Publication No. 21-03-072

DEPARTMENT OF ECOLOGY
State of Washington

Eyes Over Puget Sound

Surface Conditions Report: March 11, 2021

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

Summary conditions at a glance

LONG-TERM MARINE MONITORING UNIT

Picture by: Jesse Miller

Margaret Dutch

Secrets of the Dead, p. 3

Leftover Mud Helps Recreate Puget Sound's Past.

Tyler Burks, Skip Albertson

Climate & streams, p. 6-10

We are in a weakening La Niña. February was cold and wet and rivers washed sediments into Puget Sound. In March, rivers are running near normal and carry clear water. At the coast downwelling has stopped.

Thank you to many

People send their observations, p. 4. 43

Divers share their amazing pictures in the waters of Puget Sound. It's a good time to go diving.

Dr. Christopher Krembs

The Aerial photography, p. 13-42

From mystery clouds of sediment to oil sheens. In the season of coldest water temperatures the productive season has already started and patches of jellyfish patches are visible.

Editor: Dr. Christopher Krembs, editorial assistance: Valerie Partridge, Elisa Rauschl.

Secrets of the Dead: Leftover Mud Helps Recreate Puget Sound's Past

Maggie Dutch
Marine Sediment Monitoring Team

One program's trash is another's treasure…

Normally when our team sorts all the animals out of our mud samples, the leftovers go into the waste bin. But now, paleontologist Dr. Sue Kidwell and her students from the University of Chicago are using dead shells sorted from this material - known as "grunge" – to see what benthic communities might have been like in Puget Sound many years ago, and what ecosystem pressures transformed these ancient assemblages into what we see today.

Leftovers from a Budd Inlet sample contain many dead shell fragments

PhD candidate Broc Kokesh sorts and IDs the dead shells

Next step: compare the "dead" shell data with Ecology's "live" data

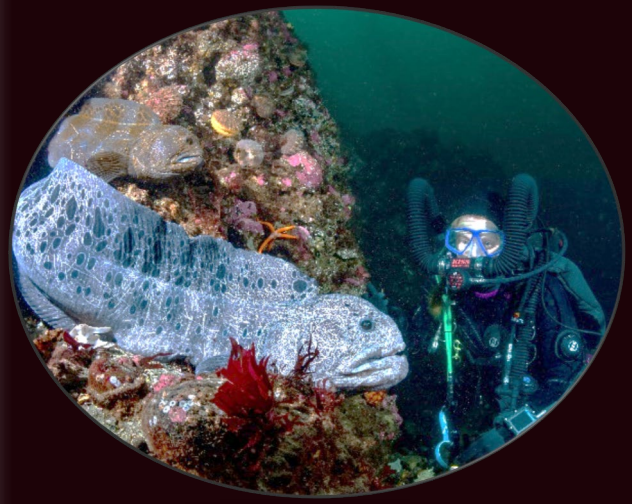
Learn more about this project on Ecology's EcoConnect blog, click here

Eyes on underwater species in Puget Sound 3-11-2021

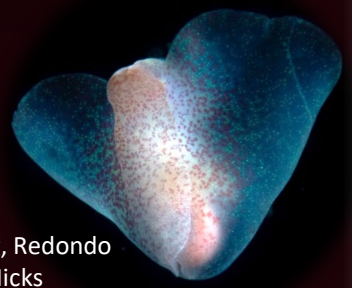
SCUBA divers in Puget Sound often encounter amazing creatures that few of us get to enjoy. Local divers shared their photos with us.

Fish-eating anemone, Strait of Juan de Fuca
By Eric Askilsrud

Candy striped shrimp, Anacortes
By Jessica Alexanderson



Wolf eel pair and diver, Gig Harbor
By Dave Hicks



Winged sea slug, Redondo
By Dave Hicks

Giant Pacific octopus, Redondo
By George Duncan

Email erau461@ecy.wa.gov if you'd like to contribute dive photos

What was the water visibility like for divers?

Only best visibility shown for **February**, in form of a small diver

Good **Visibility** Poor

Best and worst horizontal visibility at corresponding vertical depth

Location	Best Visibility		Worst Visibility	
	Horizontal Distance (ft.)	Vertical Depth (ft.)	Horizontal Distance (ft.)	Vertical Depth (ft.)
1	21	13	15	69
2	10	25	4	3
3	17	97	16	10
4	19	3	17	87
5	25	74	8	5
6	29	80	6	3
7	15	30	8	51
8	44	61	26	15
9	30	80	15	5
10	29	25	12	98
11	22	61	3	7
12	8	28	2	2
13	26	85	10	7
14	27	94	19	7
15	21	31	16	44

Find depths with high/low visibility

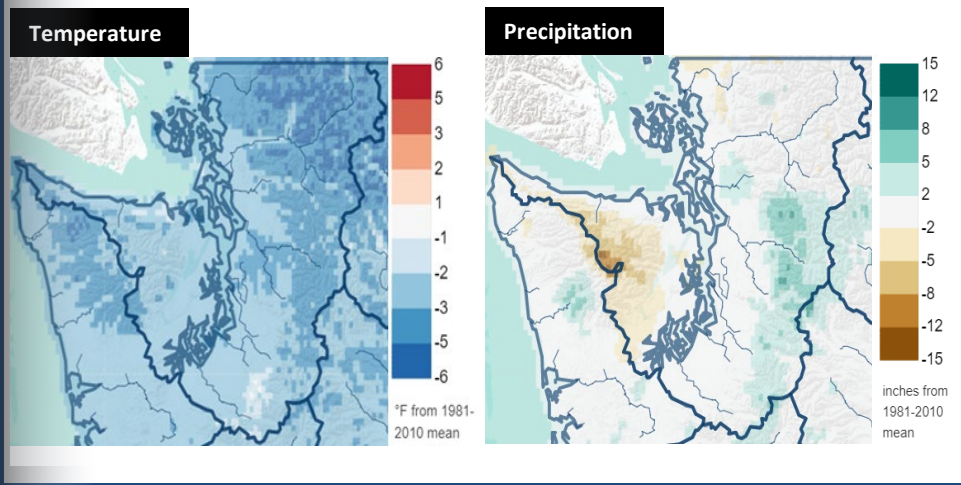
- **Best visibility** occurred in Hood Canal near Octopus Hole at around 60 ft (Location 8).
- **Poor visibility (not indicated)** occurred in Oakland Bay near Shelton.

Picture by Eric Askilsrud

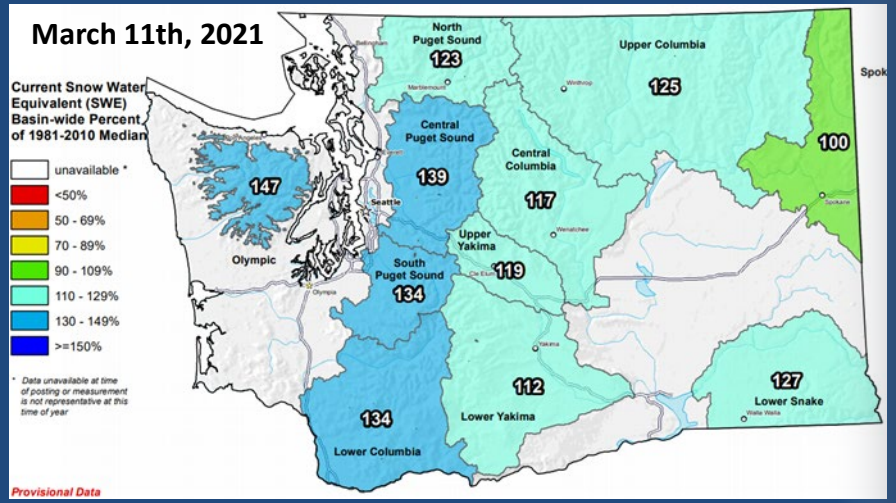
How much water and snow did we get and will it stick?

During the previous 30 days, Puget Sound air temperatures were below normal, while precipitation was generally near normal, with some spatial variation (A). With three weeks of snowpack accumulation remaining, watersheds that drain to Puget Sound hold above-normal volumes (B). Monitoring snowpack and temperature trends will be critical as we transition to spring.

A. Northwest Climate Toolbox



B. Washington SNOTEL, USDA/NRCS



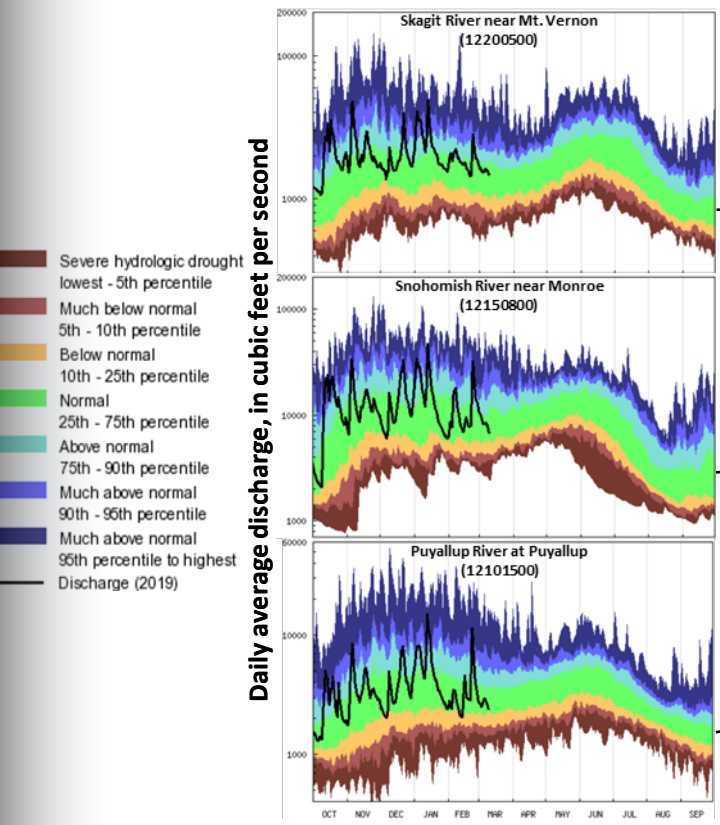
[Temperature Anomaly](#) from historical mean daily ranged from 0 to -6 °F in the Puget Sound region during the past 30 days.

[Precipitation Anomaly](#) from historical mean ranged from -12 to +12 inches in the Puget Sound region during the past 30 days.

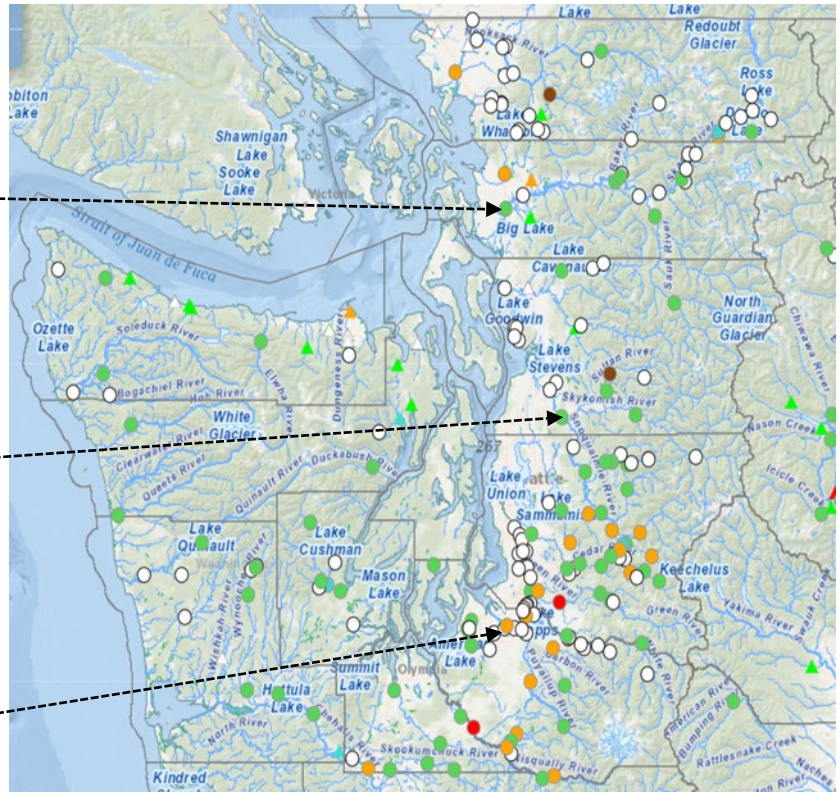
[Snow water equivalent](#) percent of median for watersheds draining to Puget Sound are above normal. As we move towards the typical peak of seasonal snowpack accumulation, April 1st, snow water equivalents are at 136% of the historical median.

Temporal: Following a series of precipitation events, including lowland snow, a dry period resulted in a return to normal freshwater inputs from major Puget Sound rivers to Puget Sound (trend charts, left).
Spatial: Geographic variation in streamflow (map, right) is dependent on the distribution of precipitation, and likely the low temperatures, leading to normal and below-normal conditions.

Select Puget Sound Streamflow Trends



Current Streamflow Conditions as of 03/11/2021



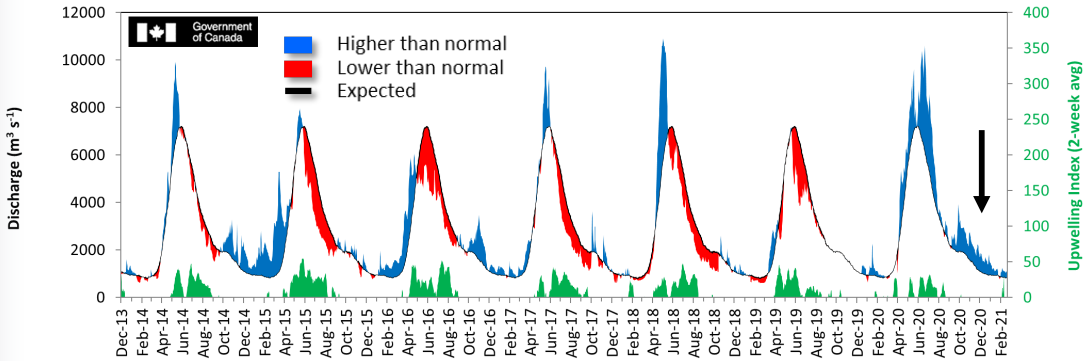
USGS WaterWatch: CLICK HERE!

Current conditions: CLICK HERE!

Climate : How well is the Salish Sea exchanging its water?

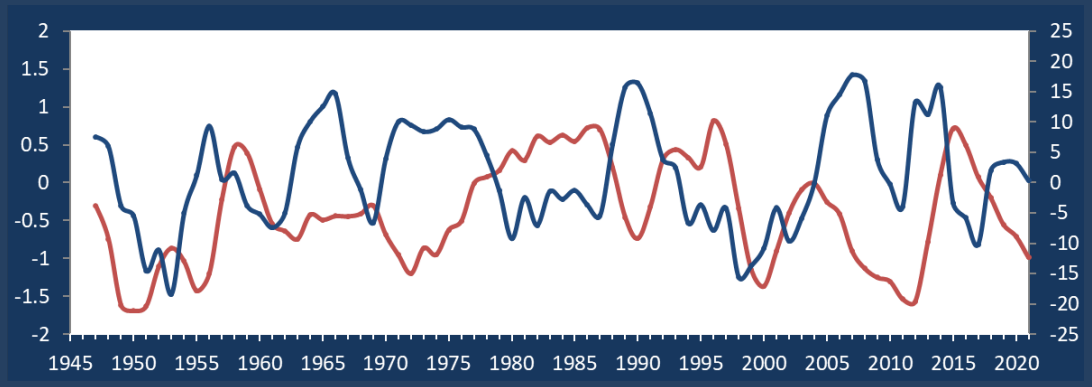
Historically, the peaks of coastal upwelling and the freshet are in sync..

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, Upwelling, and NPGO Indices



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

Water has gradually cooled (PDO). Upwelling (Upwelling Index anomaly) is expected.

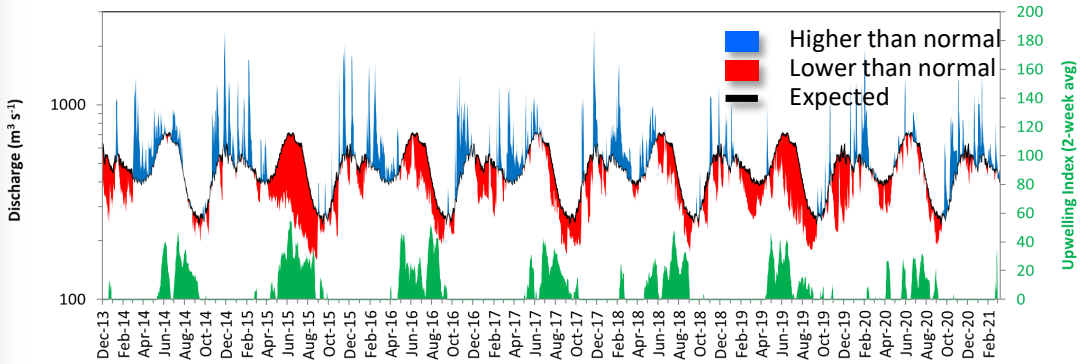
*Pacific Decadal Oscillation Index (**PDO, temperature**, explanation).*

*Upwelling Index (anomalies) (**Upwelling, low oxygen**, explanation).*

Climate: How well is Puget Sound exchanging its water?

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

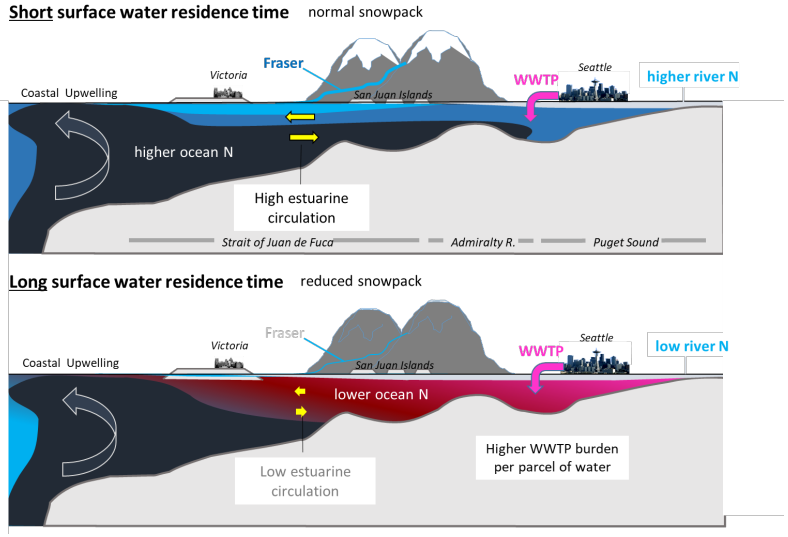
Skagit River (at midnight USGS)



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).

Combined factors influencing water quality

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. For recent river and stream inflow, see page 6.

Conditions leading up to March:

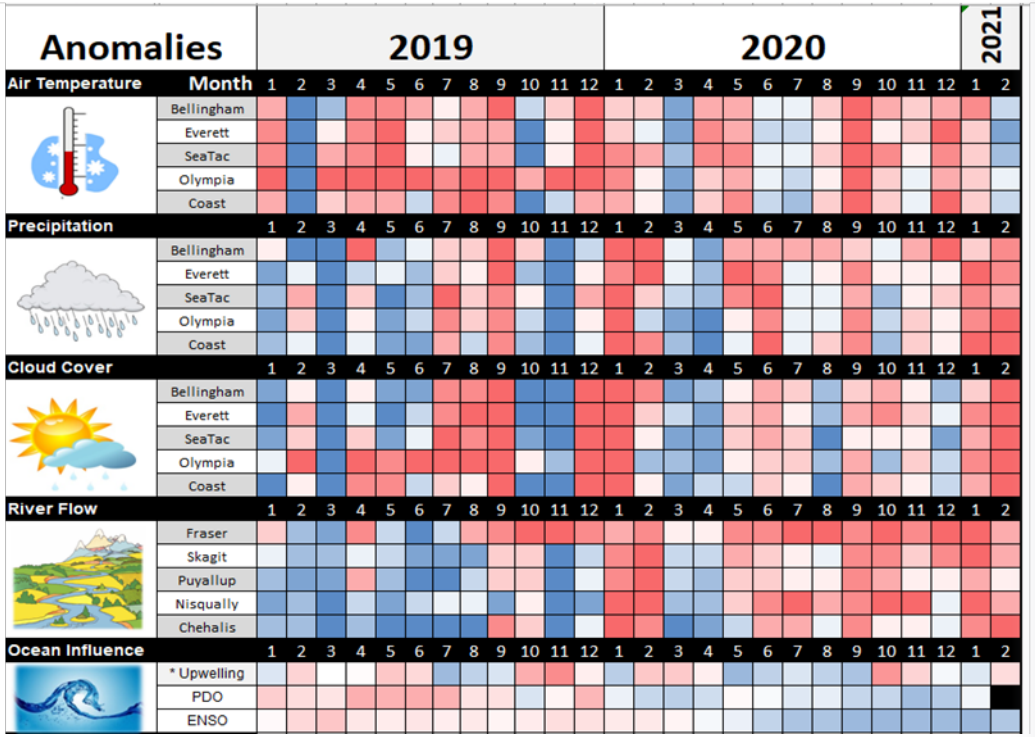
Air temperatures were generally warmer this winter, but February was cold.

Precipitation has been above normal after October.

Cloud cover levels were slightly above normal, generally being closer to normal in 2020 than in 2019.

River flows have remained higher than normal for most of the past year.

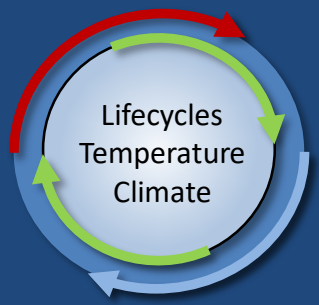
Downwelling was less pronounced in February. PDO is lower and La Niña remains.



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



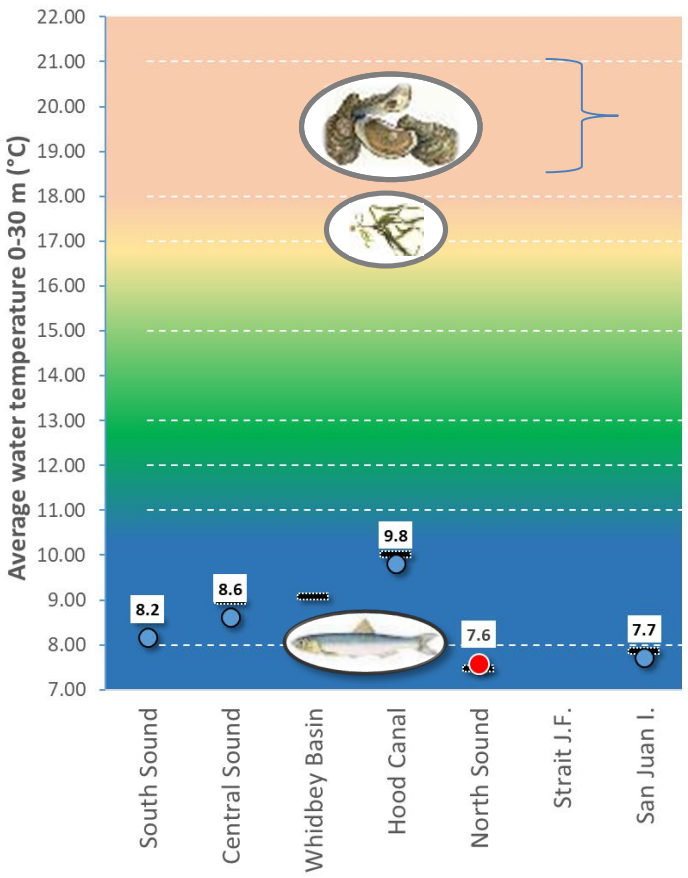
Can organisms thrive and survive?

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, average surface water (0 – 30 m) temperatures were slightly below expected across many regions. Water temperatures were in ranges for spawning for herring, but were reaching minimum survival temperature for anchovies of about 8.2 °C in South Sound, North Sound, and the San Juan Islands. Coldest water temperatures in North Sound are approaching 7.6 °C. Hood Canal could be a thermal refuge as it is still above 9 °C.



Optimal temperatures for Puget Sound organisms*

Oyster spawning range

Max temp for bull kelp and coho and Chinook salmon

Increase in HAB toxicity risk >15°C,
Dungeness crab egg production optimum

Anchovy spawning optimum
Herring and salmon growth optimum/
Herring spawning upper range 12°C
Geoduck growth optimum

Anchovy survival minimum

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

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

Stay plumbed into the the information stream…

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@lltk.org) or the Marine Waters Work Group (marinewaters@psemp.org).

What's the story so far?

Go to the webpage and read detailed discussion summaries.

DEPARTMENT OF ECOLOGY
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What were the conditions at the surface on 3-11-2021?

Southern Hood Canal and Southern inlets with organic debris. Jellyfish persist at yearly water temperature minima in finger inlets in South Sound and Sinclair Inlet. Oil sheen and wastewater diffuser plume are visible in North Sound. Rivers deliver clear water but biological activity creates localized plumes of suspended sediment in shallow areas. First blooms appear.

You have to love Portage Island, Bellingham Bay

Keeping an eye on False Bay this year, Friday Harbor

Start here

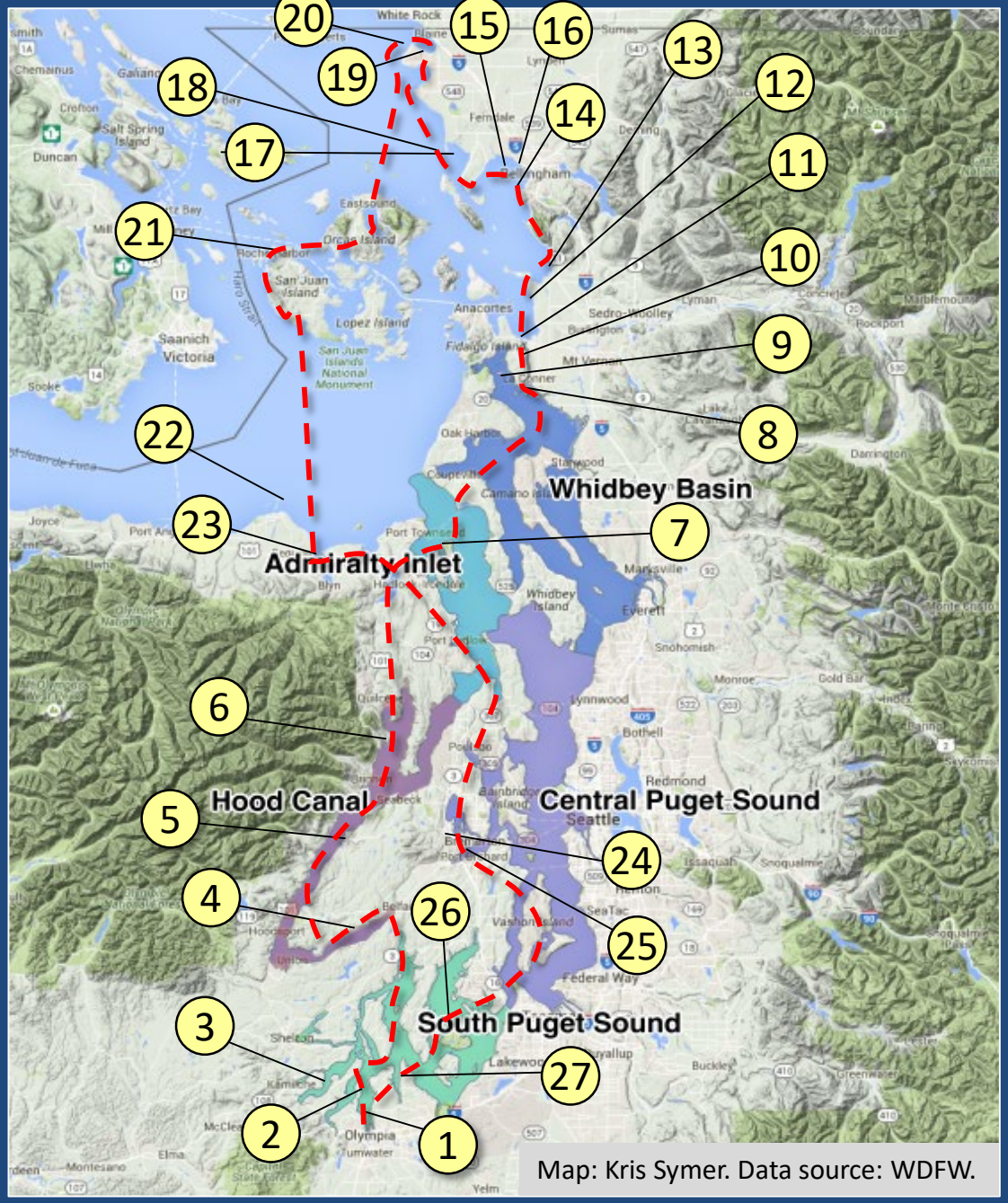
Mixing and fronts:
Tidal eddies around Hope Island; distinct tidal fronts north of Patos Island and off Marrowstone Point.

Jellyfish and fish:
Occasional patches of jellyfish in Sinclair Inlet, Budd Inlet Henderson Inlet, and Eld Inlet.

Suspended sediment:
Many places with suspended sediment in the nearshore with potential of biological origin. Brown plume in Birch Bay. Brown sediment plume in Joe Leary Slough.

Visible blooms:
Visible dark bloom in East Bay, Westcott Bay, and Southern Hood Canal. Green discoloration and signs of increased productivity in many places.

Debris:
Organic debris in Budd and Eld Inlets, southern and central Hood Canal.



DEPARTMENT OF ECOLOGY
State of Washington

Aerial navigation guide

Date: 3-11-2021

Click on numbers

Flight Observations

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

Contribute observations

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Tide data from 3-11-2021 (Seattle):

Time	Pred (ft)	High/Low
01:47 AM	8.03	H
07:52 AM	1.92	L
03:10 PM	11.25	H
09:39 PM	3.82	L

Connect aerial observation with data from ORCA moorings

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

[NANOOS NVS Data Explorer]

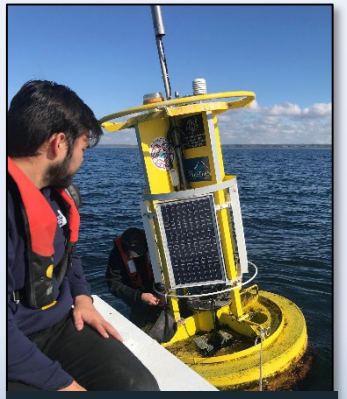
View products by mooring

Puget Sound

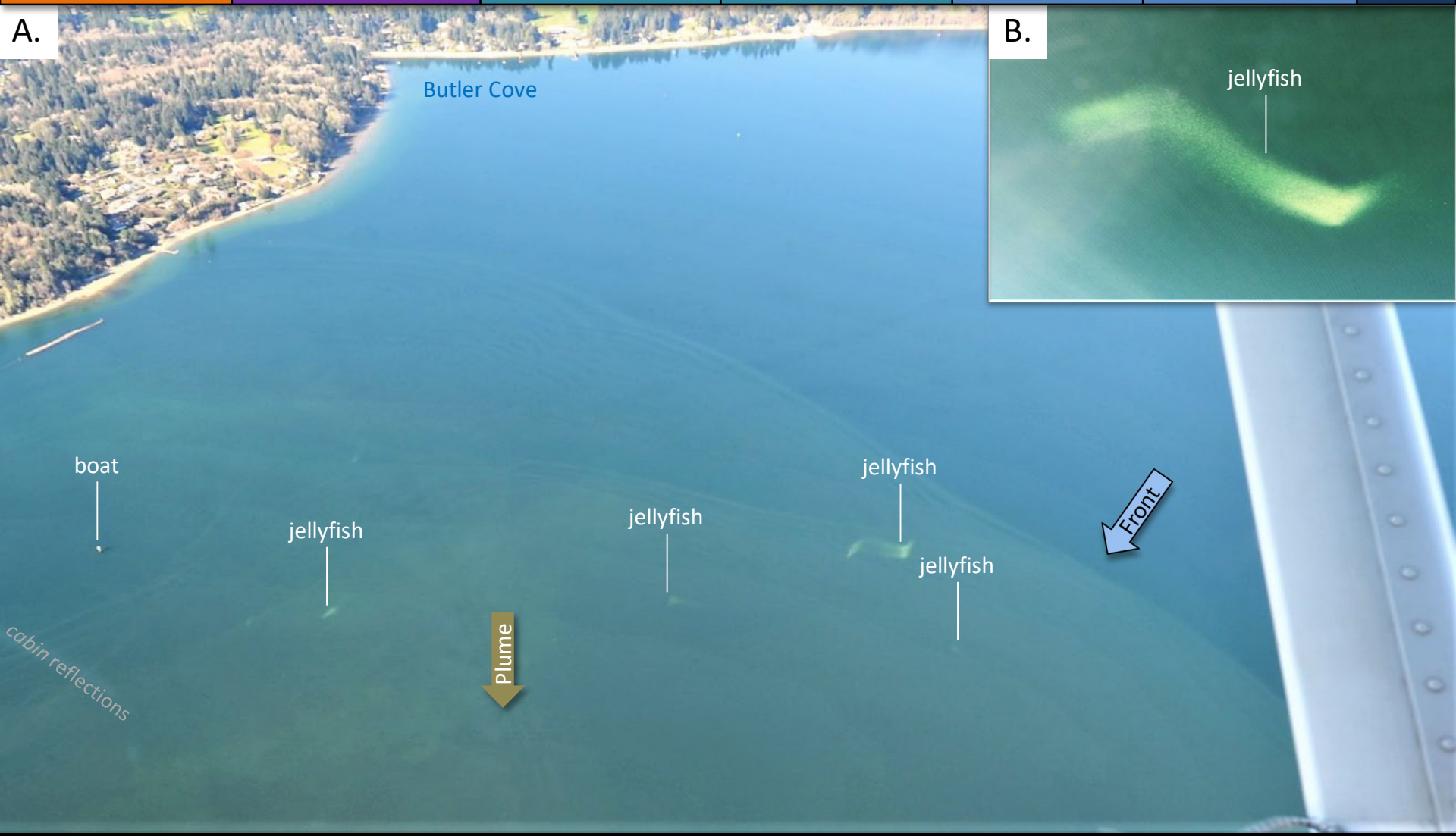
1. Carr Inlet
2. Dabob Bay
3. Hoodsport
4. Hansville
5. Point Wells
6. Twanoh

Salish Sea

7. Bellingham Bay



Thayne Yazzie, NWIC, Robert Daniels, UW/APL



A. Jellyfish patches in plume of the Deschutes River. B. Close-up of one patch, where it's possible to see individual animals. Location: Budd Inlet (South Sound), 11:23 AM

Aerial photography 3-11-2021

Distinct front with organic debris accumulating north of the front.

Location: Off Beverly Beach Dr. NW, Budd Inlet (South Sound), 11:25 AM

Aerial photography 3-11-2021

Suspended material from aquaculture activities
Location: Totten Inlet (South Sound), 11:30 AM

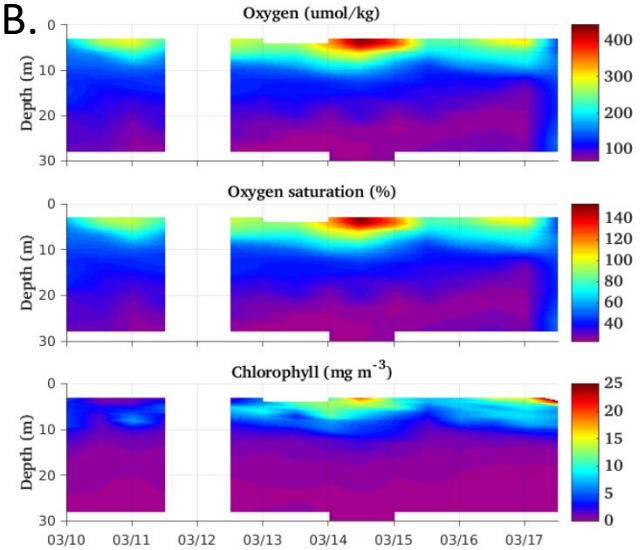
A.

Debris

Debris

cabin reflections

B.

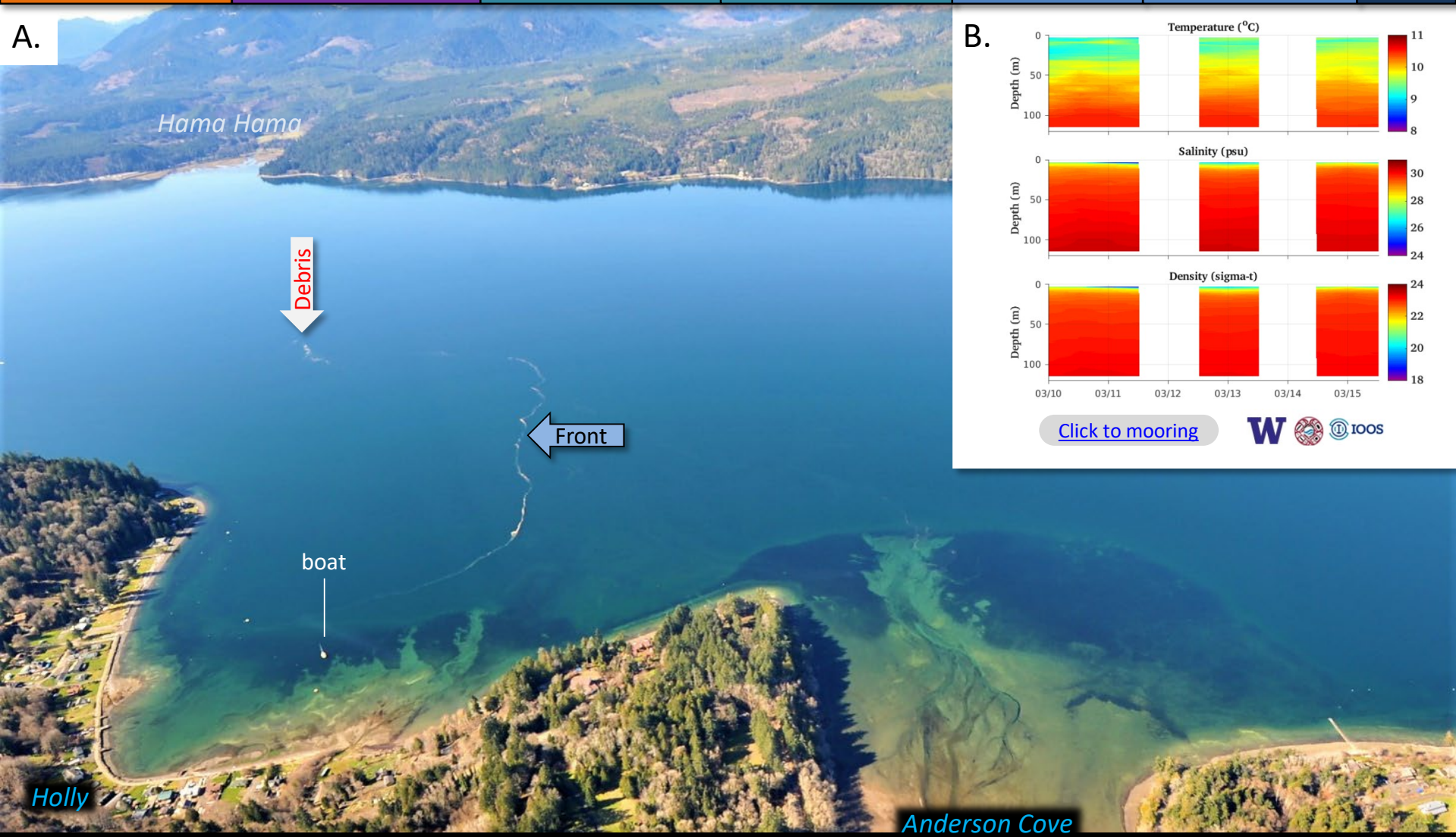


Click to mooring

IOOS

A. Large patches of organic surface debris following a bloom. B. Nearby ORCA mooring with coincident data.
Location: East of Twanoh State Park (southern Hood Canal), 11:49 AM

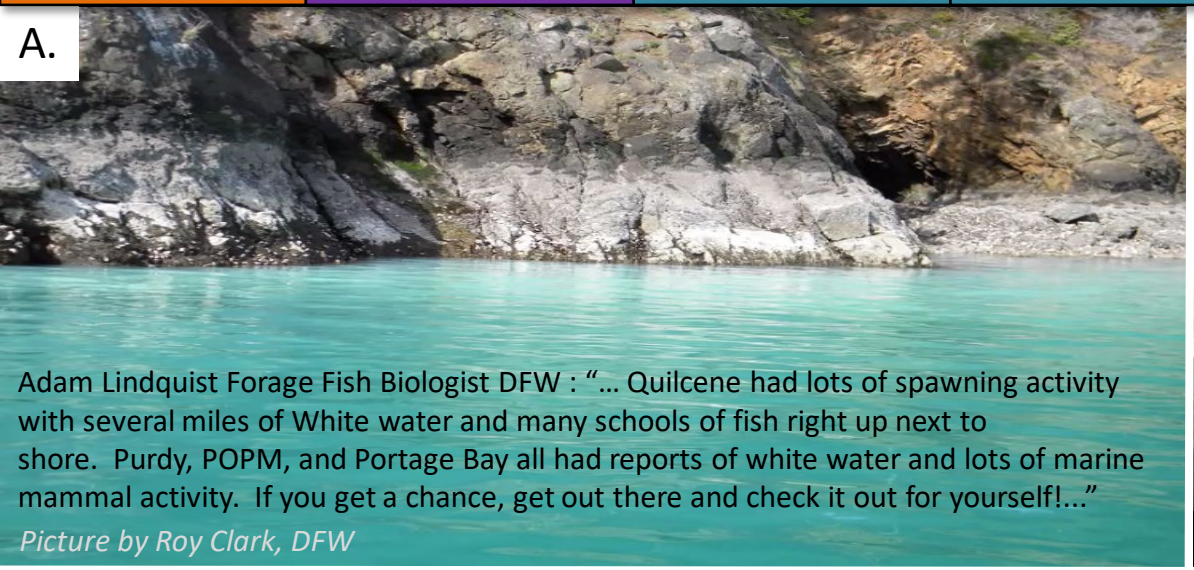
Aerial photography 3-11-2021



A. Organic surface debris following front. B. Nearby ORCA mooring with coincident data.
Location: Near Anderson Cave (central Hood Canal), 12:01 PM

Spawning herring on 3-17-2021

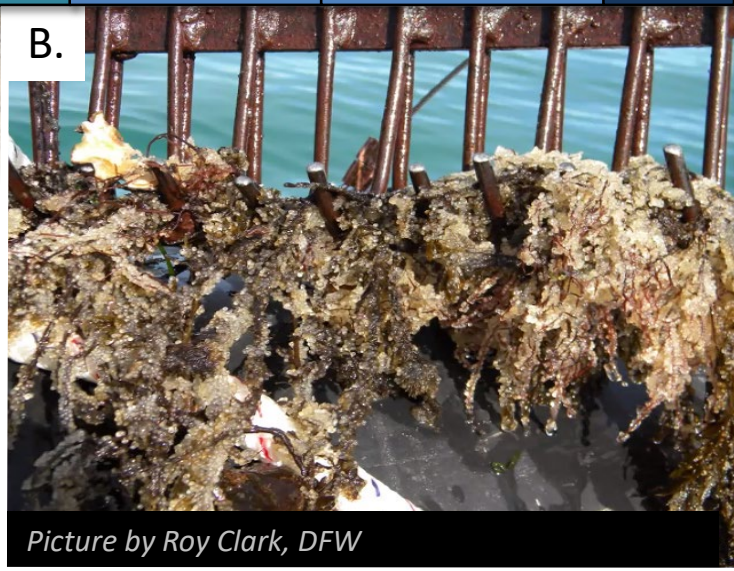
A.



Adam Lindquist Forage Fish Biologist DFW : "… Quilcene had lots of spawning activity with several miles of White water and many schools of fish right up next to shore. Purdy, POPM, and Portage Bay all had reports of white water and lots of marine mammal activity. If you get a chance, get out there and check it out for yourself!..."

Picture by Roy Clark, DFW

B.



Picture by Roy Clark, DFW

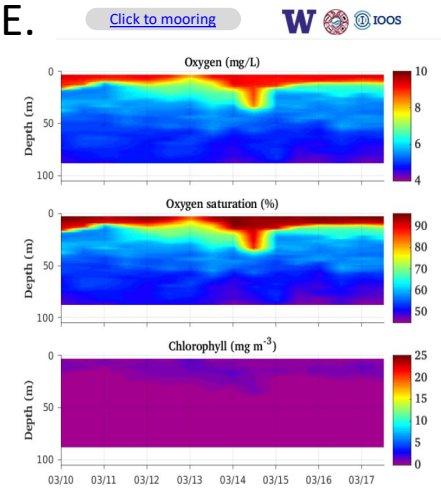
C.

Picture by Roy Clark, DFW

D.

Picture by Roy Clark, DFW

E.



Department of Fish and Wildlife reports: A-B. Quilcene herring spawning and eggs deposited on macro-algae between C-D. Jackson Cove and Pt Whitney. E. ORCA mooring data. Location: Quilcene Bay (Hood Canal)

Aerial photography 3-11-2021

Strong tidal currents at Marrowstone Point during an incoming tide.
Location: Marrowstone Island (Central Sound), 12:25 PM

Aerial photography 3-11-2021

Suspended sediment in the nearshore environment, likely biological in origin.

Location: North Fork of the Skagit River, Skagit Bay (Whidbey Basin), 12:48 PM

Aerial photography 3-11-2021

Tidal eddy with more turbid water forming south of Hope Island.
Location: Swinomish Reservation, Skagit Bay (Whidbey Island), 12:29 PM

Aerial photography 3-11-2021

Water can be very differently colored in this region depending on salinity, sediment load, and flow.

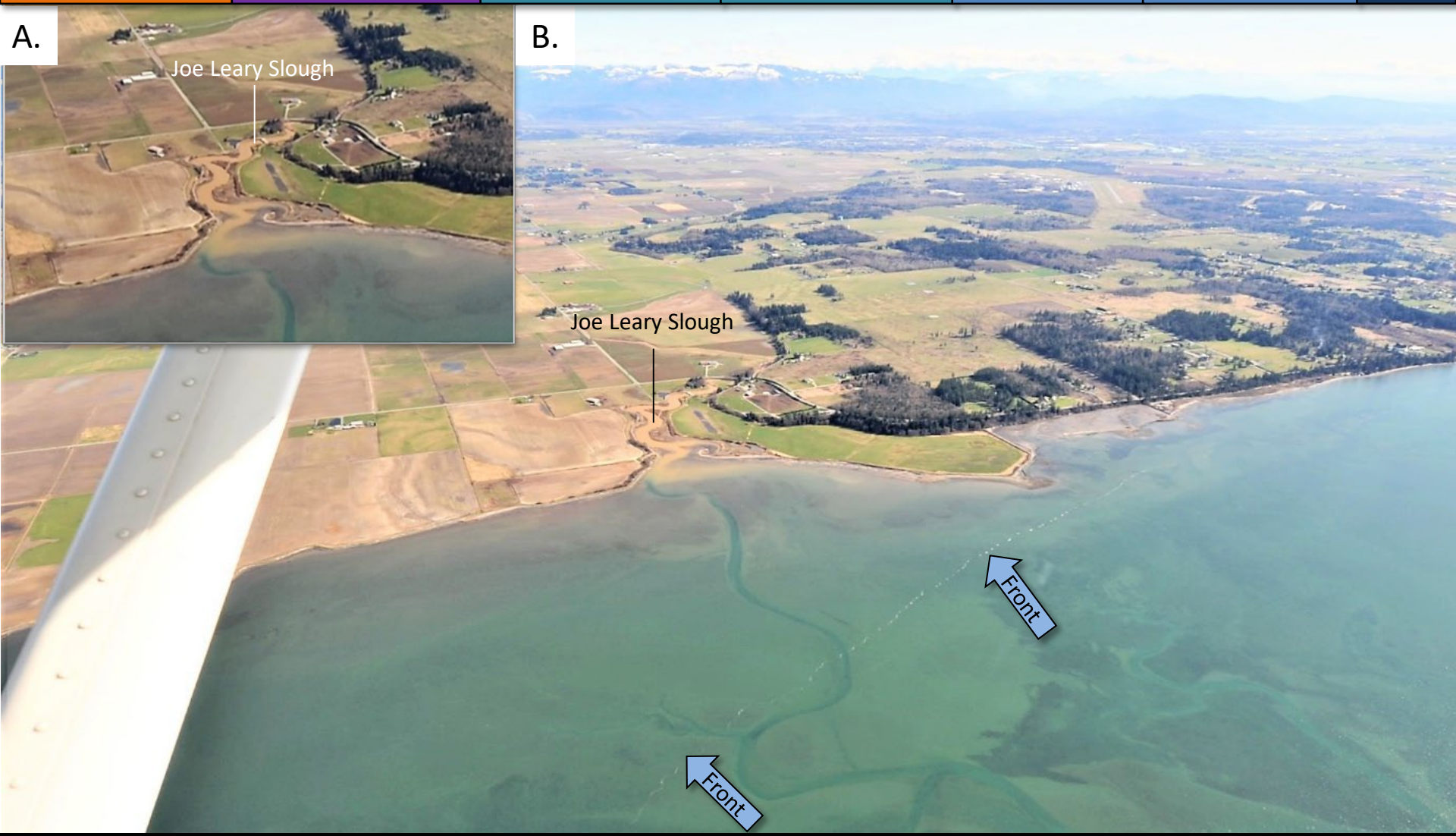
Location: Swinomish Channel (North Sound), 12:41 PM

Aerial photography 3-11-2021

Suspended sediment in the nearshore environment, likely biological in origin.

Location: Padilla Bay (North Sound) 12:42 PM

Aerial photography 3-11-2021



A. Close up of slough with very brown water and sediment. B. Padilla Bay with long front line.

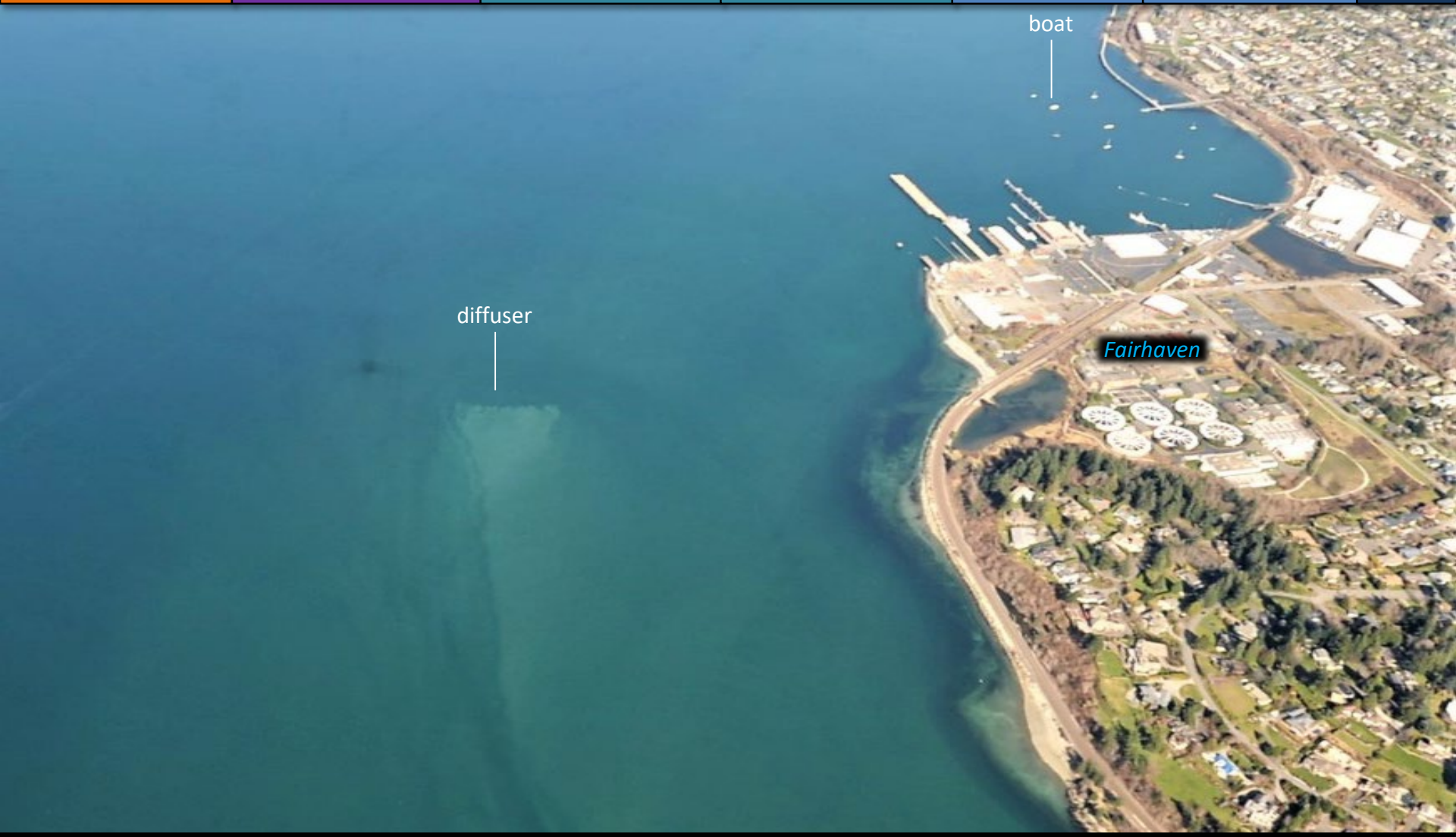
Location: Padilla Bay (North Sound) 12:44 PM

Aerial photography 3-11-2021

Samish River estuary. With suspended sediment in the nearshore, likely due to biological activity.

Location: Samish Bay (North Sound), 12:45 PM

Aerial photography 3-11-2021



Diffuser of the Fairhaven Wastewater treatment plant. Effluent can be seen miles to the south.

Location: Fairhaven Bellingham Bay (North Sound), 12:52 PM

Aerial photography 3-11-2021

Suspended sediment near the Nooksack delta, likely biological in origin. Nooksack river water is clear in contrast.

Location: Bellingham Bay (North Sound), 12:54 PM

Aerial photography 3-11-2021

Suspended sediment at the entrance to Squalicum Harbor.
Location: Bellingham Bay (North Sound), 12:55 PM

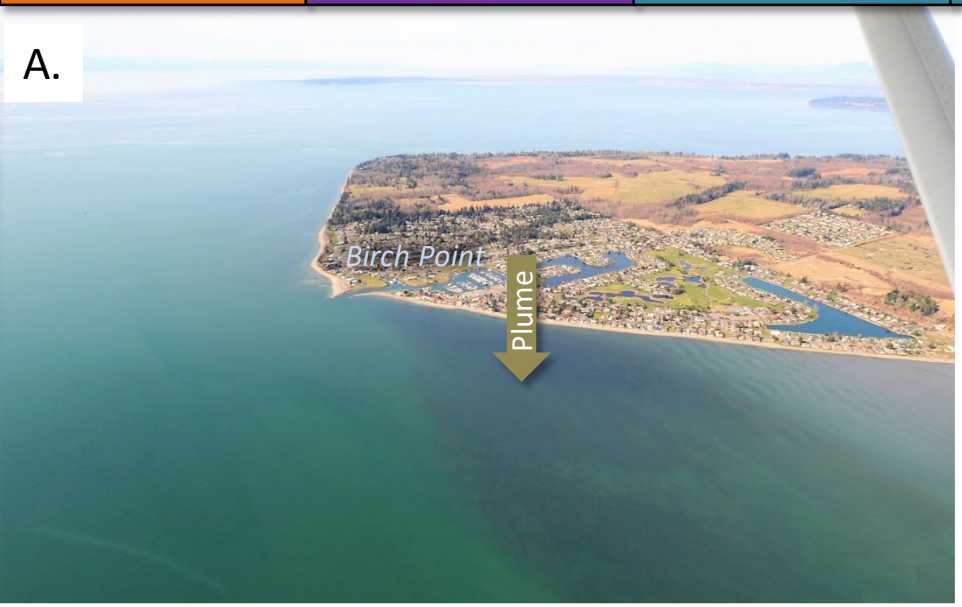
Aerial photography 3-11-2021

Suspended sediment near the Lummi river delta. Likely biological in origin.

Location: Lummi Bay (North Sound), 1:02 PM

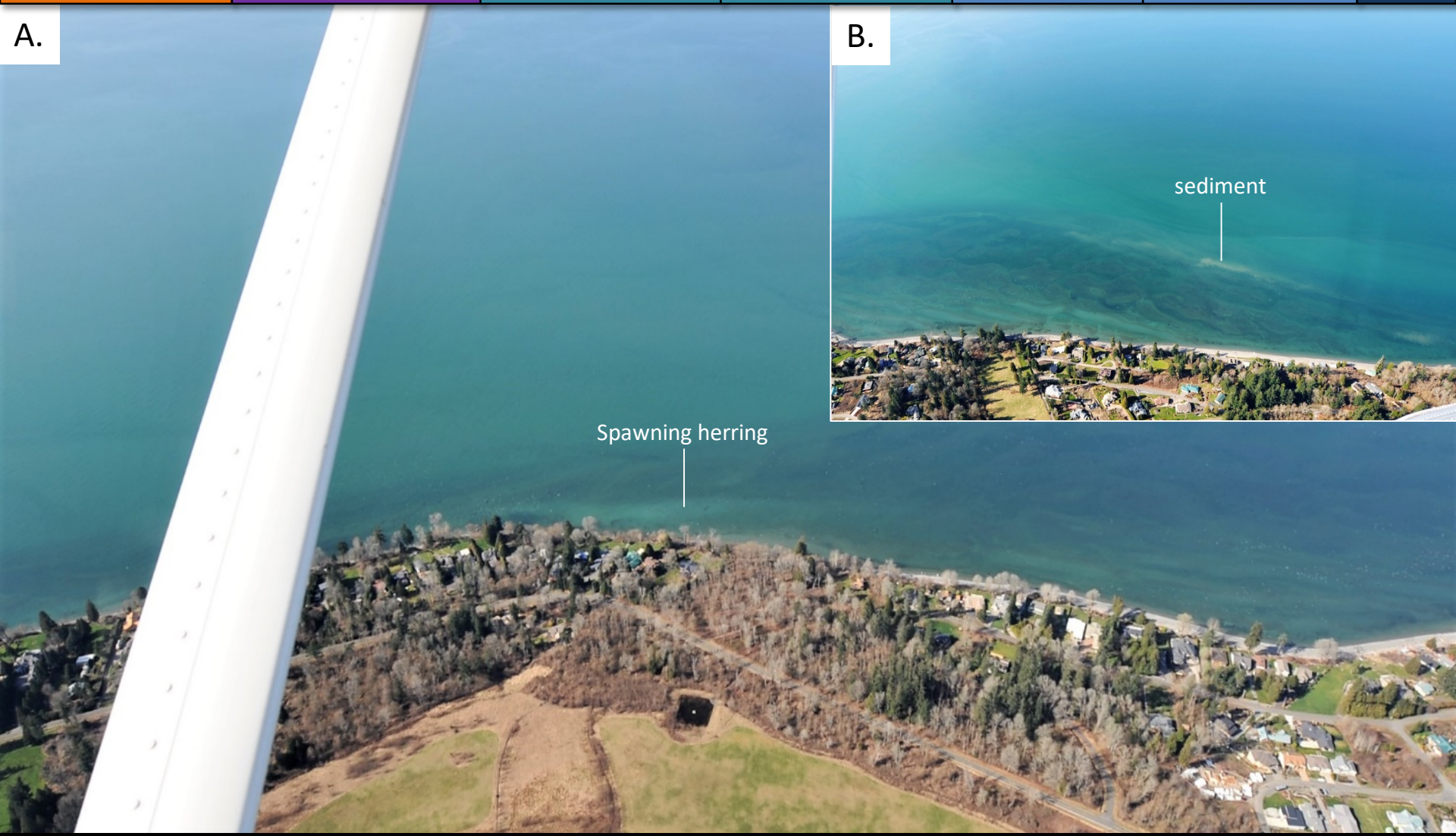
Aerial photography 3-11-2021

Oil sheen about ¼ mile long. Location: outside Lummi Bay (North Sound), 1:04 PM



A-B. Brown water from Terrel creek in Birch Bay. C. Diatom mats in shallows of Drayton Harbor
Location: A-B. Birch Bay, C-D. Drayton Harbor (North Sound), 1:12 PM

Aerial photography 3-11-2021



A. White water and seagulls likely indicate spawning herring B. Small patches of grey water with sediment.
Location: North of Birch Point (North Sound), 1:16 PM

Aerial photography 3-11-2021

Beginning algal bloom in Westcott Bay
Location: Friday Harbor (San Juan Islands), 1:35 PM

Aerial photography 3-11-2021

Suspended sediment movement helps spit grow.

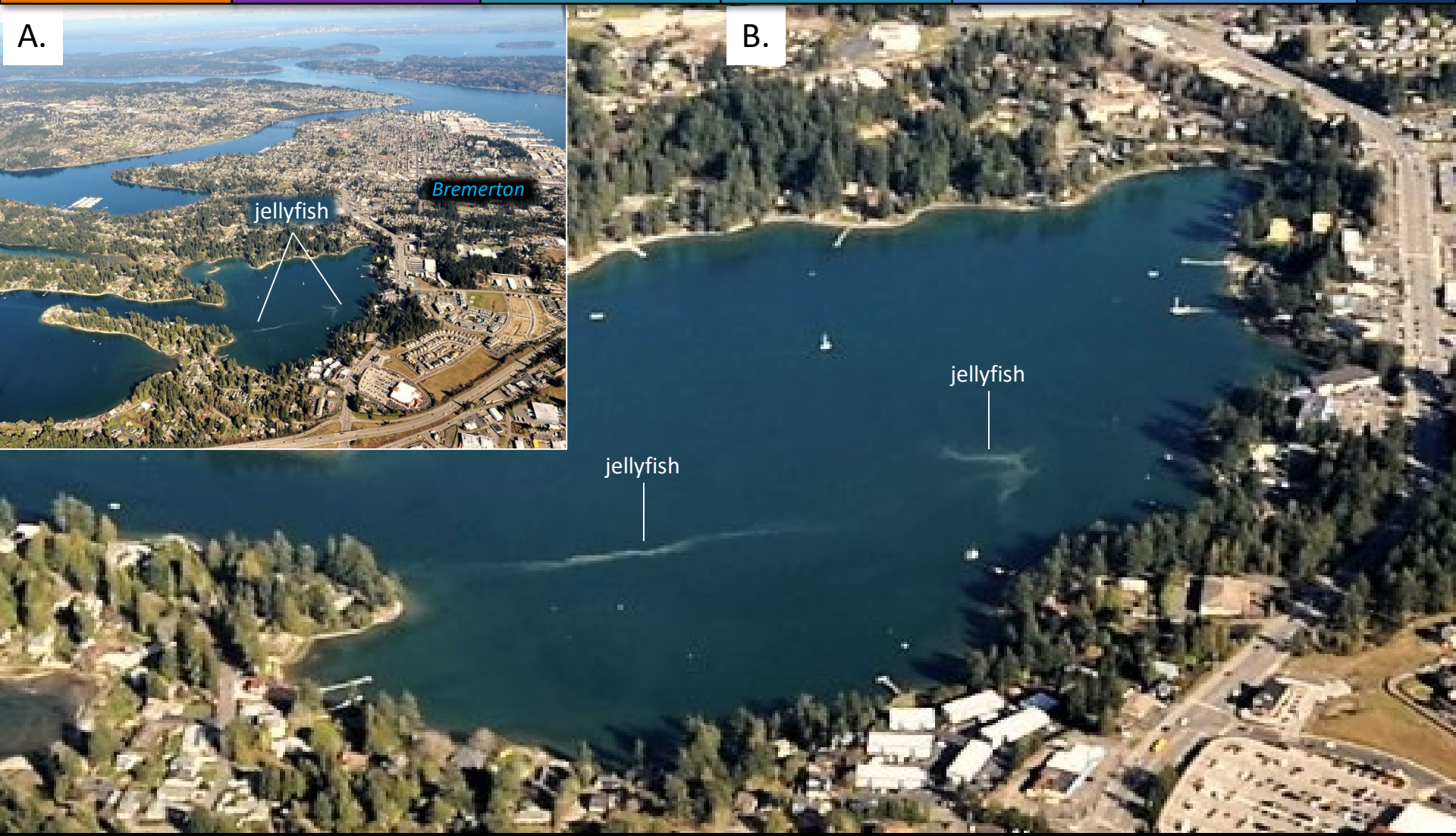
Location: Dungeness Spit (Straits of Juan de Fuca) 1:51 PM

Aerial photography 3-11-2021

Beautiful entrance to Sequim Bay. Nothing to report other than beauty.

Location: Sequim (North Sound), 1:54 PM

Aerial photography 3-11-2021

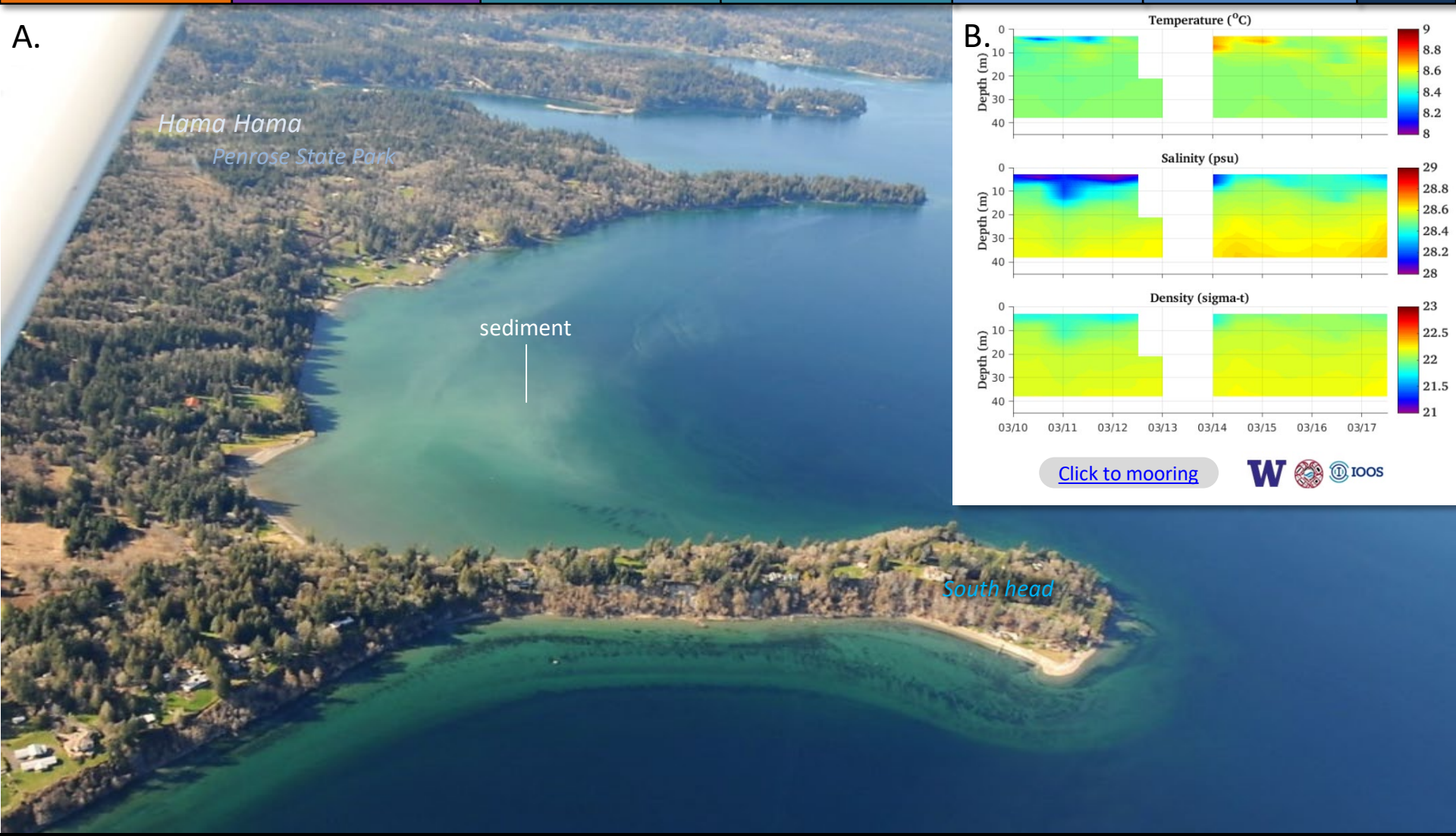


Jellyfish aggregations and early signs of phytoplankton growth.
Location: Oyster Bay, Dyes Inlet (Central Sound), 2:19 PM

Aerial photography 3-11-2021

Three patches of jellyfish. Location: Sinclair Inlet (Central Sound), 2:21 PM

Aerial photography 3-11-2021



A. Suspended sediment or spawning herring. B. Nearby ORCA mooring data coincident with overflight.
Location: Delano Bay, Carr Inlet (South Sound) 2:36 PM

Aerial photography 3-11-2021

Small patch of jellyfish, plume and front near Woodard Bay. Location: Henderson Inlet (South Sound) 2:42 PM

Help us cover important events in Puget Sound

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Help us to document important environmental events and places on Puget Sounds waters and beaches.

Jellyfish

Algal blooms

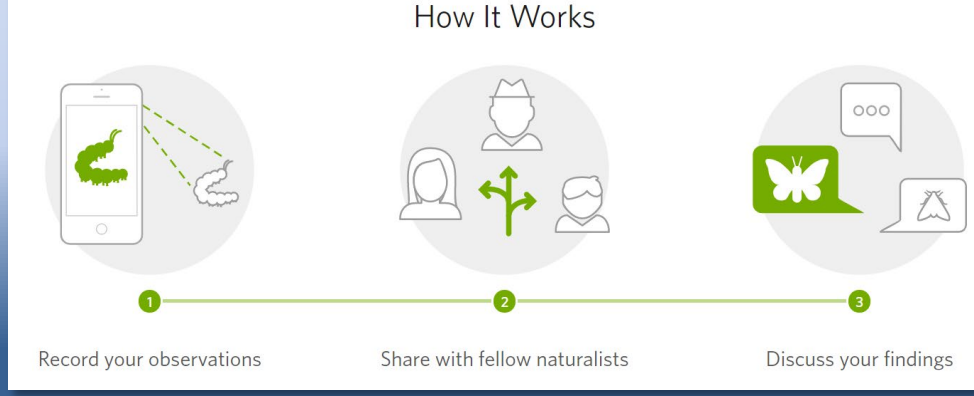
Noctiluca blooms

Macro-algae

Click on the images above what you want to report

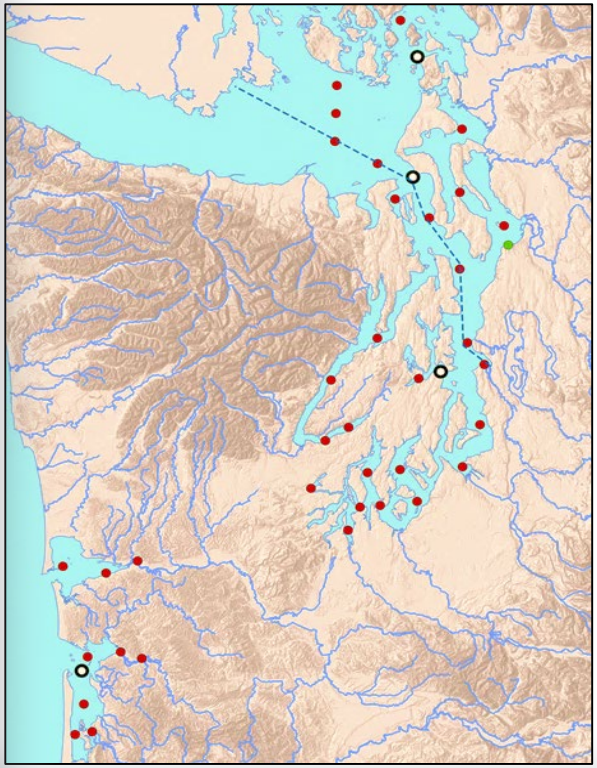
[A Community for Naturalists, Eyes Over Puget Sound]

Start reporting observations and share them with with us.



Long-term monitoring data from Puget Sound and Coastal Bays

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



https://apps.ecology.wa.gov/eim/search/SMP/MarineAmbientSearch.aspx?StudyMonitoringProgramUserId=MarineAmbient&StudyMonitoringProgramUserIdSearchType=Equals

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We have published 91 editions!

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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.

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Christopher.Krembs@ecy.wa.gov
Marine Monitoring Unit
Environmental Assessment Program
Washington State
Department of Ecology

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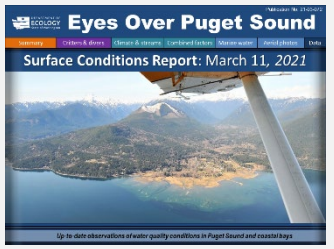

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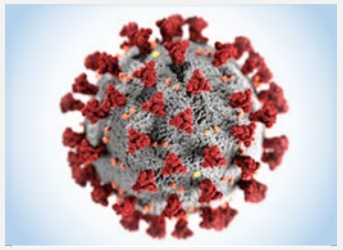

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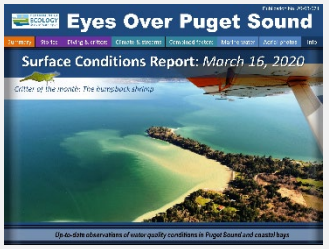

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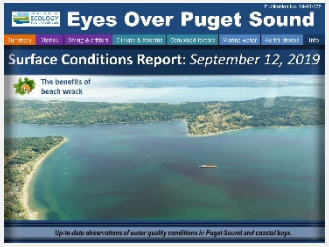

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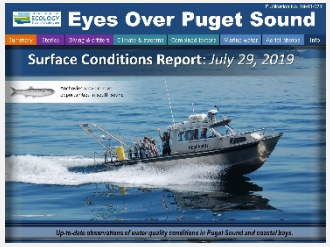

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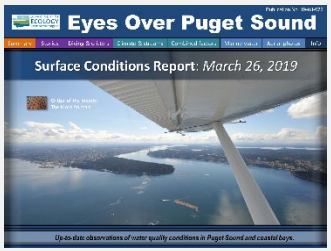

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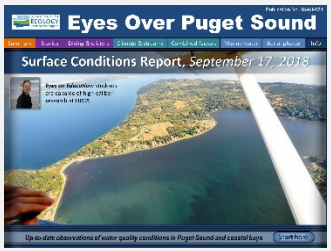

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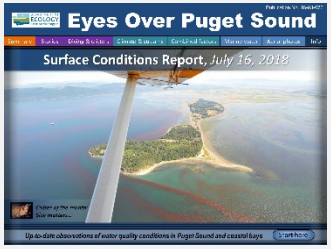

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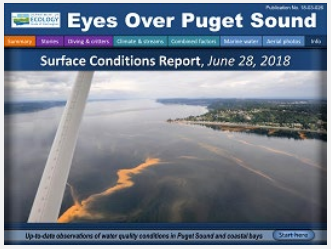

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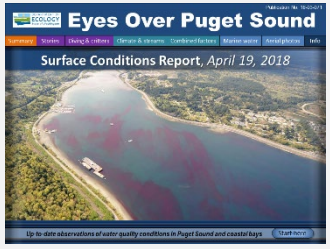

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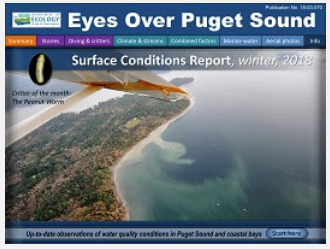

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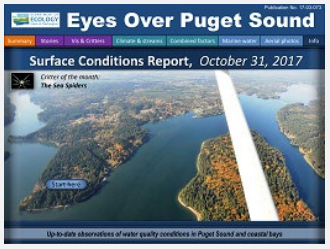

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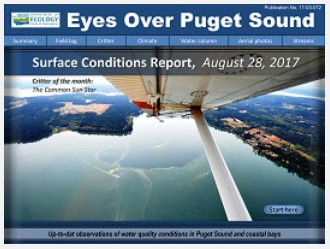

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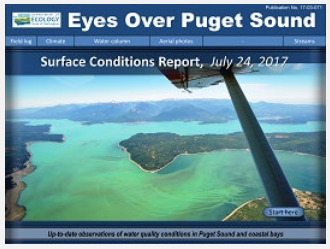

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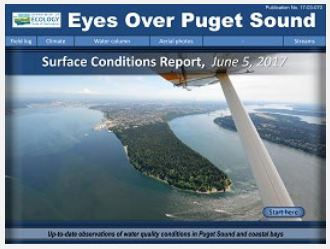

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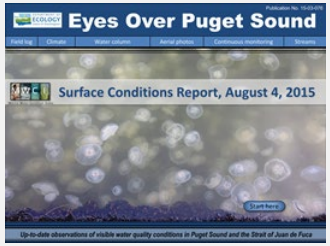

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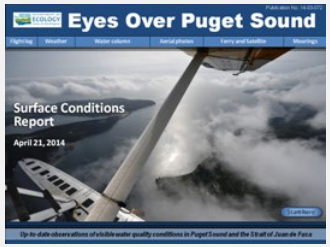

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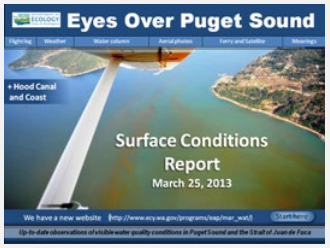

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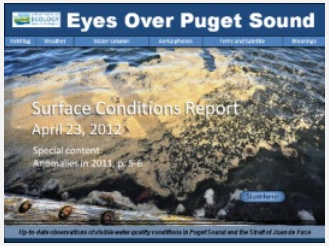

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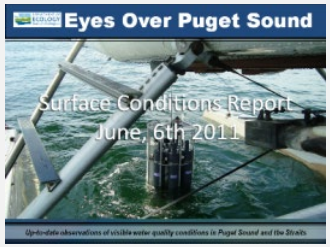

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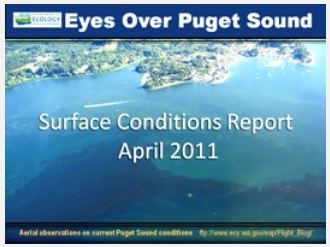

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