



Eyes Over Puget Sound

Summary	Stories	Diving & critters	Climate & streams	Combined factors	Marine water	Aerial photos	Info
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Surface Conditions Report: *March 26, 2019*



Critter of the month:
The Moss Animals



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

*Allison Brownlee
Mya Keyzers*



*Tyler Burks
Jim Shedd*



Skip Albertson



*Dr. Christopher
Krembs (Editor)*



Personal stories

[p. 3](#)

Generating high quality data takes work and attention to detail.

Climate & streams

[p. 6](#)

River flows have been low this winter because fall and winter were relatively warm and dry. February snow could not reduce the deficit. Luckily, warmer conditions at the end of March normalized streamflow in snow-dominated watersheds, but not so for rain-dominated watersheds.

Water temperature and food web

[p. 10](#)

It is getting too cold for anchovies in South Sound and the Juan de Fuca Strait. Hood Canal is a thermal refuge for cold-sensitive species.

Aerial photography

[p. 11](#)

The productive season is in full swing in the finger inlets of South Sound, Kitsap Peninsula, and Quartermaster Harbor. Jellyfish aggregations are present in Budd, Eld, Totten, and Sinclair Inlets. Following a strong bloom in Hood Canal last month, *Noctiluca* is present in southern Hood Canal and Totten Inlet.

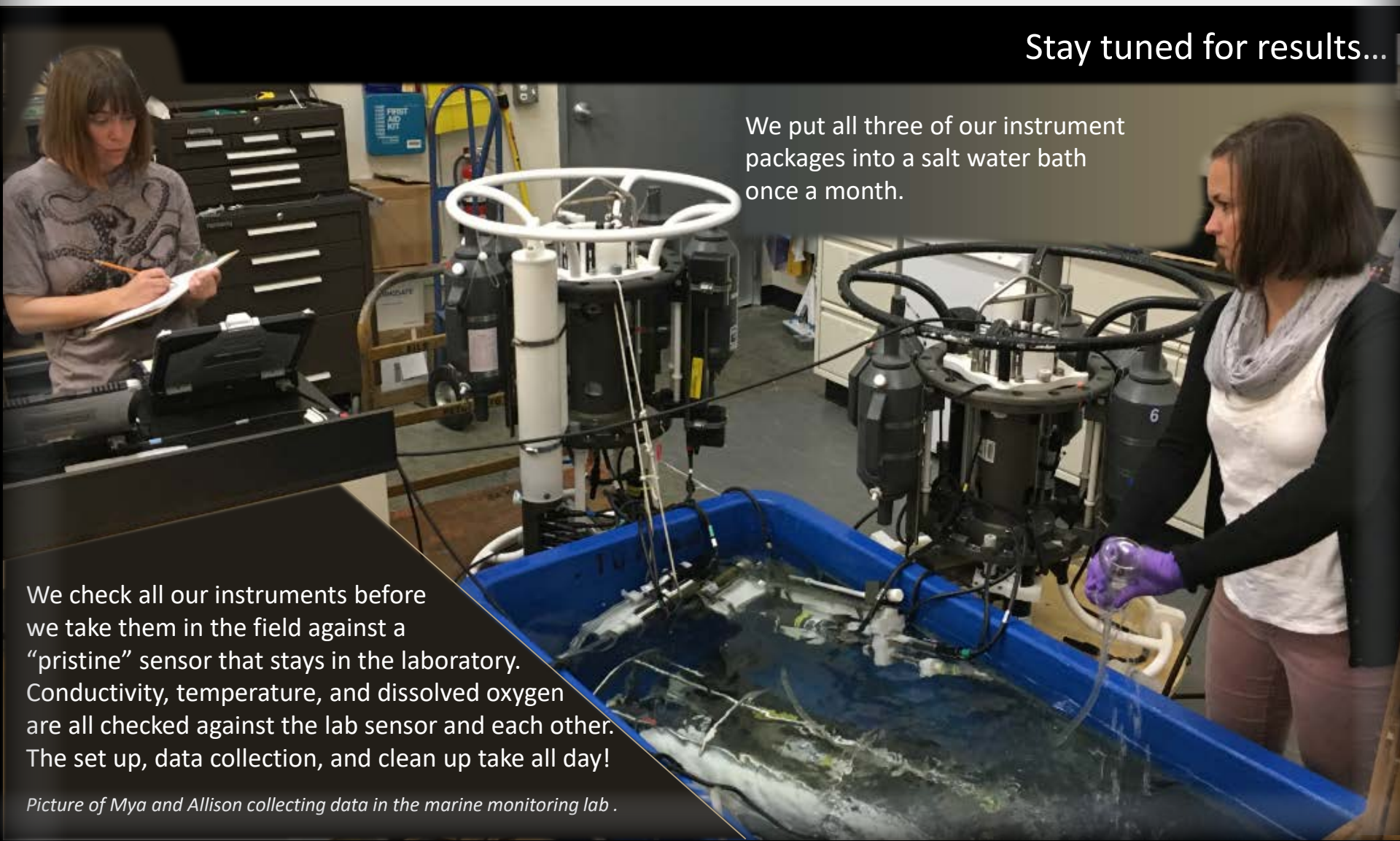
Come into the lab and see how we assure the highest data quality

Stay tuned for results...

We put all three of our instrument packages into a salt water bath once a month.

We check all our instruments before we take them in the field against a “pristine” sensor that stays in the laboratory. Conductivity, temperature, and dissolved oxygen are all checked against the lab sensor and each other. The set up, data collection, and clean up take all day!

Picture of Mya and Allison collecting data in the marine monitoring lab.





What was the water visibility like for divers?

February



Best and worst horizontal visibility at corresponding vertical depth

Visibility can be very different at different depths at the same site.

Location	Best Visibility		Worst Visibility	
	Horizontal Distance (ft.)	Vertical Depth (ft.)	Horizontal Distance (ft.)	Vertical Depth (ft.)
1	12	11	11	3
2	19	62	2	2
3	33	84	15	5
4	22	8	19	67
5	35	84	12	3
6	43	75	8	7
7	23	69	8	8
8	14	7	12	36
9	26	54	22	5
10	25	87	22	3
11	14	33	12	5

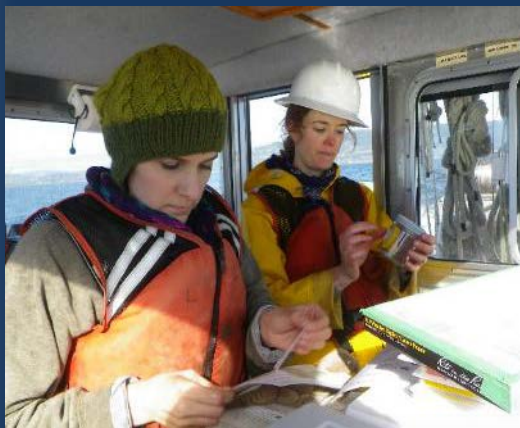


Find depths with high/low visibility

- **Best visibility** occurred in Hood Canal near Octopus Hole (location 6) with 43 ft visibility (at 75 ft depth), despite having poor visibility near the surface.
- **Poor visibility (no diver icon)** occurred in Admiralty Reach near the surface (location 2).
- The poster, “Underwater Visibility Maps – a Tool for Scuba Divers,” is available [here](#)

This is a new feature and we are soliciting feedback (skip.albertson@ecy.wa.gov).

Critter of the Month – The Moss Animals



Dany Burgess & Angela Eagleston
Marine Sediment Monitoring Team

Stuck on You

Have you ever seen what looks like a clump of weeds or a lichen-like crust stuck to a rock or some kelp in Puget Sound? If so, chances are you've spotted a moss animal, or bryozoan! Bryozoans are amazing colonial animals in plant disguises. Find out more about them in this month's blog!

Fun Bryozoan Facts

Their colonies are made up of tiny individual animals called zooids.

They can defend themselves with tiny bird beaks.

Their calcium carbonate skeletons make them a focus of new ocean acidification research.

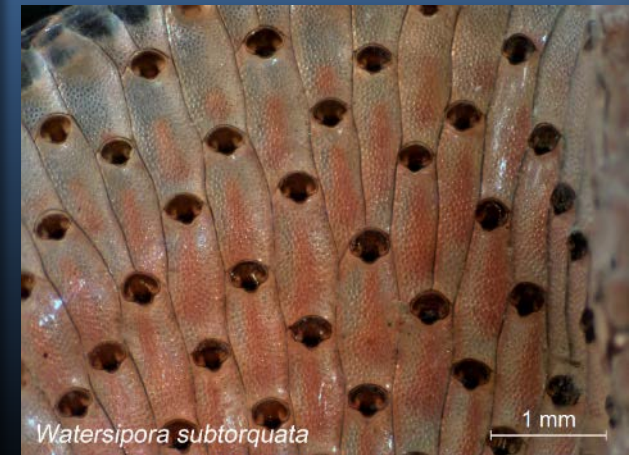


*Kelp bulb with
white encrusting
bryozoan*

Image by
Dave Cowles,
wallawalla.edu



2 mm



Watersipora subtorquata

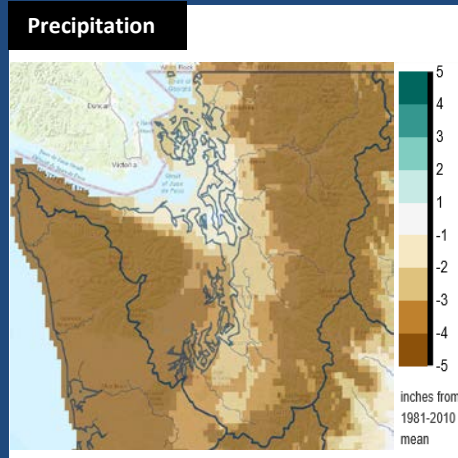
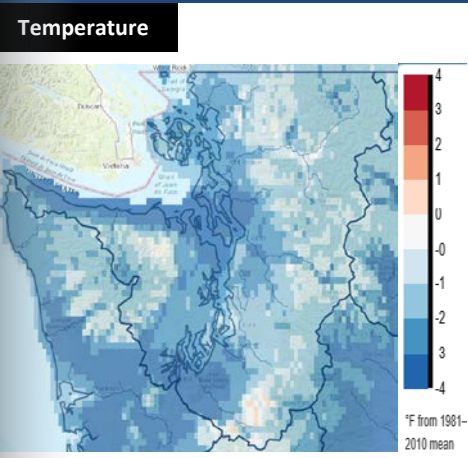
1 mm

Learn more about moss animals and other critters on Ecology's EcoConnect blog [here](#)



In March, Puget Sound air temperatures were below normal and precipitation remained below normal (A). At the seasonal peak of snowpack accumulation, watersheds that drain to Puget Sound hold below-normal volumes (B). Monitoring snowmelt rates and timing will be critical as we transition to summer with the potential for reduced flows to Puget Sound.

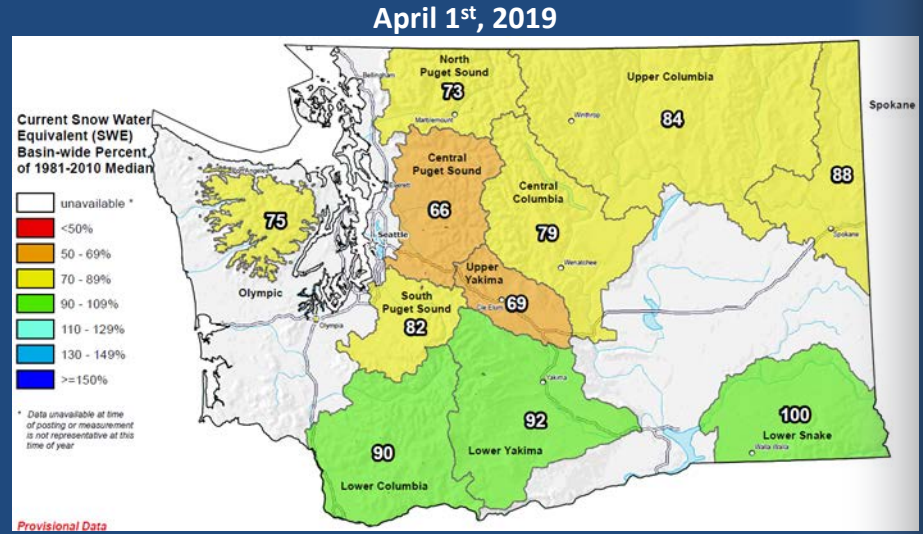
A. Northwest Climate Toolbox



Temperature Anomaly from historical mean daily ranged from 0 to -4 °F in the Puget Sound region during the past 30 days.

Precipitation Anomaly from historical mean ranged from -1 to -5 inches in the Puget Sound region during the past 30 days.

B. Washington SNOTEL, USDA/NRCS

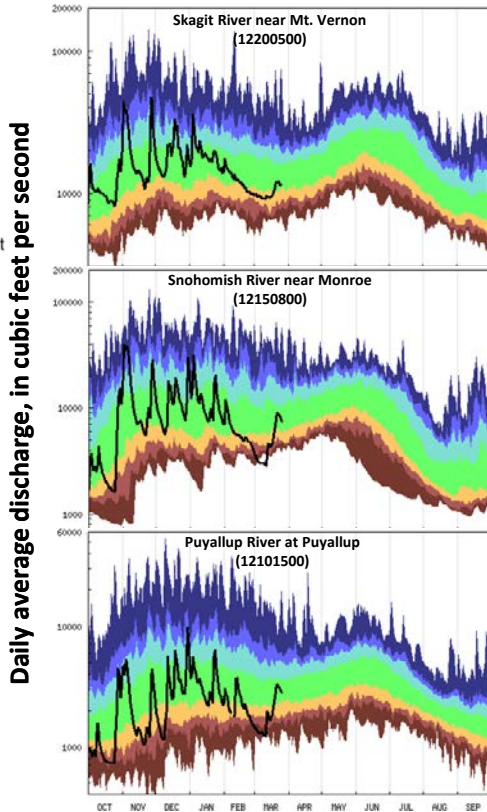


Snow water equivalent percent of median for watersheds draining to Puget Sound are below normal. At the typical peak of seasonal snowpack accumulation, April 1, Puget Sound is at 74% of its historical median.

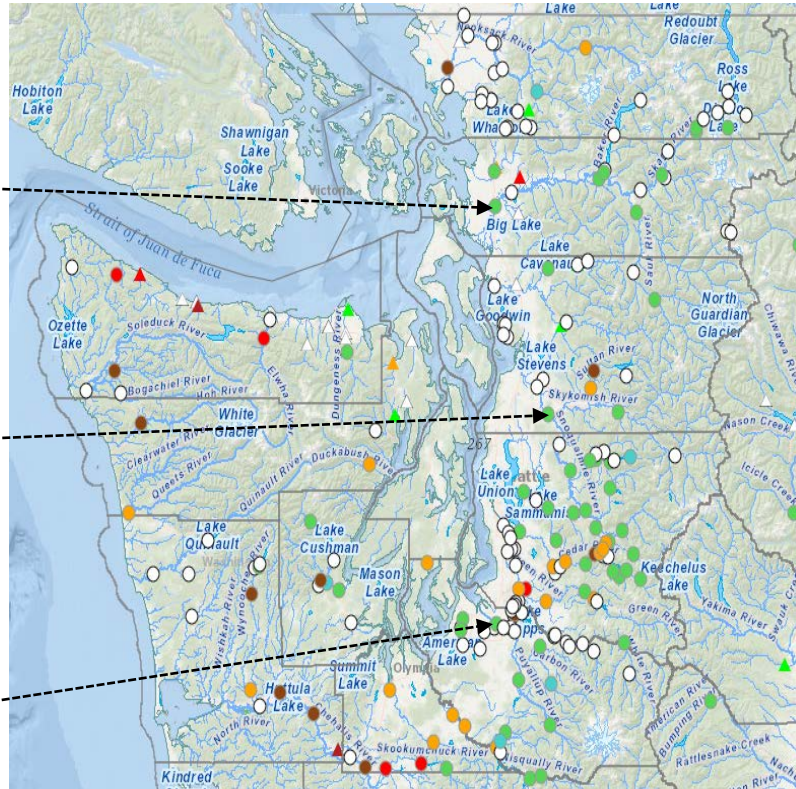
A warming trend at the end of March brought streamflow in snow-dominated watersheds up to normal levels following much below-normal conditions (see trend charts). Most stream gages are reporting normal flows except for those that are in rain-dominated watersheds (see map). Air temperature will play a critical role in determining how long our reduced snowpack can sustain streamflows to Puget Sound in the summer months.

Select Puget Sound Streamflow Trends

Current Streamflow Conditions as of 3/26/2019



- Severe hydrologic drought lowest - 5th percentile
- Much below normal 5th - 10th percentile
- Below normal 10th - 25th percentile
- Normal 25th - 75th percentile
- Above normal 75th - 90th percentile
- Much above normal 90th - 95th percentile
- Much above normal 95th percentile to highest
- Discharge (2019)



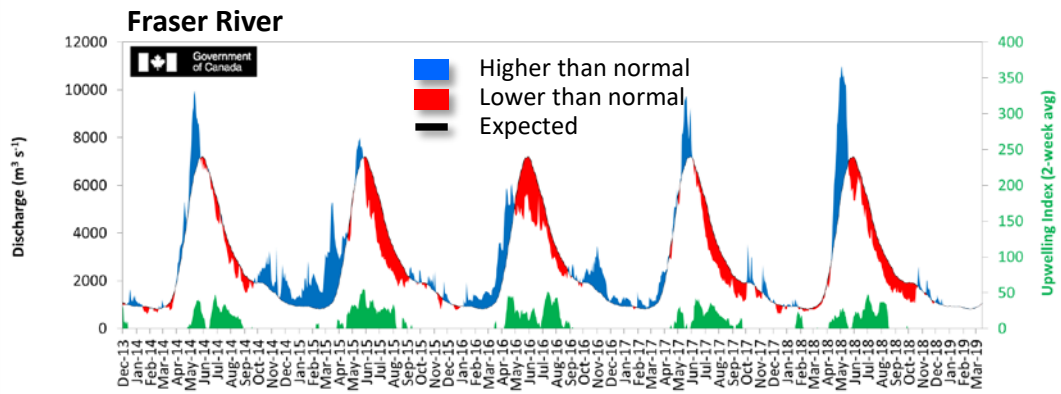
USGS Real Time Streamflow Values

- 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

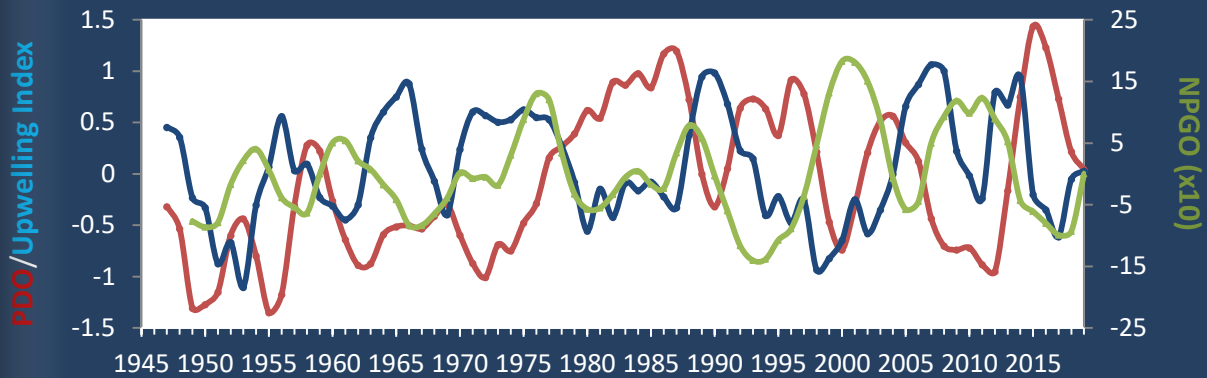
- Daily Streamflow
- ▲ Highest recorded
 - ▲ Much above normal (>90%)
 - ▲ Above normal (76-90%)
 - ▲ Normal (25-75%)
 - ▲ Below normal (10-24%)
 - ▲ Much below normal (<10%)
 - ▲ Lowest recorded
 - △ Not ranked

Historically, the peaks of coastal upwelling and the [freshet](#) are in sync. In 2018, a strong freshet preceded low flows.



The Fraser River is the major driver of [estuarine circulation](#) and water exchange between the Salish Sea and the ocean. Fraser River flows are currently very much at expected levels.

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 gone (PDO) and upwelling is expected (Upwelling Index anomaly). NPGO, which reflects the surface productivity along the coast, is expected as well.

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



In the anomaly plot, we want to connect different factors influencing water quality in the context of space and time. Conditions leading up to March 2019 were drier with lower river flows than in the 2017 – 2018 winter. The past winter has been warmer than the previous two years, but February was much colder in 2019. In 2018, fall and early winter were generally sunnier than the year before. For recent river and stream inflow, [see page 6.](#)

Conditions leading up to March:

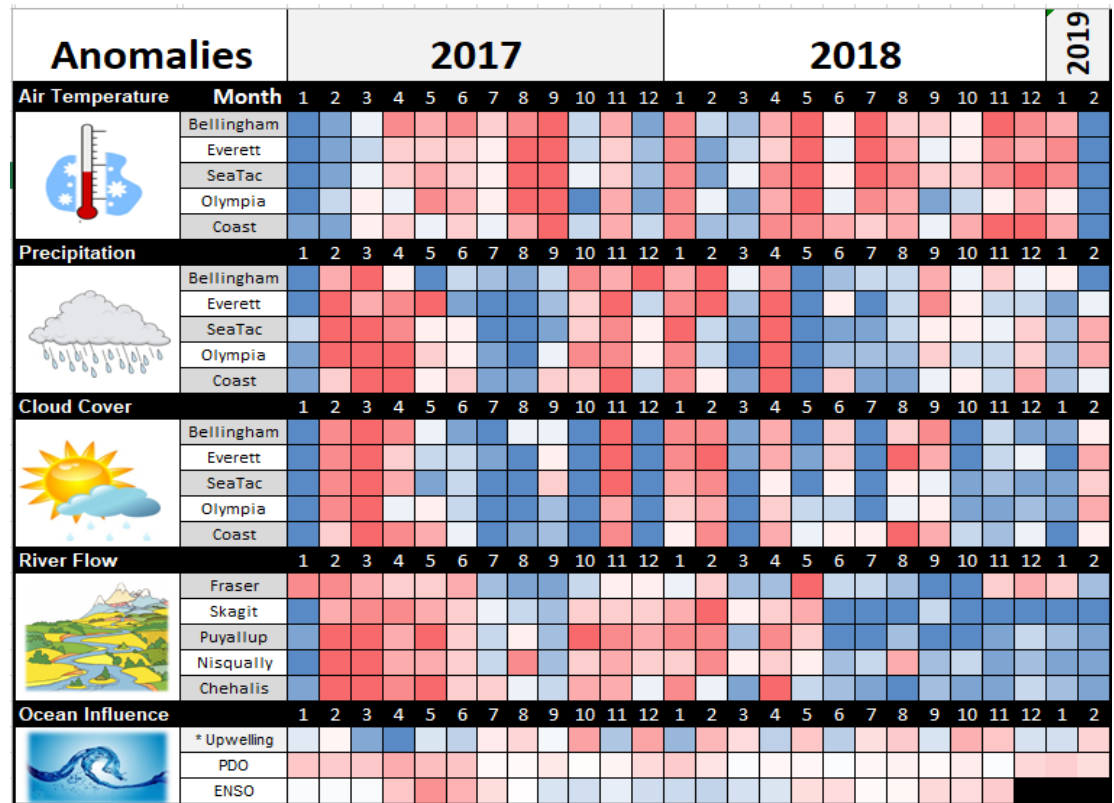
Air temperatures have generally been warmer this winter except for February.

Precipitation for the past five months has been lower than in 2017.

Sunshine (opposite of cloud cover) occurred more often than the previous winter, although February was cloudier.

River flows were low through the winter. When precipitation was higher, it was cold and became snowpack.

Upwelling and ENSO (MEI) were more moderate in 2018 than 2017.

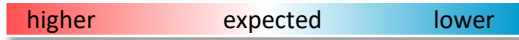


All data are from public sources: UW GRAYSKIES; river flows from USGS and Environment Canada; indices from NOAA & UW (PDO).

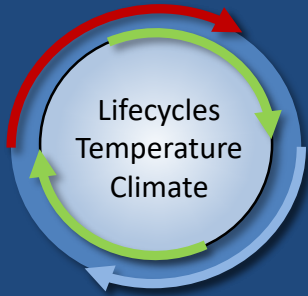
*Upwelling/downwelling Anomalies (PFEL)

PDO = Pacific Decadal Oscillation

ENSO = El Niño Southern Oscillation



No data



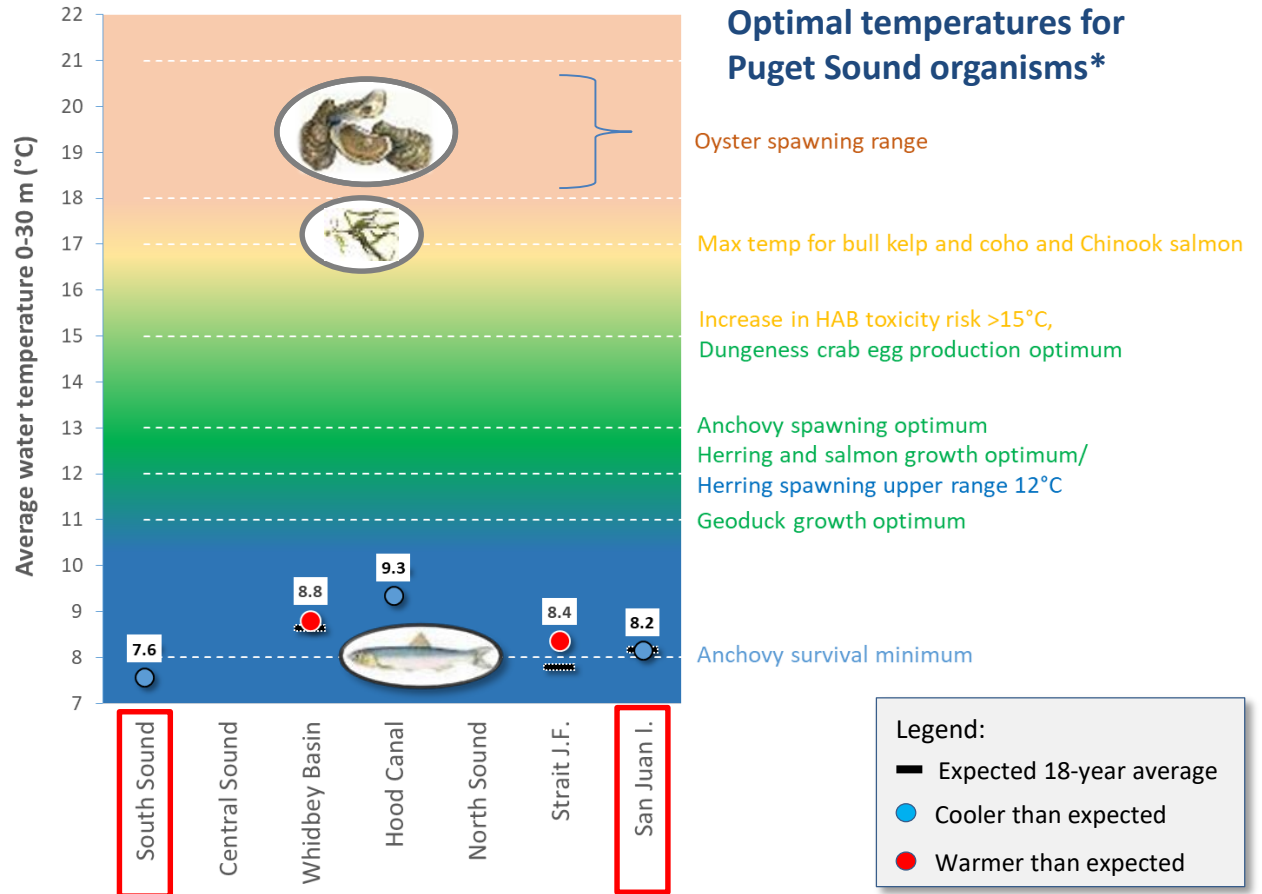
Can organisms thrive and survive?

The life cycles of organisms respond to temperature. To be successful, the timing of early life stages must line up with good growth conditions.

Temperature is important for growth, but also dictates if certain organisms can overwinter in Puget Sound (e.g., northern anchovy).

* Help us get these right. We scoured the literature for temperatures important to the success and survival of marine organisms.

In February, following a cold spell, average water temperatures in surface water (0 – 30 m deep) were cooler than the baseline (1999 – 2016) with the exception of Whidbey Basin and the Strait of Juan de Fuca. Hood Canal remained the warmest, but was lower than normal. **San Juan Island and South Sound are now at below-tolerable temperatures for anchovies** (see red boxes below).



Legend:

- Expected 18-year average
- Cooler than expected
- Warmer than expected

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The productive season is in full swing in the finger inlets of South Sound, Kitsap Peninsula, and Quartermaster Harbor. Jellyfish are present in Budd, Eld, Totten, and Sinclair Inlets. Suspended sediment detaching from shore along tidal fronts makes the distinction between sediment and spawning fish prone to error. Signs of *Noctiluca* spotted in Totten Inlet, Belfair, and Hood Canal.

[Start here](#)

Suspended sediment created by waves along the shore travels north under the Hood Canal bridge.



Mixing and fronts:

Tidal fronts carry sediment mid-channel at prominent points on the shoreline.



Jellyfish and fish:

Jellyfish patches in Budd, Eld, Totten, and Sinclair Inlets.



Suspended sediment:

Suspended sediment from rivers is low. Wave and wind re-suspend sediment near the shoreline and transport it long distances.



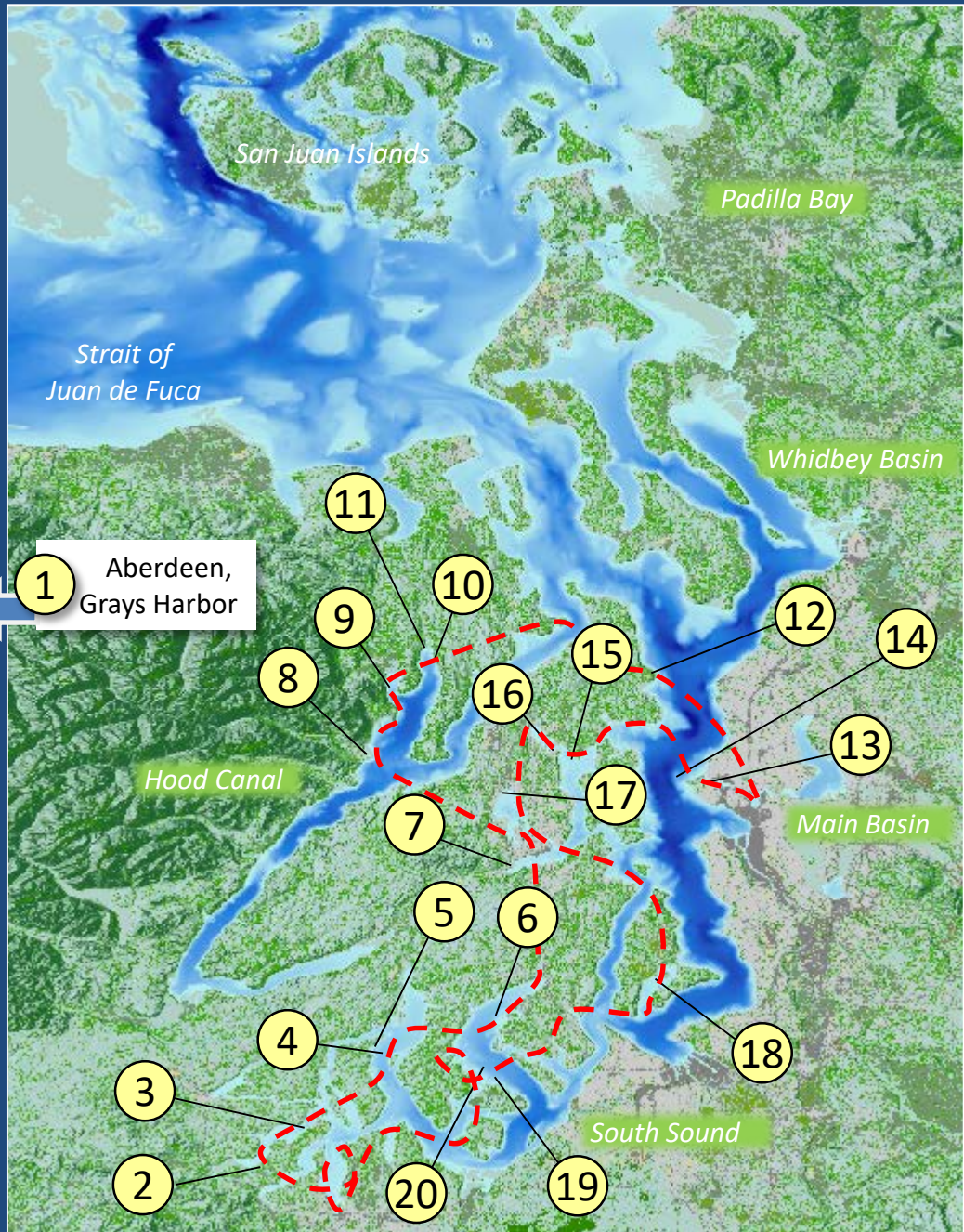
Visible blooms:

Brown-green blooms in Budd and Totten Inlets, Agate Passage, Liberty Bay, and Quartermaster Harbor. Red-brown bloom in Sinclair and Dyes Inlets and Quartermaster Harbor. Signs of *Noctiluca* (bright orange) in parts of Totten Inlet and Southern Hood Canal.



Debris:

Orange-colored organic material drifting in Totten Inlet near Steamboat Island.



Aerial navigation guide

Date: 3-26-2019

Click on numbers

Tide data from March 26, 2019 (Seattle):

Time	Pred	High/Low
3:35 AM	5.77	L
9:08 AM	10.49	H
3:59 PM	0.26	L
11:15 PM	10.18	H

Flight Observations

Sunny and windy toward the north

Map Key

--- Flight route



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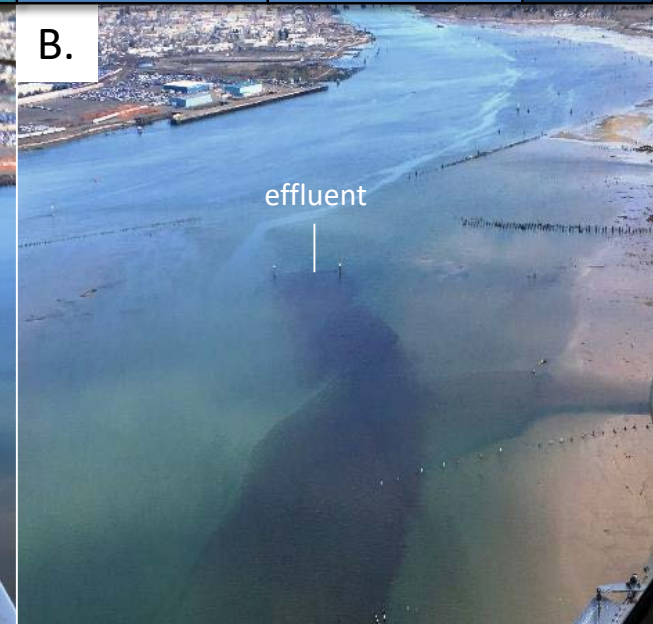
Aerial photos

Info

A.



B.



C.

9/25/2018



A. & B. Effluent from Cosmo Specialty Fiber rises to the surface. C. This also happened in September 2018.
Location: Aberdeen (Grays Harbor), 12:35 PM



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Jellyfish aggregation.

Location: Totten Inlet (South Sound), 11:49 AM



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A.



B.



(picture by Tony Melchior, 5 miles SW of Belfair)

A. Reddish organic material accumulating at surface. Could this be Noctiluca? B. Noctiluca near Belfair.
 Location: A. Carlyon Beach, (South Sound), 11:52 AM; B. Belfair (Hood Canal) 4-1-2019.



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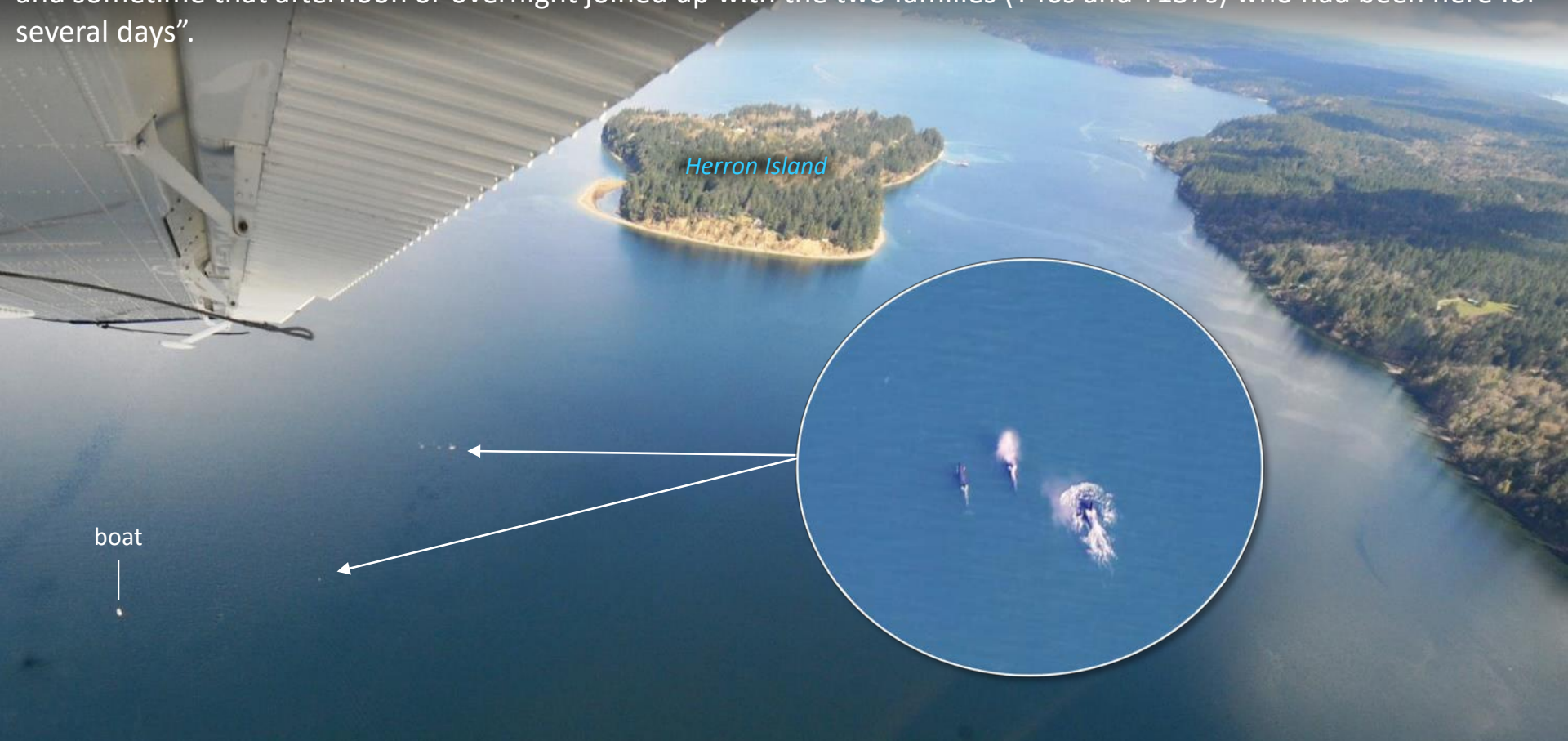
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Orca Network Whale Sighting Report from April 2, 2019

“An abundance of the mammal eating type orcas are showing up in numbers through out the Salish Sea. Puget Sound saw a large number of Ts on the 26th. This large group came down Admiralty Inlet the afternoon prior (25th) and sometime that afternoon or overnight joined up with the two families (T46s and T137s) who had been here for several days”.



Dispersed transient orca pod of >15 individuals traveling west.

Location: Case Inlet (South Sound), 11:57 AM



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Large plume of suspended sediment.

Location: Case Inlet (South Sound), 11:59 AM



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*Large aggregation of harbor seals surrounding the shallows of a haul-out site.
Location: Cutts Island, Carr Inlet (South Sound), 12:05 PM*



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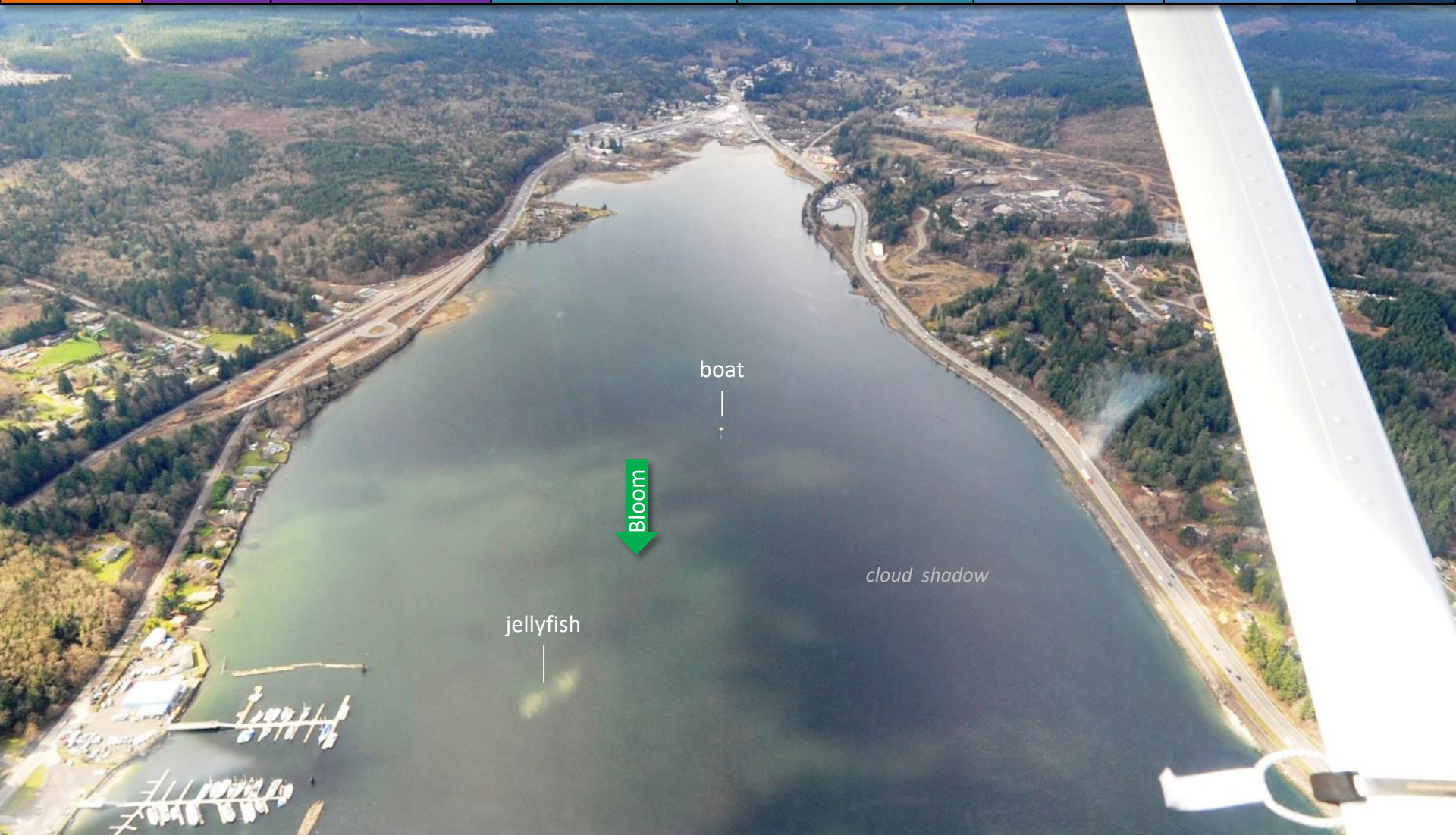
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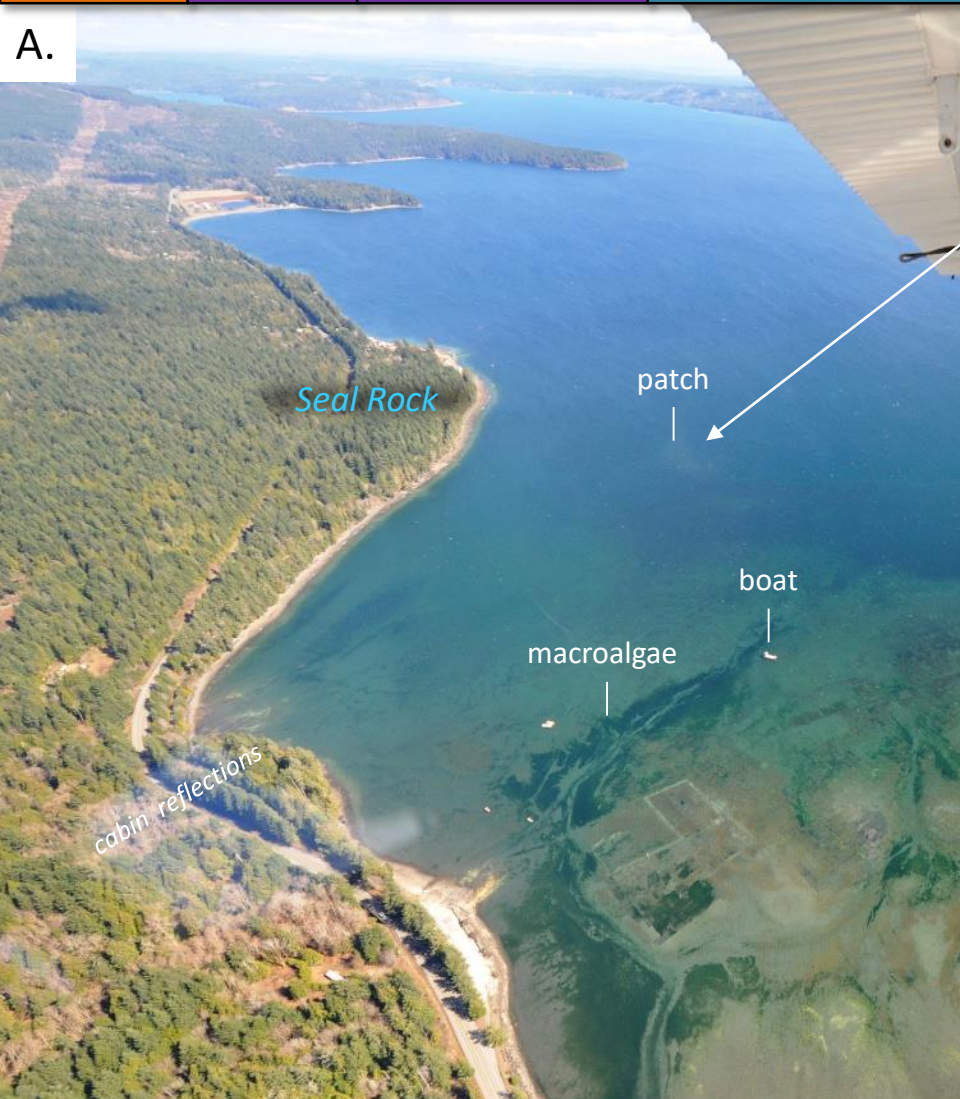


Jellyfish aggregation and early signs of a red-brown bloom.
Location: Sinclair Inlet (Central Sound), 12:15 PM



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A.



B.



A. Dosewallips River delta with macroalgae. B. Turbid patch with many seabirds.

Location: Dosewallips River, Dabob Bay (Hood Canal), 12:25 PM



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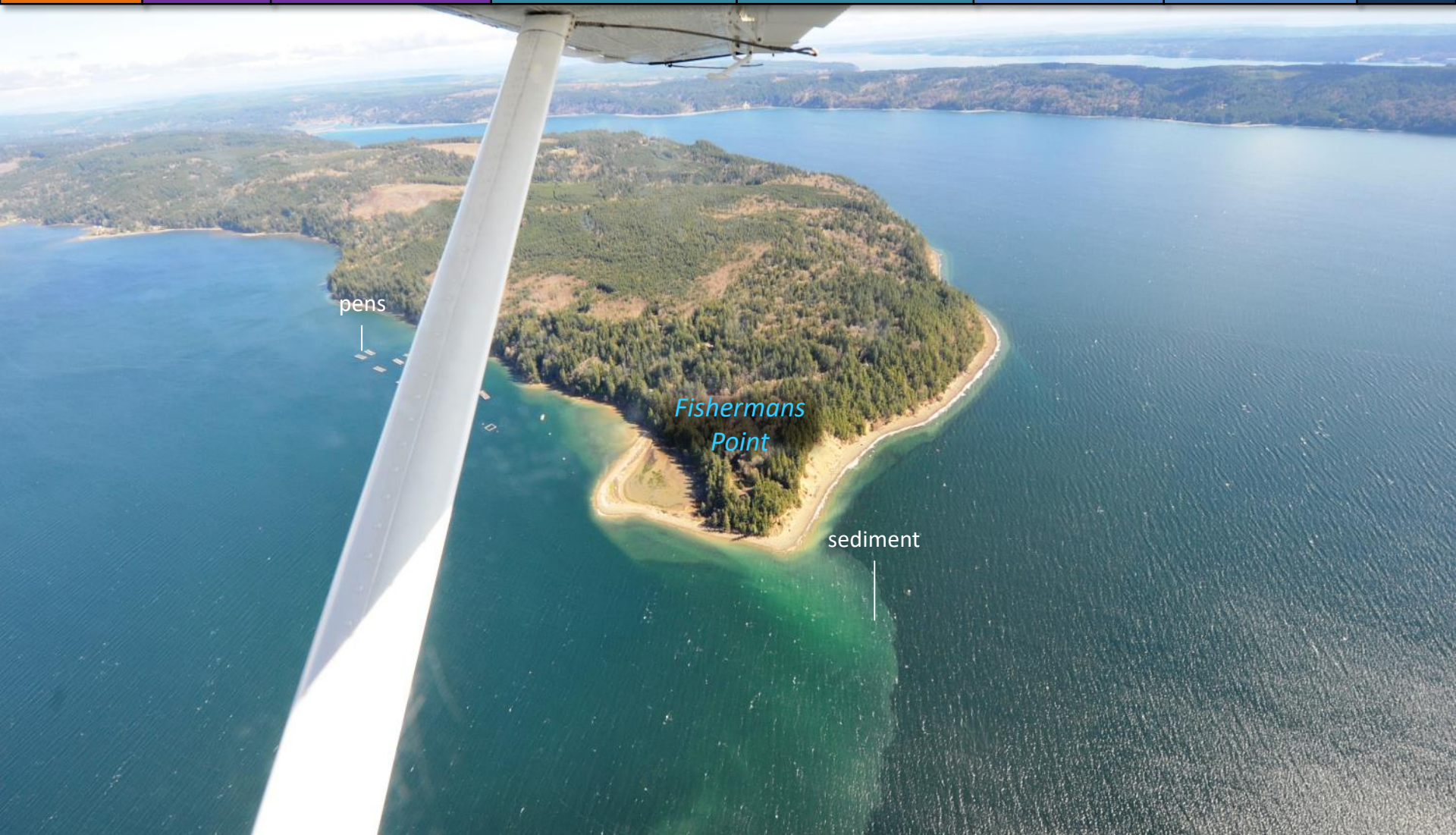
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Suspended sediment dispersing mid-channel along front.

Location: Quilcene Bay (Hood Canal), 12:28 PM



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Suspended sediment makes spotting herring impossible.

Location: Discovery Bay (Hood Canal), 12:33 PM

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A.



B.



Question:

How can you tell what might be schooling fish or seagrass?

Answer:

Google images help us figure it out.

Fish move around, whereas seagrass doesn't.

A. Dark patches not seen on Google images. B. Patches are likely fish in Dabob Bay Natural Area Preserve.

Location: Dabob Bay (Hood Canal), 12:36 PM



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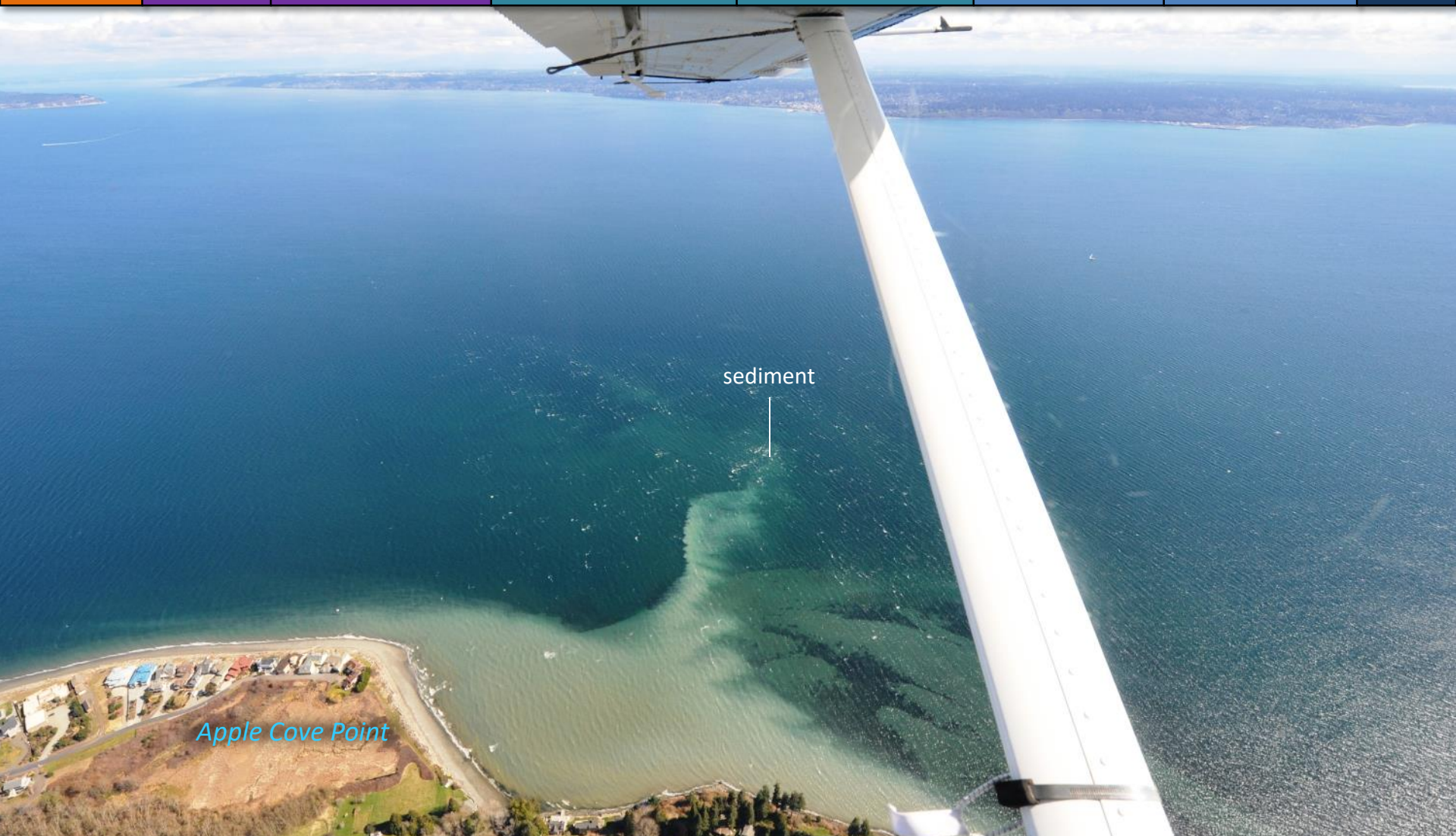
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A lot of suspended sediment, but no creek? What could have caused this?

Location: North of Kingston (Central Basin), 12:48 PM



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A big patch in shape of a double eddy containing suspended sediment likely from a prop wash.
Location: Salmon Bay (Seattle), 1:15 PM



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Suspended sediment from bluff erosion fanning out far offshore along a front.
Location: West Point (Central Sound), 1:18 PM



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Blooms of different colors meet near Agate Pass. Is the whitish water spawning herring?

Location: Agate Passage (Central Sound), 1:26 PM



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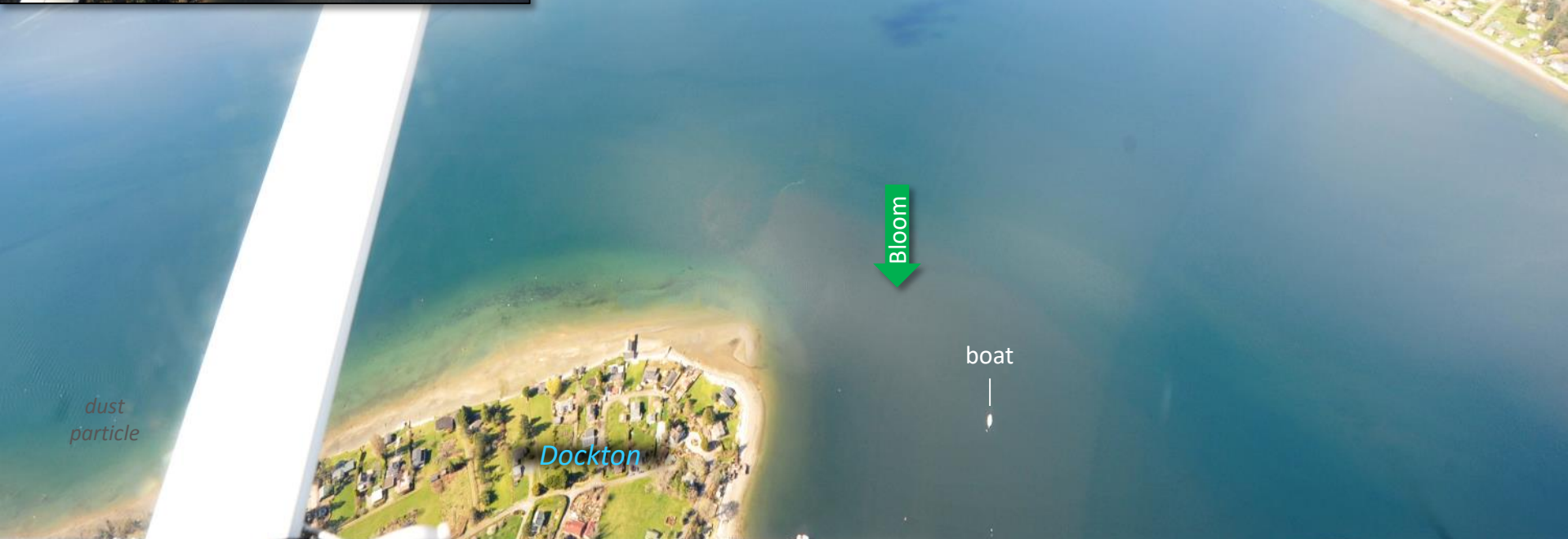
*Thick blooms at the entrance to Liberty Bay. Suspended sediment from Bjorgen Creek.
Location: Lemelo (Central Sound), 1:27 PM*

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Bloom in northern portions of Dyes Inlet.
Location: Dyes Inlet (Central Sound), 1:33 PM



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A. Brown algal bloom in the inner bay. B. Brown-reddish bloom near Dockton.

Location: Quartermaster Harbor (Central Sound), 1:46 PM



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A. We documented a tidal eddy on Feb 27, 2012 . B. Is this partially the cause for the scoured ocean floor?

Location: McNeil Island, (South Sound), 2:03 PM



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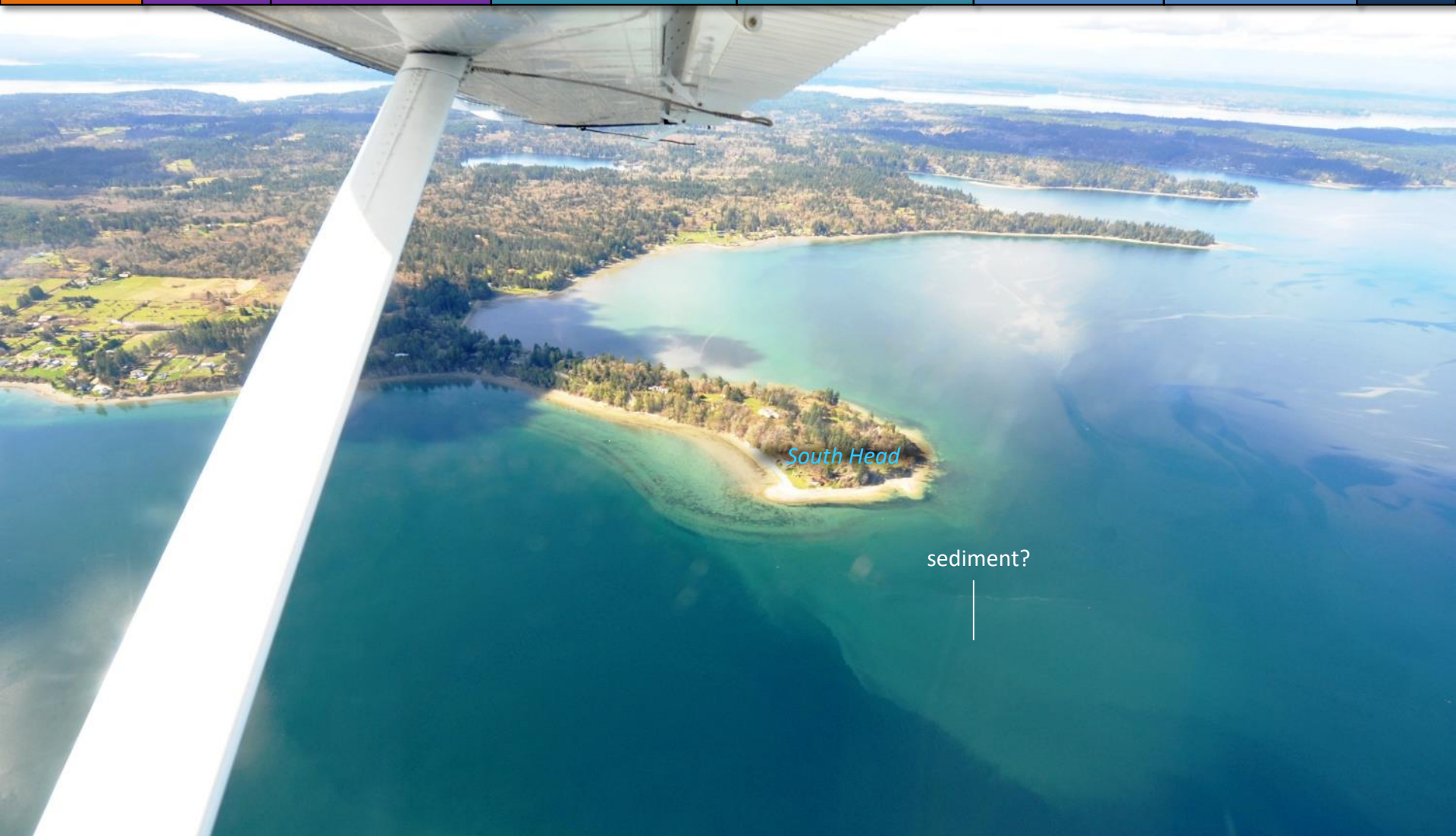
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Suspended sediment off South Head, or is it possibly spawning herring?

Location: Pitt Passage, Carr Inlet (South Sound), 1:58 PM

Find past editions of EOPS on the next pages



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We have published 80 editions!

Find all previous Eyes Over Puget Sound editions at the end of this document.

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<https://fortress.wa.gov/ecy/publications/documents/1803075.pdf>.



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Marina, and Kenmore Air.

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Marine Monitoring Unit
Environmental Assessment Program
Washington State
Department of Ecology

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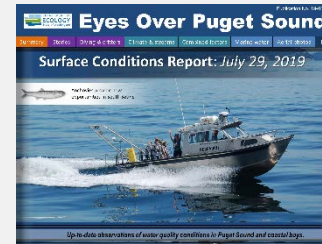
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[Publication No. 20-03-070](#)



[October_30_2019,](#)
[Publication No. 19-03-076](#)



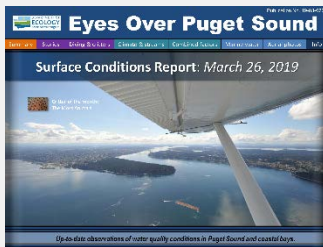
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[Publication No. 19-03-075](#)



[July_29_2019](#)
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[June_4_2019](#)
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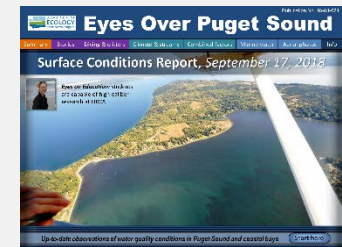
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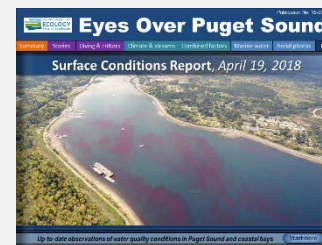
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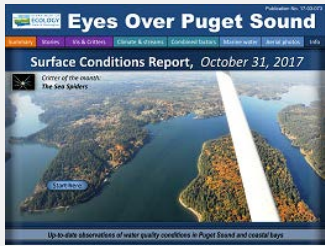
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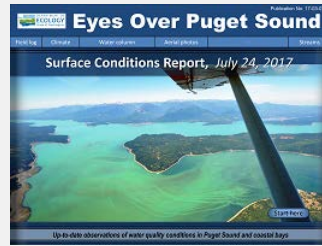
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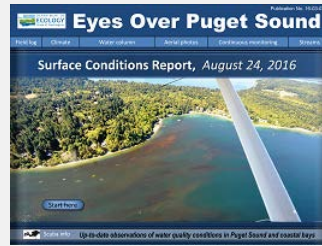
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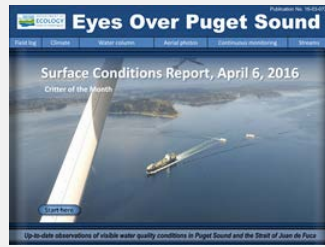
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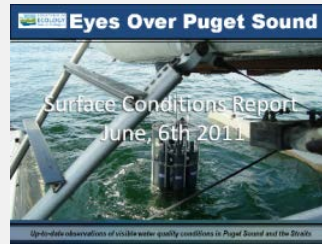
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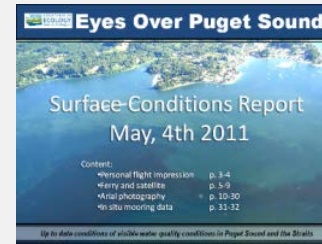
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