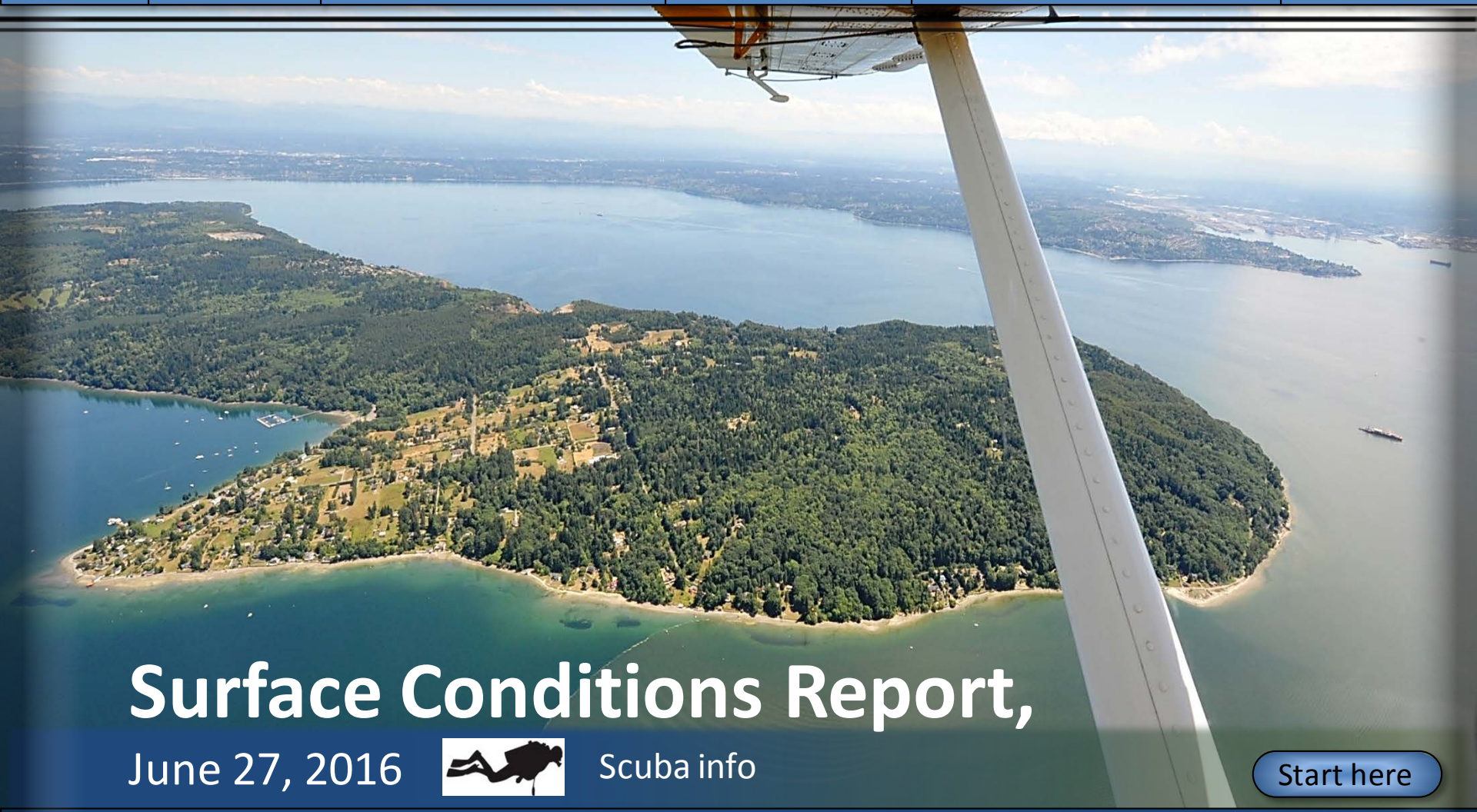
Publication No. 16-03-074

DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound



Surface Conditions Report,

June 27, 2016

Scuba info

Start here

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

Marine conditions from 6-27-2016 at a glance

LONG-TERM MARINE MONITORING UNIT

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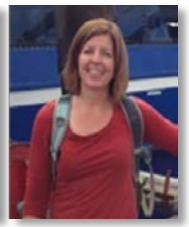
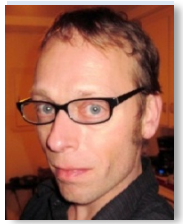


Markus von Prause



Editorial assistance provided by: Julianne Ruffner, Carol Maloy

Critter of the Month

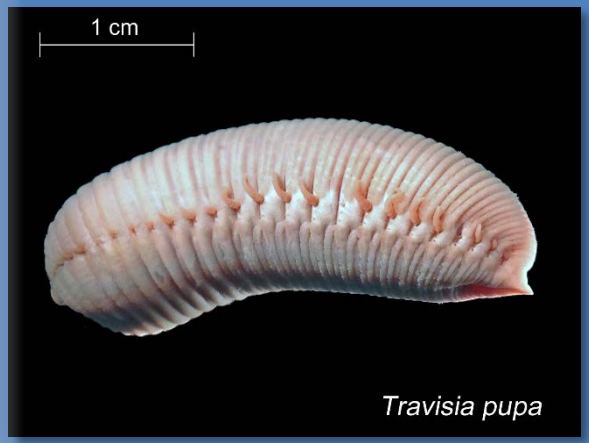
Dany Burgess & Angela Eagleston
Marine Sediment Monitoring Team

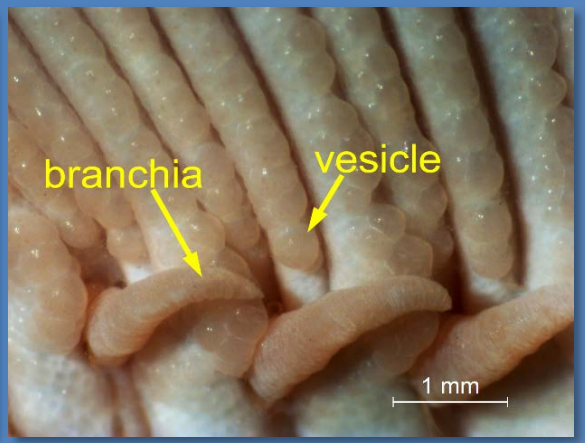
Travisia pupa – The Pacific Stinkworm

This month's critter has a face (and smell) that only a mother could love. Meet the Stinkworm, an important member of Puget Sound's benthic community.

Fun Stinkworm Facts!

- Emits a foul rotting-garlic odor when disturbed
- Functions as a bioturbator, turning over and aerating the sediment
- Can be easily identified by the size of its vesicles (warts)





Learn more about the Stinkworm and other critters on Ecology's EcoConnect blog here.

Personal Field Impression 6-27-2016

Is Your Beach Safe for Swimming this Summer?

Each year, between Memorial Day and Labor Day, the Washington State BEACH Program monitors saltwater beaches for fecal bacteria to ensure that the water is safe for swimming and other recreational activities.

KING 5 Video 1

Q13 FOX Video 2

WSU Beach Watcher, Tim Ellis, demonstrates how we collect water samples for analysis.

2016 Season Kick-Off!

Media joined us to find out how people can stay healthy while playing at the beach and how to keep their favorite beaches healthy.

We sample beaches weekly. If bacteria levels are high, we let the public know it isn't safe to swim.

Follow us on Facebook and Twitter for beach water quality updates .

The divers page, visibility 6-27-2016

What is the visibility in the water for divers?

	Best	/Depth		Least	/Depth
1)	44	/ 52		17	/ 8
2)	7	/ 48		4	/ 11
3)	50	/ 71		10	/ 5
4)	22	/ 94		13	/ 3
5)	32	/ 49		11	/ 10
6)	19	/ 98		7	/ 8
7)	23	/ 94		5	/ 5
8)	22	/ 85		5	/ 13
9)	10	/ 39		5	/ 18
10)	28	/ 90		5	/ 11
11)	27	/ 61		3	/ 25
12)	19	/ 97		5	/ 7
13)	10	/ 41		8	/ 7
14)	25	/ 98		18	/ 7
15)	23	/ 90		12	/ 18
16)	15	/ 69		11	/ 98
17)	11	/ 18		5	/ 66

Find depths with high and low visibility

- **Best visibility** was around 20-30 feet or more.
- **Poor visibility** occurred in many places of Puget Sound in the first 10 feet of the surface.
- In May, compared to April, visibility was lower due to the combined effect of phytoplankton and glacial flour from rivers.
- Many locations that reported 40-50 ft. of horizontal visibility in April only reported 20-30 feet in May.
- We use transmissiometer readings from our CTD package and convert them into horizontal visibility.

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

Natural Influence leading to 6-27-2016

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.

Summary for May 2016:

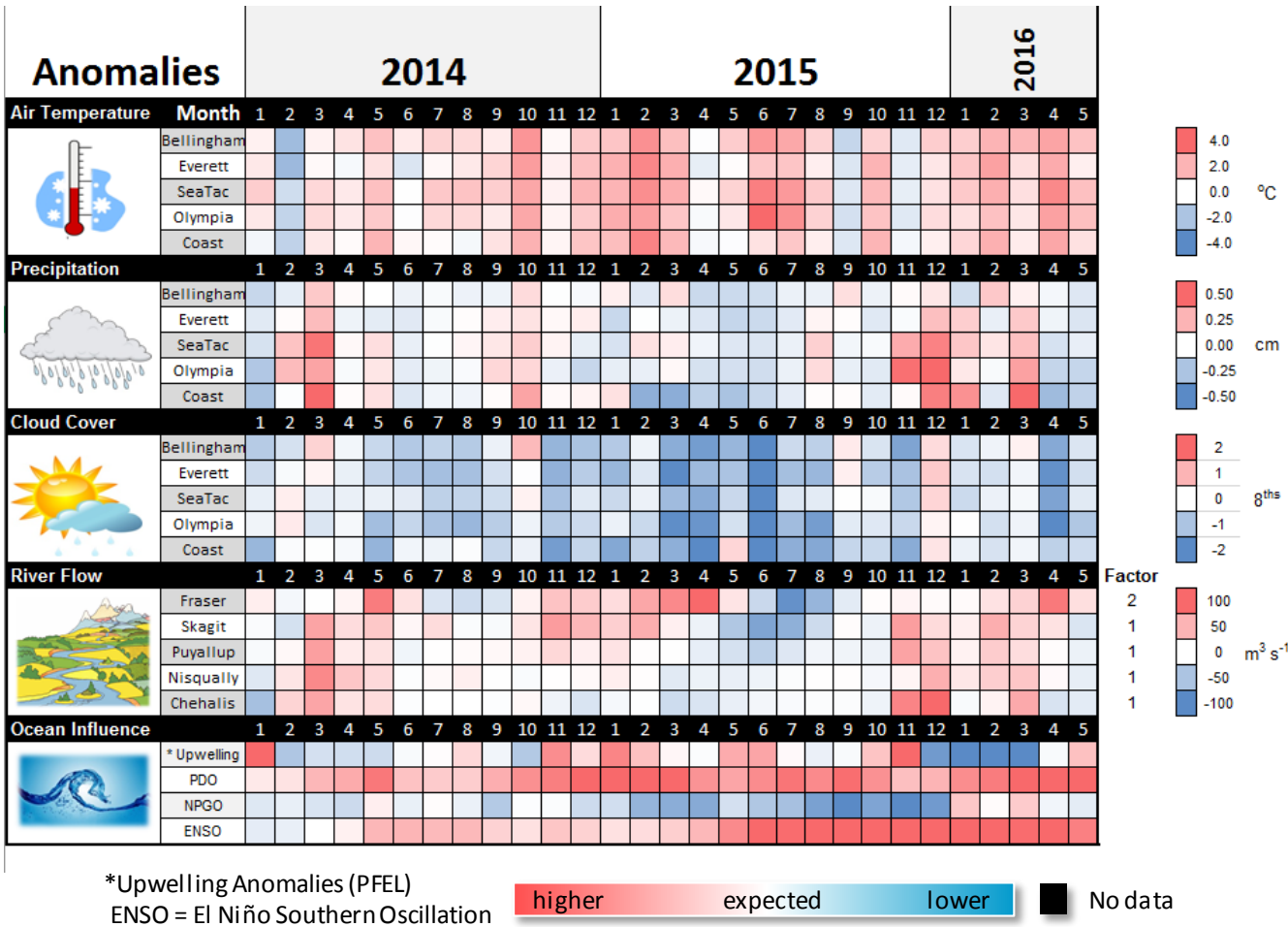
Air temperatures remain above normal in the Puget Sound lowlands.

Precipitation levels are below normal.

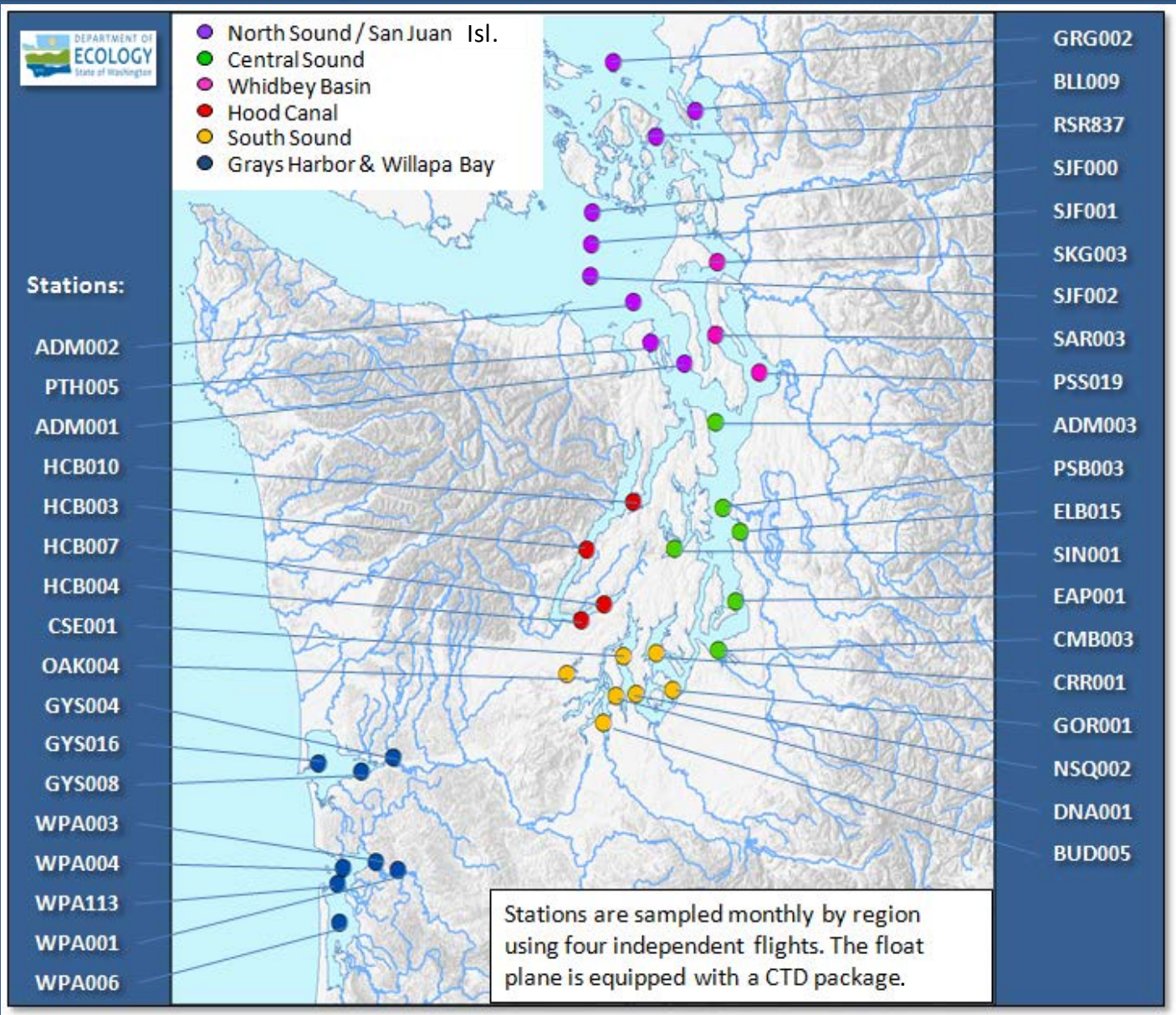
Sunshine levels have been mostly above normal (low cloud cover)

River flows are trending downward.

Upwelling is now above normal as are ENSO & PDO. El Niño trending downward.



Our long-term marine monitoring stations in Washington



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

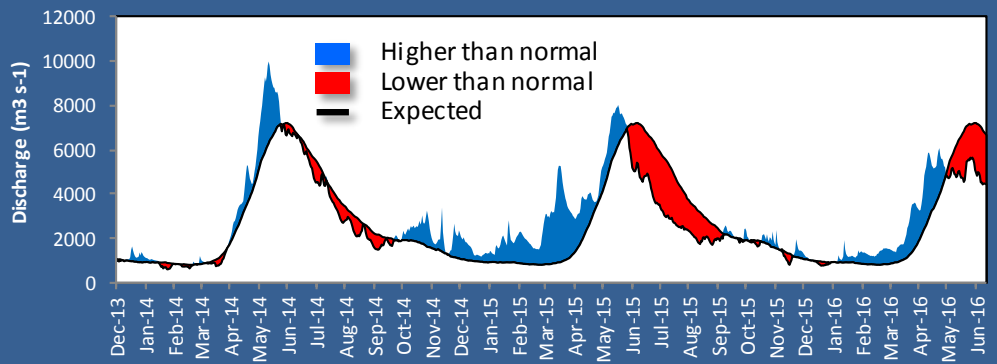
Start here

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?

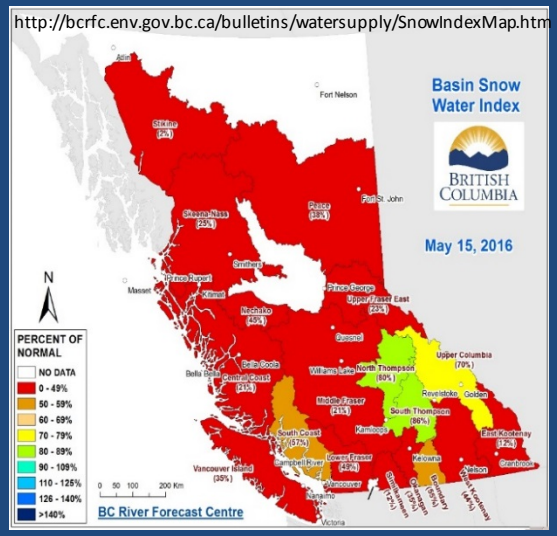
Year 2016 continues to have record breaking global temperatures. In our region, the Fraser River has not been flowing as high as last year and now flows have plummeted. Estuarine circulation is important because water temperatures in Puget Sound are still warmer than what they should be and now are breaking new records! The Fraser River is the largest freshwater source for the Salish Sea, significantly affecting estuarine circulation.



Government of Canada

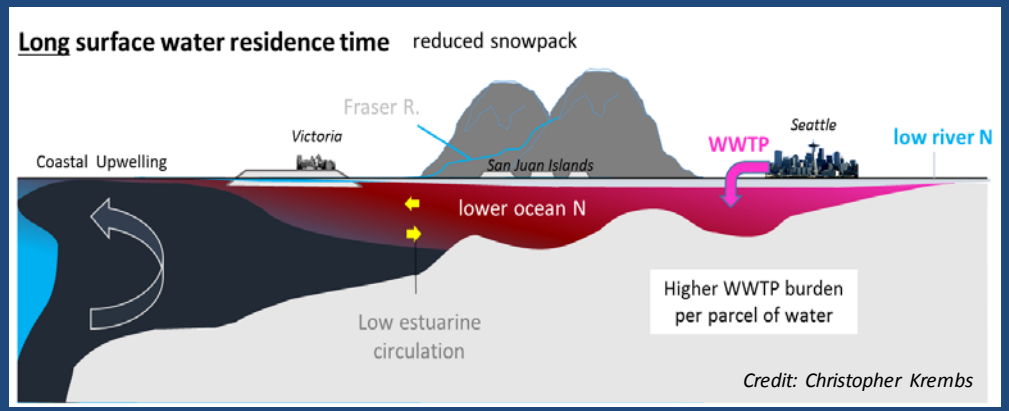
In winter and spring 2016, the Fraser River and other rivers discharged prematurely. This year's Fraser summer flow is extremely low in response to warm winter temperatures and disappearing snowpack in BC. Very low summer flows inhibit the renewal of water in Puget Sound.

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



BC, Canada didn't have much snow left by May 2016

See also NOAA



Very low Fraser River flow this summer means stagnant water in the Salish Sea and reduced exchange with the coast. As a consequence, water warms and pollution accumulates.

Physical conditions tracked in historical context

A record warm spring brought ample meltwater to Puget Sound. Salinity is remarkably lower. Record-breaking water temperatures also appear again in May and dissolved oxygen is decreasing. At the Coast, temperatures are expected while salinity is higher and oxygen is lower, suggesting upwelling.

Still higher temperature in P. Sound | **Salinity below normal** | **Decreasing 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

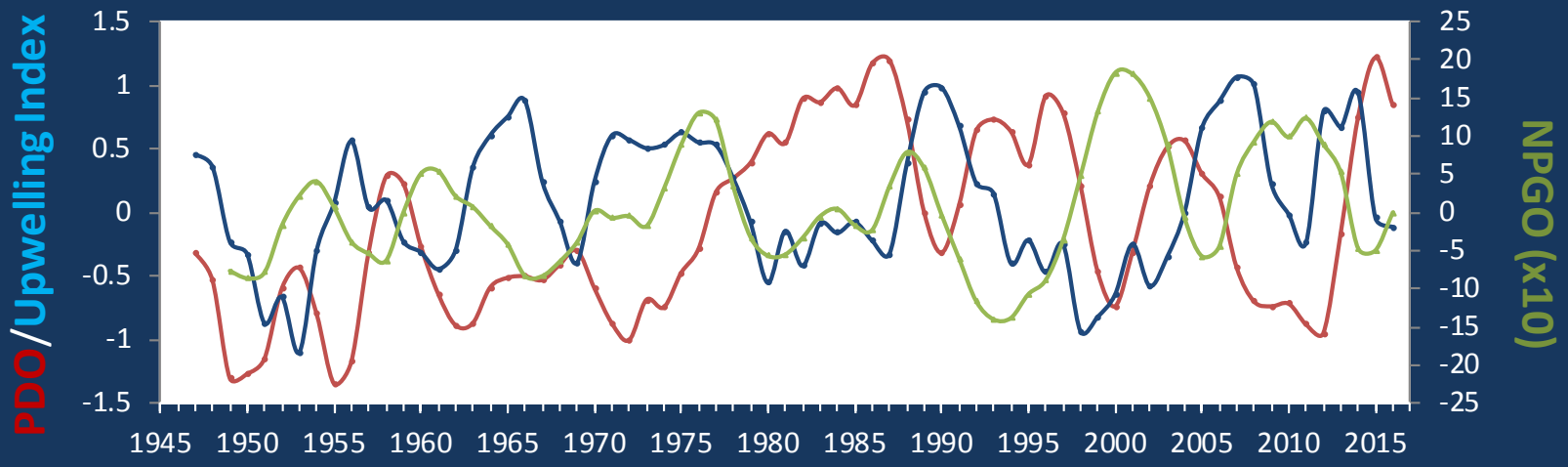
The ocean affects water quality: Ocean Climate Indices

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 long term variability: (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 is normalizing (NPGO).

Summary: Aerial photography 6-27-2016

Jellyfish in high numbers confined to Eld and Totten Inlets. Strong phytoplankton blooms in Budd, Carr, and Henderson Inlets as well as east of Bainbridge Island and Port Madison. Abundant organic material coincide with phytoplankton blooms except Henderson Inlet.

Front and two water masses. Tacoma Narrows.

Front and two water masses. Carr Inlet (McNeil I.).

Start here

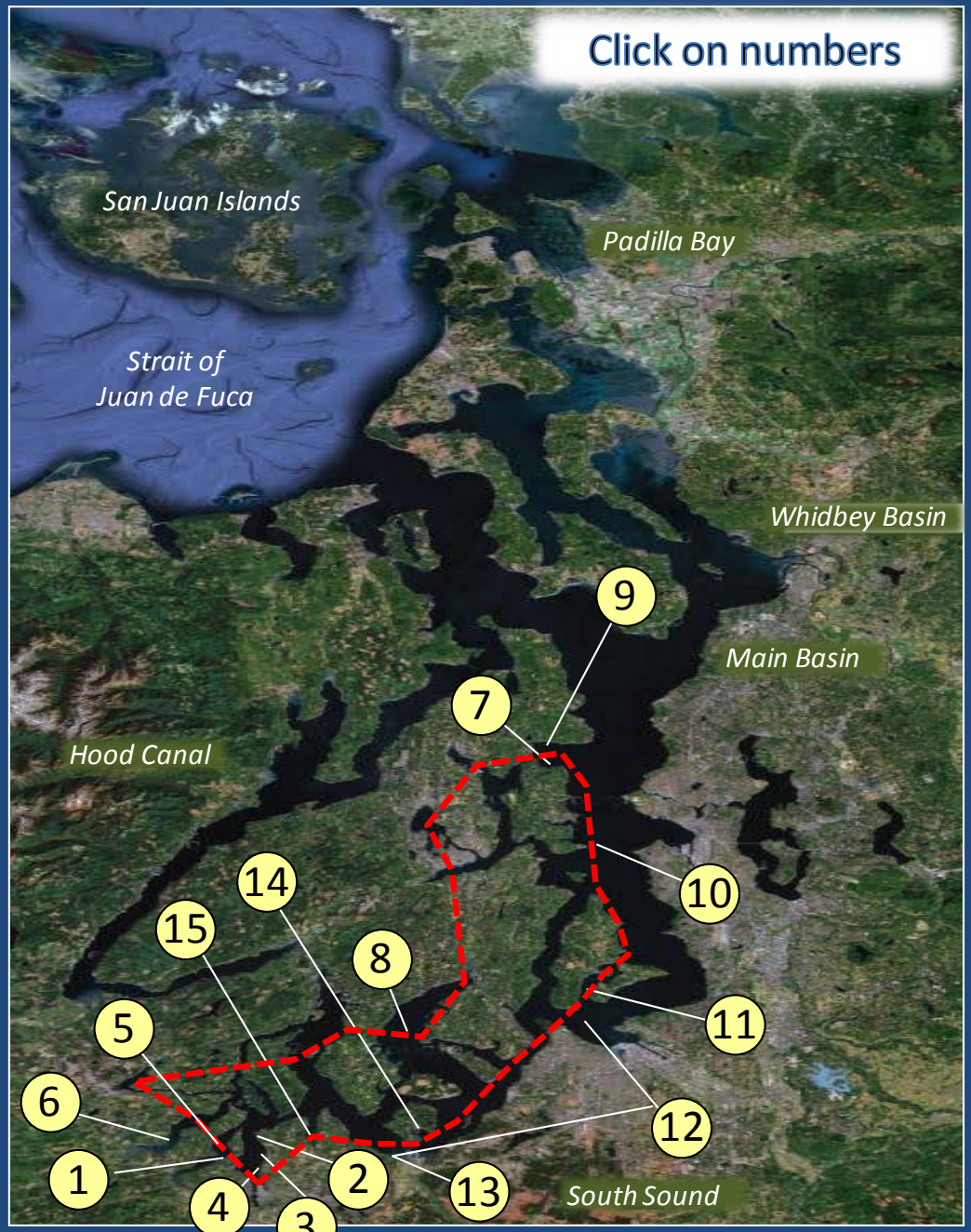
Mixing and Fronts:
Tidal fronts in Budd Inlet, off Port Madison, Restoration Point, and Tacoma Narrows.

Jellyfish:
Numerous jellyfish patches in Eld and Totten Inlets.

Suspended sediment:
A lot of suspended sediment from the Puyallup River. Little glacial flour in Nisqually Delta.

Visible blooms:
Strong red-brown blooms in Budd and Eld Inlets.
Strong green blooms in Henderson and Carr Inlets and Quartermaster Harbor.
Green-brown blooms east of Bainbridge Island.

Debris:
Abundant organic debris in Budd, Eld, and Carr Inlets, Oakland Bay, Port Madison, and east of Bainbridge Island. Noctiluca surfacing in unusual places (Oakland Bay, Budd Inlet, and Holmes Harbor).



Aerial photography and navigation guide

Date: 6-27-2016

Tide data (Seattle):

Time	Height (ft.)	High/Low
05:22 AM	3.73	L
10:48 AM	7.93	H
04:46 PM	2.2	L
11:34 PM	12.02	H

Flight Information:

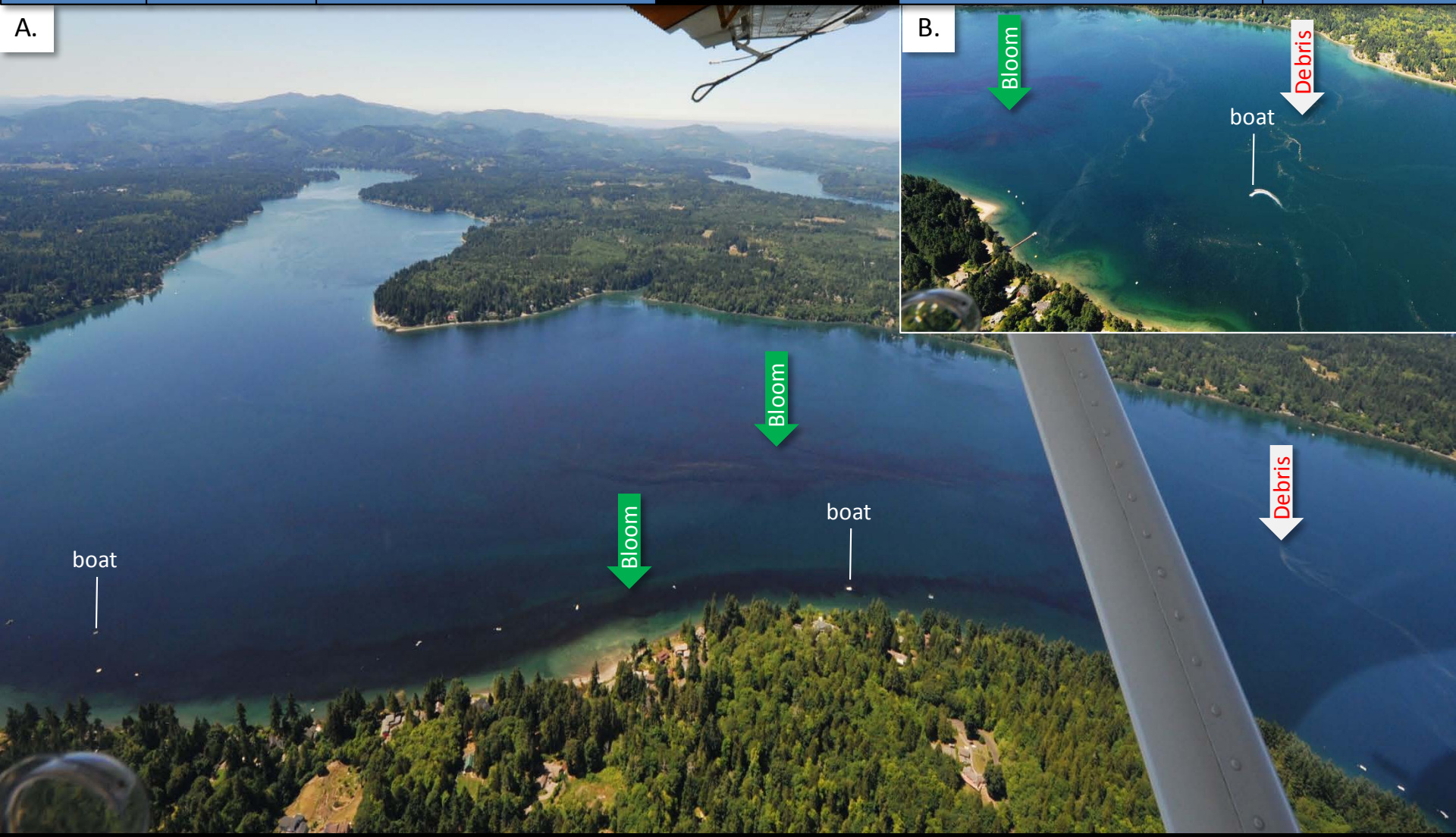
Sunny, good visibility

Flight route

Observation Maps:

Central Sound

South Sound



A. Red-brown bloom in narrow ribbons parallel to eastern shore. B. Organic debris accumulating at surface.
Location: A. Opposite Frye Cove State Park, B. Near Cooper Point, Eld Inlet (South Sound), 12:51 PM.

Organic material accumulating in large ribbons along tidal front at the entrance to Budd Inlet.
Location: Across from Boston Harbor, Budd Inlet (South Sound), 12:51 PM.

Aerial photography 6-27-2016

Red-brown bloom drifting in narrow ribbons parallel to eastern shore.

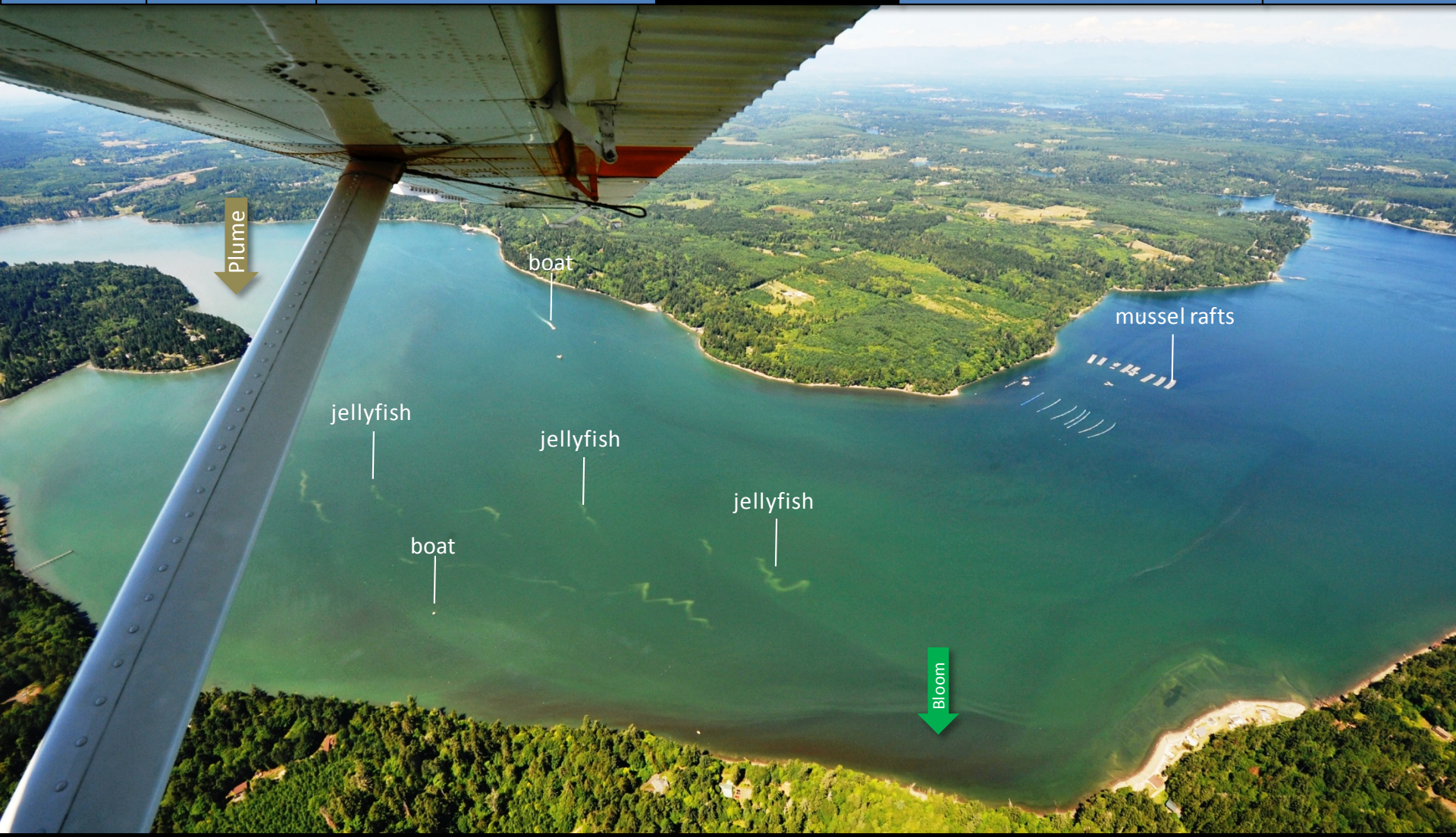
Location: Near Burfoot Park, Budd Inlet (South Sound), 12:53 PM.

Red-brown bloom with intricate patterns.

Location: South of Gull Harbor, Budd Inlet (South Sound), 12:54 PM.

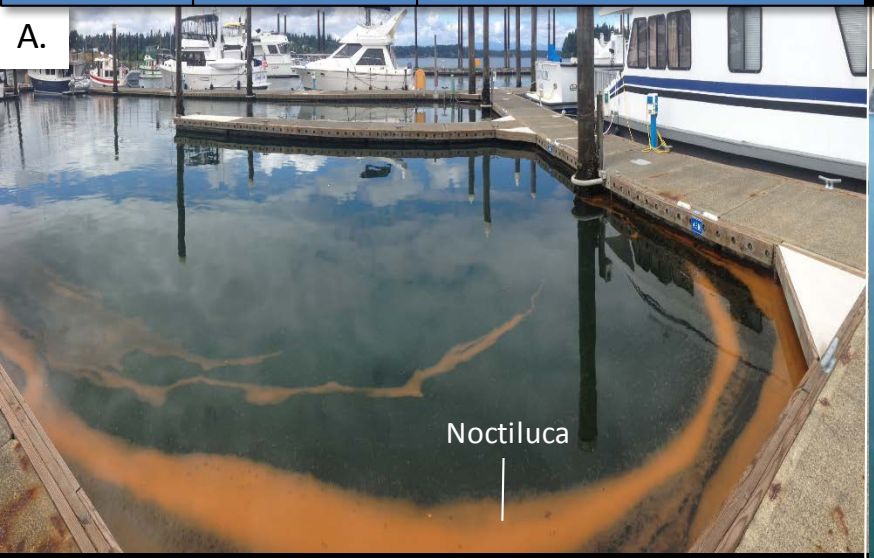
Large patches of jellyfish and organic debris.

Location: Off Sunset Beach, Eld Inlet (South Sound), 12:57 PM.



Large patches of jellyfish, sediment-rich river plume, and red-brown bloom near eastern shore.

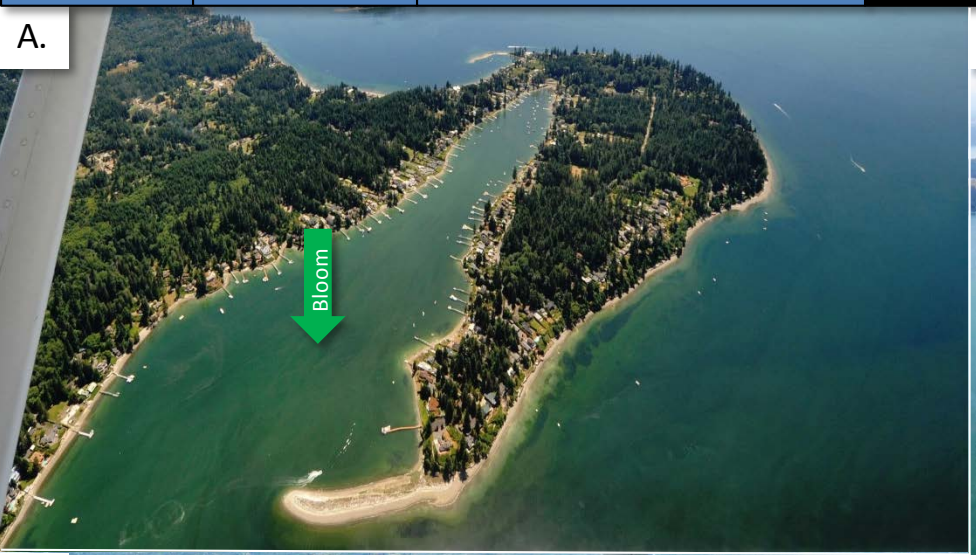
Location: Forest Beach, Carr Inlet (South Sound), 5:00 PM.

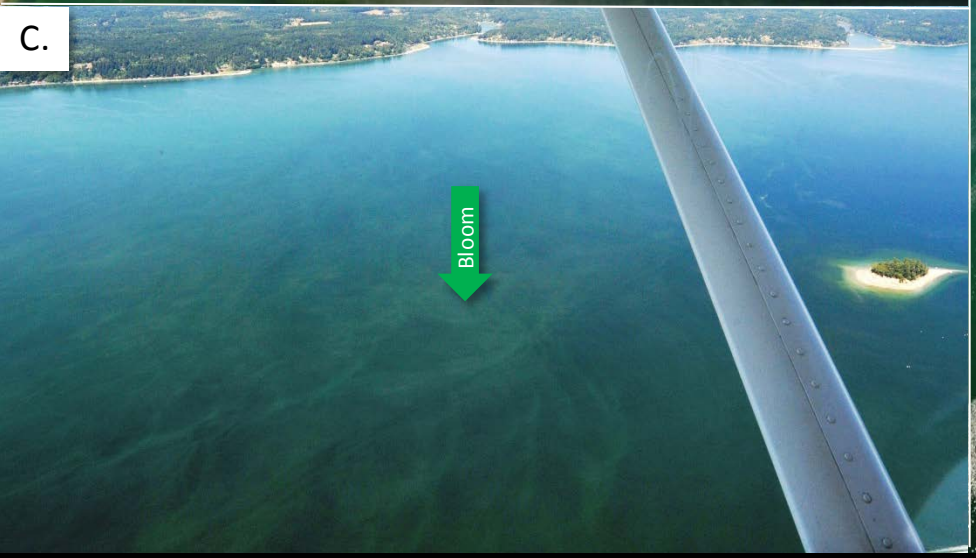


Picture by Laura Hermanson on June 13th

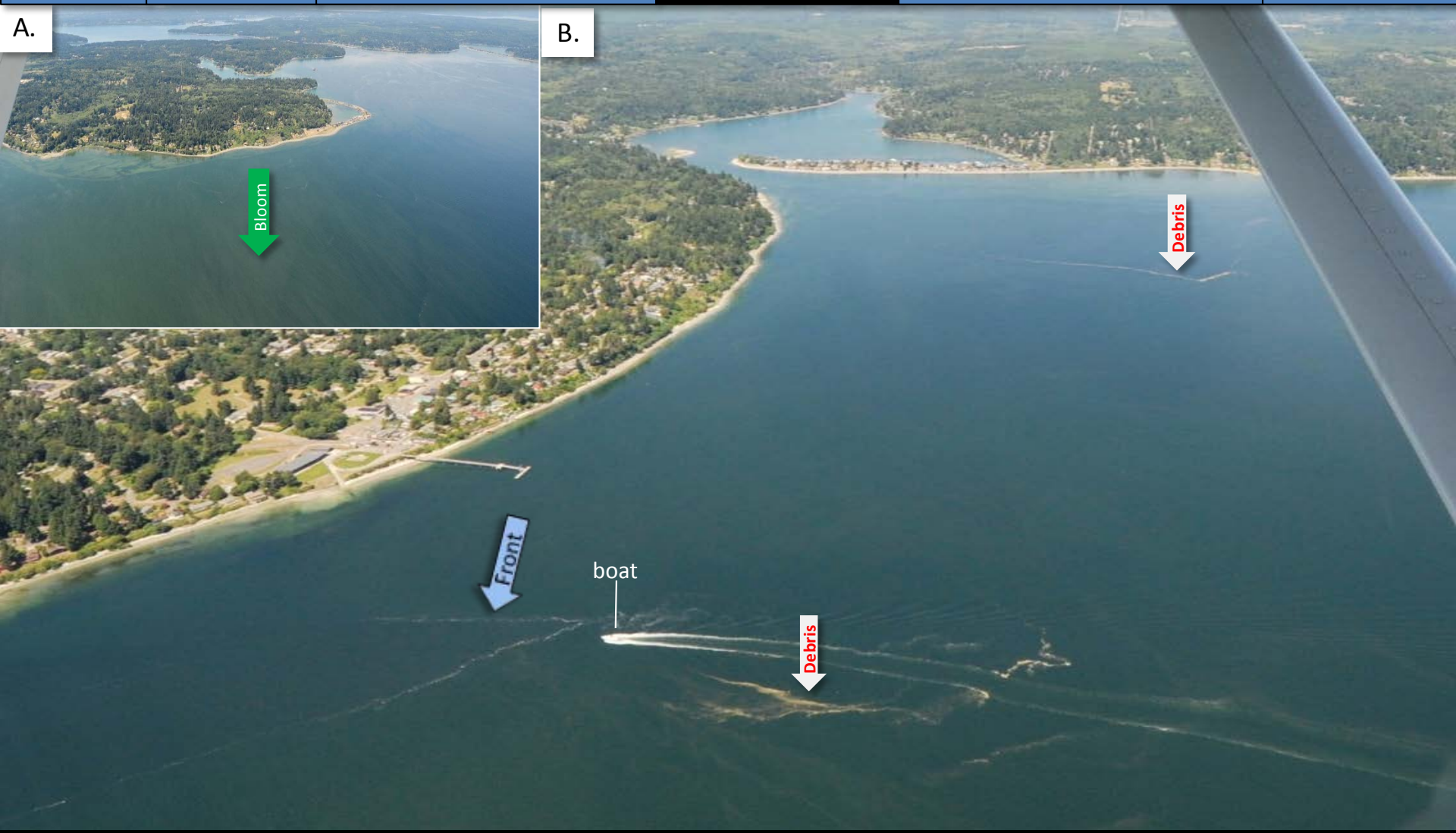
Patches of orange Noctiluca in unusual places. Location: A. Swantown Marine, Budd Inlet. B. Oakland Bay. C. Port Madison. (A. & B. South Sound. C. Central Sound).

Aerial photography 6-27-2016





A-C. Water rich in phytoplankton and B. organic material floating in large patches at the surface.
Location: *A. Forest Beach. B. Mayo Cove. C. Kopachuck Underwater Park* (South Sound), 1:15 PM.



A. Strong phytoplankton bloom. B. Large rafts of organic material of potentially spent Noctiluca at the surface in Port Madison. Location: Port Madison (Central Sound), 1:32 PM.

Strong phytoplankton bloom and organic material rafts north of tidal front off Restoration Point.

Location: Decatur Reef, Bainbridge Island (Central Sound), 1:38 PM.

Aerial photography 6-27-2016

Puyallup River plume rich in suspended sediment extending into Quartermaster Harbor. Internal waves.
Location: Vashon Island (Central Sound), 1:46 PM.

Aerial photography 6-27-2016

Large differences in glacial river flows in June in A. Puyallup, unregulated system and B. Nisqually River, regulated system. Location: A. Commencement Bay, B. Nisqually delta (Central and South Sound), 1:58 PM.

Small amounts of water with glacial flour (in contrast to Puyallup River) entering through the Nisqually River.
Location: Off Golf Course, DuPont (South Sound), 1:57 PM.

Aerial photography 6-27-2016

Organic debris and a small bloom. Location: Oro Bay, Anderson Island (South Sound), 1:57 PM.

DEPARTMENT OF ECOLOGY State of Washington

Aerial photography 6-27-2016

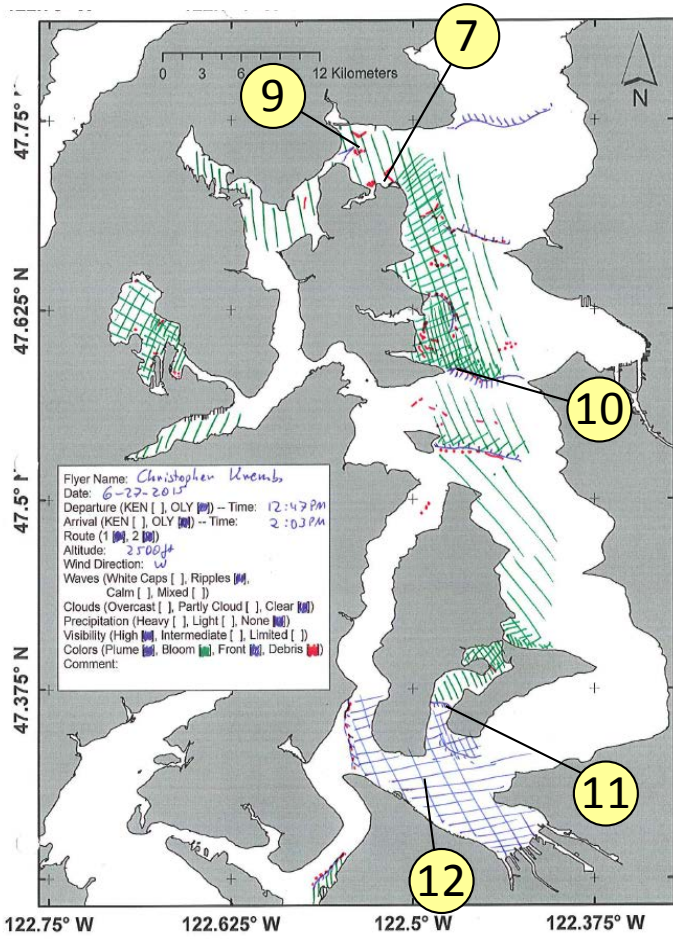
Very strong green bloom on the eastern side of inlet. Location: Henderson Inlet (South Sound), 2:01 PM.

Date: 6-27-2016

Hood Canal

n.a.

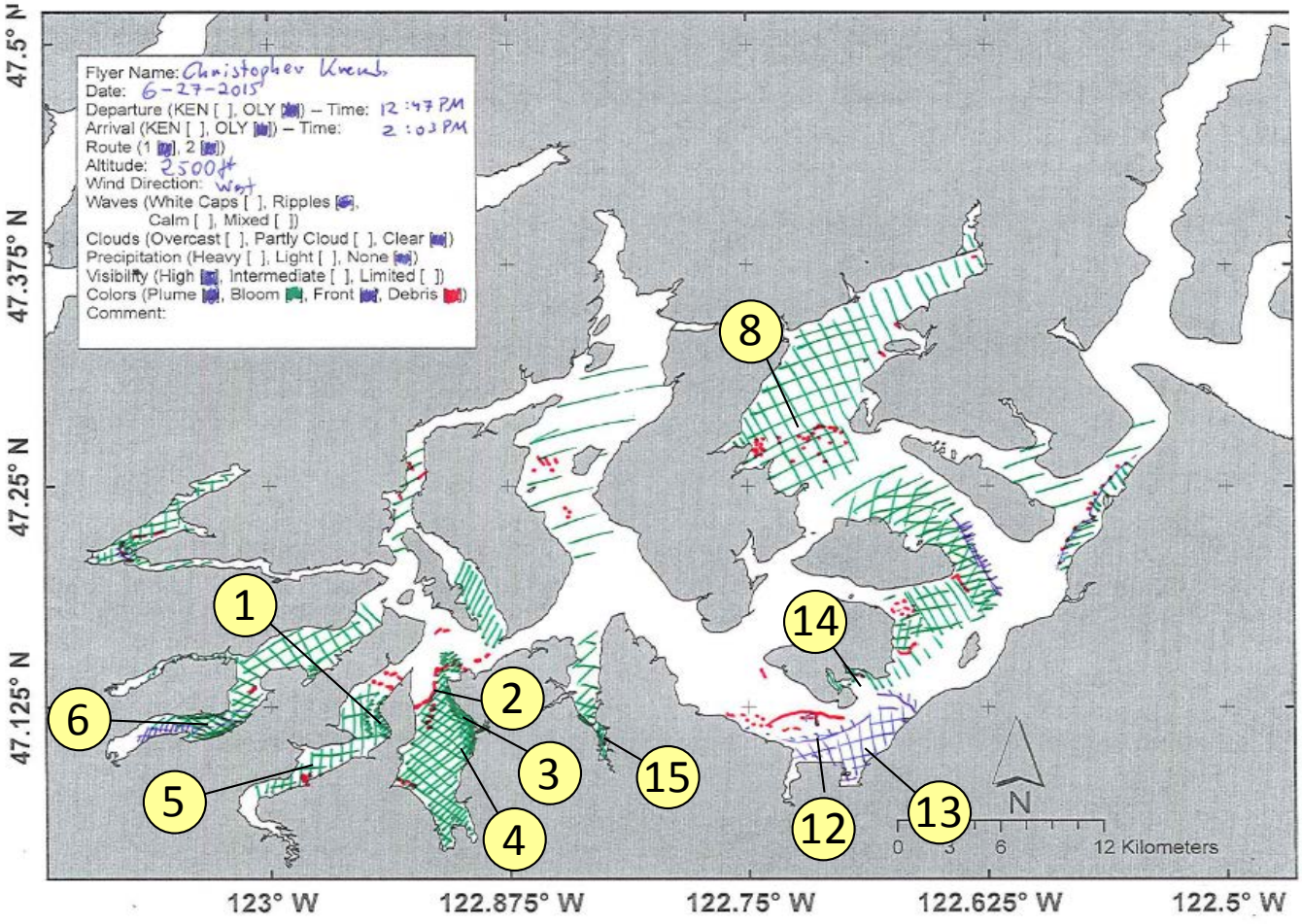
Central Sound



Numbers on map refer to picture numbers for spatial reference

Date: 6-27-2016

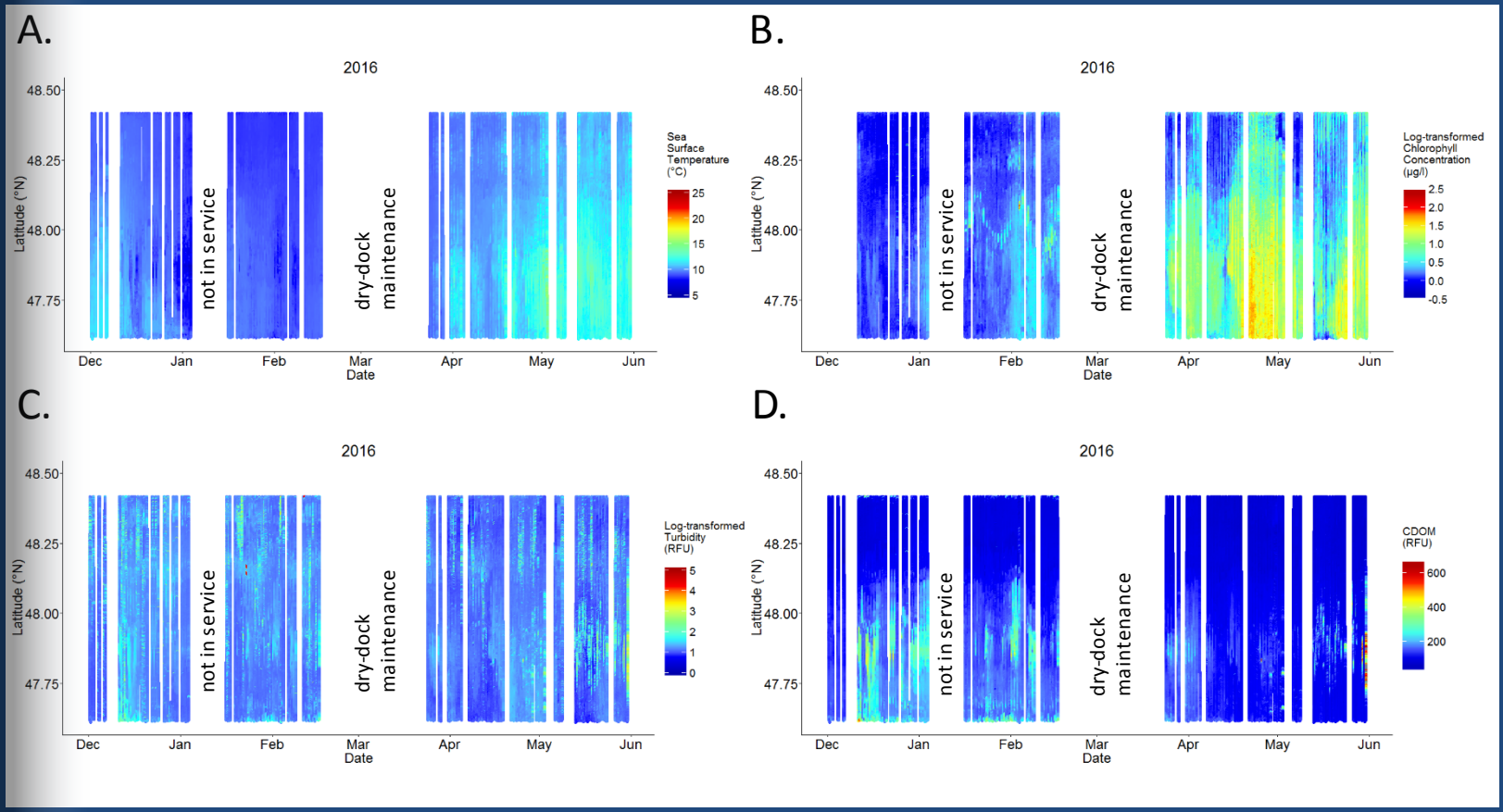
South Sound



Numbers on map refer to picture numbers for spatial reference

Continuous monitoring 6-27-2016

Summary of *Victoria Clipper IV* ferry data:
From December through May, we observed a seasonal shift in water properties. Water temperatures are >15 °C since May. High *in situ* fluorescence (an indicator of high phytoplankton biomass) and low river flows set the stage for an early start of harmful algal blooms (HABs), similar to the year 2015.

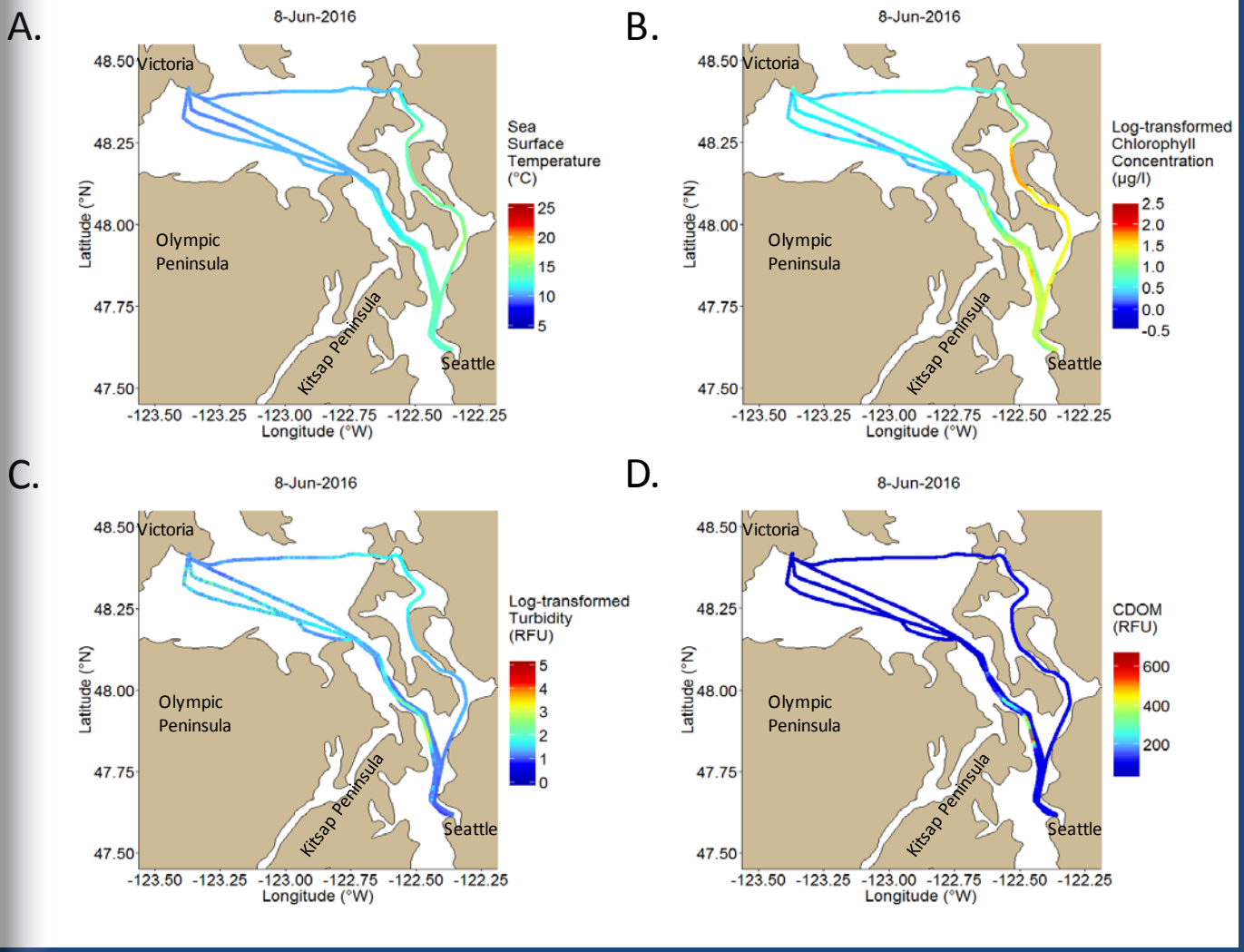


The *Victoria Clipper IV* carries sensors in its sea chest. The sensors allow us to plot over time transects of:

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

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

Continuous monitoring 6-27-2016



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 continues to warm to about 15 °C, mainly in eastern Puget Sound. Maximum temperature was 16 °C.

B. Chlorophyll: Concentrations were high just off Kitsap Peninsula and east side of Whidbey Island.

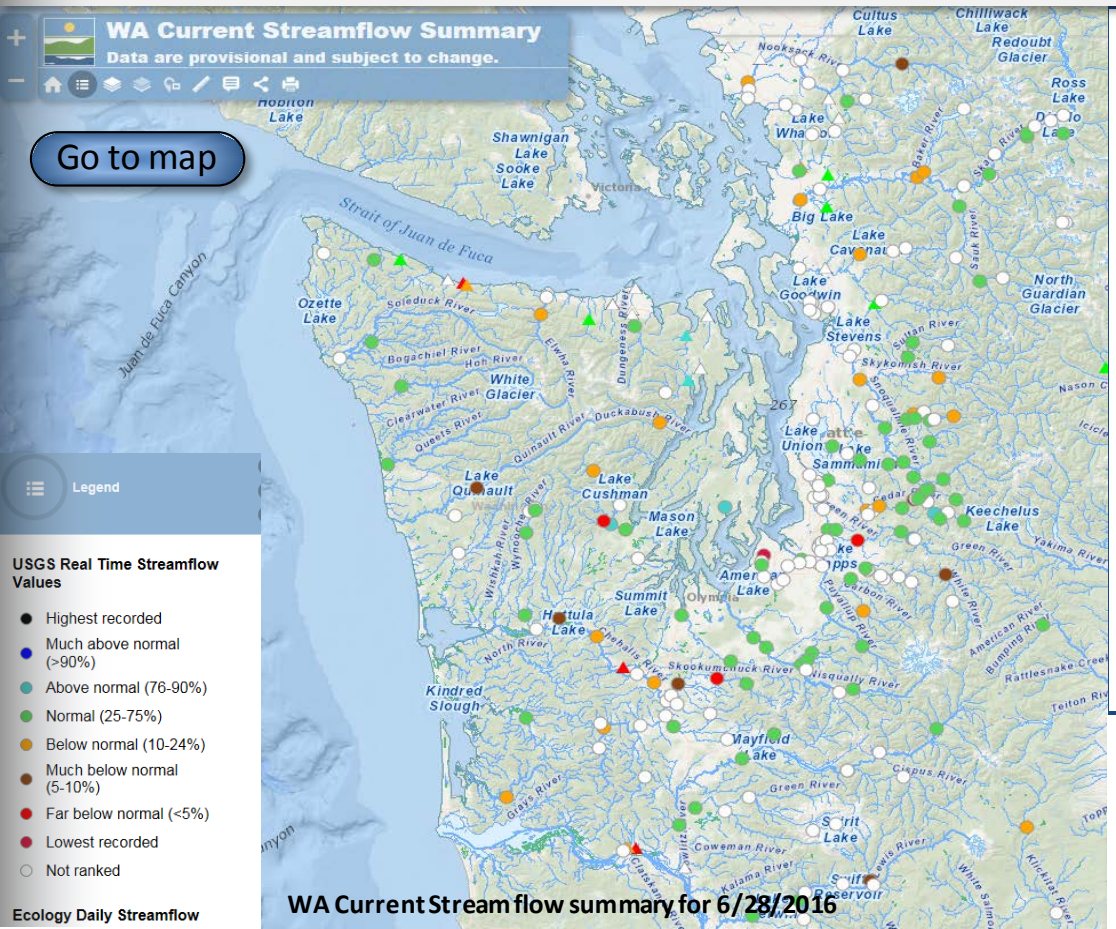
C. Turbidity: Turbidity increased, particularly just off Kitsap Peninsula.

D. Colored Dissolved Organic Matter (CDOM): Particulates in the water remained low except off Kitsap Peninsula.

Recent rain, a short-term gain for June

Markus von Prause, Ecology

River flows in the Puget Sound region have increased in June 2016 as compared to the June 2015 drought year. Flow levels at most Ecology and USGS stream monitoring sites are temporarily close to normal levels in response to recent rain in western Washington. Snow water equivalents, however, are low, providing little water in dry months, particularly towards the north of the state.

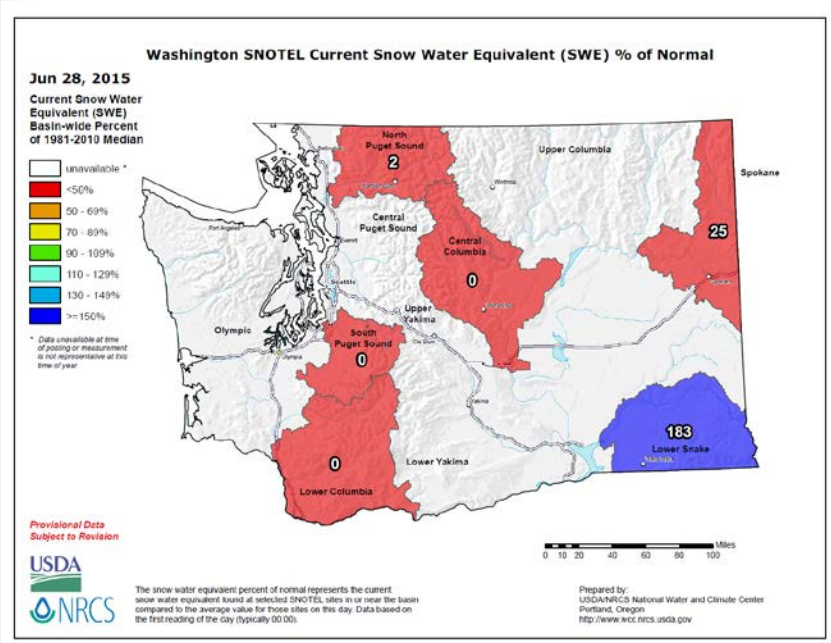


WA Current Stream flow summary for 6/28/2016

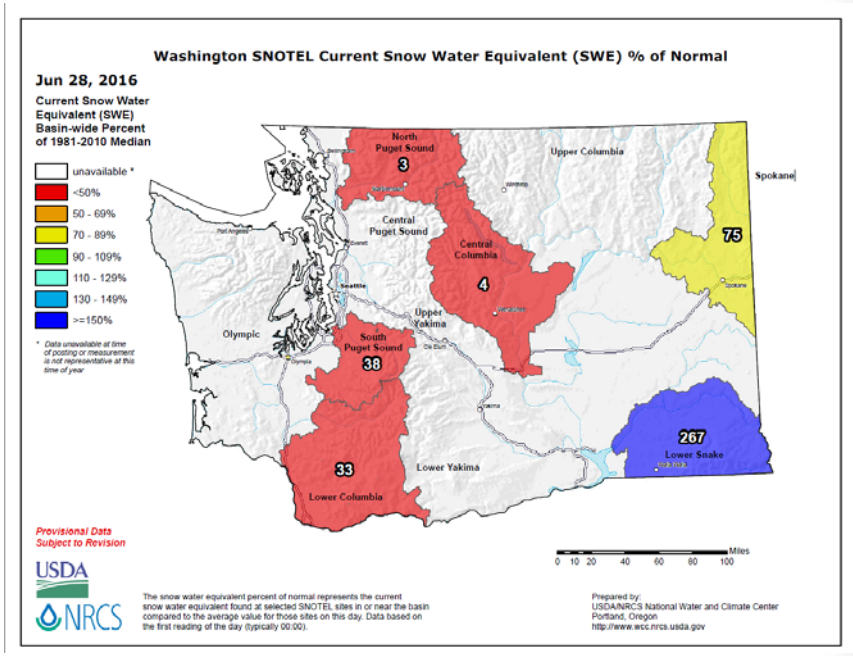
USGS Site Location for river flows in Washington	Jun-15	Jun-16
NOOKSACK RIVER AT FERNDALE	new min	better
SF NOOKSACK RIVER AT SAXON BRIDGE	new min	better
MF NOOKSACK RIVER NEAR DEMING	new min	better
NF NOOKSACK RIVER BL CASCADE CREEK NR GLACIER	new min	better
SAMISH RIVER NEAR BURLINGTON	<20%	unchanged
SKAGIT RIVER NEAR MOUNT VERunchanged	new min	better
BAKER RIVER AT HENRY THOMPSON BR AT CONCRETE	<20%	unchanged
SAUK RIVER NEAR SAUK	new min	better
CASCADE RIVER AT MARBLEMOUNT	new min	better
PILCHUCK RIVER NEAR SNOHOMISH	new min	better
SNOHOMISH RIVER NEAR MONROE	new min	better
TOLT RIVER NEAR CARNATION	new min	better
RAGING RIVER NEAR FALL CITY	<20%	unchanged
SF SNOQUALMIE RIVER AB ALICE CREEK NEAR GARCIA	new min	better
NF SNOQUALMIE RIVER NEAR SNOQUALMIE FALLS	new min	better
MIDDLE FORK SNOQUALMIE RIVER NEAR TANNER	new min	better
SULTAN RIVER BELOW POWERPLANT NEAR SULTAN	<20%	unchanged
SKYKOMISH RIVER NEAR GOLD BAR	new min	better
ISSAQUAH CREEK NEAR MOUTH NEAR ISSAQUAH	<20%	better
CEDAR RIVER AT RENTON	<50%	better
ROCK CREEK NEAR MAPLE VALLEY	new min	better
GREEN RIVER NEAR AUBURN	<50%	better
BIG SOOS CREEK ABOVE HATCHERY NEAR AUBURN	<20%	unchanged
NEWAUKUM CREEK NEAR BLACK DIAMOND	<20%	unchanged

Table shows river flows at selected stations (also see map) in 2015 compared to historical values for the same month (% of normal). Compared to 2015, June flows in 2016 are higher in response to recent rain. Snow water equivalents, however, remain low.

June 2015



June 2016



Snow water equivalents in Washington State were very low in 2015 when Washington was declared to be in a drought. High precipitation improved conditions in winter 2015/16, yet record warm temperatures in spring 2016 melted the snowpack quickly.

In the North Puget Sound and Central Columbia basins, snow water equivalents still remain very low this year, even when compared to the 2015 drought in June. In southern and eastern Washington, conditions are less severe than last year.

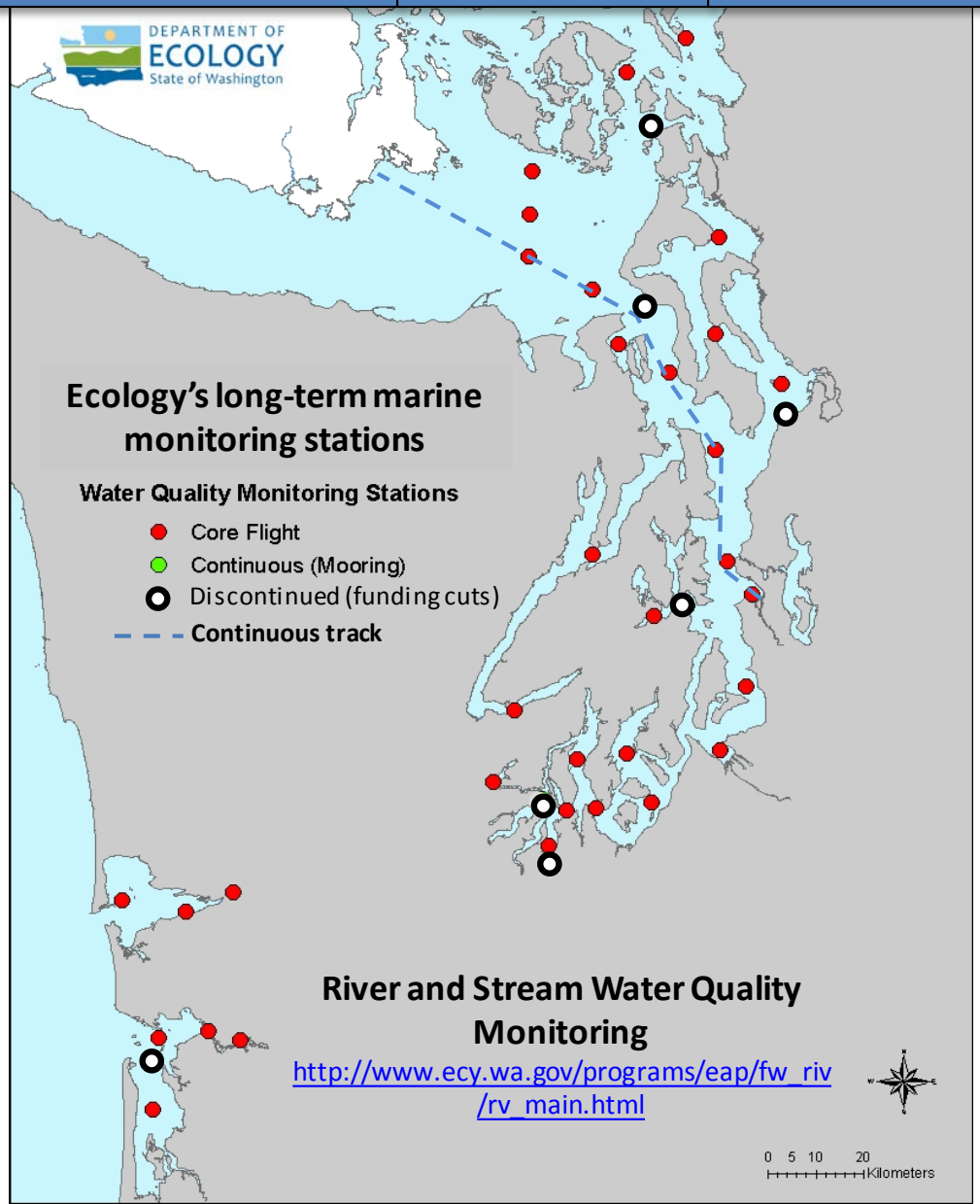
Get data from Ecology's Marine Monitoring Programs

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
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Marine Monitoring Unit
Environmental Assessment Program
WA Department of Ecology

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