



# Eyes Over Puget Sound

[Summary](#)[Herring & planes](#)[Climate & streams](#)[Combined factors](#)[Marine water](#)[Aerial photos](#)[Data](#)

## Surface Conditions Report: April 1, 2021



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

Summary

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LONG-TERM MARINE MONITORING UNIT



*Mike MacKay*

## Herring and Planes, [p. 3-4](#)

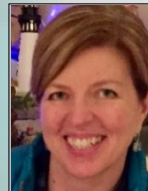
Capturing these events from a plane provides valuable information.



*Skip Albertson*

## Climate & streams, [p. 5-7](#)

After a wet winter, spring has been noticeably drier, warmer, and sunnier, and river flows are near normal levels.



*Julia Bos*

## Water quality, [p. 8-9](#)

Salinity in Coastal Bays and Puget Sound is higher, especially in areas with rain-fed river sources.



*Dr. Christopher Krembs*

## Aerial photography, [p. 10-38](#)

The spring bloom is developing, though not very pronounced, but *Noctiluca* is already visibly present in Hood Canal." . Suspended sediment frequently seen near rivers and creeks, failing bluffs, and human activities. Oil sheen in Salmon Bay.



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Mike MacKay uses his airplane to support the documentation of herring spawning events in North Sound. For more information about his work contact: Mike MacKay <[starsailor@fidalgo.net](mailto:starsailor@fidalgo.net)>.



Explore aerial observations of herring spawn events in Whatcom County 2015 – 2021 by Mike MacKay



Summary

Herring & planes

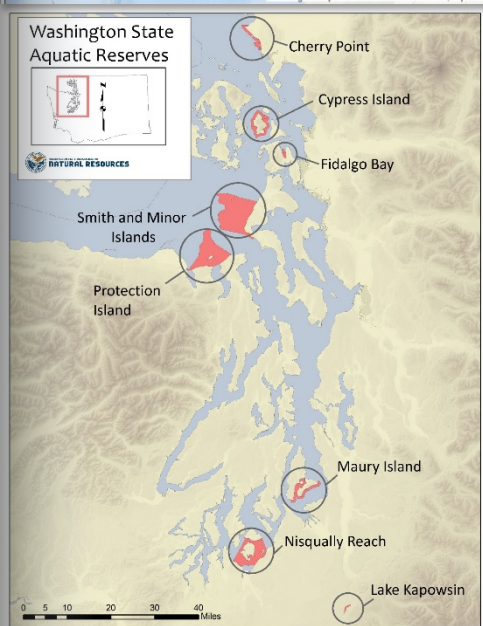
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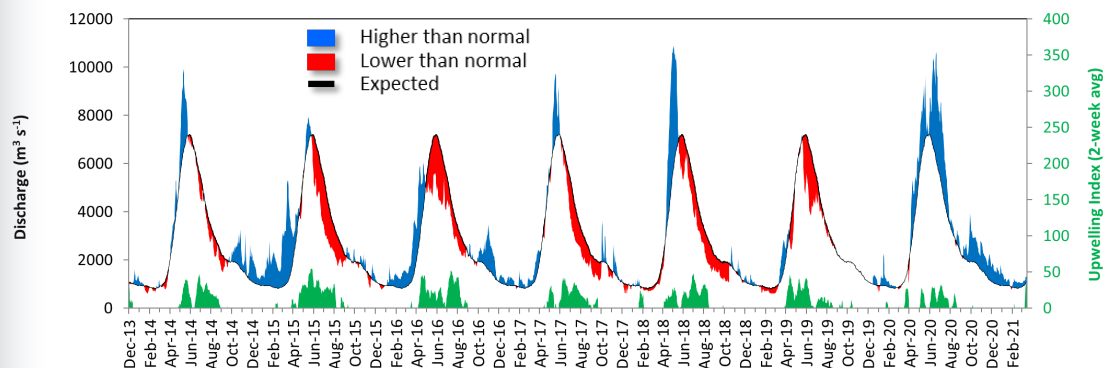


In 2000, the state Department of Natural Resources created the Cherry Point Aquatic Reserve to “protect the significant environmental resource” of the area — including herring.



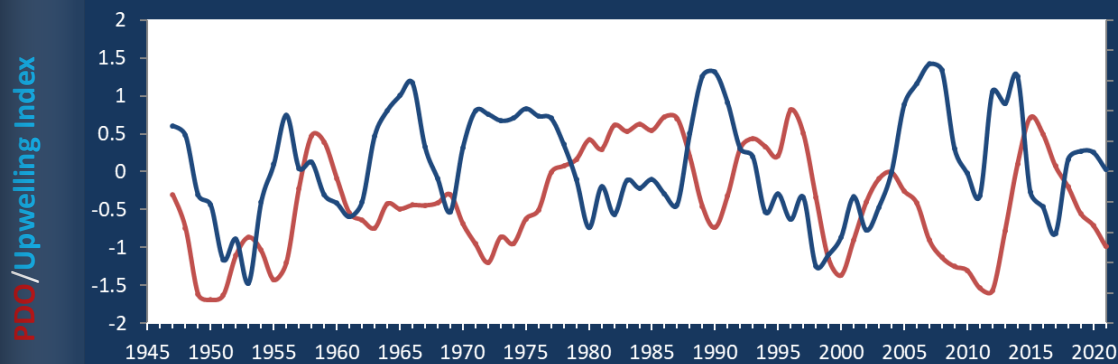
Historically, the peaks of coastal upwelling and the [freshet](#) are in sync.

## Fraser River (at midnight)



The Fraser River is the major driver of [estuarine circulation](#) and water exchange between the Salish Sea and the ocean. The Fraser River flows normalize after high flows in 2020 and winter 2021.

## Three-year running average of PDO and Upwelling Indices



How do ocean boundary conditions affect the quality of water the Salish Sea exchanges with the ocean?

Water has gradually cooled (PDO).  
Upwelling (Upwelling Index [anomaly](#)) is at expected level.

Pacific Decadal Oscillation Index (**PDO**, **temperature**, [explanation](#)).

Upwelling Index (anomalies) (**Upwelling**, **low oxygen**, [explanation](#)).

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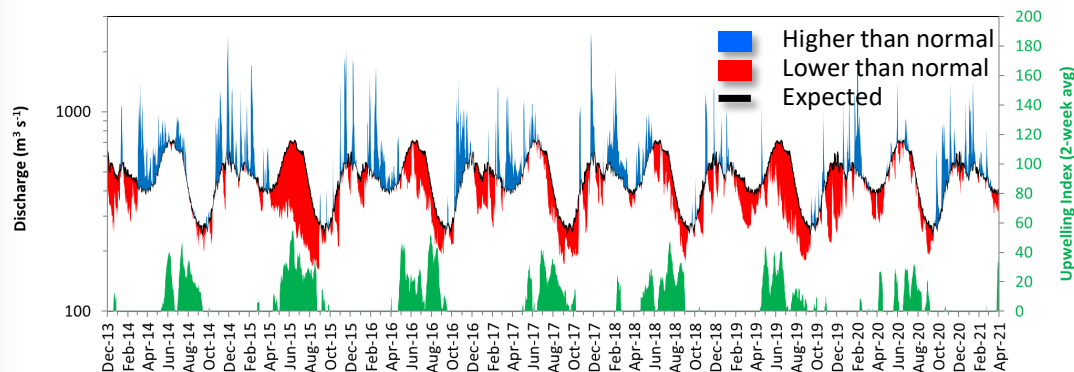
Marine water

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The Skagit River is the largest freshwater source for Puget Sound. It is a river that is regulated.

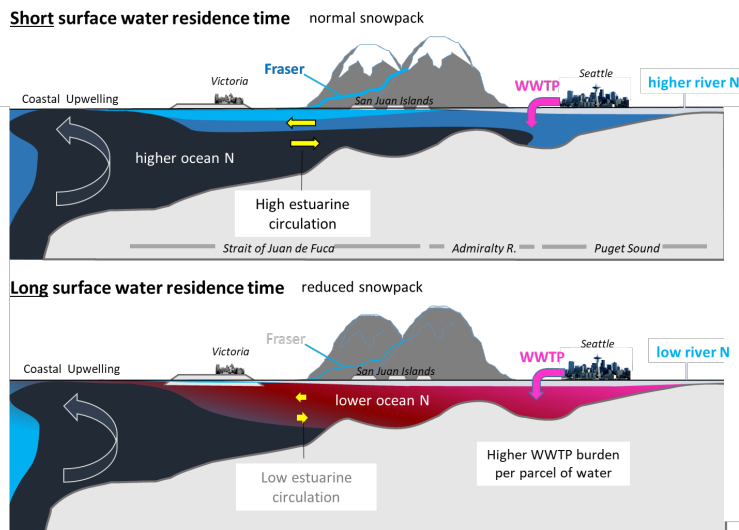
**Skagit River** (at midnight USGS)



The Skagit River freshet is no longer clearly pronounced, because it is a regulated system for hydroelectric power generation. However, drought years and low flows can be seen in the river's discharge data. In the last year, flows of the Skagit appear more normal.

Normal river flows drive **“natural”** nutrient inputs and keep the **water cool**.

Low river flows change the **nutrient balance** and make **water warmer**.



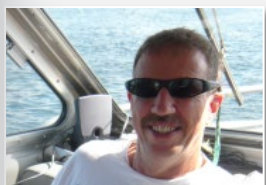
River flows and upwelling in the summer influence our water quality.

Rivers strengthen estuarine circulation in the Salish Sea. This is important in the summer.

Upwelled ocean water provides cool, nutrient-rich water.

For that to happen, we need northerly winds and good river flows (a good snowpack) during periods of water exchange through Admiralty Reach (neap tides).





In the anomaly plot, we want to connect different factors influencing water quality in the context of space and time. We do this with a heat map and anomalies by month for selected regions from north to south.

## Conditions leading up to April:

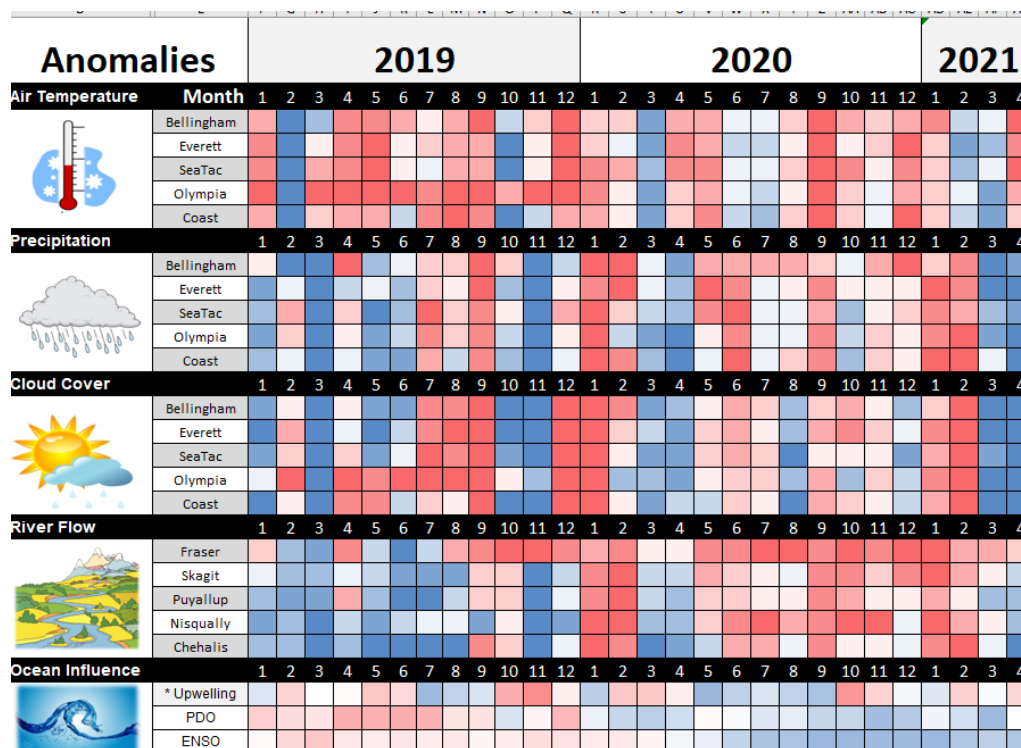
**Air temperatures** were generally warmer this winter, but February & March were cold.

**Precipitation** has been below normal in March & April, an abrupt change from January and February.

**Cloud cover** has been low in March & April.

**River flows** have been higher than normal but returning to normal.

**Downwelling** was less pronounced in February. PDO is lower and La Niña remains.



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

higher expected lower

No data

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## Marine Water Conditions: 2021 Temperature, Salinity, and Dissolved Oxygen

### Coastal Bays

T: Warmer

S: **Max Salinity**

DO: Lower

### Salish Sea

T: Expected temps

S: Saltier at depth, especially Strait of JdF/San Juans

DO: Variable. April mostly expected with S. Sound lows

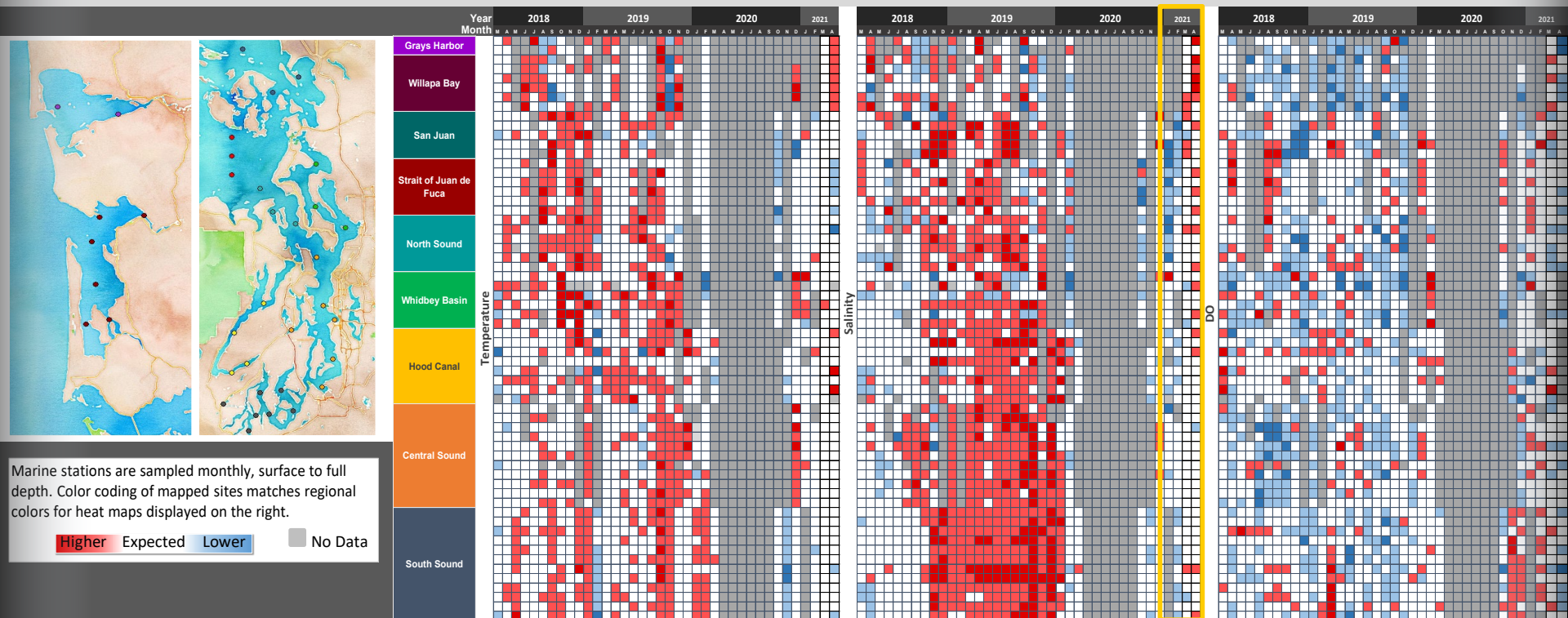
Record highs in Jan. and Feb. for both precipitation and river discharge switched to record lows in Mar. and Apr. This impacted salinity in Coastal Bays and Puget Sound, especially areas that have rain-fed river sources.

Baseline: 1999-2020 (expanding)

### Temperature

### Salinity

### Dissolved Oxygen





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## Stay up-to-date on unfolding stories relevant to our region



The **Marine Waters Work Group** (PSEMP) releases a summary of its bimonthly **Marine Condition Update**, covering the Puget Sound region, coastal waters, and the North Pacific.

To participate in the webinar every other month, join our email list by emailing Iris Kemp ([ikemp@littk.org](mailto:ikemp@littk.org)) or the Marine Waters Work Group ([marinewaters@psemp.org](mailto:marinewaters@psemp.org)).

Stay plumbed into the the information stream...

## What's the story so far?

Go to the [webpage](#) and read detailed discussion summaries.

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The spring bloom is developing, though not very pronounced, but *Noctiluca* is already visibly present in Hood Canal. Suspended sediment frequently seen near rivers and creeks, failing bluffs, and human activities. Oil sheen in Salmon Bay.

[Start here](#)

Wave-exposed Sunlight Beach, Whidbey Island



Restoration Point, Bainbridge I.; Geologically interesting



Front

## Mixing and fronts:

Internal waves in Saratoga Passage, mixing near Sucia and Matia Islands.



## Jellyfish and fish:

Small but numerous patches of jellyfish in Budd Inlet, some patches in Eld Inlet and Sinclair Inlet.

Plume

## Suspended sediment:

Nearshore in Port Madison, Whidbey Island, Port Susan, Swinomish Canal, Joe Leary Slough, Nooksack River delta, Sucia and Matia Islands, Hood Canal, Squaxin Island.

Bloom

## Visible blooms:

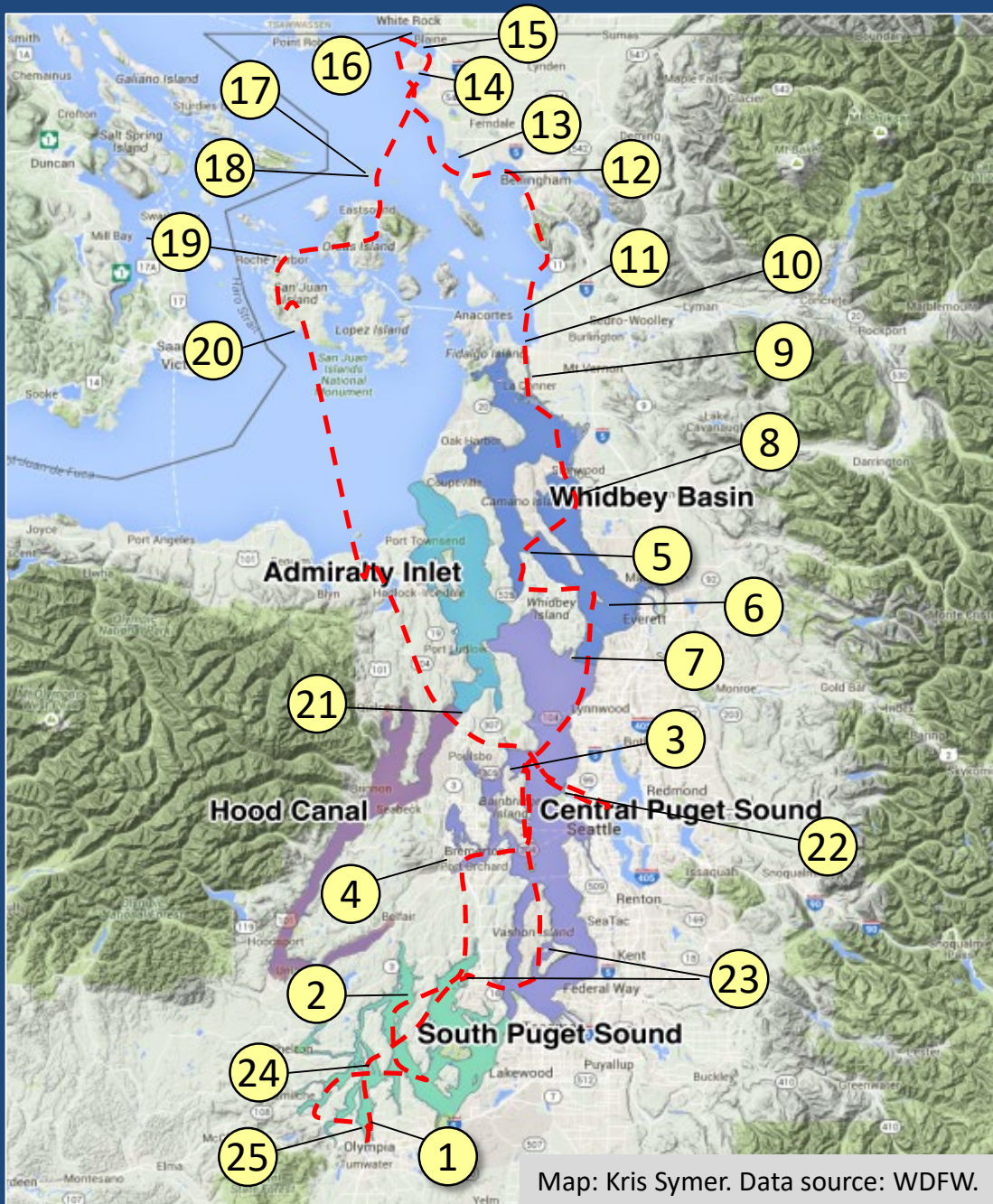
*Noctiluca* blooming in southern Hood Canal. Many places with phytoplankton discoloration. A small red-brown bloom in Budd Inlet.

Debris

## Debris:

Organic debris not very abundant.





DEPARTMENT OF  
**ECOLOGY**  
State of Washington



## Aerial navigation guide

Date: 4-1-2021

Click on numbers

### Flight Observations

South Sound: low clouds; north of  
Tacoma: broken ceiling, sunny.

Contribute observations

**iNaturalist**



Tide data from 4-1-2021 (Seattle):

Time	Pred (ft)	High/Low
02:02 AM	4.73	L
07:43 AM	11.71	H
02:33 PM	-1.39	L
09:28 PM	11.07	H





## Connect aerial observation with data from ORCA moorings



Nick Michel-Hart,  
John Mickett, UW/APL.



[NANOOS NVS Data Explorer](#)



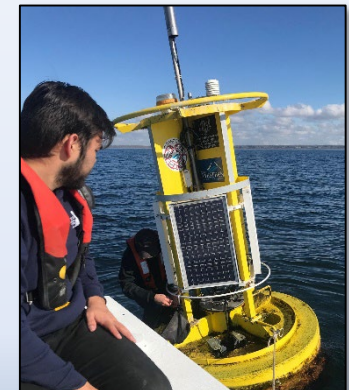
### View products by mooring

#### Puget Sound

- ① [Carr Inlet](#)
- ② [Dabob Bay](#)
- ③ [Hoodsport](#)
- ④ [Hansville](#)
- ⑤ [Point Wells](#)
- ⑥ [Twanoh](#)

#### Salish Sea

- ⑦ [Bellingham Bay](#)



Thayne Yazzie, NWIC,  
Robert Daniels, UW/APL



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Herring &amp; planes

Climate &amp; streams

Combined factors

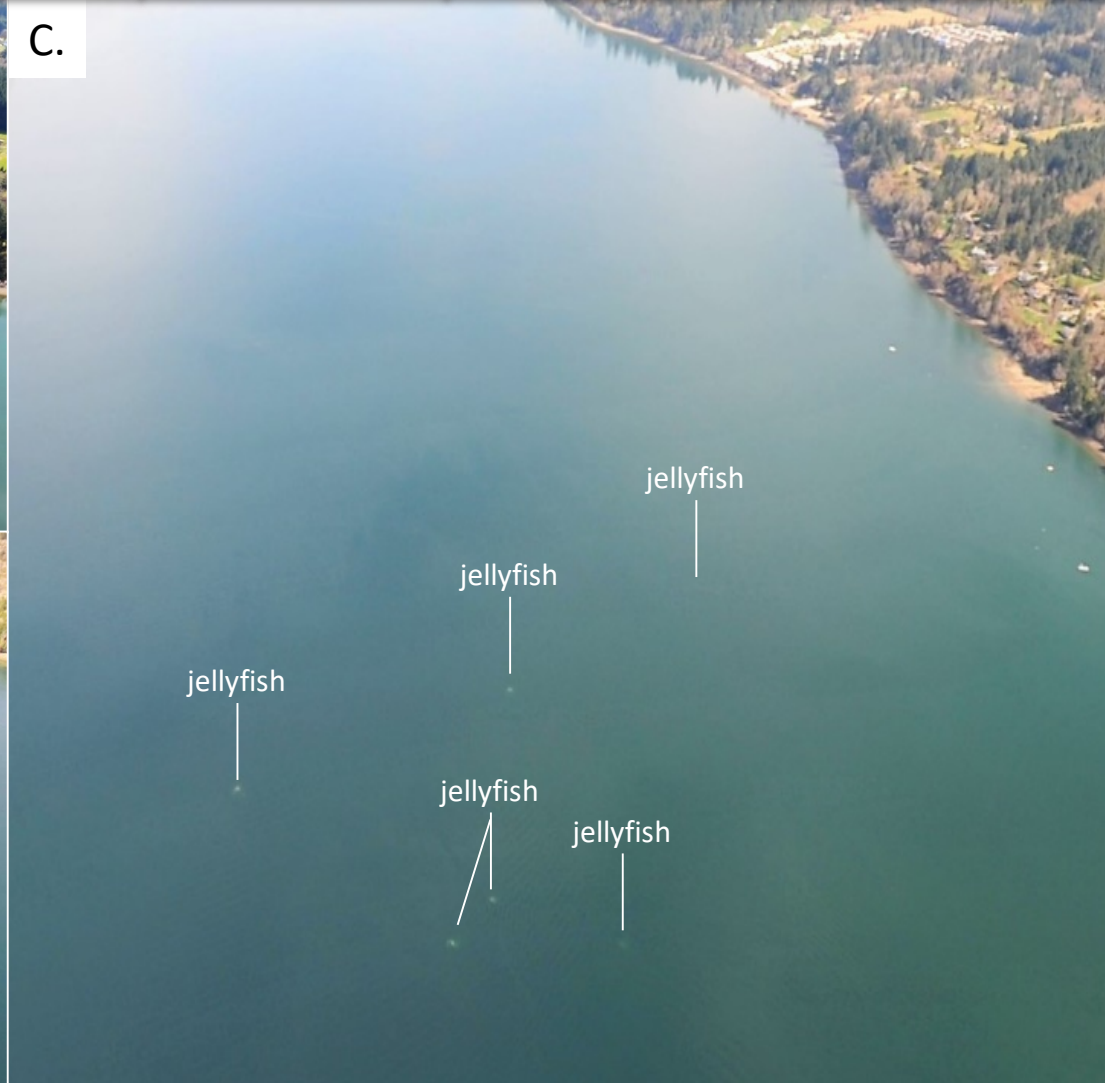
Marine water

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C.



A. Organic material patch. B and C. small but numerous patches of jellyfish on west (B) and east side of Inlet.  
Location: Budd Inlet (South Sound), 11:57 AM



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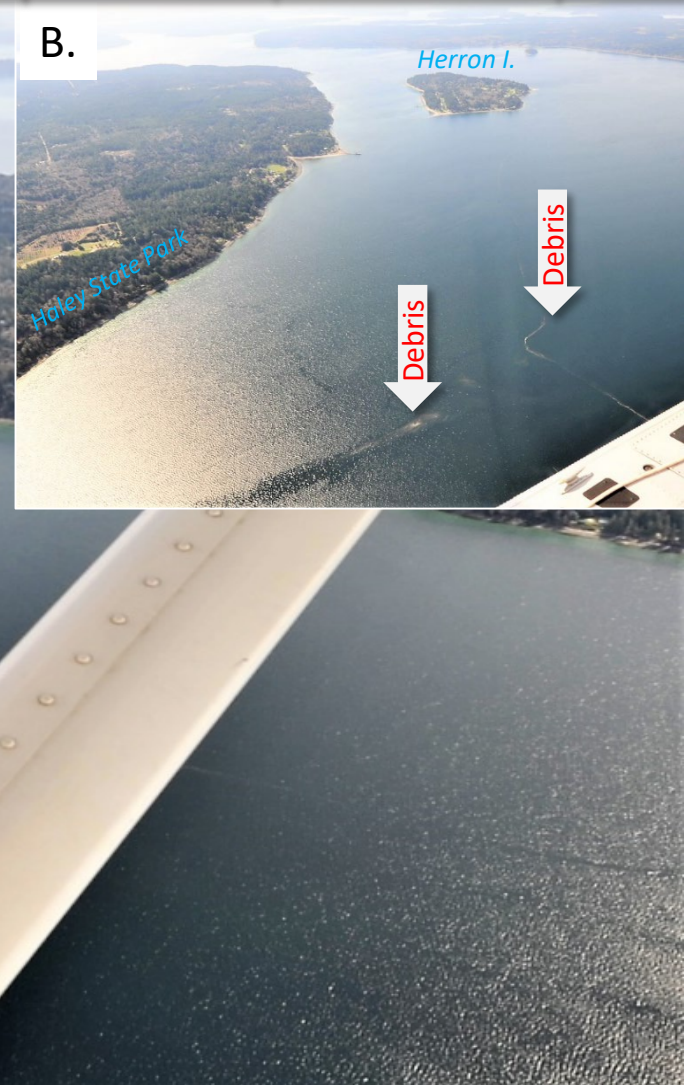
Aerial photos

Data

A.



B.



*Front with organic debris accumulations and big patch of organic material.*  
Location: Off Haley State Park, Case Inlet (South Sound), 12:25 PM





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*Suspended sediment nearshore.*

Location: West Port Madison Nature Reserve, Port Madison (Central Sound), 12:47 PM





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*Patches of jellyfish.* Location: Sinclair Inlet (Central Sound), 12:35 PM





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*Internal waves running northward (right) in Saratoga Passage. The interaction with the surface makes them visible.*  
Location: Near Anderson Cave (Whidbey Basin), 1:11 PM





Summary

Herring &amp; planes

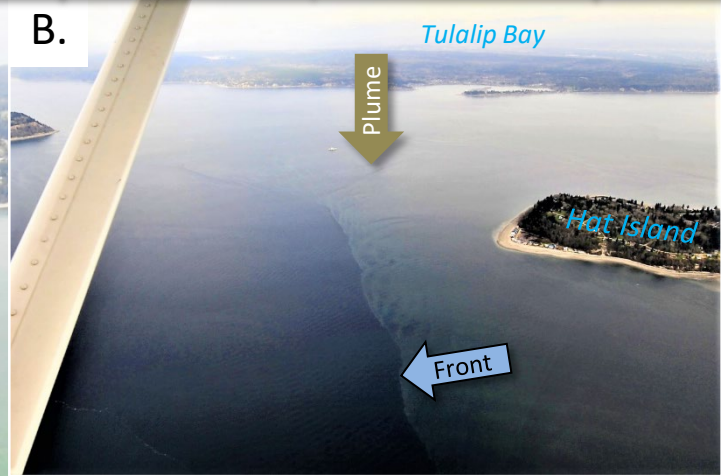
Climate &amp; streams

Combined factors

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A. Stillaguamish River plume with bloom of phytoplankton. B. Water with sediment and bloom flowing from Port Susan into Possession Sound. Location: A. Saratoga Passage, B. Hat Island (Whidbey Basin), 1:02 PM





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WHIDBEY ISLAND, Wash. -- A large mudslide took out part of a steep hill on the southeastern shore of Whidbey Island on January 15<sup>th</sup>, 2021. The slide was reported just north of the end of Possession Beach Walk, and just missed a row of homes perched on the shoreline.

[Watch video](#) (KOMONEWS) [Watch video](#) (King5 News)



*Remnants of the mudslide in January are still visible and leave a trail of sediment during the incoming tide.*

Location: Whidbey Island (Central Sound), 12:58 PM





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Sediment-rich water of the Stillaguamish River flowing both into A. & B. Port Susan and C. & D. Skagit Bay.  
Location: Camano Island (Whidbey Basin), 1:16 PM





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B.



A. Rain and flooded fields carry much sediment into local drainage channels that B. enter Swinomish Channel.  
Location: La Conner (Swinomish Reservation), 1:23 PM





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*Dense gold-olive green-colored diatom mats form in the shallows of the southern reaches of Padilla Bay.*

Location: Padilla Bay (North Sound), 1:26 PM





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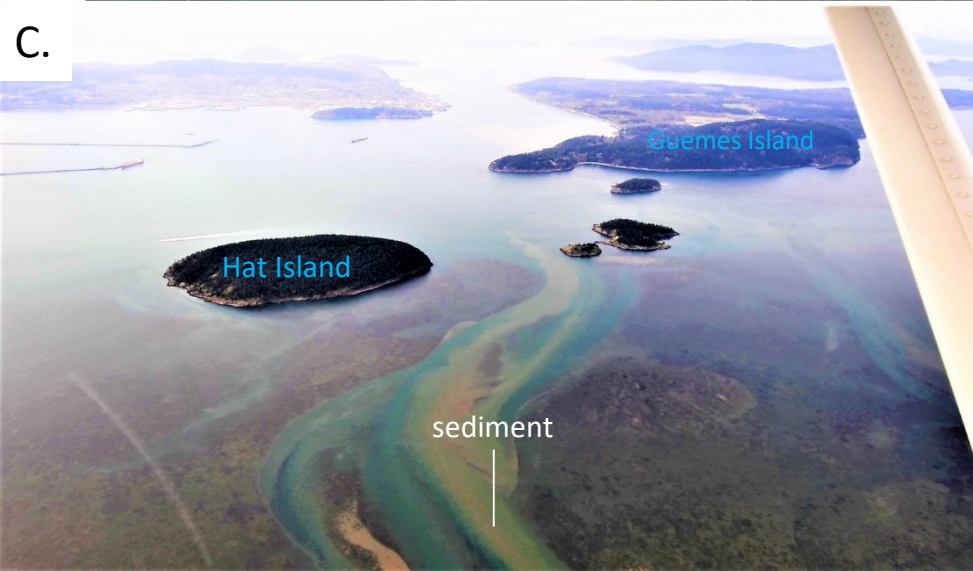
Climate &amp; streams

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*Eelgrass beds of Padilla Bay. A. Tidal gully carrying whitish material (likely not sediment). B. Joe Leary Slough with sediment C. traveling past Hat Island. D. Patches devoid of eelgrass. Location: Padilla Bay (North Sound), 1:27 PM*





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Nooksack River plume with suspended sediment. A. From a distance. B. Close-up showing fine structure of sediment entering the bay. Location: Bellingham Bay (North Sound), 1:36 PM





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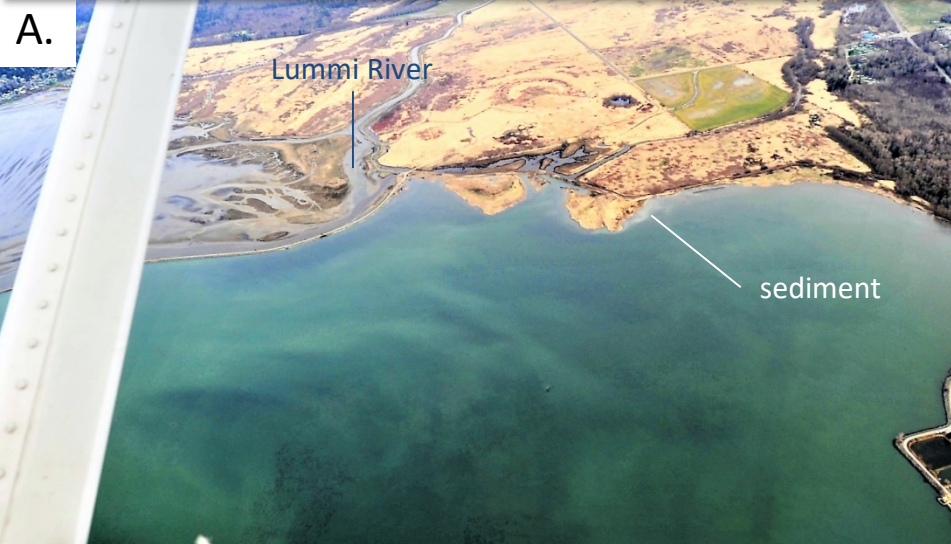
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A. Lummi Bay with Lummi River delta, B. diked aquatic enclosure, and C. marina. D. Near-shore suspended sediment. Location: A.-C. Lummi Bay, D. Cherry Point (North Sound), 1:39 PM





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A.



B.



C.



*Birch Bay with A. suspended sediment forming over the shallows on low tide, B. front separating different water masses, C. Terrel Creek discharging brown water. Location: Birch Bay (North Sound), 1:46 PM*





Summary

Herring &amp; planes

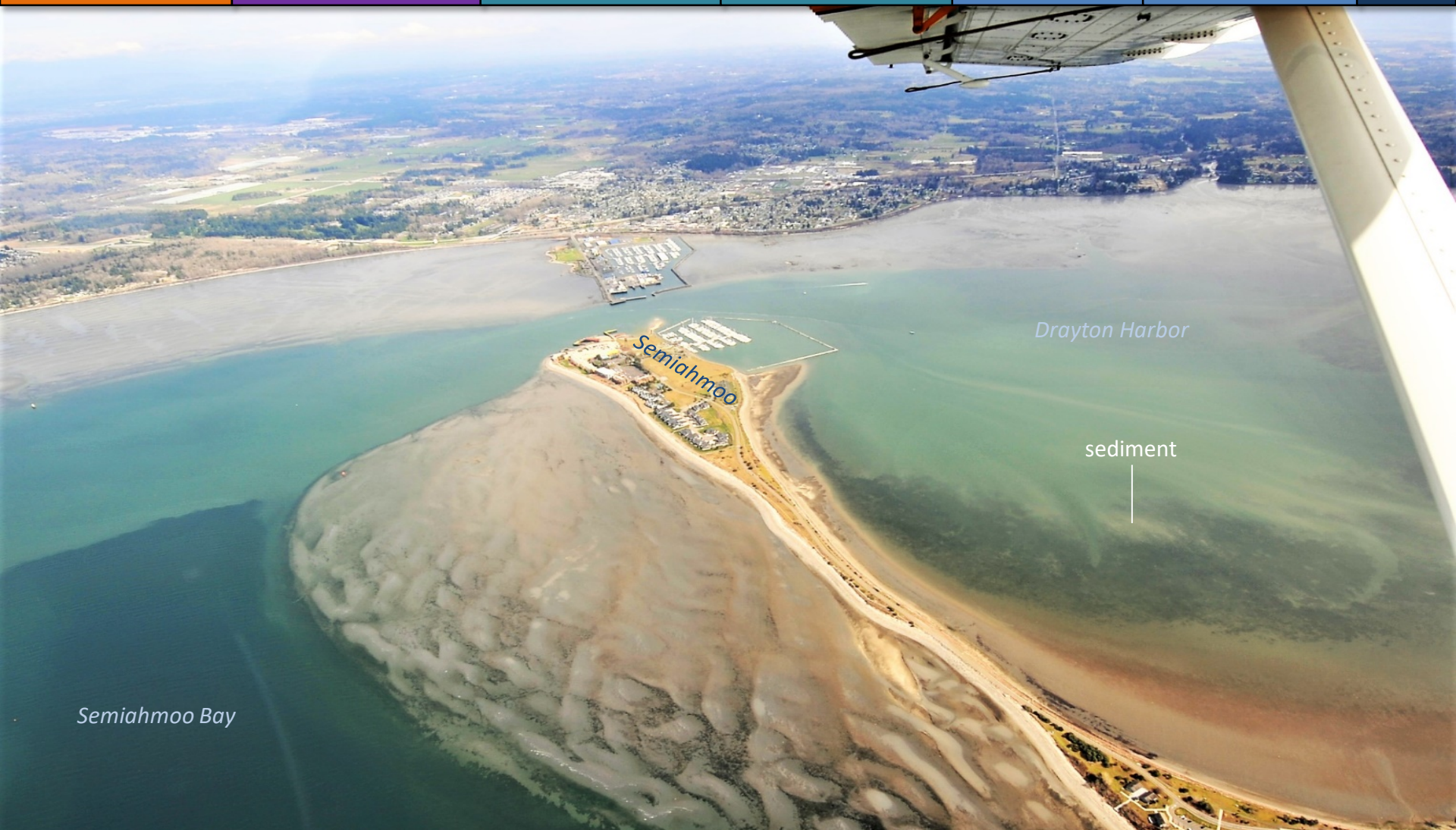
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*Seagrass in Semiahmoo Bay and suspended sediment forming in Drayton Harbor on low tide.*  
Location: Birch Bay (North Sound), 1:49 PM





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Blaine Harbor

*Blaine Harbor at low tide.*

Location: Drayton Harbor (North Sound), 1:48 PM





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*Sediment shows circulation pattern of sediment-rich water through Echo Bay.*

Location: Sucia Island (San Juan Islands), 1:58 PM





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*Sediment shows circulation pattern of sediment-rich water mixing south of Matia Island.*

Location: Matia Island (San Juan Islands), 1:58 PM





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*Beginning of a spring bloom in Westcott Bay.  
Location: Westcott Bay, Roche Harbor (San Juan Island), 2:09 PM*





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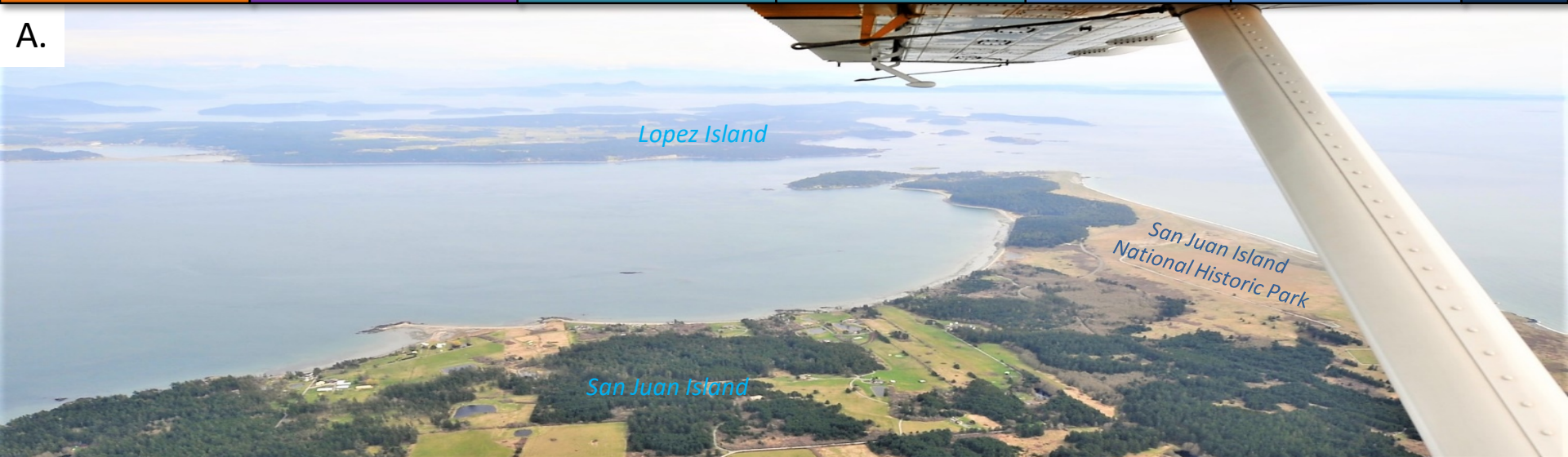
Combined factors

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A.



B.



A. View of San Juan Island and Lopez Island. B. View of False Bay and Haro Strait, San Juan Island.  
Location: San Juan Island (San Juan Islands), 2:14 PM





Summary

Herring &amp; planes

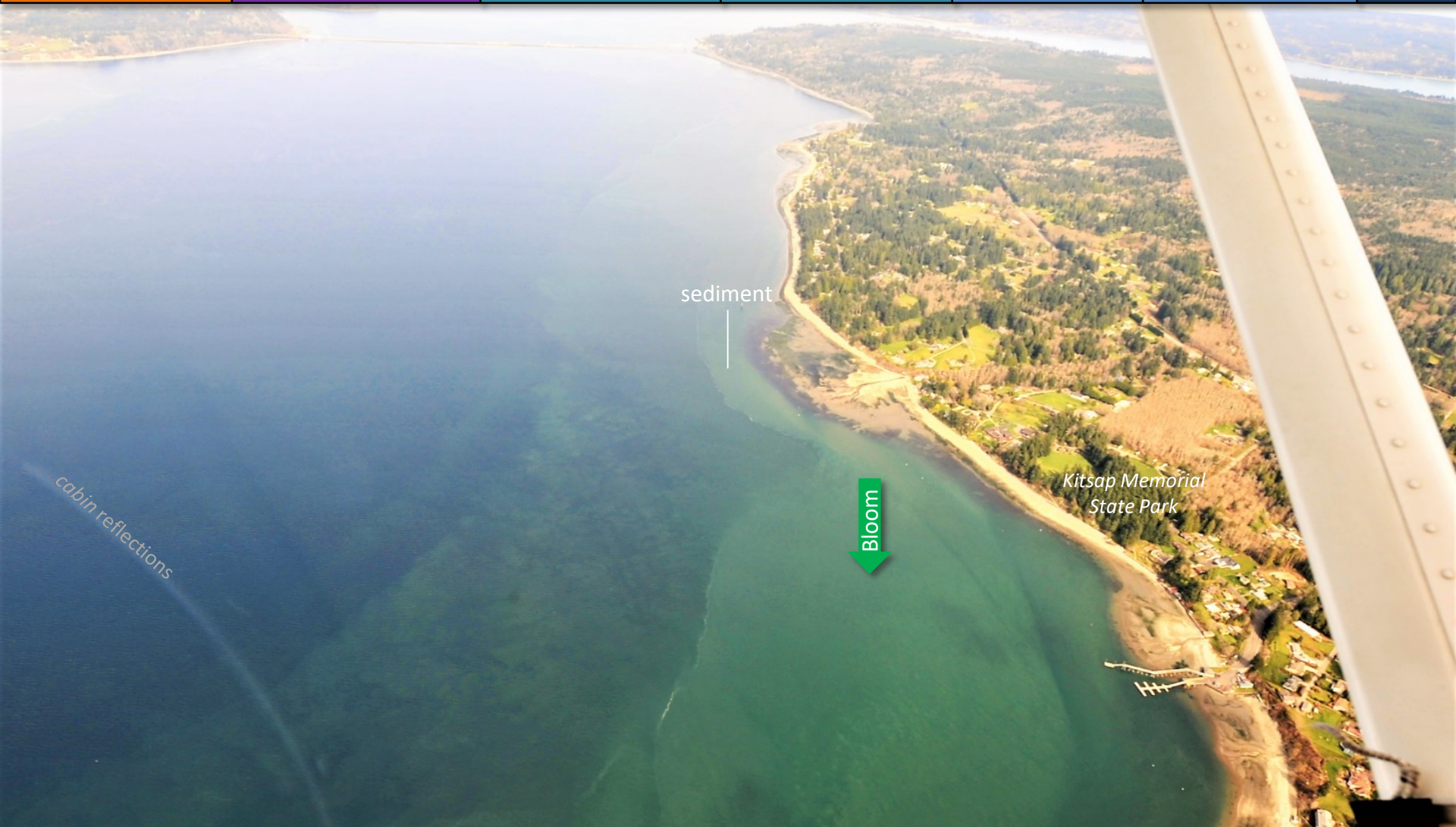
Climate &amp; streams

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*Sediment-rich water with bloom showing current pattern and mixing.*

Location: Northern Hood Canal (Hood Canal), 2:42 PM





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A. Suspended sediment east of Ballard bridge. B. Oil Sheen amongst boats of North West Dock.  
Location: Salmon Bay, Seattle (Central Sound) 2:51 PM





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Populated bays do not show strong blooming activity. A. Rosendale, B. Horsehead Bay, C. Gig Harbor, D. Quartermaster Harbor. Location: Southern Kitsap Peninsula and Vashon Island (South and Central Sound), 3:32 PM





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*Suspended sediment nearshore, likely in association with human activity.*

Location: Squaxin Island (South Sound), 3:42 PM





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*Red-brown bloom and suspended sediment.*  
Location: Budd Inlet (South Sound), 3:48 PM





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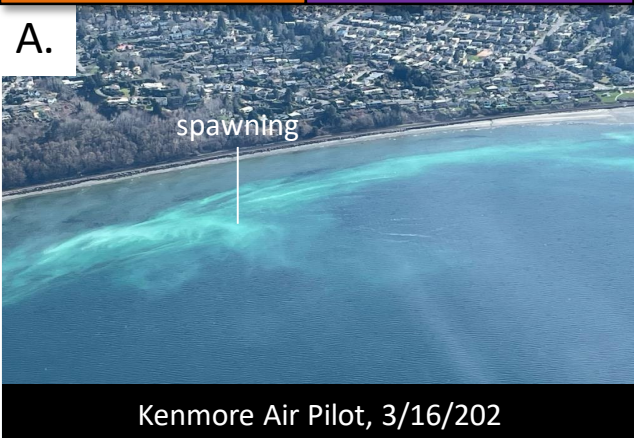
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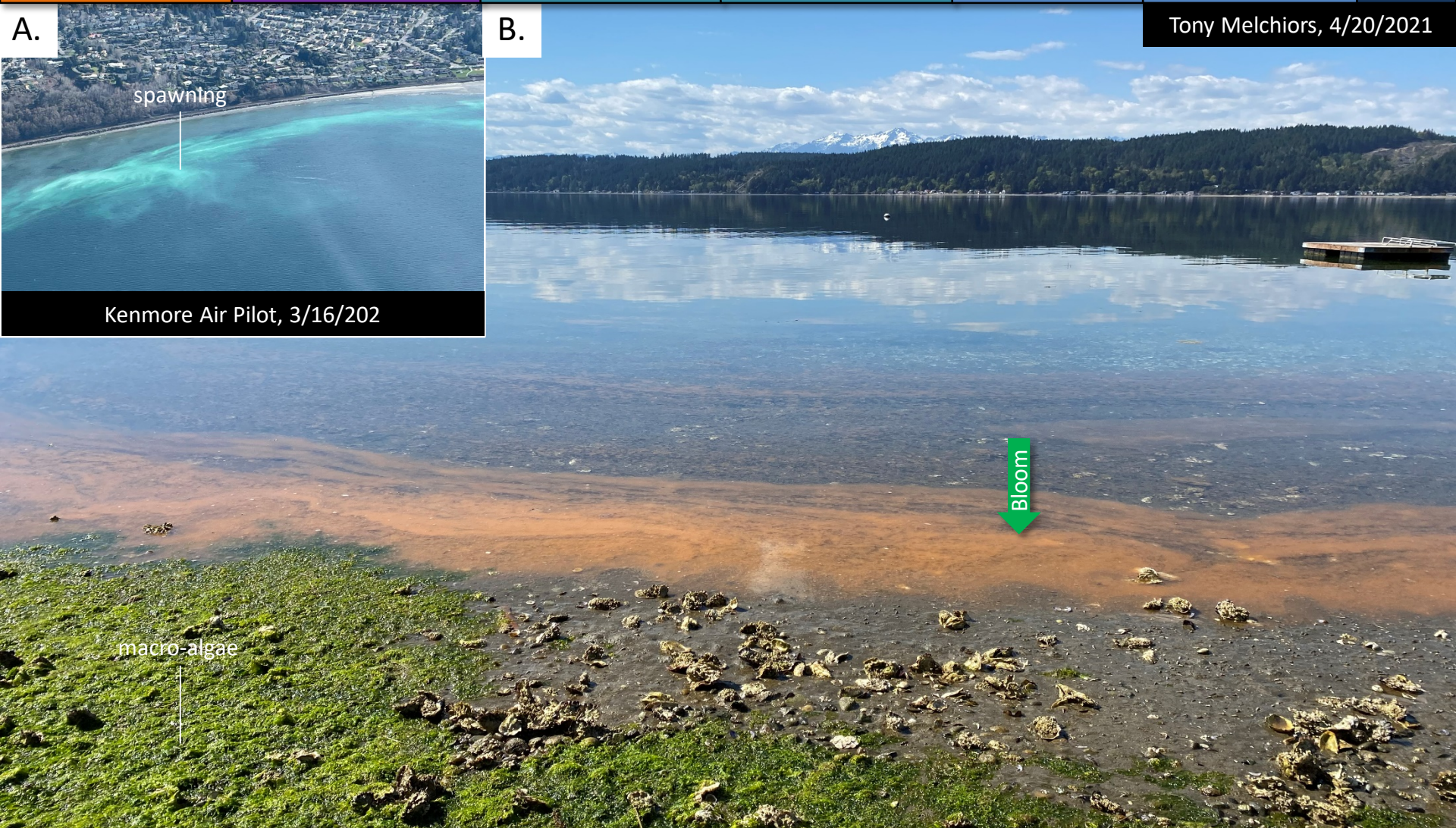
Data

A.



Kenmore Air Pilot, 3/16/202

B.



A. Spawning herring, off Carkeek Park, Seattle. B. Nearshore Noctiluca bloom and macroalgae, NE between Belfair and Union.





# Help us cover important events in Puget Sound



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## iNaturalist



Help us to document important environmental events and places on Puget Sound's waters and beaches.

Jellyfish



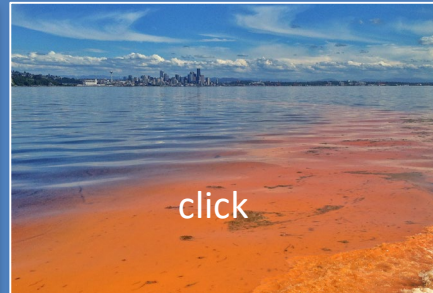
click

Algal blooms



click

*Noctiluca* blooms



click

Macro-algae



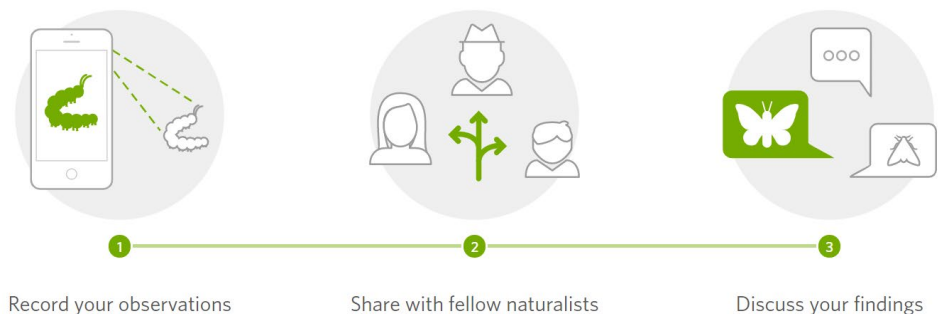
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Click on the images above what you want to report

[A Community for Naturalists,](#)  
[Eyes Over Puget Sound](#)

Start reporting observations and share them with with us.

How It Works





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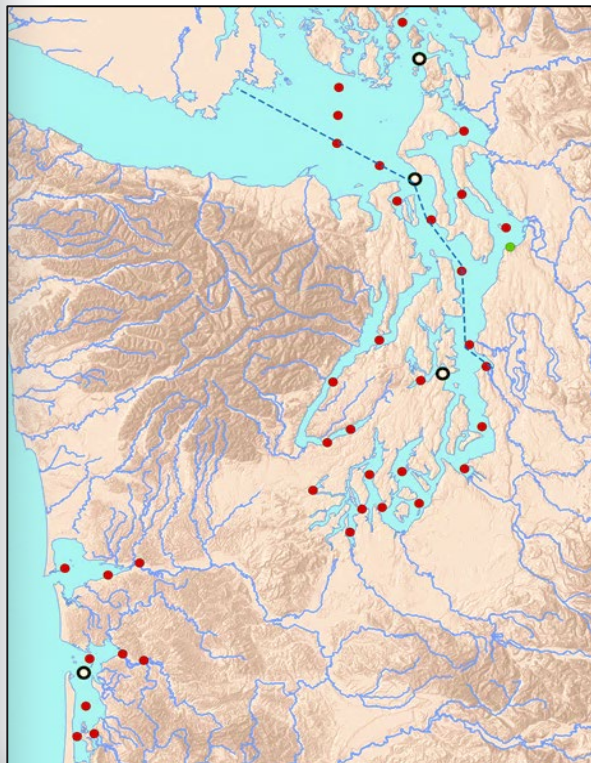
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## Long-term monitoring data from Puget Sound and Coastal Bays

- 39 stations sampled monthly
- 16 physical, chemical, biogeochemical parameters
- data from 1999-present





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**We have published 92 editions!**

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

**Recommended Citation (example for September 2018 edition):**

Washington State Department of Ecology. 2018. Eyes Over Puget Sound: Surface Conditions Report, September 17, 2018. Publication No. 18-03-075. Olympia, WA.  
<https://fortress.wa.gov/ecy/publications/documents/1803075.pdf>.



Many thanks to our business partners:  
Shannon Point Marine Lab (WWU), Swantown  
Marina, and Kenmore Air.

**Contact:**

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Environmental Assessment Program  
Washington State  
Department of Ecology

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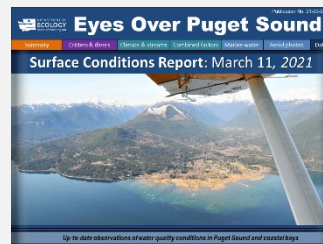
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June\_17\_2021  
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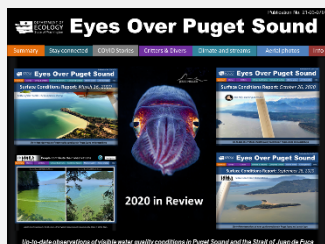
April\_1\_2021  
[Publication No. 21-03-073](#)



March\_11\_2021  
[Publication No. 21-03-072](#)



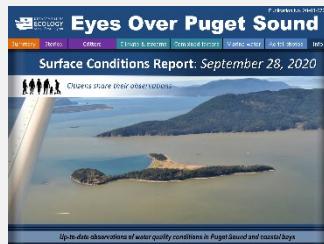
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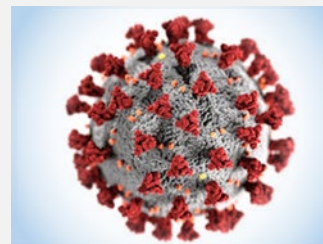
January\_14\_2021  
[Publication No. 21-03-070](#)



October\_26\_2020,  
[Publication No. 20-03-073](#)



September\_28\_2020,  
[Publication No. 20-03-072](#)



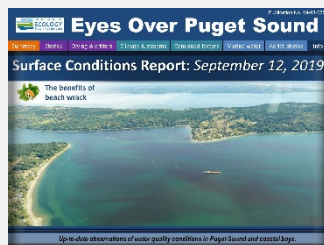
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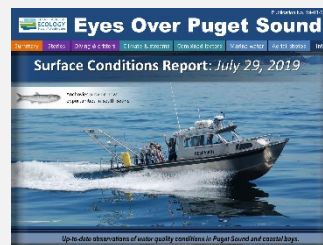
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October\_30\_2019,  
[Publication No. 19-03-076](#)



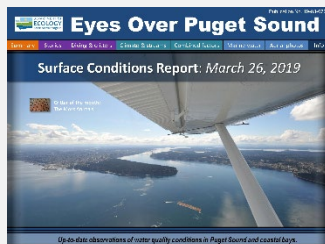
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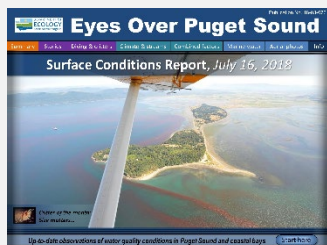


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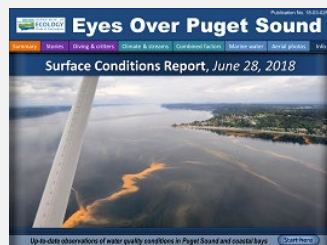


September\_17\_2018,  
[Publication No. 18-03-074](#)





**July\_16\_2018,**  
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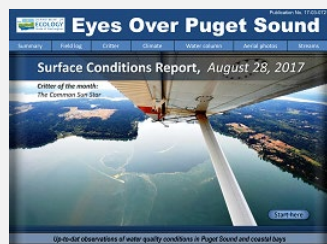
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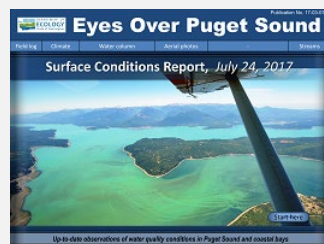
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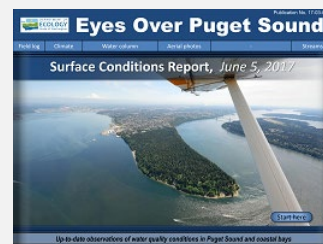
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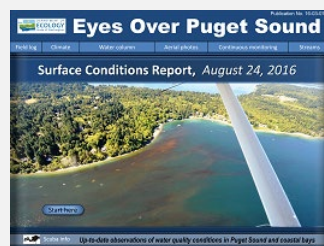
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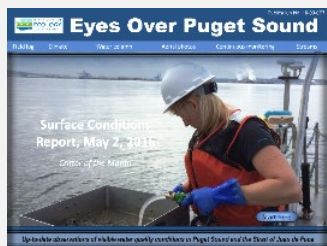
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**March\_16\_2016,**  
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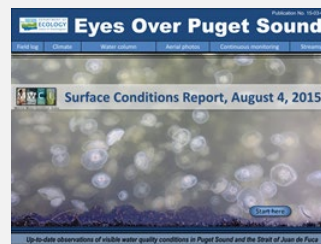
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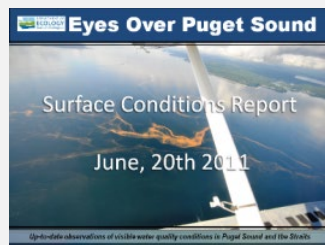
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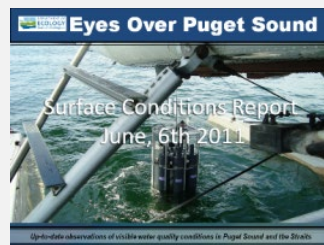
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