



# Eyes Over Puget Sound

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## Surface Conditions Report, *August 28, 2017*



*Critter of the month:*  
***The Common Sun Star***

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

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*Mya Keyzers  
Allison Brownlee*



*Skip Albertson*



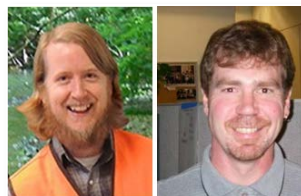
*Julia Bos*



*Dr. Christopher  
Krembs (Editor)*



*Tyler Burks  
Jim Shedd*



## Personal impressions

[p. 3](#)

How do we know if benthic invertebrate communities are changing?

## Climate influences

[p. 5](#)

Warm air temperatures and abundant sunshine continue, but river flows are dropping in the Fraser River. Upwelling has picked up slightly.

## Water column

[p. 8](#)

Puget Sound is fresher than it's ever been the past 17 years. Warmer temperatures persist around West Point, Elliott and Commencement Bays.

## Aerial photography

[p. 11](#)

Large rafts of drifting macroalgae in Central Sound. Diverse blooms in colors of green, orange and red-brown. Jellyfish abundance low. Case Inlet with intense bloom.

## Streams

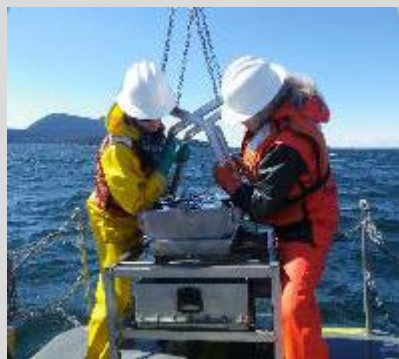
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Warmer and drier conditions persisted. Despite a robust snowpack this spring, the supply of freshwater to Puget Sound is variable.

## How do we know if benthic invertebrate communities are changing?

Nicole Marks – Washington Conservation Corps intern

### Monitoring benthic invertebrates (benthos)



We collect sediment from our long-term monitoring stations in Puget Sound using a double van Veen sediment grab.

We sieve the benthos from the sediment and preserve them for lab identification/analysis.

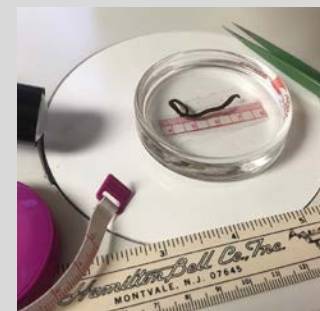


Megafauna! Not all our critters are as large as this bloodworm.

### Measuring biomass and size class



Each identified specimen is weighed (grams) and measured (millimeters).



Benthos are categorized into size classes: small, medium, large, and megafauna.



Measurements will be used to form a Puget Sound benthic invertebrate biomass baseline, which can tell us more about change in benthic communities than abundance data alone. Check out our [poster](#)!



## Critter of the Month – The Common Sun Star



Dany Burgess & Angela Eagleston  
Marine Sediment Monitoring Team



### *Crossaster papposus*

There's nothing common about this month's solar eclipse-themed critter!

The Common Sun Star may be beautiful, but it is also a dominant predator, playing an important role in Puget Sound benthic communities.



### Fun Sun Star Facts!

- Comes in a variety of colors and patterns, but almost always has 11 arms
- Can “smell” its prey using chemical receptors
- Can shoot its stomach out of its body to digest food items that won't fit into its small mouth (pictured below)



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**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).

## July Summary:

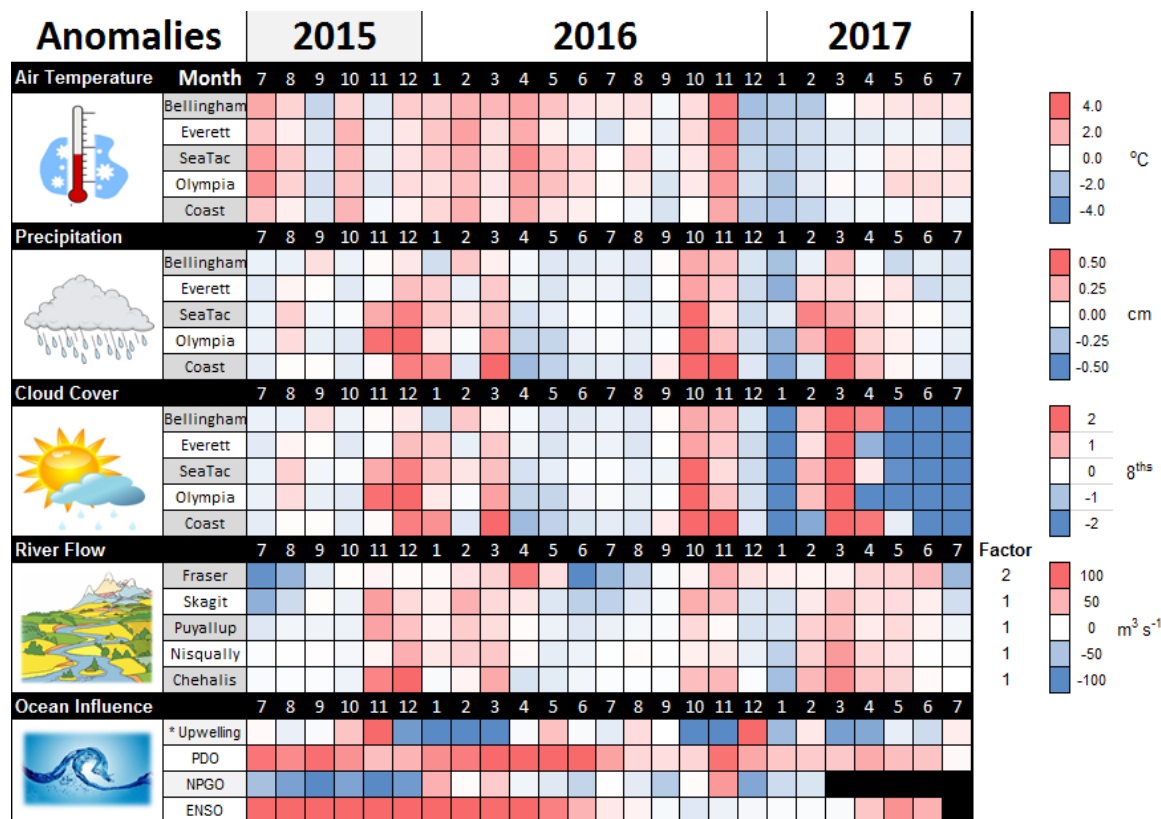
**Air temperatures** have been mostly above normal since May.

**Precipitation** levels have been very low.

**Sunshine** levels have been above normal for most of the summer.

**River flows** are dropping to below normal in the Fraser and Skagit Rivers.

**Upwelling** is slightly above normal. PDO is trending down, but still warm-phase.



\*Upwelling Anomalies (PFEL)

PDO = Pacific Decadal Oscillation

NPGO = North Pacific Gyre Oscillation

ENSO = El Niño Southern Oscillation

higher

expected

lower

No data



# Our long-term marine monitoring stations in Washington

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- 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

Station network of ambient  
water quality monitoring stations

We use a boat and a chartered float plane equipped with a CTD package to access our monthly monitoring stations.

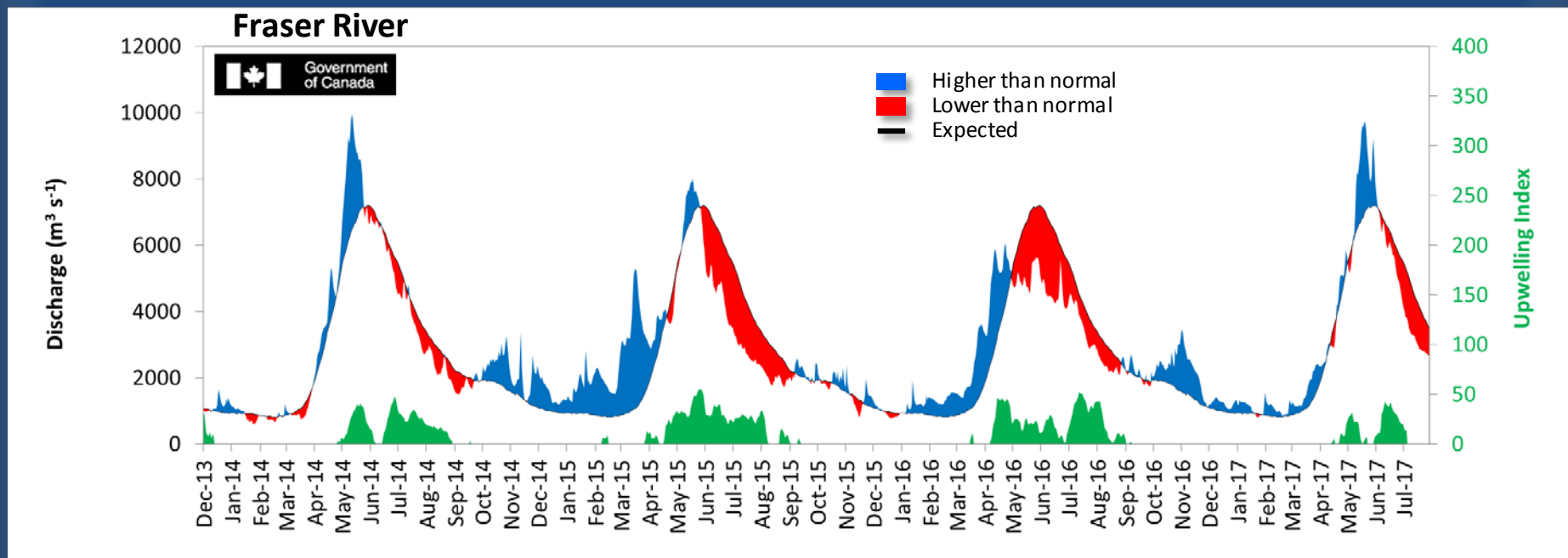
[Start here](#)

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 2016 had record-breaking global temperatures. The year 2017 is looking much better. Fraser River flows were normal or higher than normal in early June and similar to the year 2014. However, due to weaker than normal **upwelling** along the coast, we expect that the inflow of low-oxygen, nutrient-rich, salty water into Puget Sound has been lower.

The Fraser River is the major driver of estuarine circulation and water exchange with the ocean. Historically, peaks of coastal upwelling and the freshet are in sync.



[Wikipedia:](#) The term **freshet** is most commonly used to describe a spring thaw resulting from snow and ice melt in rivers located in the northern latitudes of North America.

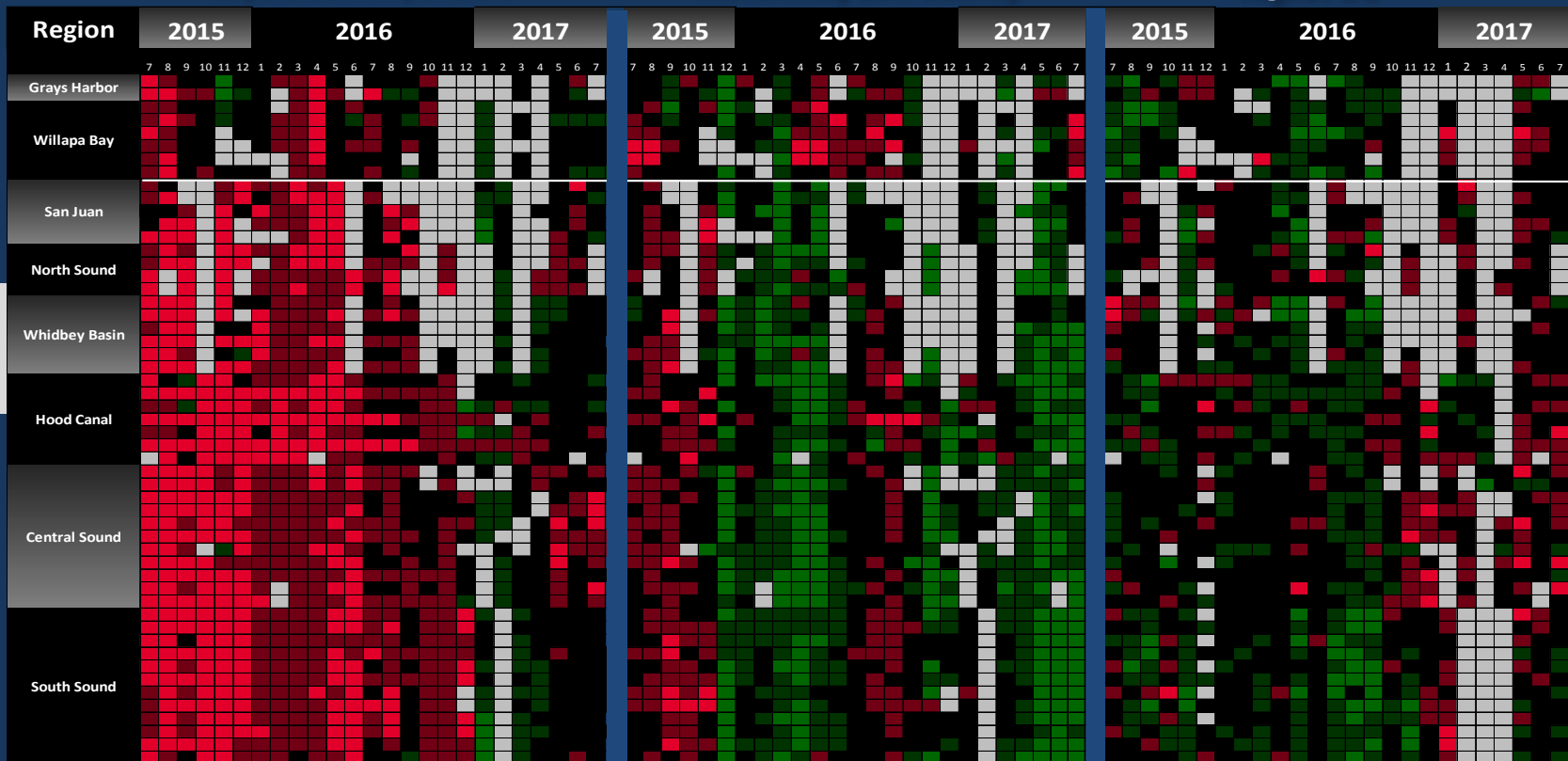
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As of July 2017, warmer temperature persists in Central Sound with 17-year surface maxima measured near West Point and in Elliott and Commencement Bays. **Low salinity persists.** A continued trend of significantly fresher conditions in Puget Sound has been measured since November, 2016. Central Sound and Hood Canal also show higher DO values continuing into July.

## Expected Temperature

## Historically Low Salinity

## Higher DO



■ = higher than expected ( $> *IQR$ )

■ = expected ( $= *IQR$ )

■ = lower than expected ( $< *IQR$ )

■ = higher than previous measurements

■ = no data

■ = lower than previous measurements

$*IQR = \text{Interquartile Range (25}^{th} - 75^{th} \text{ percentiles); } n = 17$

[Explore profiles at all stations](#)

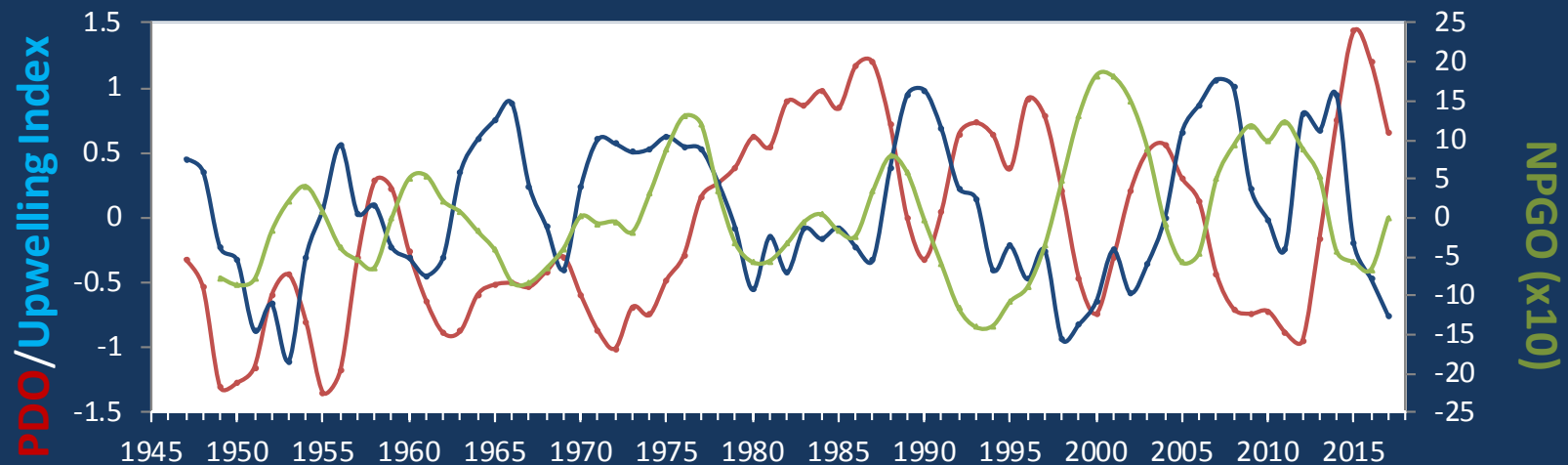


# The ocean affects water quality: Ocean Climate Indices

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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**) [\(explanation\)](#)

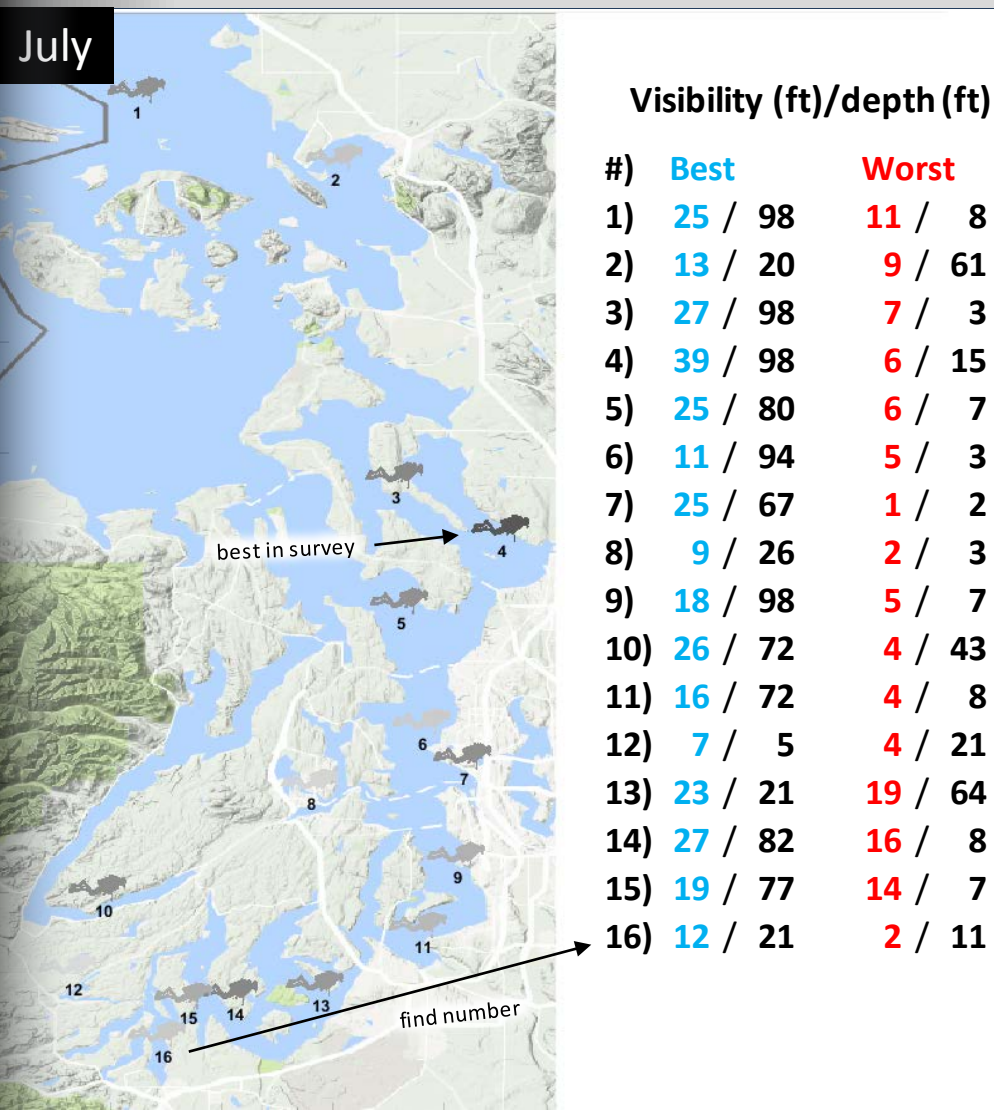
## Three-year running average of PDO, Upwelling, and NPGO index scores



Ocean boundary conditions long-term variability: (a) water is still warm (PDO), (b) upwelling of low oxygen and high nutrient ocean water are low (Upwelling Index anomaly), and (c) surface productivity along the coast is near normal (NPGO).



## What was the visibility (ft) in the water for divers?



### Find depths with high and low visibility

- Best visibility** was 39 feet around Mukilteo. Seattle and south had lower viz in July.
- Poor visibility** occurred in many places to the south of Seattle, but also in Bellingham Bay.
- 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



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

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Large rafts of drifting macroalgae in Central Sound. Diverse blooms in Case and Carr Inlets in colors of green, orange and red-brown. Many red-brown blooms seen in most inlets of South and Central Sound. Jellyfish abundance low, confined mostly to Eld Inlet. Orange and green blooms could be Noctiluca?

Start here

Red-brown bloom in Dyes Inlet (Oyster Bay)



## Mixing and Fronts:

Tidal fronts in Port Madison, East Passage, Dalco Passage, Case and Carr Inlets. Tidal eddy in Dyes Inlet. Internal waves in Case Inlet, East Passage and Commencement Bay.



## Jellyfish:

Occasional jellyfish patches limited to Eld Inlet, rare in Budd Inlet.



## Suspended sediment:

Glacial flour entering with Puyallup River and extending into East Passage and Quartermaster Harbor



## Visible blooms:

Green: Northern portions of Case and Carr Inlets.

Orange: Case and Carr Inlets and Quartermaster Harbor. Some looking like Noctiluca.

Red-brown: Dyes and Sinclair Inlets; Totten, Eld, Budd and Henderson Inlets; Carr and Case Inlets; Dalco Passage.



## Debris:

Large rafts of macroalgae in large portions of Central Sound. Organic debris floating at the surface in Case and Carr Inlets.

Noctiluca bloom on beach, Portage, Vashon Island

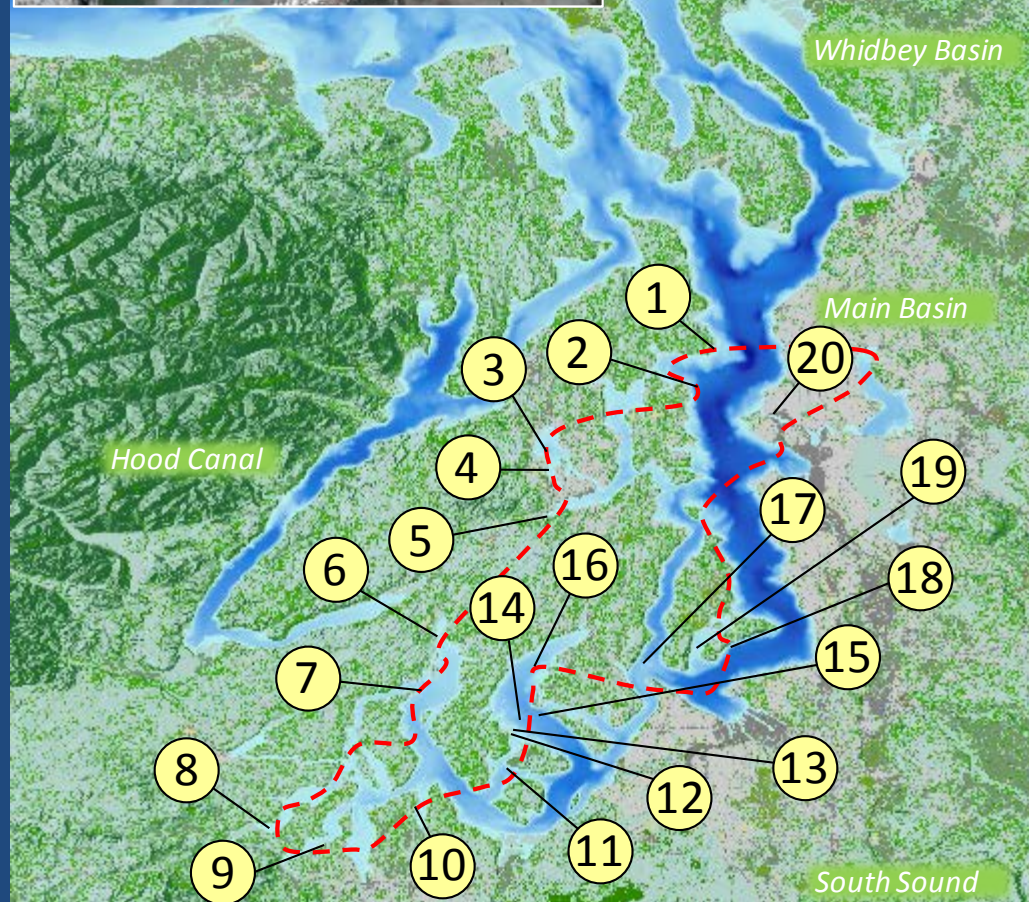






Aug, 28, 2017. <http://wasmoke.blogspot.com/>

Click on numbers



## Aerial photography and navigation guide

**Date: 8-28-2017**

### Tide data (Seattle):

Time	Height (ft)	High/Low
04:24 AM	1.85	L
11:02 AM	8.77	H
4:30 PM	5.59	L
10:26 PM	9.87	H

### Flight Information:

Sunny, but wildfires lower visibility.

--- Flight route

### Observation Maps:

Central Sound

South Sound



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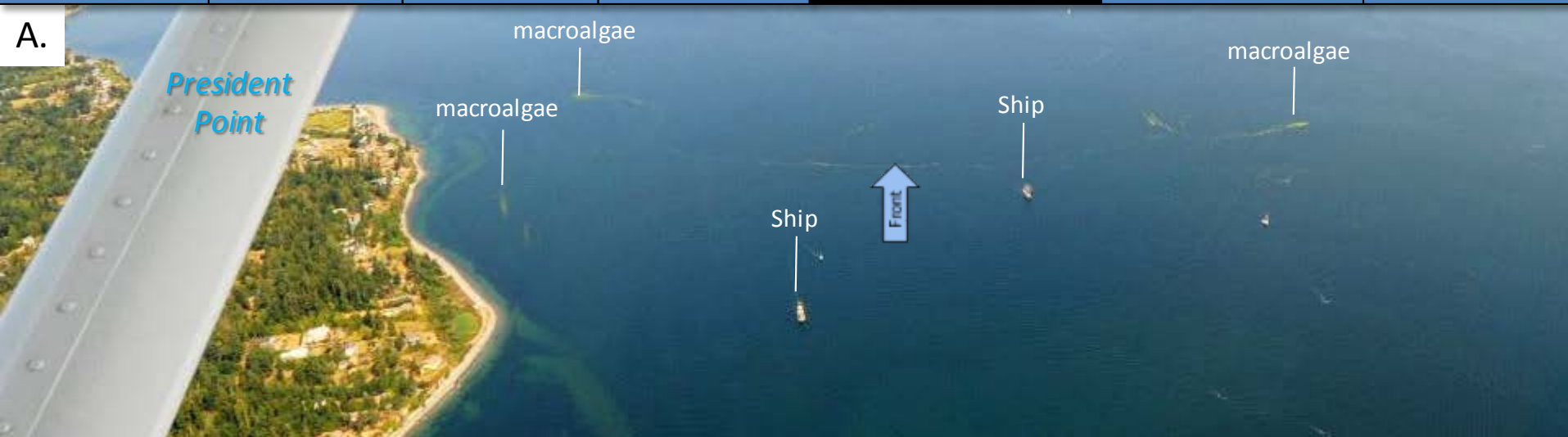
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A.



B.



*Large rafts of macroalgae.*

Location: A. President Point, B. Point Jefferson, Port Madison (Central Sound), 12:37 PM.



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*Large rafts of macroalgae.*

Location: Off Point Monroe, Port Madison (Central Sound), 12:41 PM.





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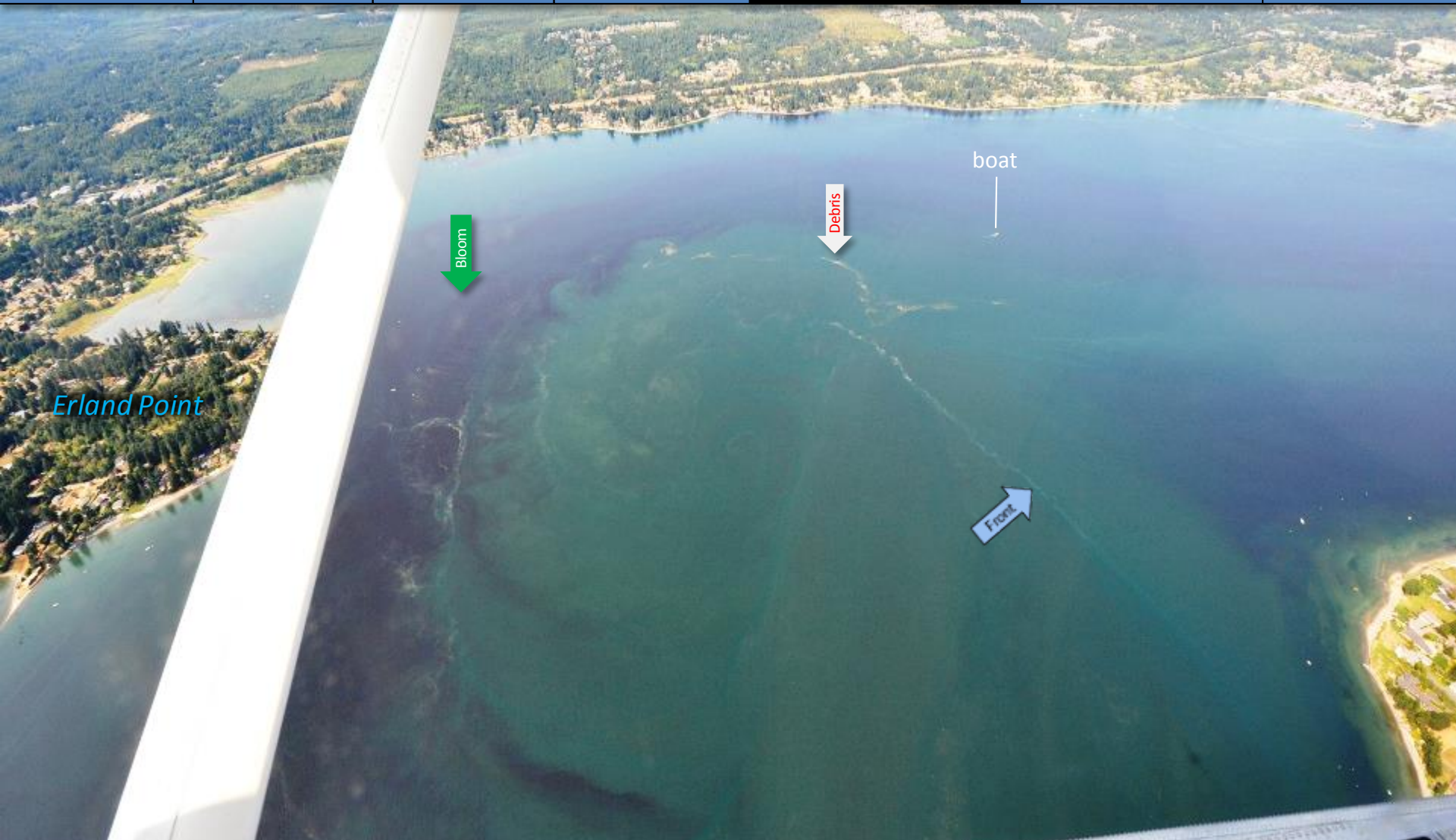
Critter

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*Large red-brown bloom and large tidal eddy.*

Location: Erland Point, Dyes Inlet (Central Sound), 12:48 PM.



*Large red-brown bloom and front.*

Location: Elwood Point, Dyes Inlet (Central Sound), 12:49 PM.



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*Red-brown bloom mixed in with water colored in green-ochre.*

Location: Sinclair Inlet (Central Sound), 12:52 PM.



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*Green bloom.*

Location: North Bay, Case Inlet (South Sound), 12:59 PM.



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*Noctiluca bloom mixed in with green bloom along tidal front.*  
Location: *Off Stretch Island, Case Inlet (South Sound), 1:03 PM.*



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*Red-brown bloom, suspended sediment.*

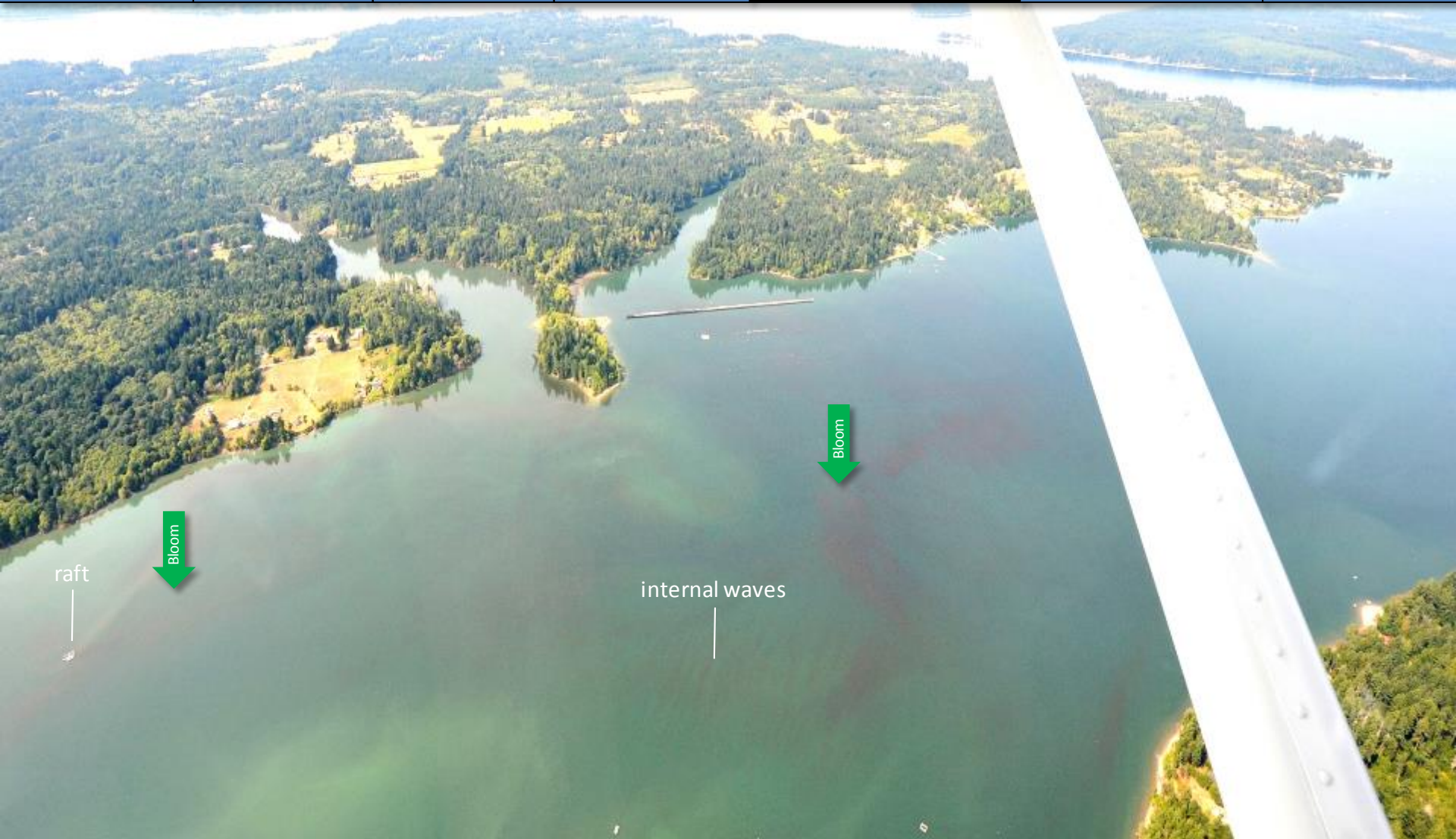
Location: Burns Point, Totten Inlet (South Sound), 1:15 PM.



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*Red-brown bloom and occasional jellyfish patches.*

Location: Eld Inlet (South Sound), 1:18 PM.

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*Red-brown bloom, weak internal waves.*  
Location: Henderson Inlet (South Sound), 1:24 PM.



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*Organic material accumulating at tidal fronts.*  
Location: Balch Passage (South Sound), 1:27 PM.



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*Organic material accumulating at tidal front next to intense green and orange bloom.*  
Location: Off Samego Point, McNeil Island, Carr Inlet (South Sound), 1:32 PM.



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*Organic material accumulating at tidal front next to intense green and orange bloom.*  
Location: Off Samego Point, McNeil Island, Carr Inlet (South Sound), 1:32 PM.



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*Internal waves forming in near-surface green and orange bloom.*

Location: Carr Inlet (South Sound), 1:33 PM.



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*Orange and green near-surface blooms meeting at front.*  
Location: *Fox Island, Carr Inlet (South Sound), 1:33 PM.*





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*Red-brown bloom and organic material accumulating at fronts.*

Location: Cutts Island, Carr Inlet (South Sound), 1:36 PM.



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*Macroalgae accumulating at tidal front. To the right, red-brown bloom.*  
Location: Off Gig Harbor, Case Inlet (Central Sound), 1:41 PM.





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*Large rafts of macroalgae accumulating along front. Plume of Puyallup River extending north.  
Location: Off Maury Island (Central Sound), 1:45 PM.*



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*Rafts of macroalgae accumulating along front. Plume of Puyallup River extending into Quartermaster Harbor. Location: Entrance of Quartermaster Harbor (Central Sound), 1:46 PM.*



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*An urban waterway without oil sheens. A good day!*  
Location: Salmon Bay, Seattle (Central Sound), 2:00 PM.

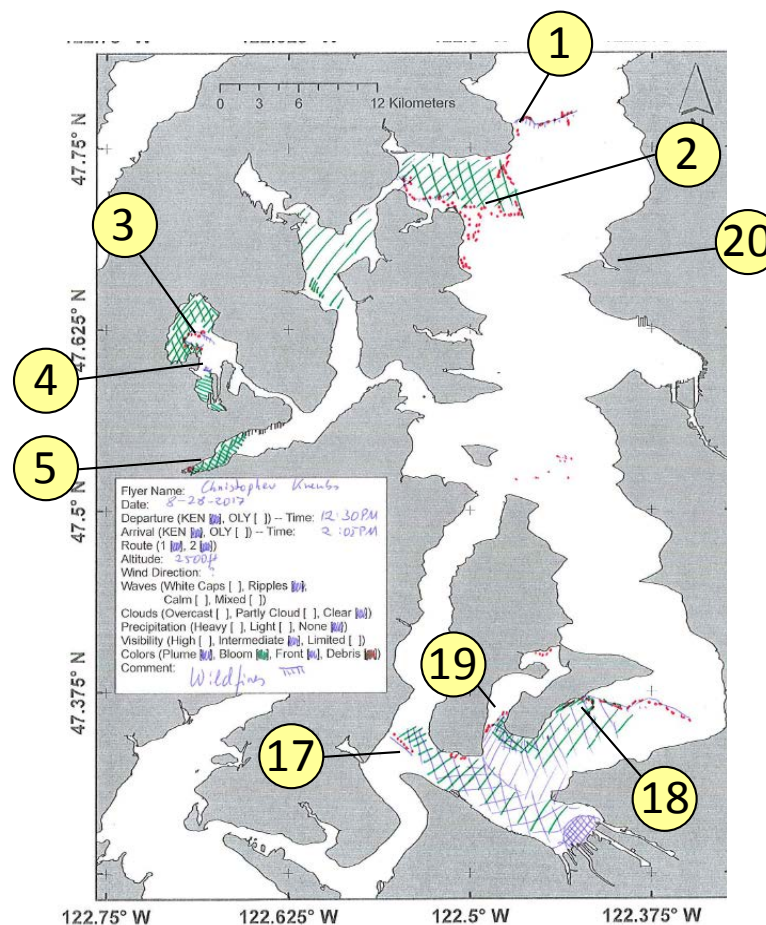


**Date: 8-28-2017**

Hood Canal

Central Sound

n.a.



*Numbers on map refer to picture numbers for spatial reference*





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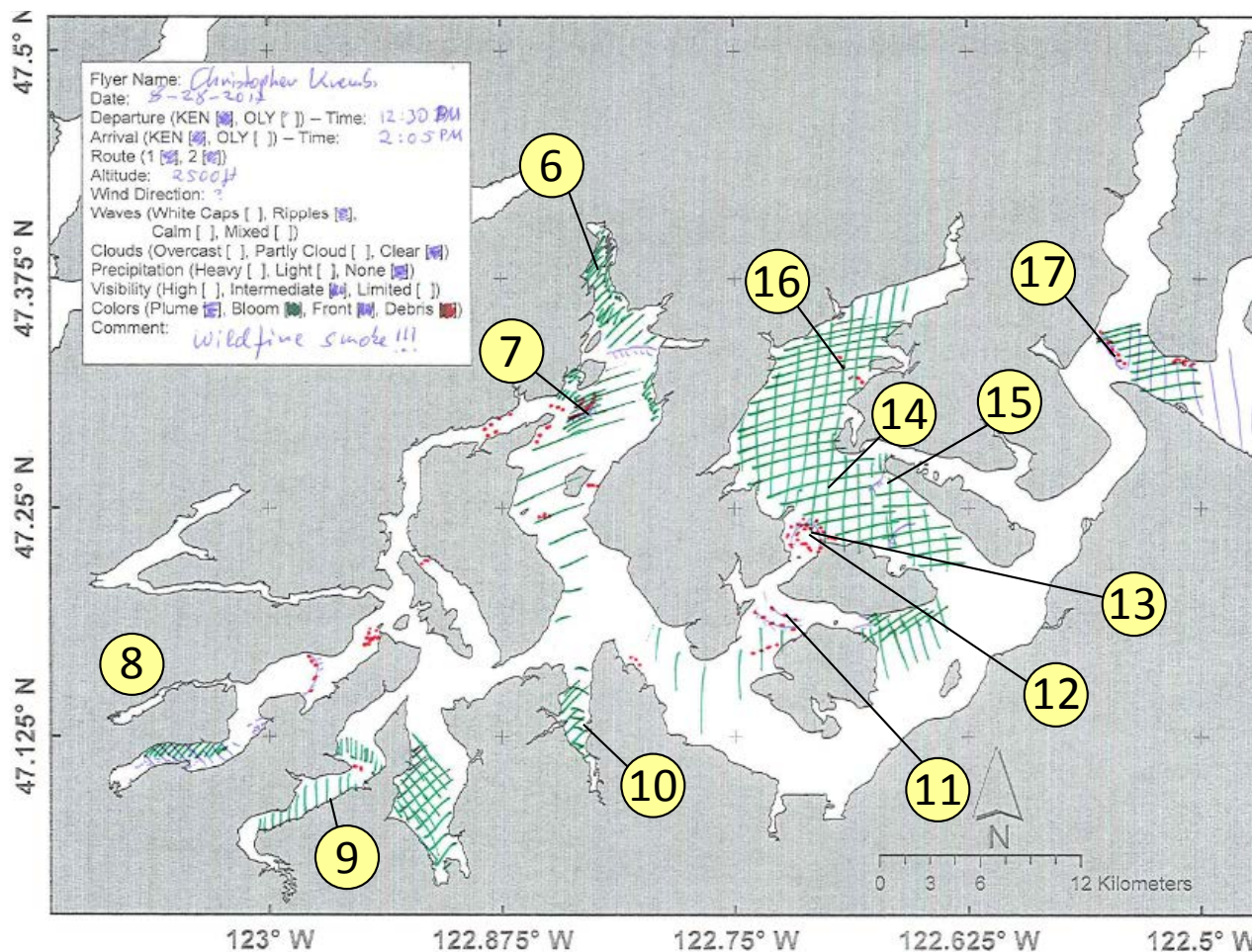
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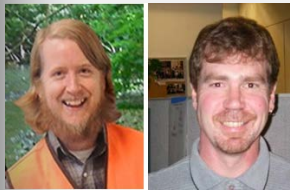
Streams

**Date: 8-28-2017**

**South Sound**



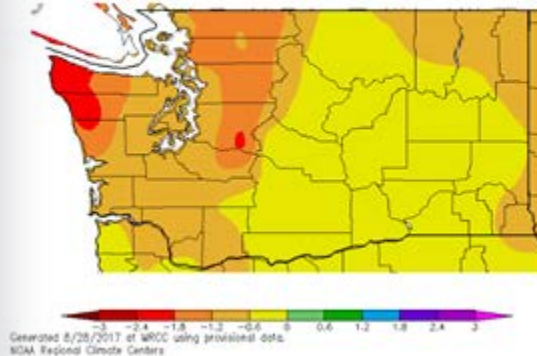
**Numbers on map refer to picture numbers for spatial reference**



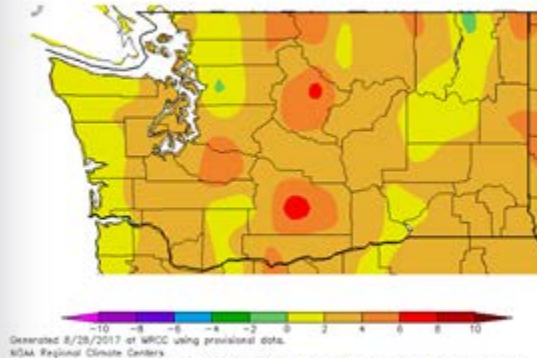
Tyler Burks,  
Jim Shedd  
Ecology

Warmer and drier conditions persisted in western WA. Despite a robust snowpack this spring, the supply of freshwater to Puget Sound is somewhat variable. The Skagit, Snohomish, and Stillaguamish Rivers are below normal due to a lack of precipitation. Rivers of south Puget Sound and from the Olympic Mountains are generally flowing normal to below normal.

Precipitation Departure from Average (in.)  
7/29/2017 - 8/27/2017

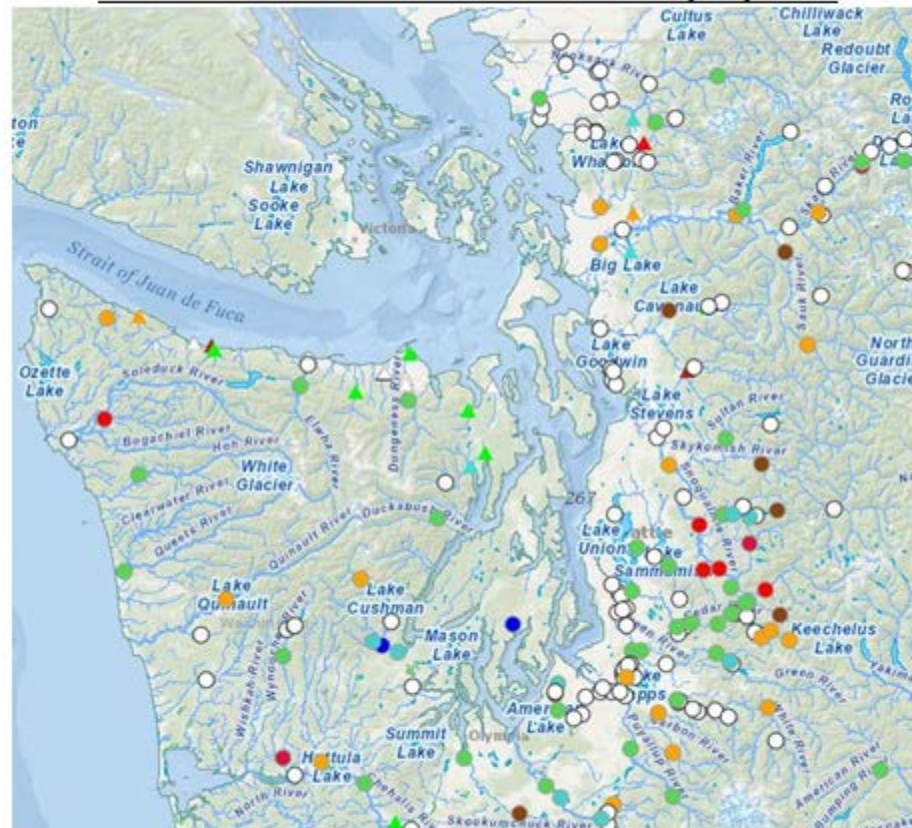


Ave. Temperature dep from Ave (deg F)  
7/29/2017 - 8/27/2017



[https://wrcc.dri.edu/anom/was\\_anom.html](https://wrcc.dri.edu/anom/was_anom.html)

**Current Streamflow Conditions as of 8/29/2017**



**USGS Real Time Streamflow Values**

- Much above normal (>90%)
- Above normal (76-90%)
- Normal (25-75%)
- Below normal (10-24%)
- Much below normal (5-10%)
- Far below normal (>5%)
- Lowest recorded
- Not Ranked

**Ecology Daily Streamflow**

Daily Streamflow

- ▲ Highest recorded
- ▲ Much above normal (>90%)
- ▲ Above normal (76-90%)
- ▲ Normal (25-75%)
- ▲ Below normal (10-24%)
- ▲ Much below normal (<10%)
- ▲ Lowest recorded
- △ Not ranked

Click on the map to see current conditions



# Get data from Ecology's Marine Monitoring Programs



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## Long-Term Monitoring Network

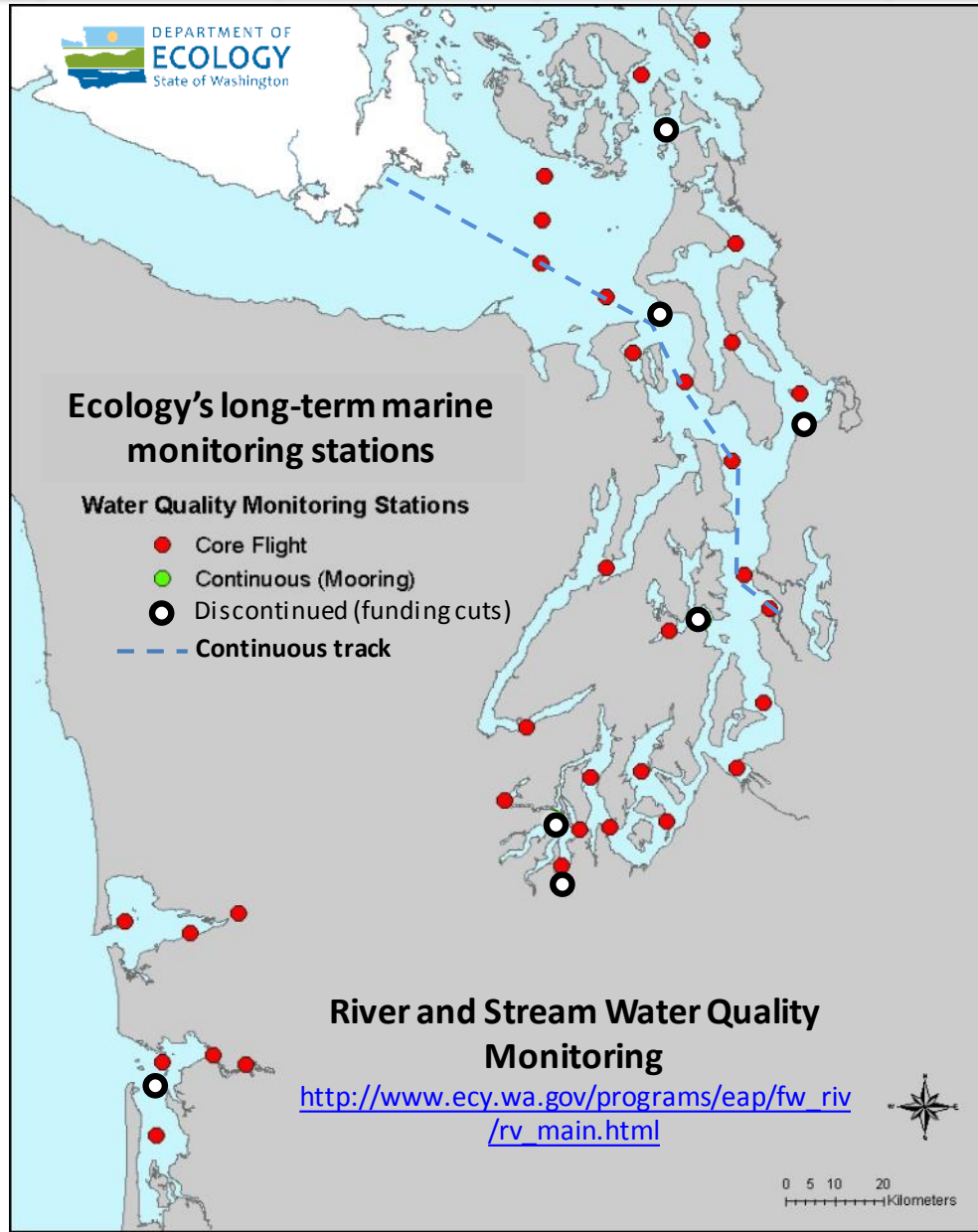


[christopher.krembs@ecy.wa.gov](mailto:christopher.krembs@ecy.wa.gov)



## Access core monitoring data:

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



## Discontinued mooring network



[Suzan.Pool@ecy.wa.gov](mailto:Suzan.Pool@ecy.wa.gov)



## Access historic mooring data:

[http://www.ecy.wa.gov/programs/eap/mar\\_wat/dat\\_a.html](http://www.ecy.wa.gov/programs/eap/mar_wat/dat_a.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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Marine Monitoring Unit  
Environmental Assessment Program  
WA Department of Ecology

