133 Output 02/09/2016

Period 7 Day 02/03/2016 to 02/10/2016 2016

— 05B090 N.F. Stilly @ Oso 262.00 Discharge (cfs) AT
○ 05B090 N.F. Stilly @ Oso 262.00 Discharge (cfs) Measured flow GAGEDQ



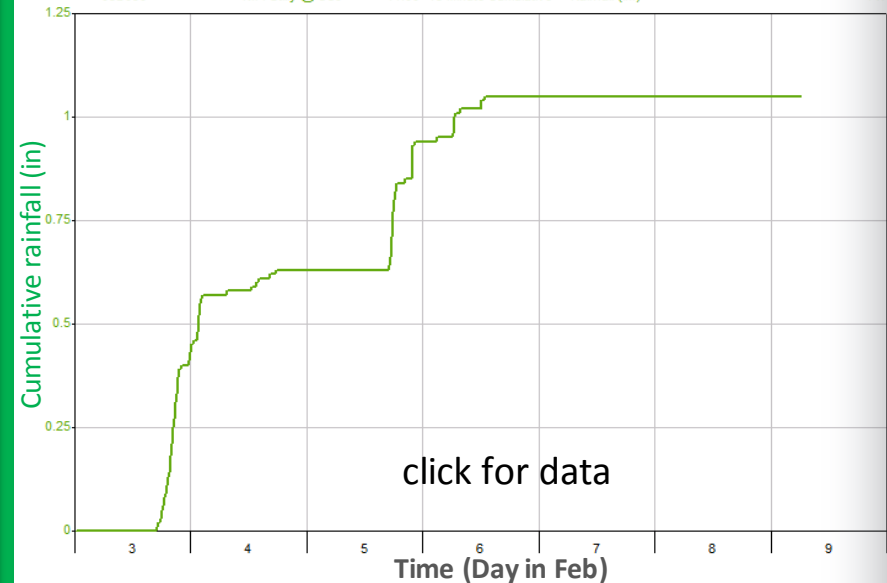
A sharp increase in streamflow started Monday afternoon on the **North Fork Stillaguamish River** at Oso, consistent with warm air temperatures.

Washington State Dept. of Ecology

HYPLOT V133 Output 02/09/2016

Period 7 Day 02/03/2016 to 02/10/2016 2016

— 05B090 N.F. Stilly @ Oso 11.00 15 Minute Cumulative Rainfall (in.) AT



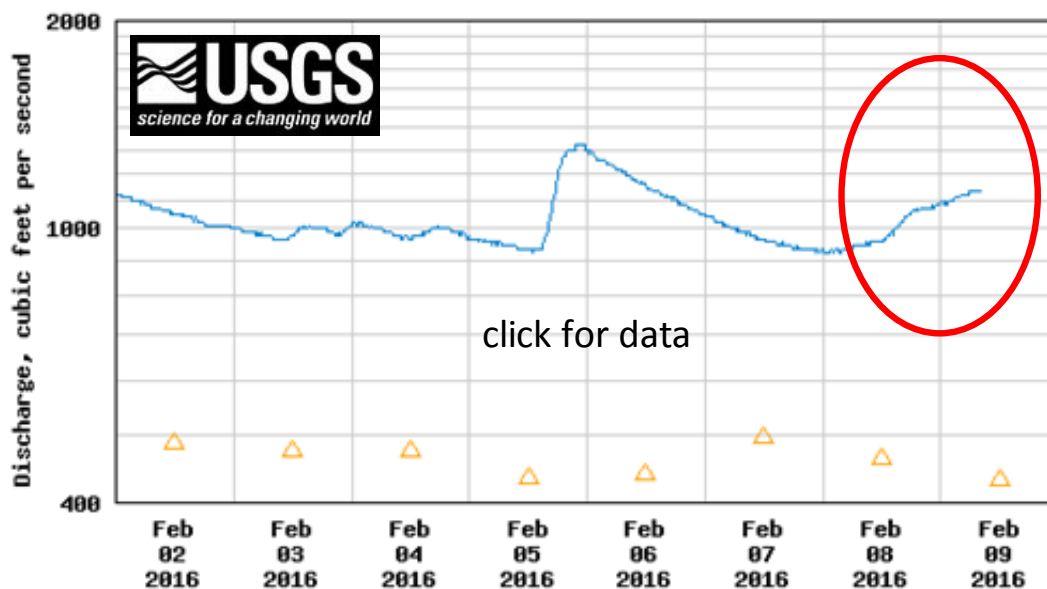
Rainfall in the area ended around mid-day on Saturday, meaning that **Monday's spike in stream flow is a result of melting of recently fallen snow.**



Discharge, cubic feet per second

Most recent instantaneous value: 1,130 02-09-2016 08:00 PST

USGS 12056500 NF SKOKOMISH R BL STAIRCASE RPDS NR HOODSPORT, WA



----- Provisional Data Subject to Revision -----

△ Median daily statistic (90 years) — Discharge

While we are losing a bit of snowpack to this warm weather, things are still in decent shape for February. But will El Niño conditions continue?

Read NOAA's El Niño update:



Update: It's got a lot going on

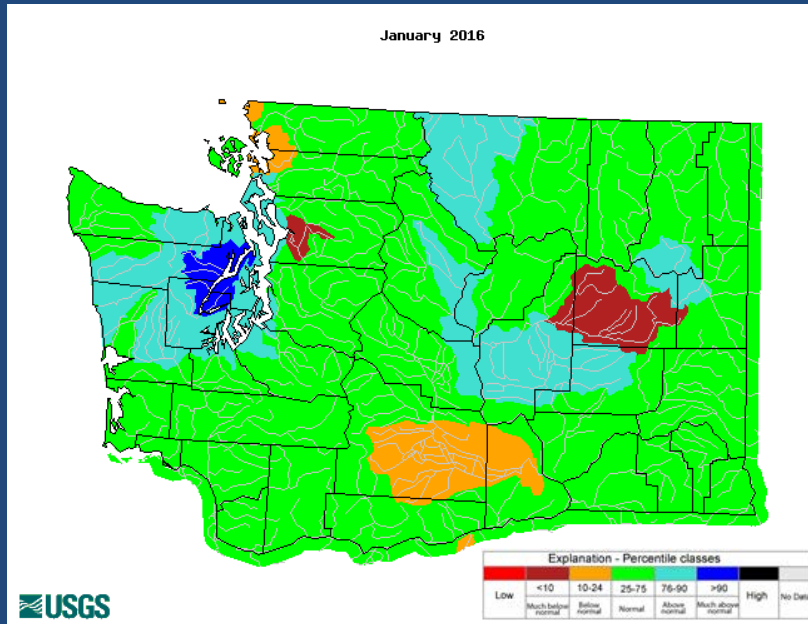
Author: Emily Becker.
Thursday, January 14, 2016

A similar rise in stream flow on Monday afternoon can be seen on the hydrograph from the USGS stream gage on the **North Fork Skokomish River near Hoodsport.**

[Read here](#)



Jim Shedd,
Ecology

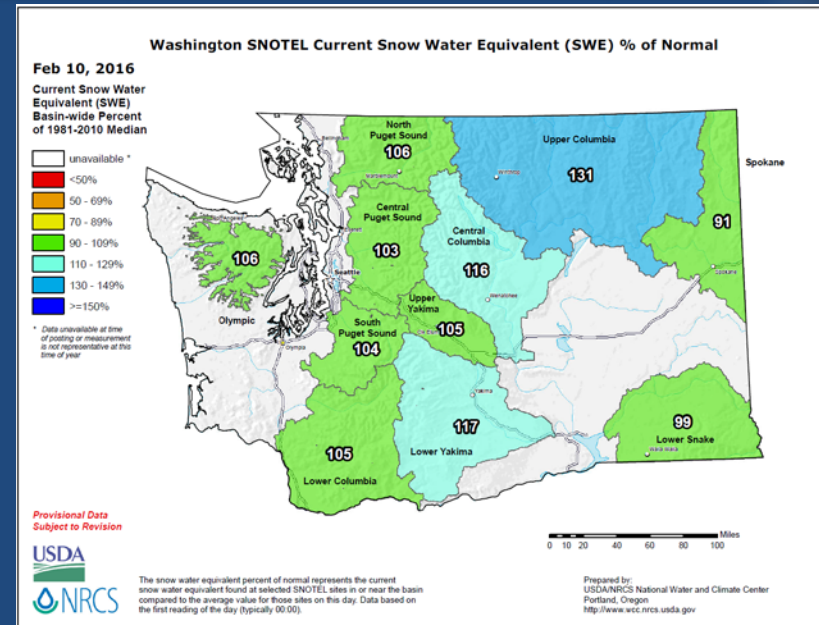


January 2016 monthly mean for rivers and streams across Washington compared to historic January flows.

In January, the south and western zones of the Puget Sound basin experienced higher streamflows than normal in response to above normal precipitation.

See link to January precipitation map:

<http://www.wrcc.dri.edu/wwdt/archive.php?folder=pon1>



Snow water equivalencies including the Olympic Peninsula are normal or slightly above normal on February 10.

In January, temperatures were near normal throughout the Puget Sound basin. We are in much better condition than last year but temperatures are warmer than normal.

Link to January temperature map:

<http://www.wrcc.dri.edu/wwdt/archive.php?folder=mdn1>

Get data from Ecology's Marine Monitoring Programs



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams

Long-Term Monitoring Network

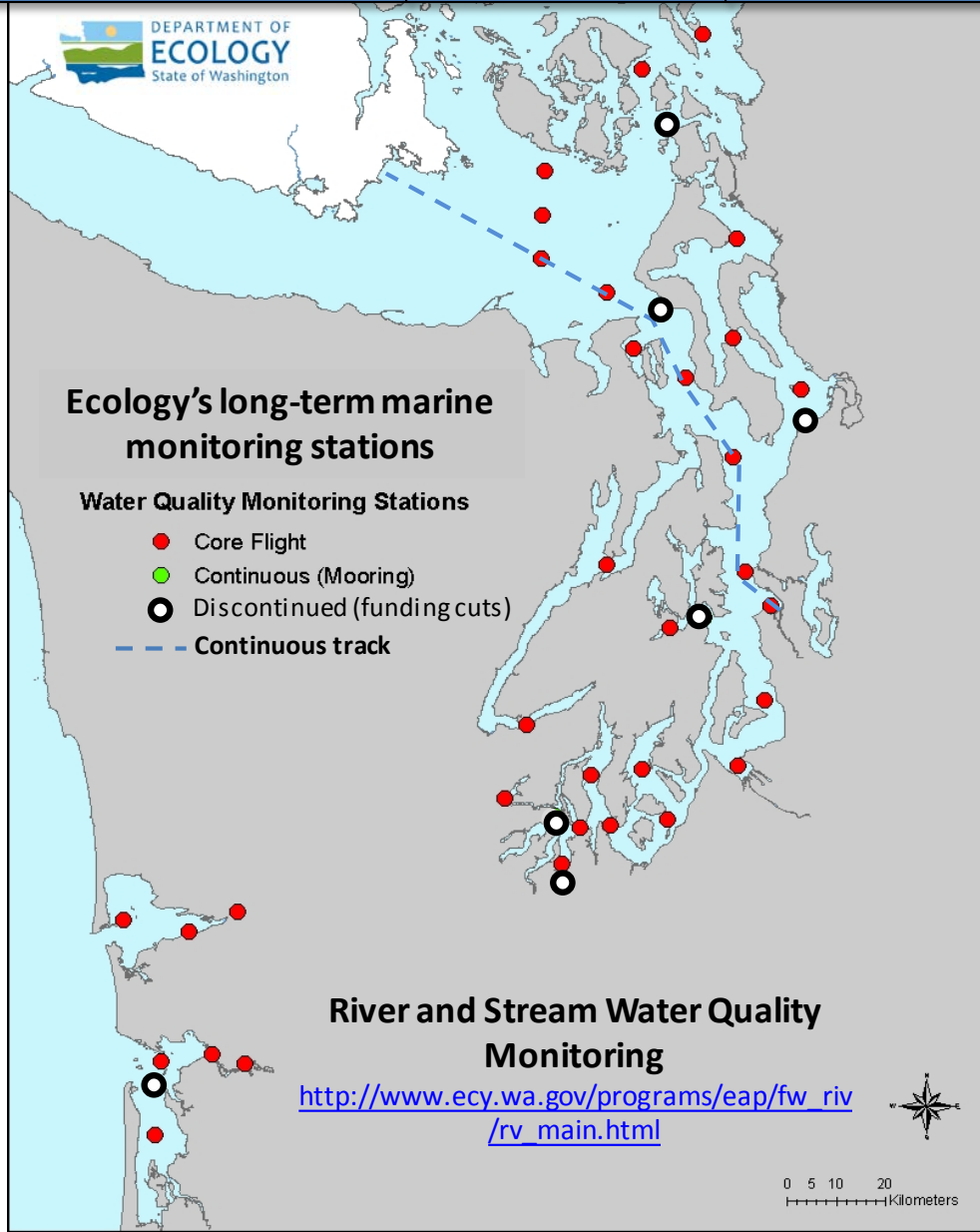


christopher.krems@ecy.wa.gov



Access core monitoring data:

<https://fortress.wa.gov/ecy/eap/marinewq/mwdata/set.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>



Field log

Climate

Water column

Aerial photos

Continuous monitoring

Streams

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