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DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound

Surface Conditions Report, *October 31, 2017*

Critter of the month:
The Sea Spiders

Start here

Up-to-date observations of water quality conditions in Puget Sound and coastal bays

Summary conditions at a glance

LONG-TERM MARINE MONITORING UNIT

Juhi LaFuente

Skip Albertson

Tyler Burks
Jim Shedd

Suzan Pool
Julia Bos

Dr. Christopher Krembs (Editor)

Personal stories

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Meet our new Washington Conservation Corps intern, Juhi LaFuente

Climate & Streams

p. 6

During October air temperatures are cooler and precipitation higher than normal, while sunshine remained abundant.
As a result tributaries throughout Puget Sound and the Olympic Mountains are generally flowing normal after below normal flows over the late summer particularly in the north Sound region.

Marine waters

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Puget Sound is fresher than it's ever been the past 17 years. Warmer temperatures remain in South Sound in September. In October surface water temperature in the Straits begin to cool and rivers discolor surface waters.

Aerial photography

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Blooms are small and confined to inlets. Jellyfish patches are practically absent. Leaves begin to drift on the water with some orange debris looking like a dying bloom of Noctiluca.

Editorial assistance provided by: Julianne Ruffner, Suzan Pool, Carol Maloy

Meet our new Washington Conservation Corps intern

It is getting cold out there! Juhi's first marine survey on our research vessel Skookum.

Juhi LaFuente

Juhi joined our marine team to conduct water and sediment surveys, work in our laboratory, and support both the Toxic Studies and BEACH program.

We are really happy to have her in the program for the next year!

Juhi Brings Experience

Juhi graduated from Western Washington University with a BS in Environmental Science. She studied Tropical Marine Biology and Ecology in La Paz, Mexico, followed by an AmeriCorps position at the Port Townsend Marine Science Center. There she worked on aquaria, husbandry for the invertebrates and fish, and public communication and outreach.

What was the visibility in the water for divers?

September

Visibility (ft)/depth (ft)

Best/Depth, Least/Depth

1)	29	30	15	11
2)	16	30	9	94
3)	21	3	17	79
4)	40	43	19	5
5)	20	33	19	80
6)	37	57	16	15
7)	32	95	27	8
8)	38	97	13	13
9)	41	79	21	3
10)	15	43	4	5
11)	44	97	15	36
12)	25	57	7	31
13)	46	97	5	5
14)	7	31	6	13
15)	23	51	20	92
16)	22	97	17	16
17)	14	87	13	18
18)	13	48	5	20

Find depths with high and low visibility

- **Best Visibility** was nearly 50 feet south of Three Tree Point toward Browns Point and Commencement Bay.
- **Poor vibility** occurred in many places in South Puget Sound, but also in Bellingham Bay and near Bremerton/Silverdale.
- We use transmissometer readings from our CTD package and convert them into horizontal visibility. See our recent publication for details: Underwater visibility Maps – a Tool for Scuba Divers.

Read poster

Visibility

good — poor

This is a new feature, and we are soliciting feedback (salb461@ecy.wa.gov). Eventually we will feature the most recent data.

Critter of the Month – The Sea Spiders

Dany Burgess & Angela Eagleston
Marine Sediment Monitoring Team

The Pycnogonids

BOO! If you're scared of spiders, this month's creepy Critter might give you a fright. Find out why the Sea Spider is not actually a spider at all, and why its amazing legs do many spooktacular things!

Fun Sea Spider Facts

- Species from polar oceans can grow to the size of a dinner plate.
- Their blood is pumped by the gut, not the heart.
- The male sea spider cares for the eggs, holding them with a special pair of legs.

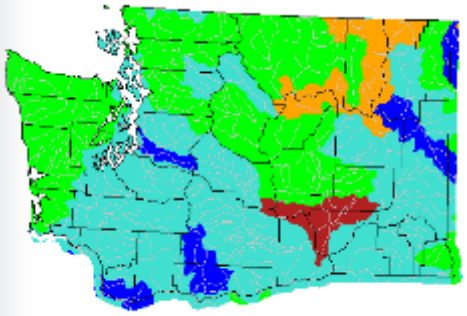
Learn more about Sea Spiders and other critters on Ecology's EcoConnect blog here

How much water flows into coastal marine waters?

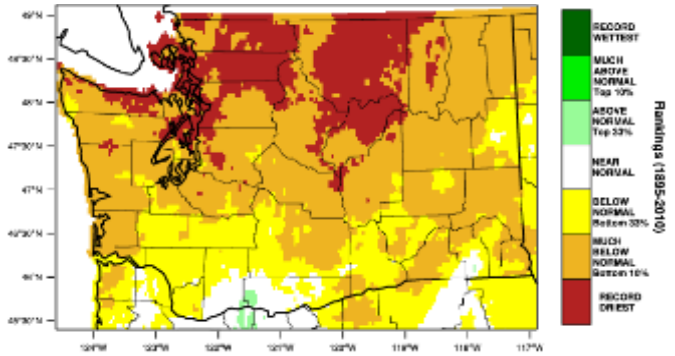
Tyler Burks, Jim Shedd

After warm and very dry summer conditions in the Puget Sound, conditions returned to mostly normal in October. Temperatures and precipitation were close to average throughout the region. As a result, tributaries throughout Puget Sound and the Olympic Mountains are generally flowing normally after below normal flows over the late summer, particularly in the north Sound region.

Washington Stream flows
October, 2017

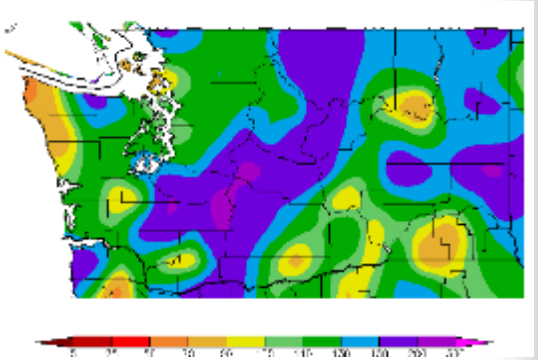


Washington - Precipitation
July – September 2017 Percentile



WestWide Drought Tracker, U Idaho/WRCC Data
Source: PRISM (Prelim), created 16 OCT 2017

Percent of Average Precipitation (%)
Oct, 6, 2017 – Nov, 4, 2017



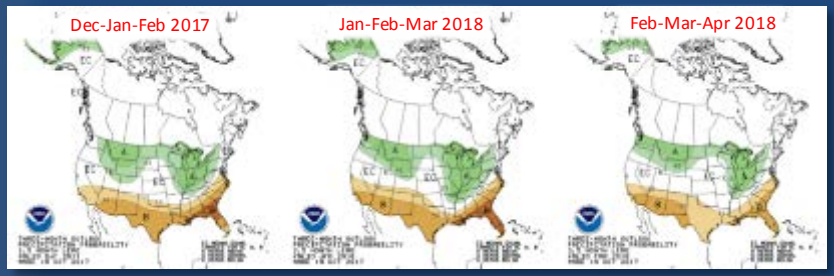
Generated 11/5/2017 at WRCC using proDivingional data.
NOAA Regional Climate Centers

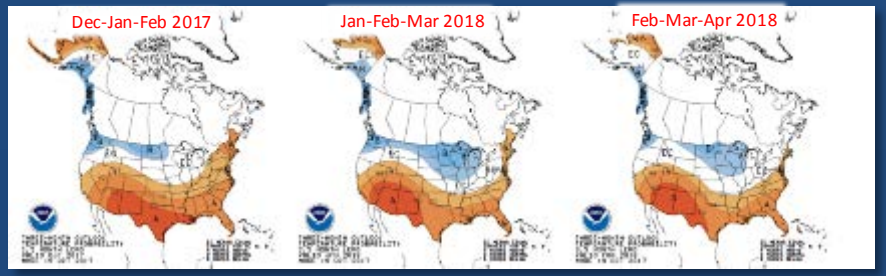
Streamflows returned to normal in October after much of the basin experienced below and much below normal flows in the month of September.

October saw the return of much needed precipitation after below average and even record breaking dry periods in parts of the Olympics and north Cascades. Last October (2016) saw record breaking precipitation in much of the Puget Sound region. Interestingly, Olympia had 28 rainy days in October 2016 in contrast to only 11 days this year. Yet October 2017 still saw normal to above normal precipitation.

How much water flows into coastal marine waters?

Climatologists predict wetter and cooler conditions this winter and early spring due to an expected La Niña. Could this mean a good supply of cool water flowing to Puget Sound in the spring and summer?



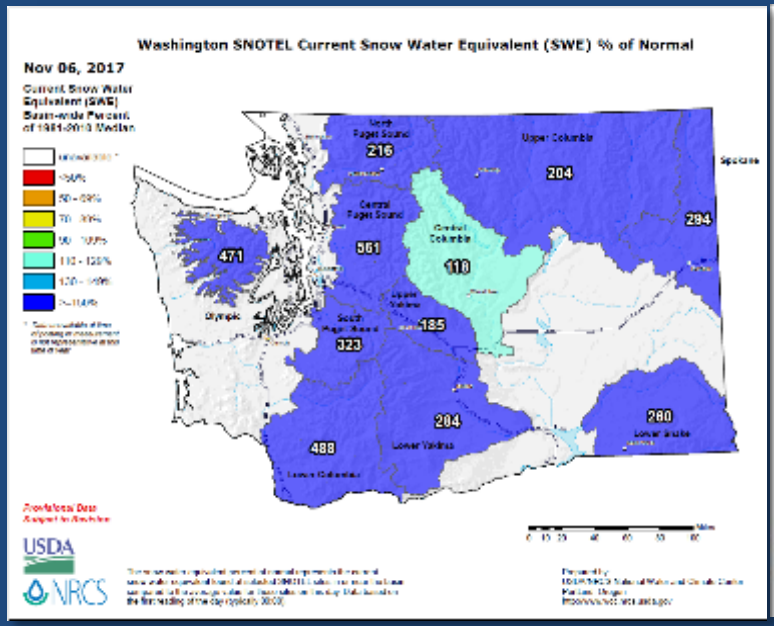


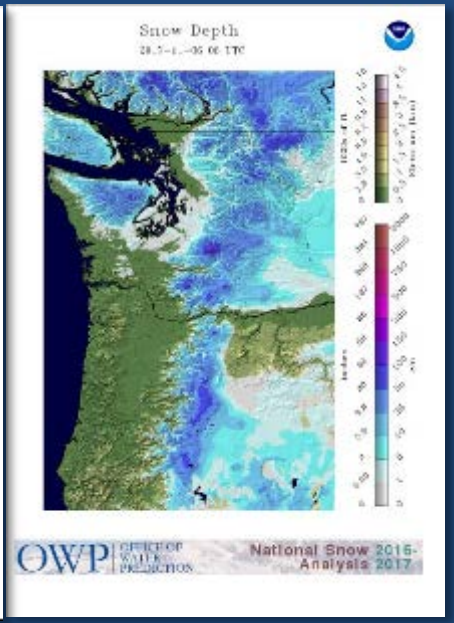
The map on the upper left shows higher than usual probability of above normal precipitation. The map on the right show a higher chance of cooler temperatures. Click here

Very early snow water equivalence (SWE) in the mountains is off to a good start.

The past two years SWE was generally higher than normal.

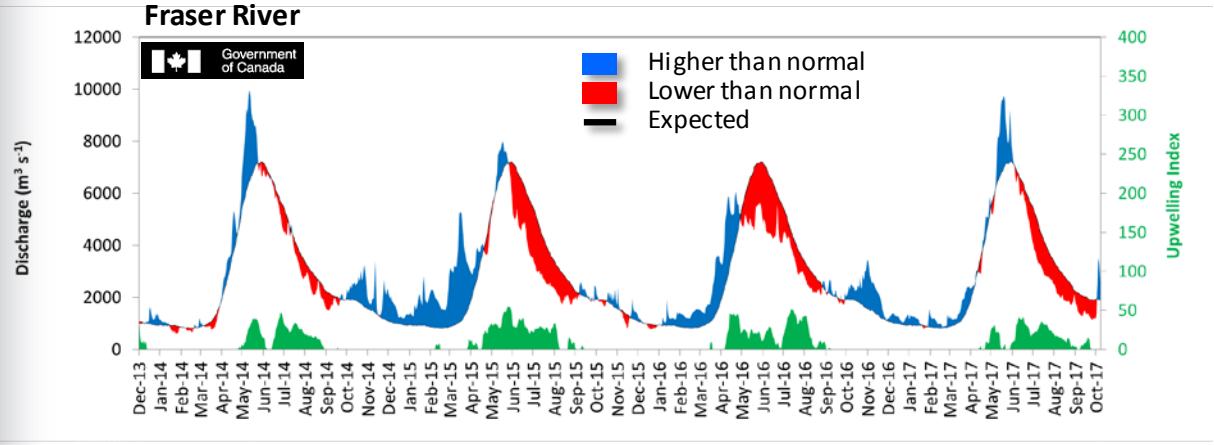
Will we see the same in 2018? The graphics on the left shows current snow accumulation.





Climate influences: How well is Puget Sound exchanging its water?

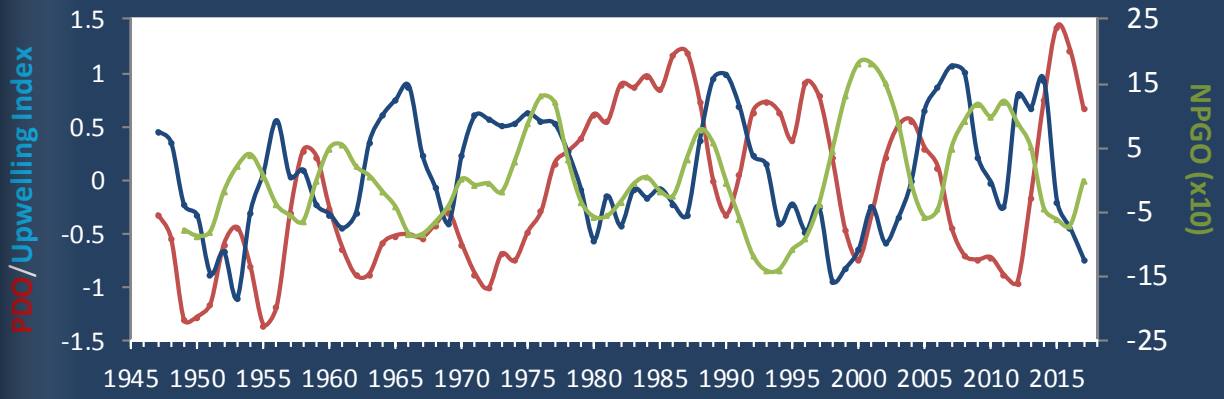
Historically, peaks of coastal upwelling and the freshet are in sync.



The Fraser River is the major driver of estuarine circulation and water exchange with the ocean.

Fraser River flows were higher than normal in July. Then flows got weaker. Lower Fraser River and weaker upwelling along the coast favored a reduced inflow of low-oxygen water from the coast and positively influence oxygen conditions.

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



How do ocean boundary conditions affect the quality of water we exchange with the ocean.

Past years warm water is fading (PDO), upwelling of low oxygen and high nutrient ocean water are low (Upwelling Index anomaly), and surface productivity along the coast is near normal (NPGO).

*Pacific Decadal Oscillation Index (**PDO, temperature**, explanation). Upwelling Index (anomalies) (**Upwelling, low oxygen**, explanation). North Pacific Gyre Oscillation Index (**NPGO, productivity**, explanation).*

What's the story of influences affecting water quality?

Climate and natural influences include weather, river flows, and the adjacent ocean conditions that affect our marine waters. This graphic provides context for interpreting Puget Sound marine conditions. All data from public sources: weather from UW Grayskies; river flows from USGS and Environment Canada; indices from NOAA, UW (PDO), and E. Di Lorenzo (NPGO).

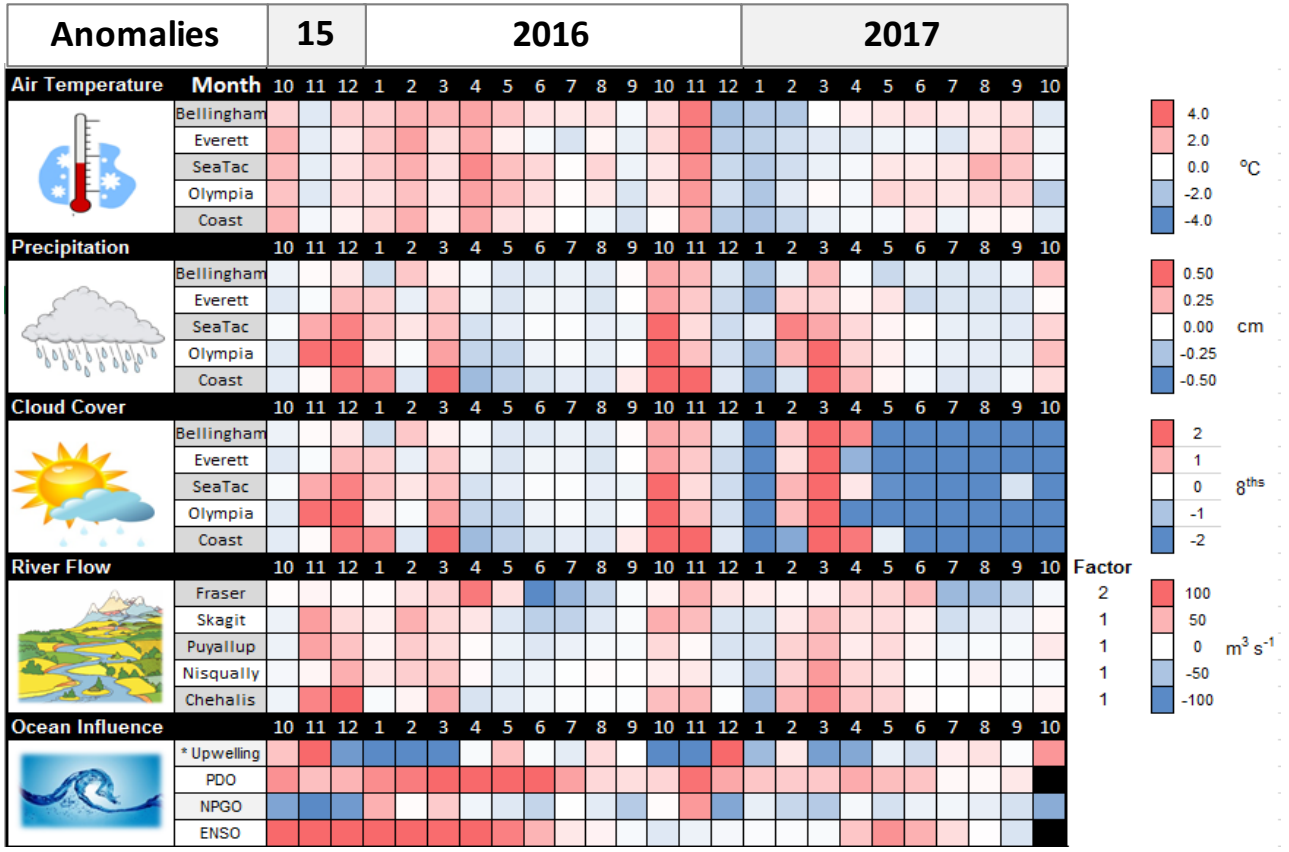
Summary:
Air temperatures fell below normal during October after being mostly above normal since May.

Precipitation levels had been low, but are now above normal.

Sunshine levels have been consistently above normal since May.

River flows are increasing back to normal after low flows through the summer.

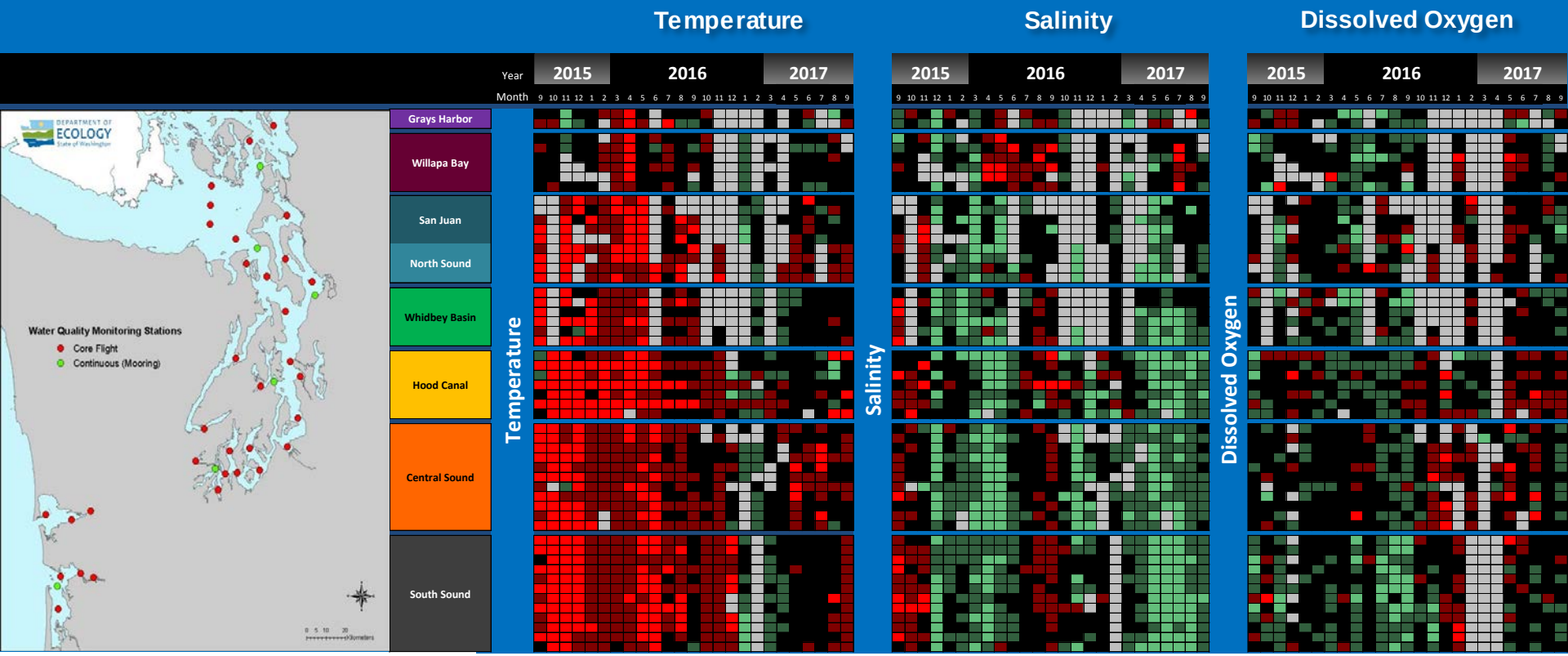
We expect **downwelling** in fall, but it's currently weaker. ENSO is trending cooler, towards La Niña.



*Upwelling Anomalies (PFEL)
PDO = Pacific Decadal Oscillation
NPGO = North Pacific Gyre Oscillation
ENSO = El Niño Southern Oscillation

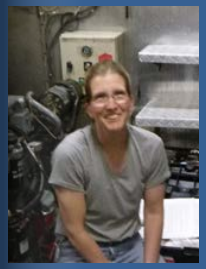
How did water quality respond to recent conditions?

As of Sept 2017, warmer temperature persists in South Sound. **Very low salinity persists in Hood Canal, Central and South Sound.** Significantly fresher conditions in Puget Sound occurred since November, 2016. In September higher dissolved oxygen values continue in Hood Canal while dissolved oxygen is lower in Central Sound.

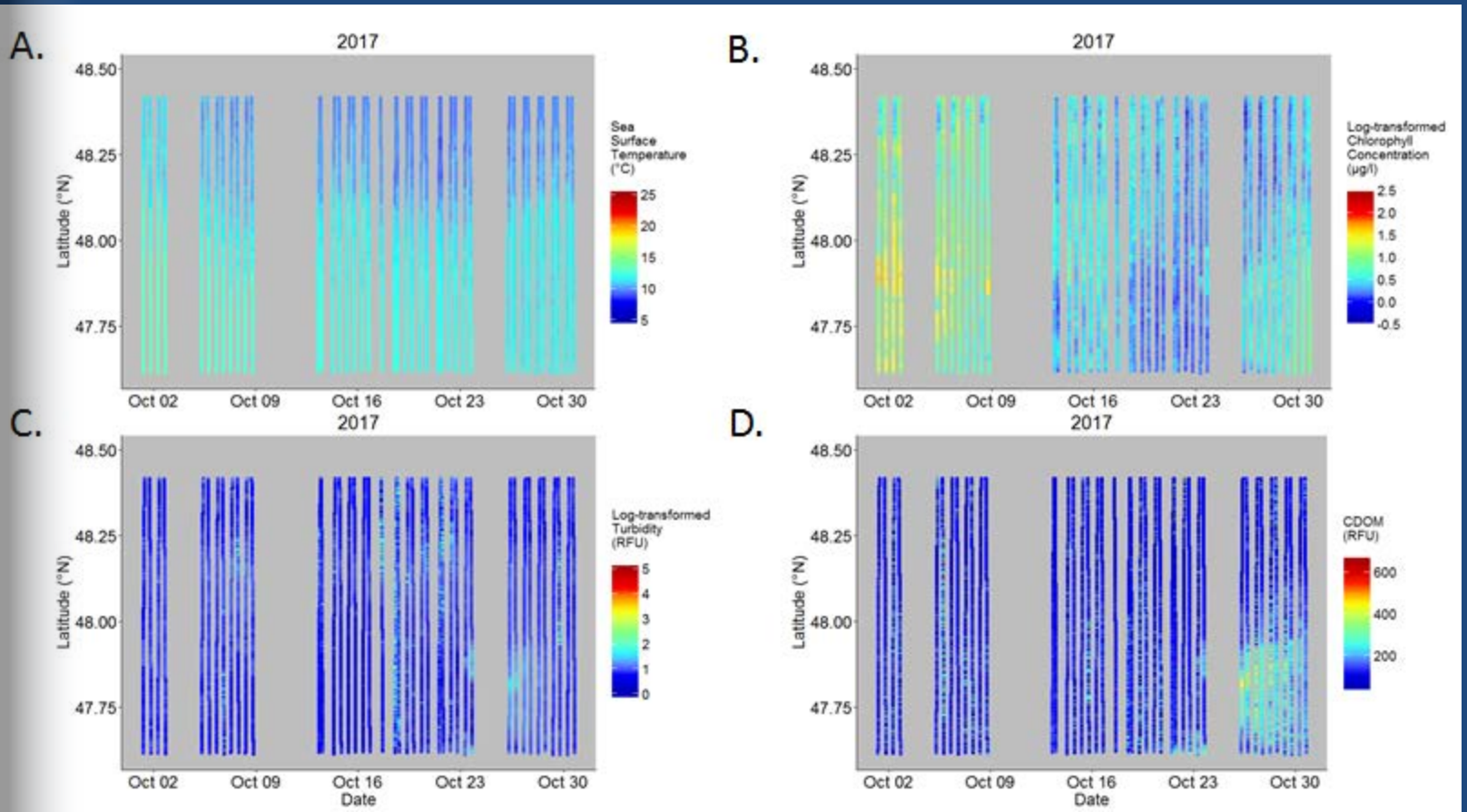


Ecology's monthly monitoring station network. Surface to full depth.

What are conditions at the surface?



Summary of *Victoria Clipper IV* ferry data:
Surface water temperature cooled in the Strait of Juan de Fuca. Moderate chlorophyll concentrations in Puget Sound occurred in early October followed by clearing in mid-month. Turbidity and CDOM were noisy until late October when river outflows contributed to an increase near the Triple Junction. Gaps in the data are explained by the vessel remaining in port.



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.

What are conditions at the surface?

The productive season is coming to an end, blooms are getting smaller, mainly in the color of red-brown. Jellyfish patches are practically absent. Leaves begin to drift on the water with some orange debris in Case Inlet looking like a fading bloom of the dinoflagellate Noctiluca.

Start here

Narrow Hammersley Inlet connecting Oakland Bay

Seattle enjoying the last sunny days of fall

Front

Mixing and Fronts:
Fronts along Deschutes River plume. Otherwise uneventful.

Jellyfish:
Jellyfish patches rare, seen only in Budd Inlet.

Plume

Suspended sediment:
Uneventful

Bloom

Visible blooms:
Red-brown: Dyes, Sinclair, Eld, Budd and Henderson Inlets.

Debris

Debris:
Leaves drifting at the surface in Inlets of South Sound. Ribbons of orange in Case Inlet accumulating along fronts. Potentially being Noctiluca?

Aerial photography and navigation guide

Date: 10-31-2017

Tide data (Seattle):

Time	Height (ft)	High/Low
02:31 AM	8.35	H
08:22 AM	2.77	L
2:57 PM	11.18	H
9:32 PM	2.92	L

Flight Information:

Sunny, Divingibility slightly hazy.

Flight route

Observation Maps:

Central Sound

South Sound

Lower altitude. Red-brown bloom. Front of the Deschutes River with organic material debris.
Location: Budd Inlet (South Sound), 2:47 PM.

Higher altitude. Red-brown bloom. Front of the Deschutes River with organic material debris.

Location: Budd Inlet (South Sound), 2:49 PM.

Red-brown bloom and orange surface debris.
Location: Eld Inlet (South Sound), 2:52 PM.

Intense red-brown bloom confined to western side of the bay.

Location: Eld Inlet (South Sound), 2:52 PM.

Tidal eddy.
Location: Totten Inlet (South Sound), 2:54 PM.

Orange surface debris.

Location: Big Cove, Totten Inlet (South Sound), 2:55 PM.

Aerial photography 10-31-2017

Orange surface debris along front.

Location: Herron Island, Case Inlet (South Sound), 3:00 PM.

Orange surface debris along front.

Location: Across Stretch Island, Case Inlet (South Sound), 3:02 PM.

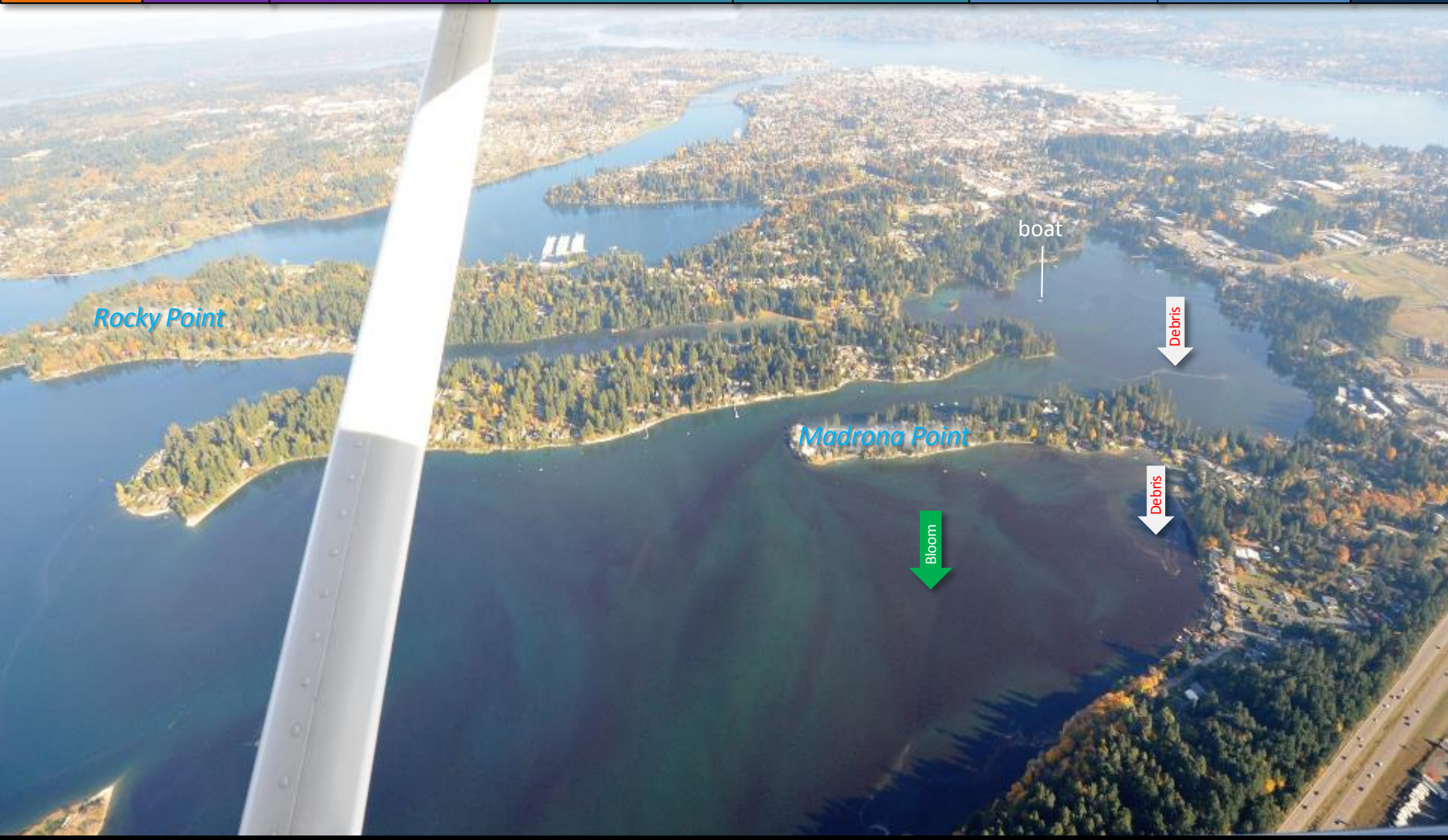
Some surface debris.

Location: Burley Lagoon, Carr Inlet (South Sound), 3:06 PM.

Aerial photography 10-31-2017

Red-brown bloom.

Location: Sinclair Inlet (Central Sound), 3:11 PM.



Red-brown bloom and some surface debris.

Location: Ostrich Bay, Dyes Inlet (Central Sound), 3:13 PM.

Organic material accumulating at tidal front next to red-brown bloom.
Location: Entrance to Ostrich Bay, Dyes Inlet (Central Sound), 3:13 PM.

Organic material accumulating at tidal front next to red-brown bloom.

Location: Liberty Bay (Central Sound), 3:17 PM.

Red-brown bloom.

Location: Liberty Bay (Central Sound), 3:17 PM.

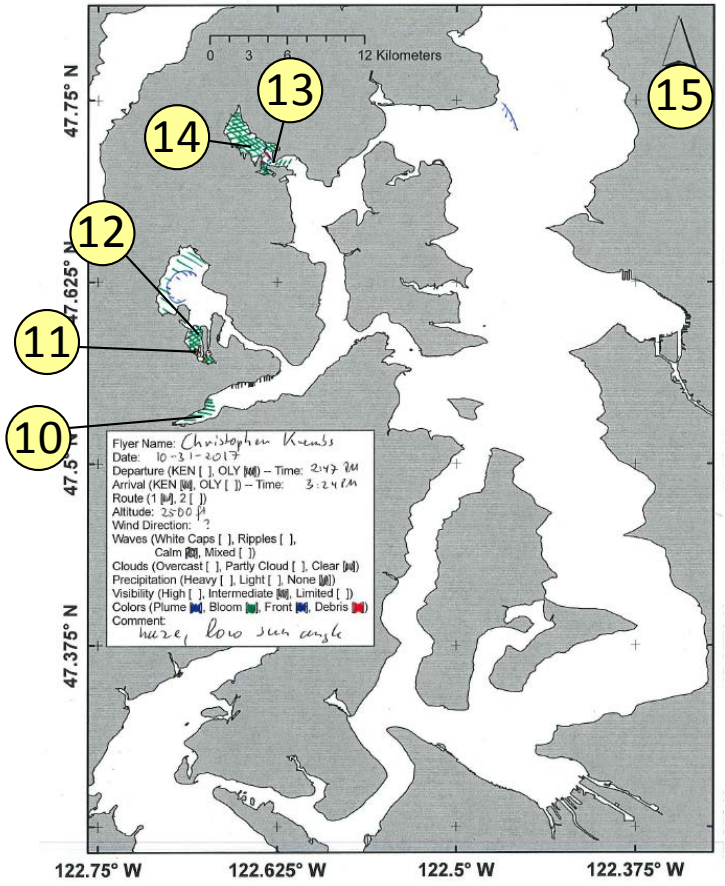
Jay, our new pilot at the helm of the Kenmore Beaver floatplane.
Location: Getting ready for the approach to Kenmore Base (Seattle), 3:22 PM.

Date: 10-31-2017

Hood Canal

n.a.

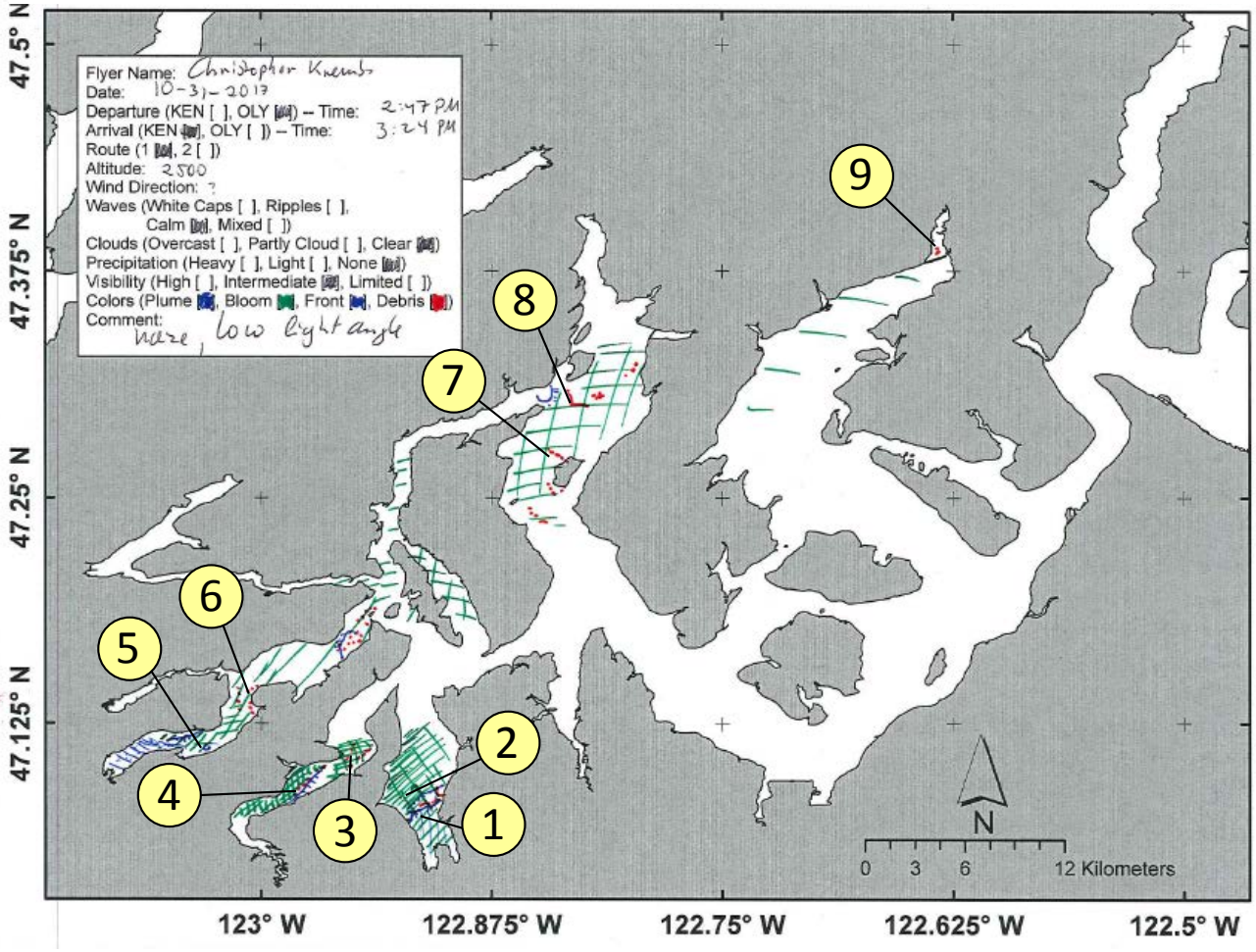
Central Sound



Numbers on map refer to picture numbers for spatial reference

Date: 10-31-2017

South Sound



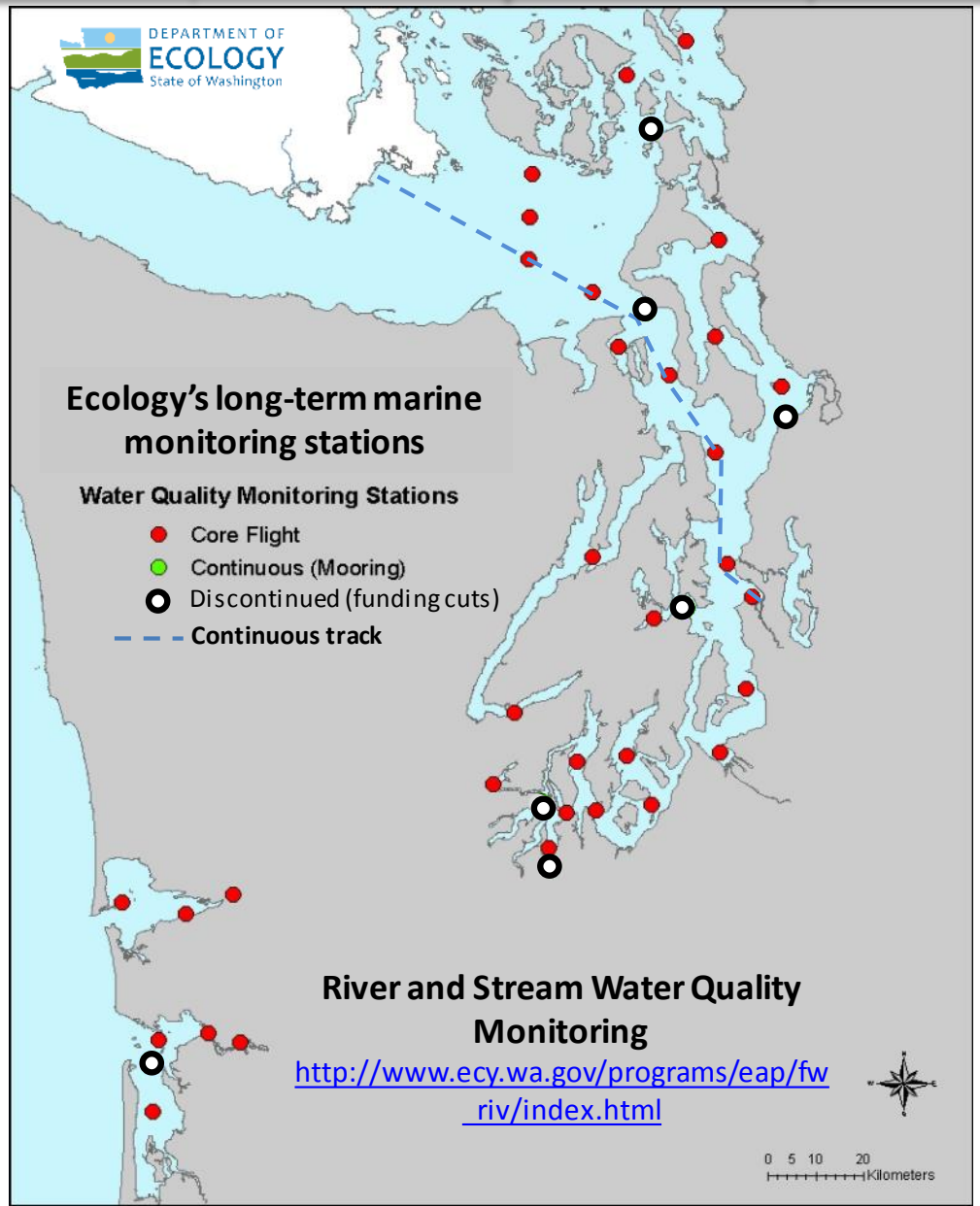
Numbers on map refer to picture numbers for spatial reference

Get data from Ecology's Marine Monitoring Programs

Long–Term Monitoring Network

Christopher.Krembs@ecy.wa.gov

Access core monitoring data:
https://fortress.wa.gov/ecy/eap/marinewq/mwdataset.asp



En route ferry monitoring

Suzan.Pool@ecy.wa.gov

Discontinued mooring network
http://www.ecy.wa.gov/programs/eap/mar_wat/data.html

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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Environmental Assessment Program
WA Department of Ecology

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