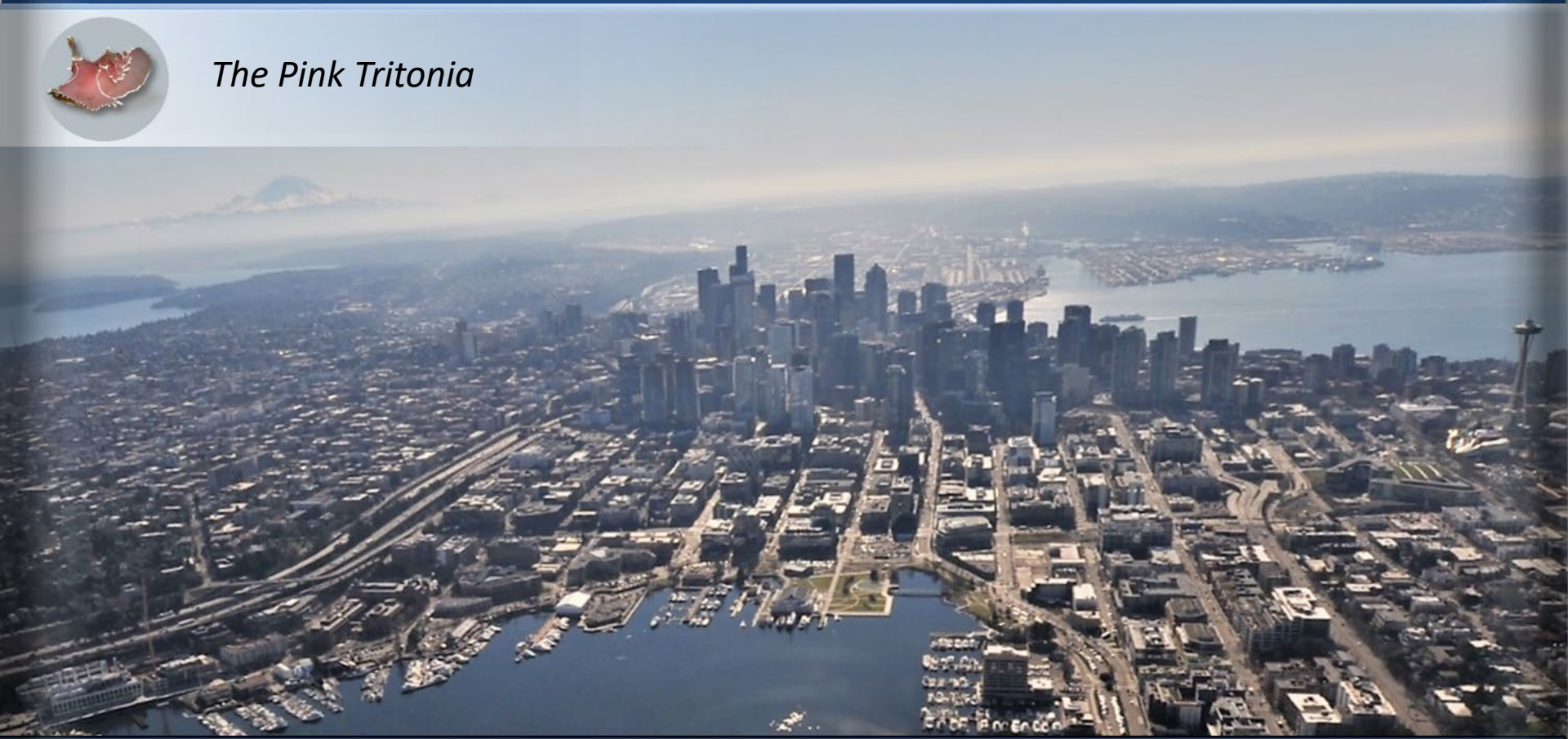
Publication No. 22-03-071

DEPARTMENT OF ECOLOGY
State of Washington

Eyes Over Puget Sound

Surface Conditions Report: Feb 25, 2022



The Pink Tritonia

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

Summary conditions at a glance

LONG-TERM MARINE MONITORING UNIT

Artists corner, p. 3

Showcasing the natural beauty of Puget Sound through photography.

Tyler Burks, Skip Albertson

Climate & streams, p. 10

The winter has been colder with ample rain. In response, river flows were higher during winter. Currently, temperatures are still cooler but it got drier. Due to a robust and early winter, watersheds that drain to Puget Sound still hold a normal snowpack.

Julia Bos

Water quality, p. 16

Higher summer salinities in Puget Sound transitioned to fresher water in fall and winter. In Puget Sound, oxygen levels are higher and water temperatures are cooler except in South Sound.

Dr. Christopher Krembs

Aerial photography, p. 17

Relatively quiet late winter conditions and mostly clear water. Some areas show first signs of the spring bloom. Organic material drifting at the surface in Port Susan and Carr Inlet. Small jellyfish patches are present in Eld Inlet. Urban waterways appear clean.

Editor: Dr. Christopher Krembs, editorial assistance: Dany Burgess, Valarie Partridge

Puget Sound is beautiful and inspiring

Showcasing the natural beauty of Puget Sound through photography

"The moment in a herring's life": Herring spawning in Quilcene Bay, by Dave Parks and CWI, 3/6/2022

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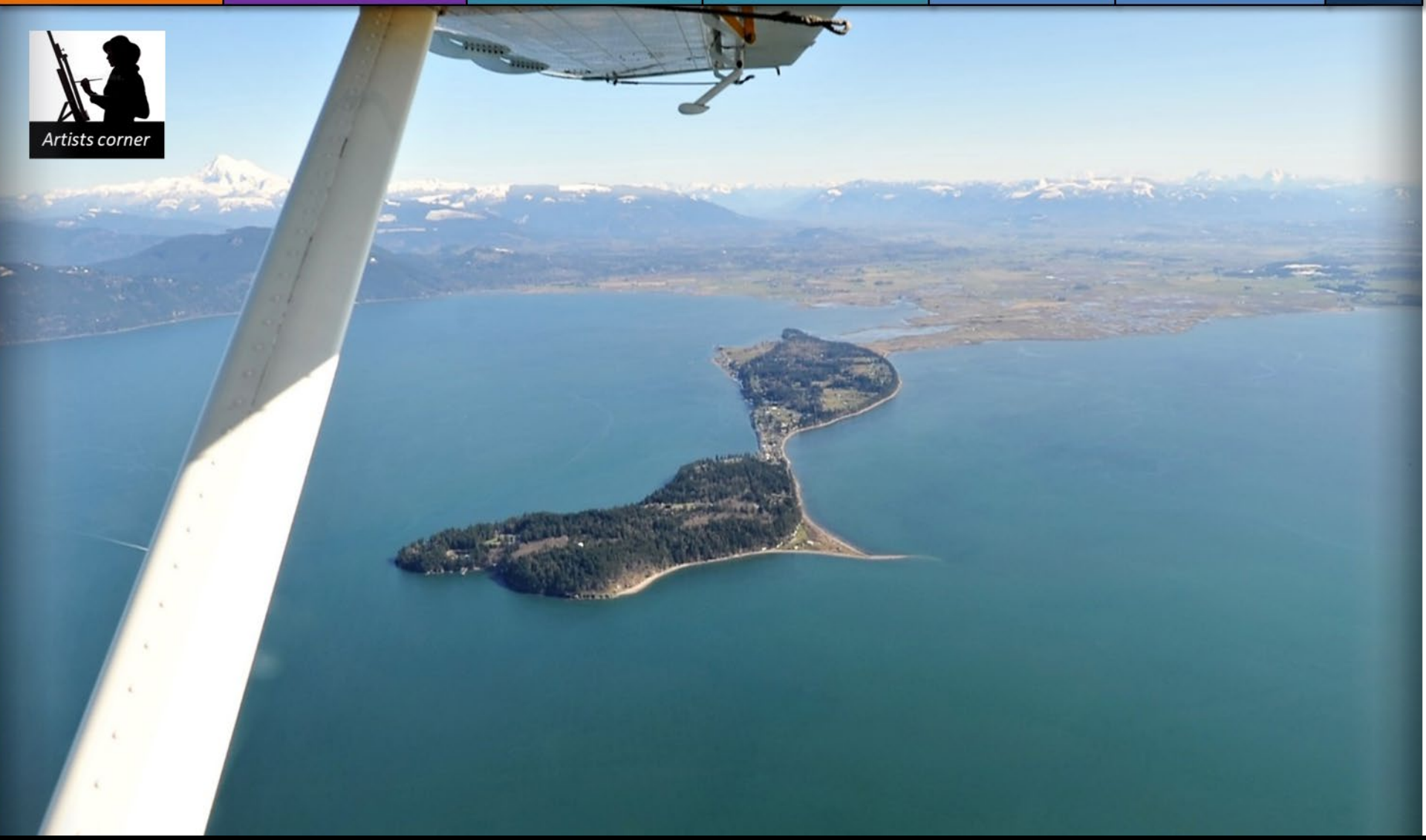
State of Washington

Puget Sound is beautiful and inspiring



"Animal inspirations": Samish Island

"A natural explorers dream": Sucia Island, San Juan Islands

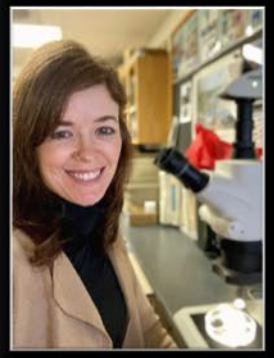
Puget Sound is beautiful and inspiring

"Loving Portage Island": Bellingham Bay

Puget Sound is beautiful and inspiring

"Heading due west ends here": Fir Island Road

Critter of the Month – The Pink Tritonia



Tritonia spp.

The pink tritonia has it all – charm, talent, and the ability to keep taxonomists and other scientists on their toes! Aside from being a formidable predator, this incredible sea slug has anatomical features and abilities that have wowed researchers in Puget Sound – and beyond – for decades.

Fun Pink Tritonia Facts

- They can move much faster than typical "slug speed"
- They navigate using their "magnetic" bodies
- For small critters, they have giant brain cells!

Photo by Paul Anderson

Photo by Jan Kocian

Photo by Dave Cowles

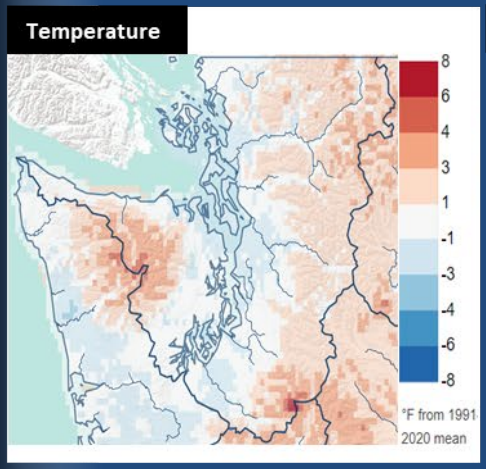
Learn more about the pink tritonia and other critters on Ecology's EcoConnect blog, click here

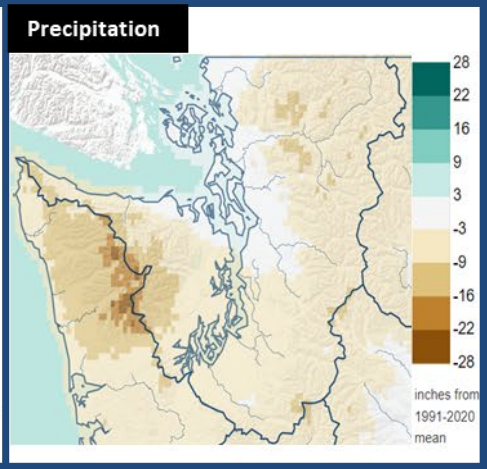
DEPARTMENT OF ECOLOGY State of Washington

How much water did we get and what can we expect?

In February, Puget Sound air temperatures (with some inversions) were generally below normal, and so was precipitation (A). Due to a robust early snowfall in winter, watersheds that drain to Puget Sound hold near-normal snowpack (B) to feed rivers during summer. Monitoring the building snowpack as well as keeping an eye on air temperatures will be critical to predict river flows as we transition to spring.

A. Northwest Climate Toolbox



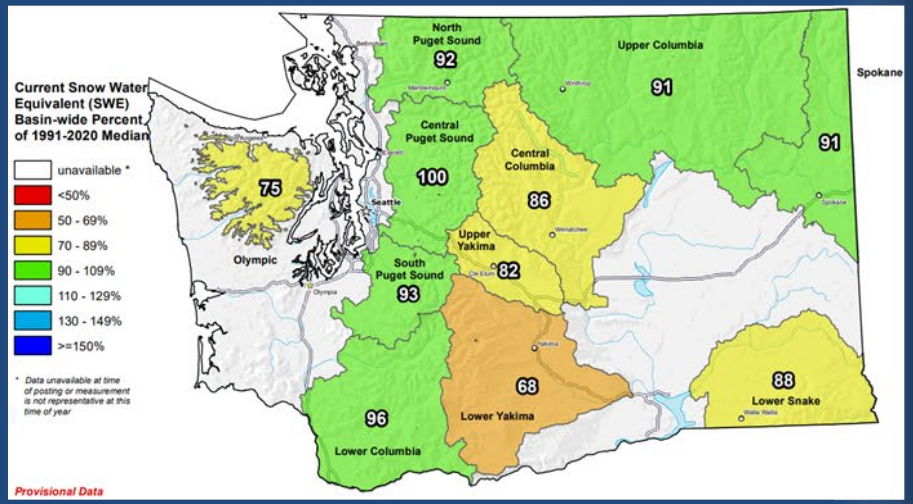


Temperature Anomaly from historical mean daily ranged from -4 to +8 °F in the Puget Sound region during the past 30 days.

Precipitation Anomaly from historical mean ranged from +3 to -16 inches in the Puget Sound region during the past 30 days.

B. Washington SNOTEL, USDA/NRCS

February 24th, 2022

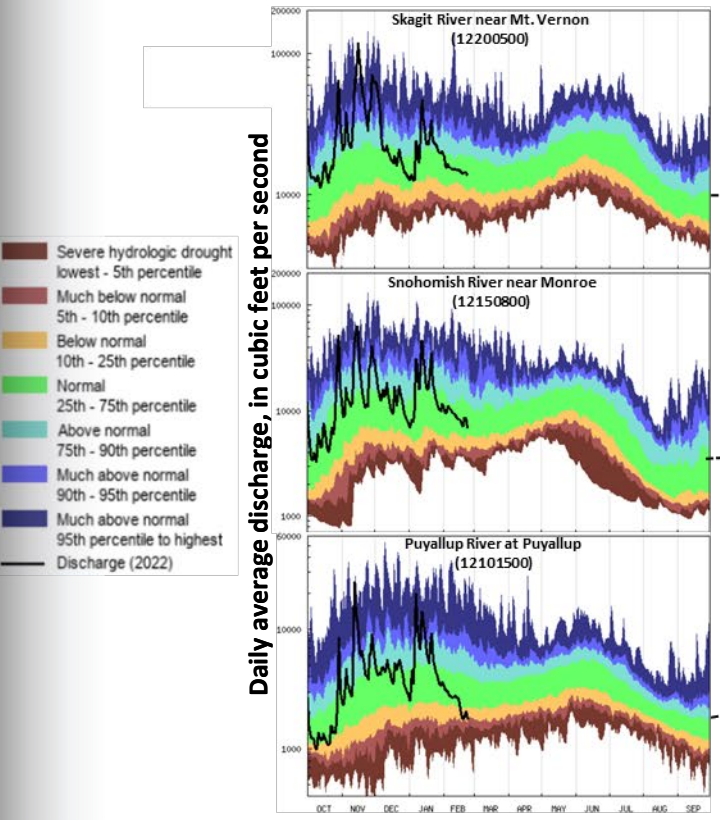


Snow water equivalent percent of median for watersheds draining to Puget Sound near normal. As we move towards the typical peak of seasonal snowpack accumulation, April 1st, snow water equivalents are at 90% of the historical median.

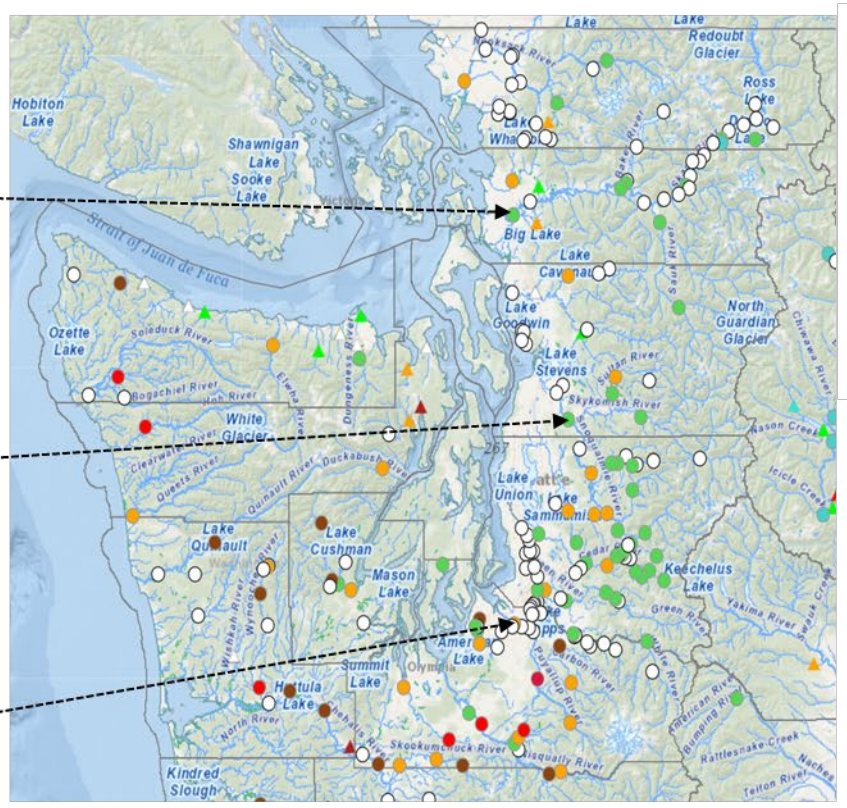
How much water currently flows into Puget Sound?

Temporal: After a very wet first half of January, a sustained dry period for the most part normalized freshwater inputs from major rivers to Puget Sound (trend charts, left).
Spatial: Variation in streamflow (map, right) are caused by differing rates of receding rivers following rain events, as well as freezing temperatures retaining water in the form of ice and snow.

Select Puget Sound Streamflow Trends



Current Streamflow Conditions as of 02/24/2022



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

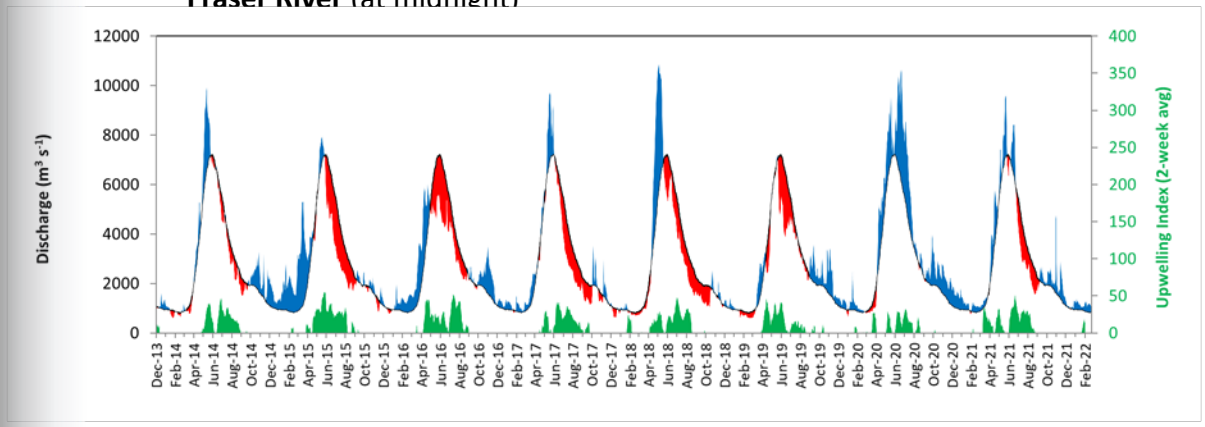
USGS WaterWatch: CLICK HERE!

Current conditions: CLICK HERE!

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

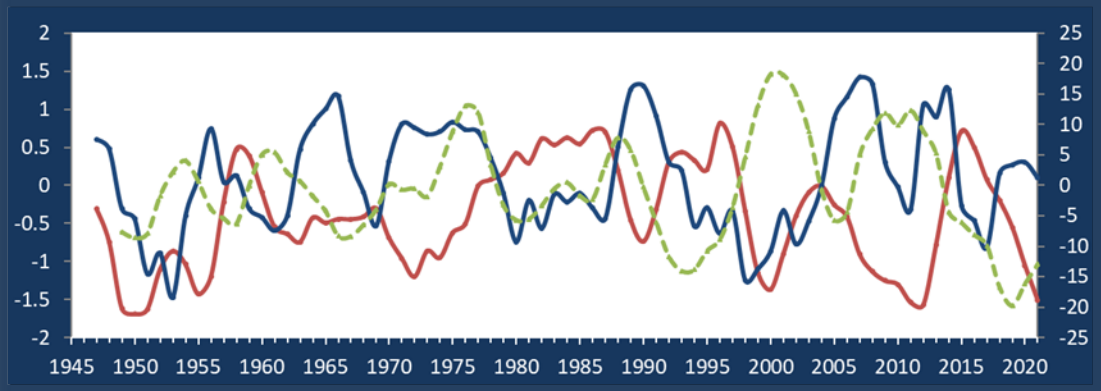
Historically, the peaks of coastal upwelling and the freshet are in sync.

Fraser River (at midnight)



The Fraser River is the major driver of estuarine circulation and water exchange between the Salish Sea and the ocean. Fraser River flows in winter 2021/22 were at expected levels. Upwelling off the coast in summer 2021 generally coincided with peak flows.

Three-year running average of PDO, Upwelling, and NPGO Indices



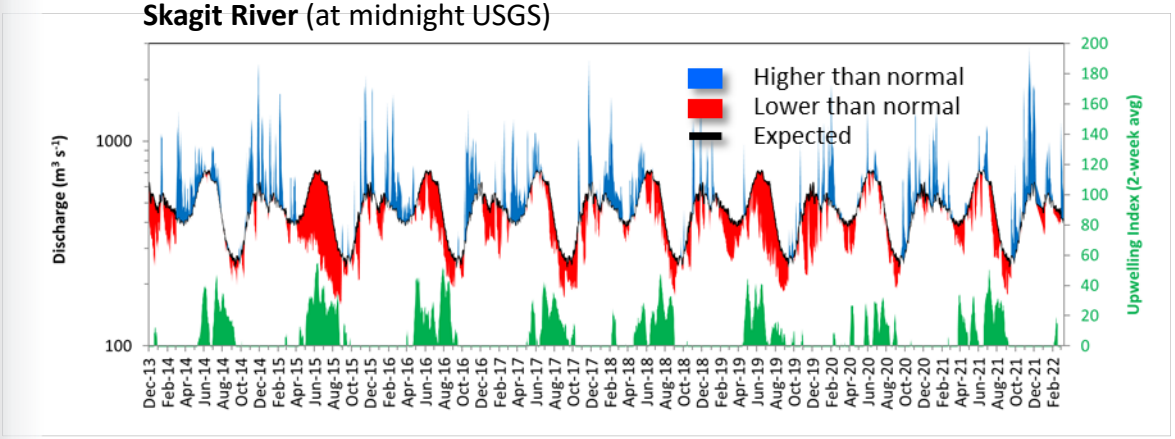
How do ocean boundary conditions affect the quality of water the Salish Sea exchanges with the ocean?

Water has gradually cooled (PDO). Upwelling (Upwelling Index anomaly) is at expected level. Productivity in the eastern Pacific is lower (NPGO; last updated Jan 2022).

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

Climate: How well is Puget Sound exchanging its water?

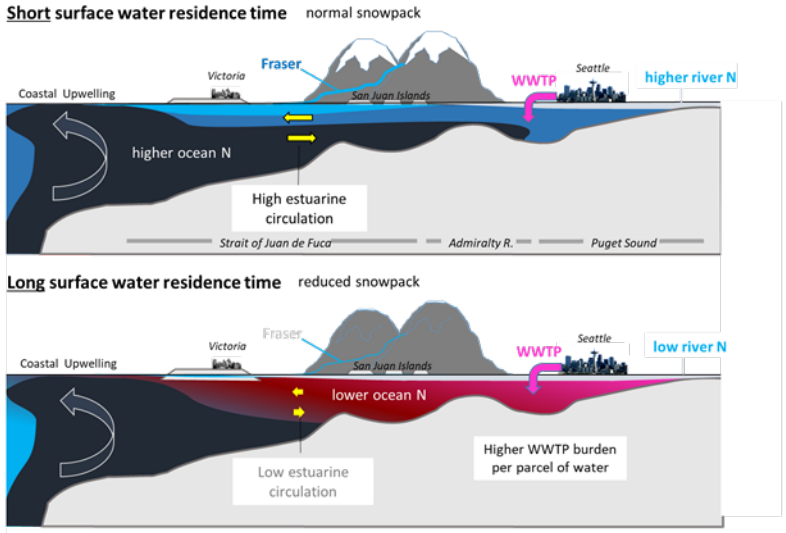
The Skagit River is the largest freshwater source for Puget Sound. It is a river that is regulated.



The Skagit River freshet is no longer clearly pronounced, because the river is a regulated system for hydroelectric power generation. However, drought years and low flows can be seen in the river's discharge data. In 2021, flows were higher than 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. All data are from public sources: UW GRAYSKIES; river flows from USGS and Environment Canada; indices from NOAA & UW (PDO).

Conditions leading up to March (2022):

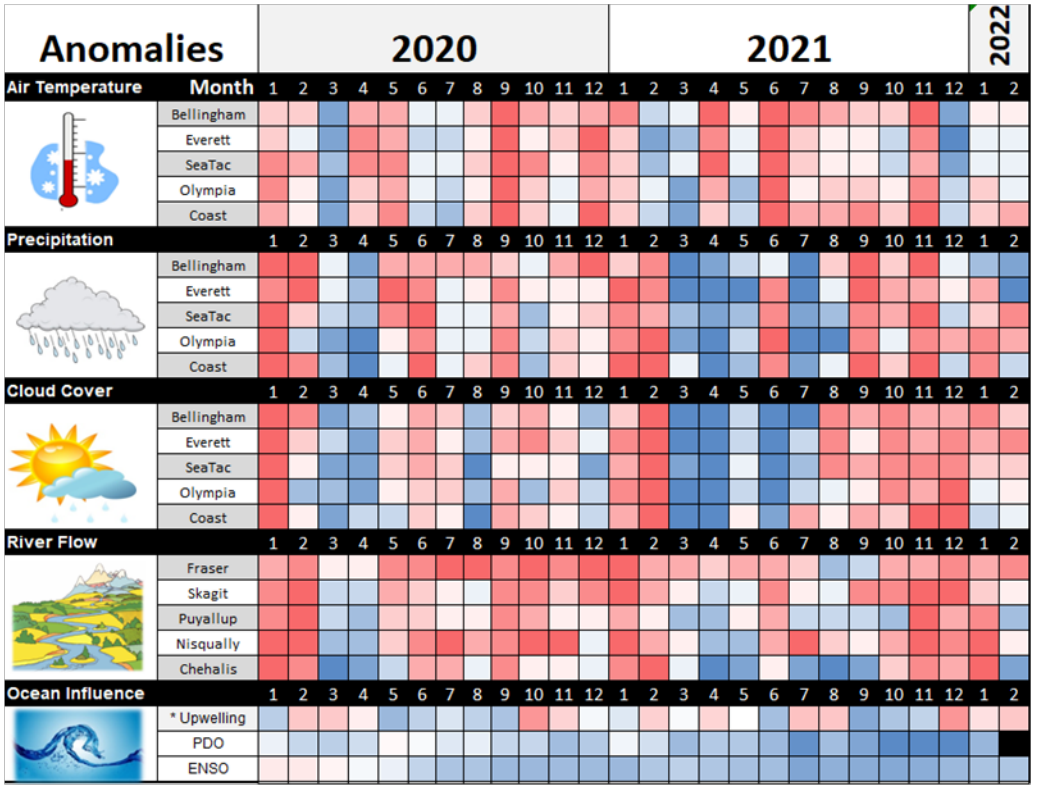
Air temperatures have been variable after a cold December.

Precipitation has been above normal except recently to the extreme north.

Cloud cover has mostly been higher since August.

River flows have been higher except recently in the Puyallup and Chehalis.

Downwelling has been weaker since December. PDO & ENSO are in cold phase (La Niña).



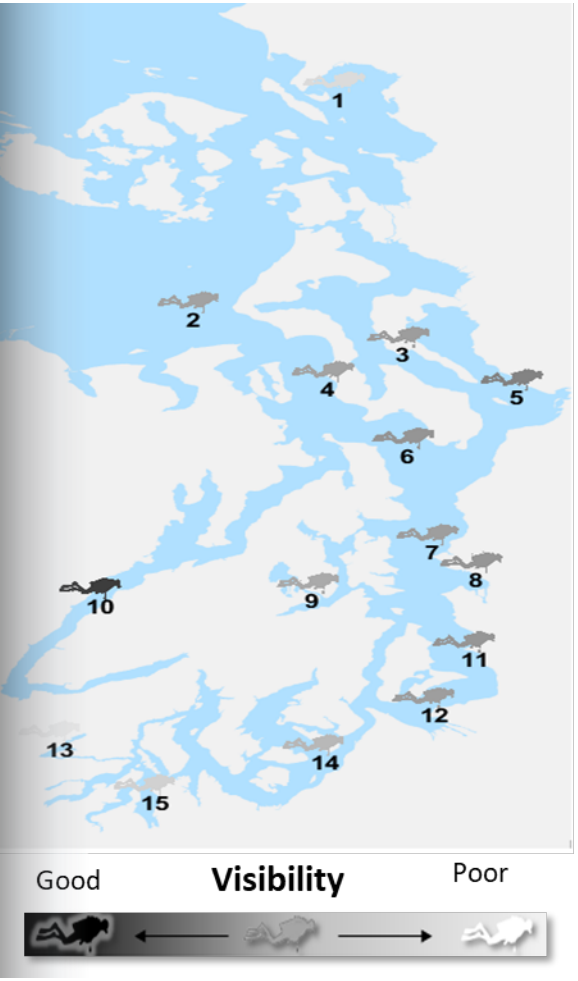
higher — expected — lower ■ No data

*Upwelling/downwelling Anomalies (PFEL)
PDO = Pacific Decadal Oscillation
ENSO = El Niño Southern Oscillation

How far and what can you see underwater?

What was the water visibility like for divers?

Diver visibility, January 2022



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	7	20	7	36
2	21	5	17	3
3	22	98	7	5
4	21	7	19	98
5	29	98	1	5
6	24	57	5	5
7	22	98	15	5
8	24	90	9	7
9	19	36	8	48
10	45	64	13	7
11	24	98	20	7
12	22	92	9	3
13	5	56	3	23
14	16	64	14	3
15	10	20	5	56

Find depths with high/low visibility

- **Best visibility** (45 ft) occurred near Octopus Hole in Hood Canal, at a depth of 64 ft (Location 10).
- **Poor visibility (no diver icon)** of 1 ft occurred in Mukilteo at a depth of around 5 ft (Location 5).

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

Boundary conditions lead to salinity fluctuations

Marine Water Conditions: 2022 temperature, salinity, and dissolved oxygen

Coastal Bays

T: *Higher*
S: *Expected*
DO: *Expected*

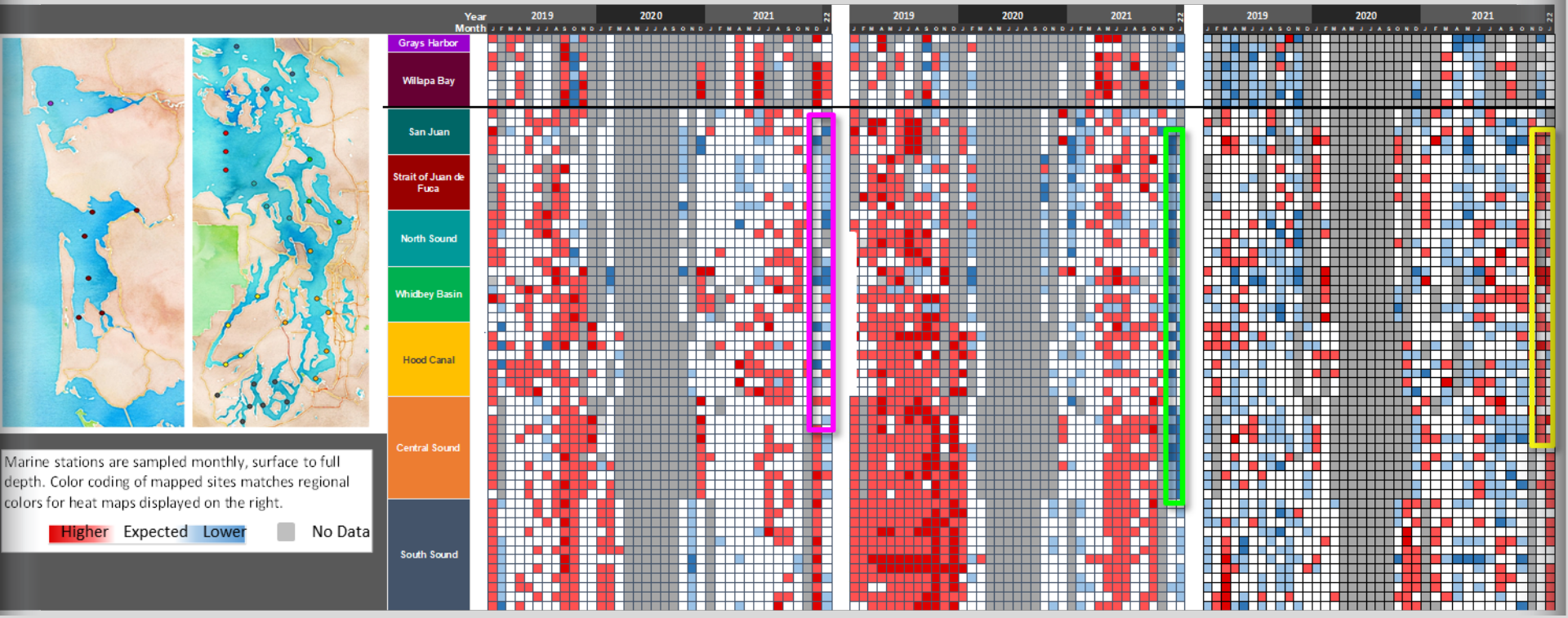
Salish Sea

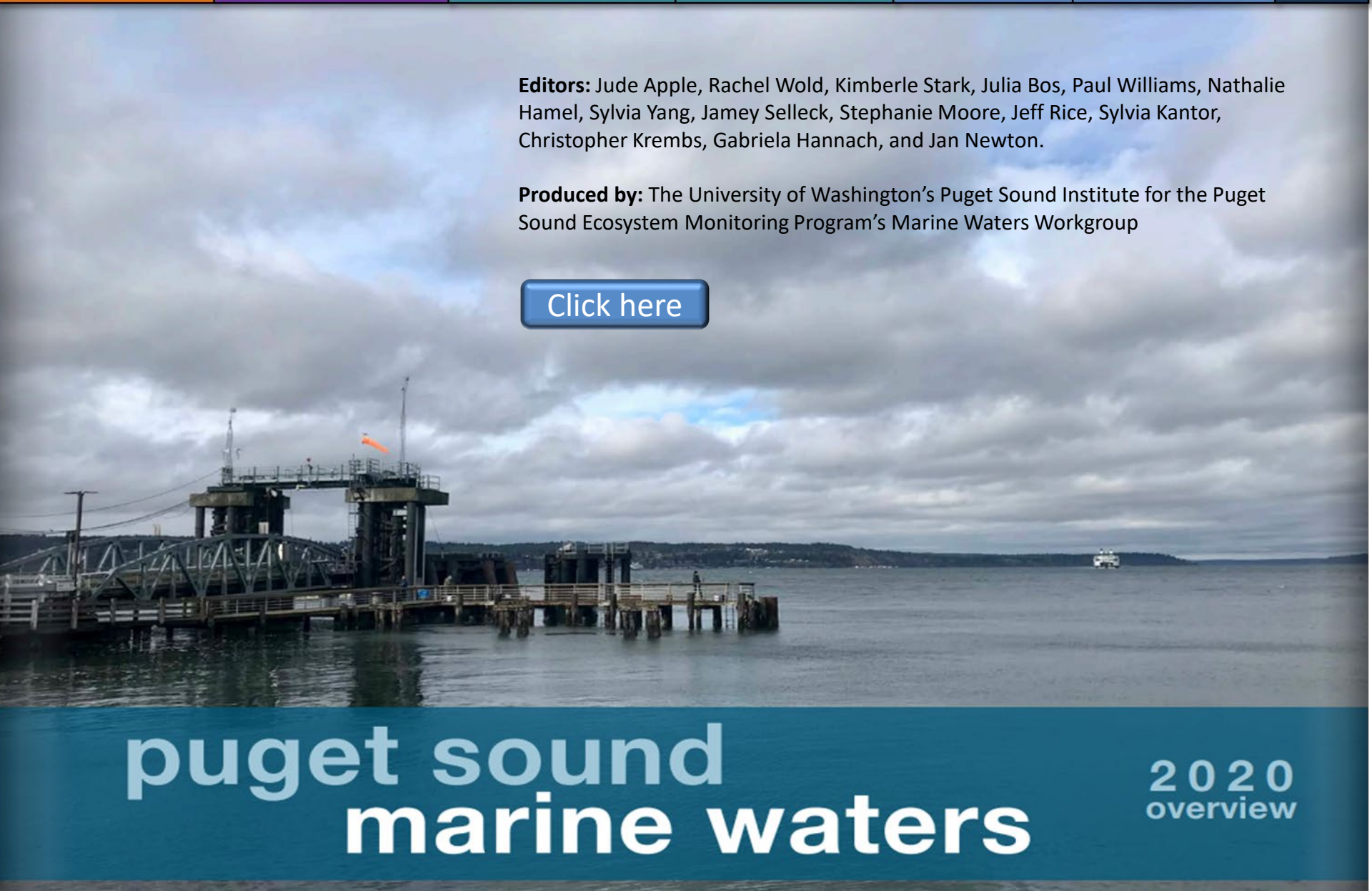
T: Cooler with the exception of South Sound (box).
S: Fresher, to a lesser degree in South Sound (box).
DO: Higher to a lesser extent in South Sound (box).

Higher summer salinities in Puget Sound transitioned to fresher water in fall and winter. Puget Sound oxygen levels are higher and water temperatures are cooler, except in South Sound.

Baseline: 1999-2021 (expanding)

Temperature | Salinity | Dissolved Oxygen





Editors: Jude Apple, Rachel Wold, Kimberle Stark, Julia Bos, Paul Williams, Nathalie Hamel, Sylvia Yang, Jamey Selleck, Stephanie Moore, Jeff Rice, Sylvia Kantor, Christopher Krembs, Gabriela Hannach, and Jan Newton.

Produced by: The University of Washington's Puget Sound Institute for the Puget Sound Ecosystem Monitoring Program's Marine Waters Workgroup

Click here

puget sound marine waters

2020 overview

What were the conditions at the surface on 2-25-2022

Relatively quiet late winter conditions and mostly clear water. Some areas show first signs of the spring bloom. Organic material drifting at the surface in Port Susan and Carr Inlet. Small jellyfish patches are present in Eld Inlet. Urban waterways appear clean.

Elisa Rauschl assisting with the IR camera

I am a sea star decorating this page

Start here

Front

Mixing and fronts:
Mixing near Matia Island, internal waves off Birch Point

Jellyfish and fish:
A few small jellyfish patches in Eld Inlet

Plume

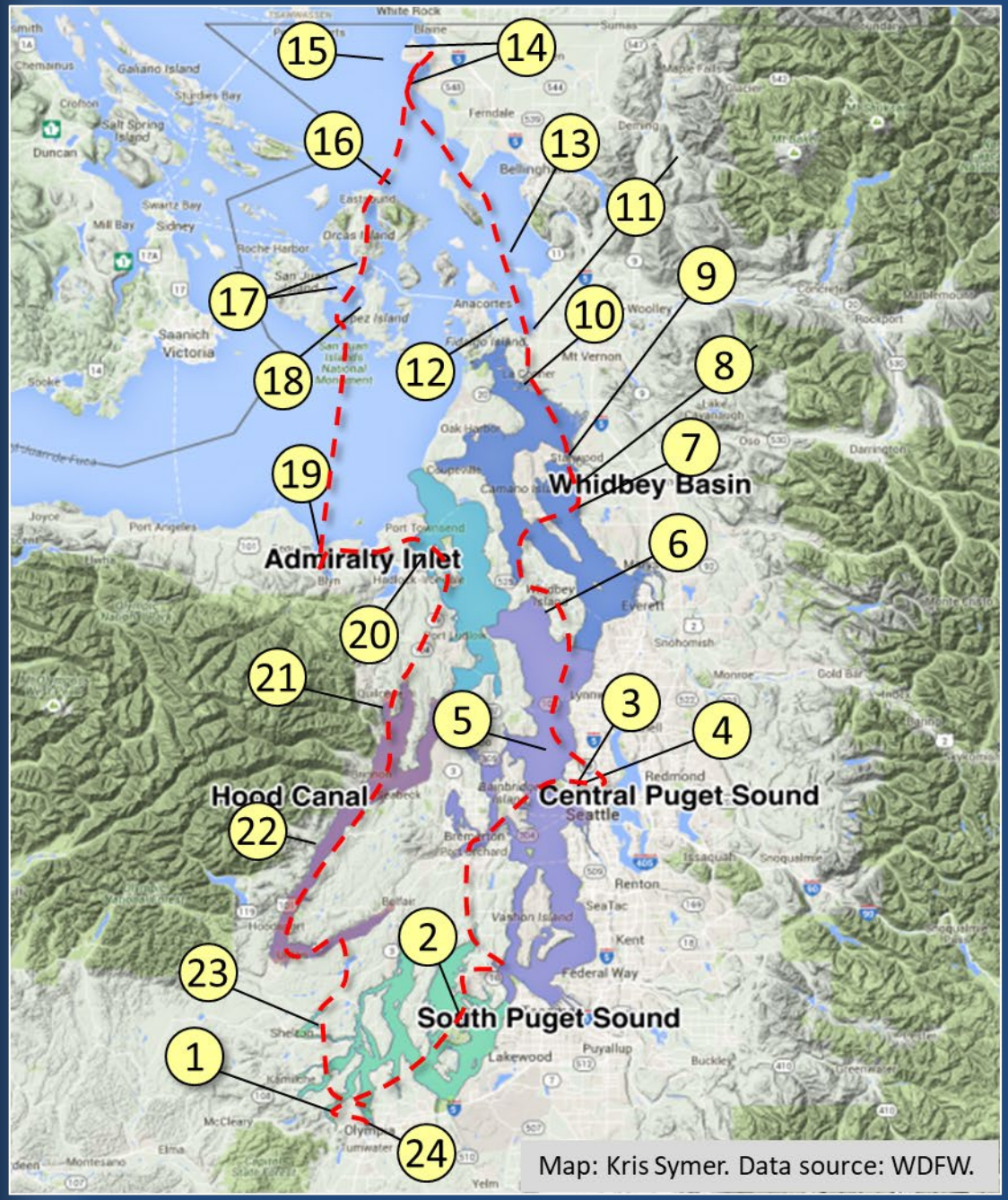
Suspended sediment:
Suspended sediment in Eld Inlet due to aquaculture, and in the shallows of the Stillaguamish delta, Padilla Bay, and Sequim Bay due to natural causes

Bloom

Visible blooms:
Early bloom activity in Port Townsend, Birch Bay, and around Shaw Island

Debris

Debris:
Patches of organic material drifting in Carr Inlet and Port Susan



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State of Washington

Aerial navigation guide

Date: 2-25-2022

Click on numbers

25

Flight Observations

High visibility, sunny

Tide data from 2-25-2022 (Seattle):

Time	Feet	High/Low
02:07 AM	12.76	H
06:40 AM	9.22	L
11:28 AM	13.72	H
07:18 PM	-0.68	L

North West Environmental Moorings real-time data

Navigate

Connecting aerial observation with data from ORCA moorings

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

NANOOS NVS Data Explorer

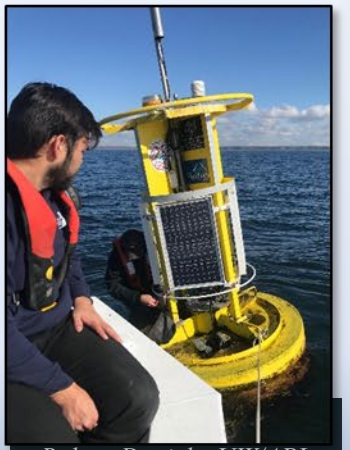
View products by mooring:

Puget Sound

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

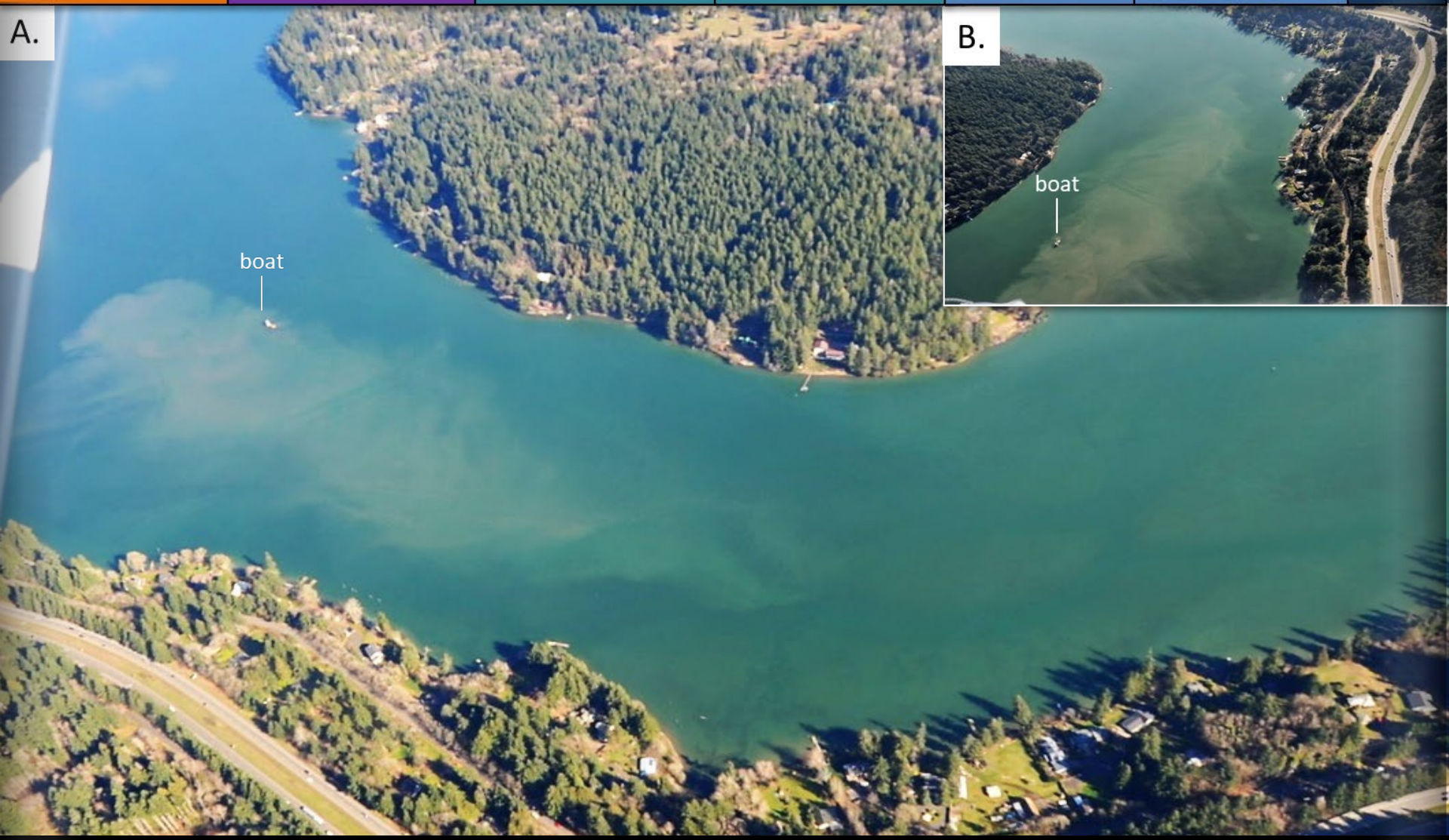
Salish Sea

7. Bellingham Bay
8. Friday Harbor



Robert Daniels, UW/APL

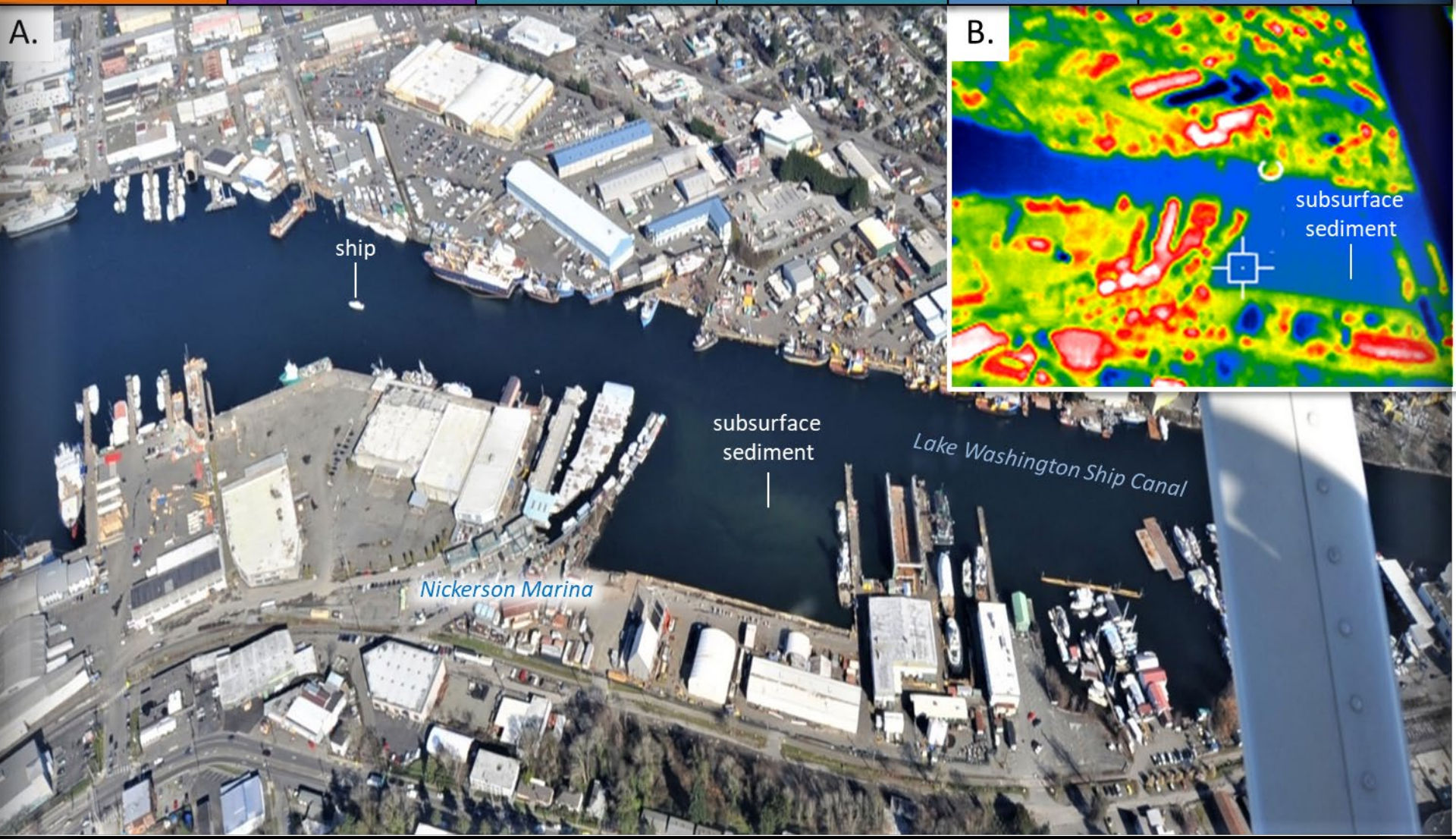
Aerial photography 2-25-2022



Marine vessel associated with large sediment plume. A. looking north, B. looking south.
Location: Southern Eld Inlet (South Sound), 11:32 AM

Aerial photography 2-25-2022

Organic material floating at surface. Location: Carr Inlet (South Sound), 11:45 AM



A. Subsurface suspended sediment with B. no thermal signature differing from surrounding.
Location: Across Nickerson Marina, Lake Washington Ship Canal (Central Sound), 12:07 PM

Aerial photography 2-25-2022

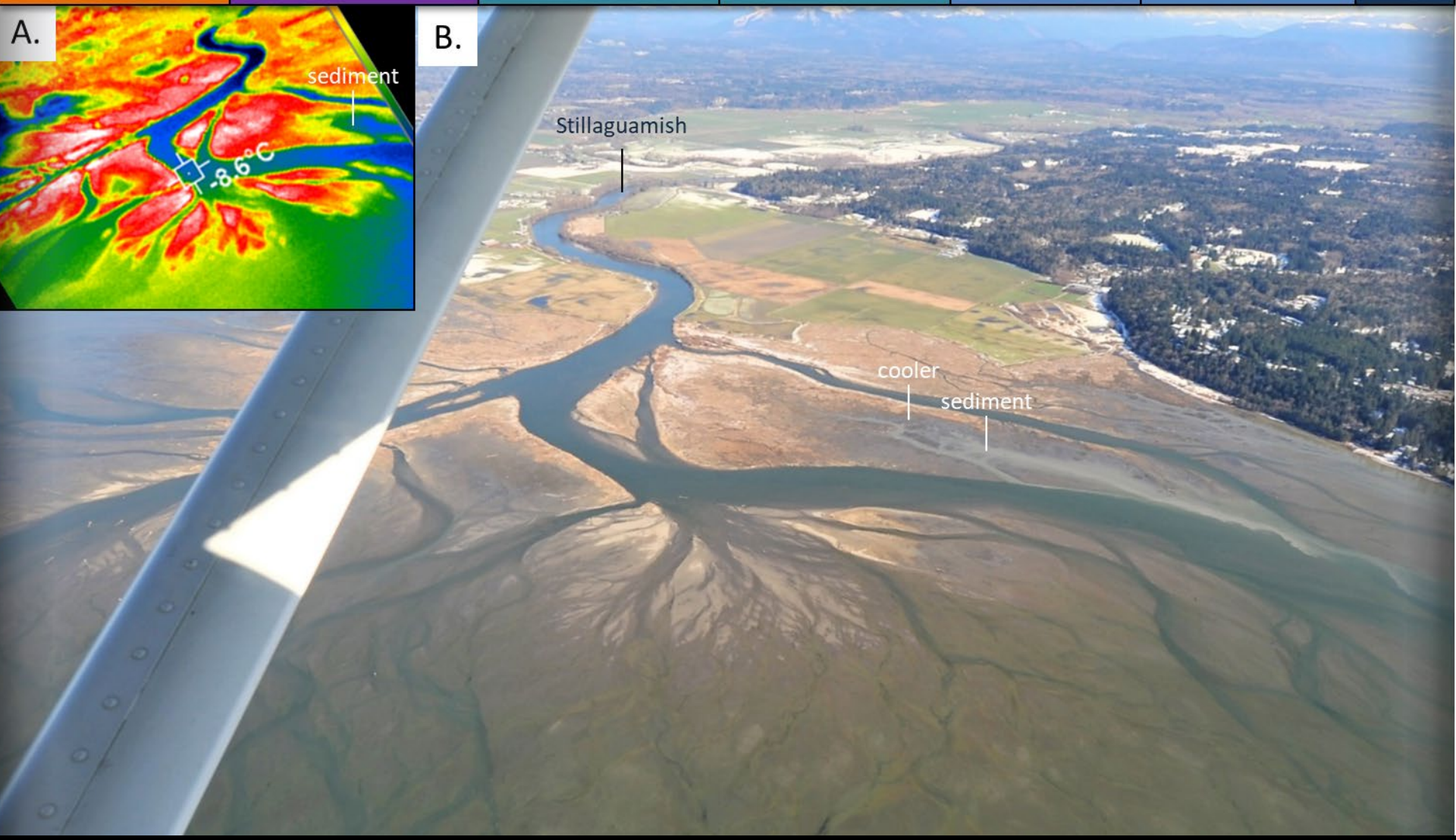
A. Busy urban waterway in Ballard. B. IR camera showing industrial areas with sites of active heating and cooling.
Location: Seattle (Central Sound), 12:07 PM

More than 25 boats fishing on western shores from Point Jefferson all the way to Kingston.
Location: East of Port Madison (Central Sound) 12:19 PM

A. Freshwater plume of boggy water B. Recurring lines of exposed sediment, devoid of vegetation.
Location: Western shore of Whidbey Island (Central Sound), 12:28 PM

Aerial photography 2-25-2022

Organic material floating at surface in Port Susan. Location: Port Susan (Whidbey Basin), 12:37 PM



A. Stillaguamish estuary with warmer, sun-exposed mud flats. B. Suspended sediment in a region that is also cooler.
Location: Stillaguamish estuary (Whidbey Basin), 12:40 PM

Aerial photography 2-25-2022

Suspended sediment flows into West Pass (Stillaguamish water) during incoming tide.

Location: Skagit Bay (Whidbey Basin), 12:42 PM

Aerial photography 2-25-2022

Shady regions remain cooler and still carry snow.

Location: Skagit Bay (North Sound), 12:49 PM

Aerial photography 2-25-2022

Locally-suspended sediment during high tide, suggesting some biological activity.

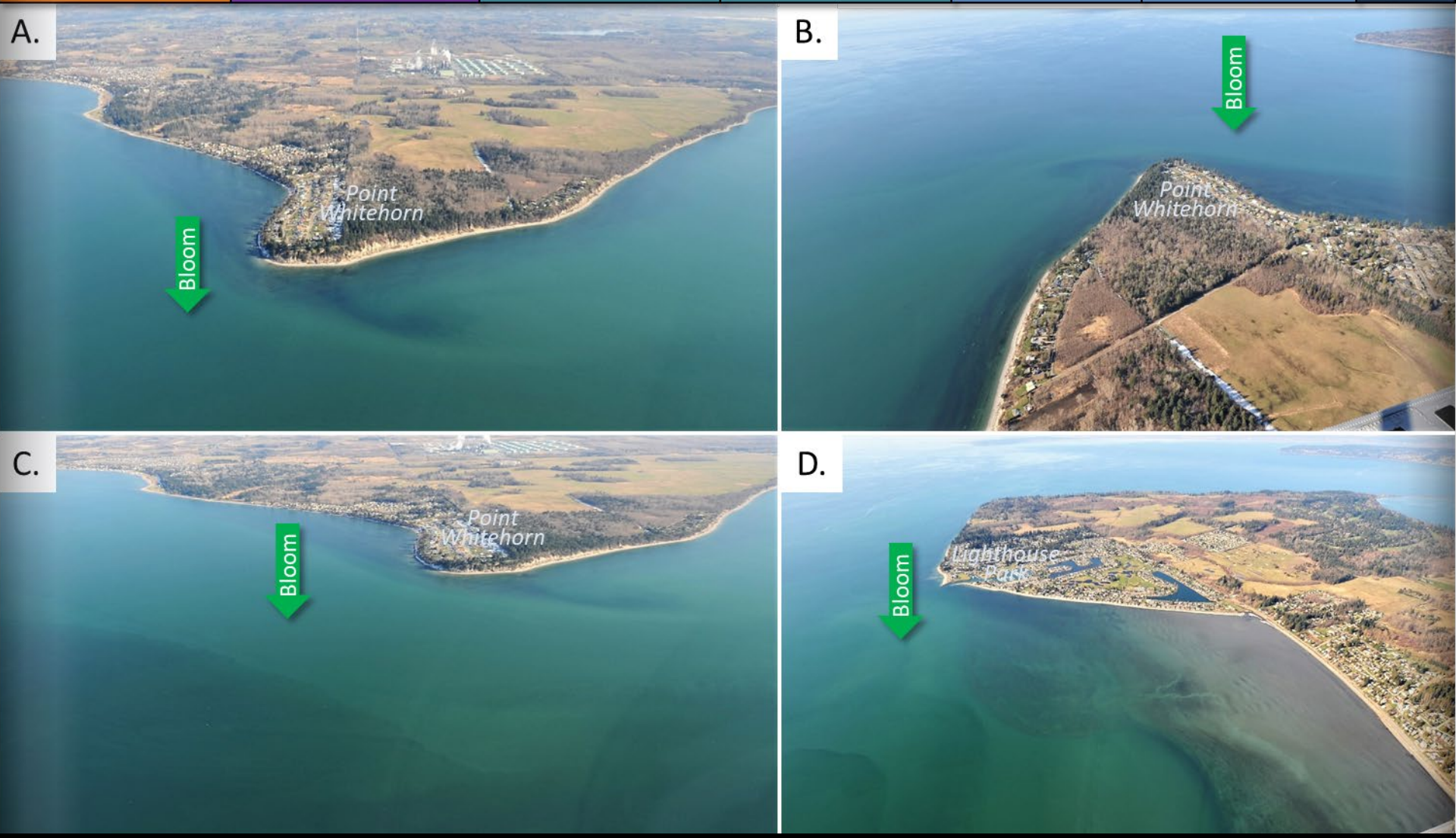
Location: Padilla Bay (North Sound), 12:54 PM

Aerial photography 2-25-2022

Quiet conditions near Anacortes. Location: Padilla Bay (North Sound), 12:55 PM

Bellingham Bay, a busy waterway. Oil tankers waiting to be filled at the Marathon Anacortes Refinery.
Location: Bellingham Bay (North Sound), 12:58 PM

Aerial photography 2-25-2022



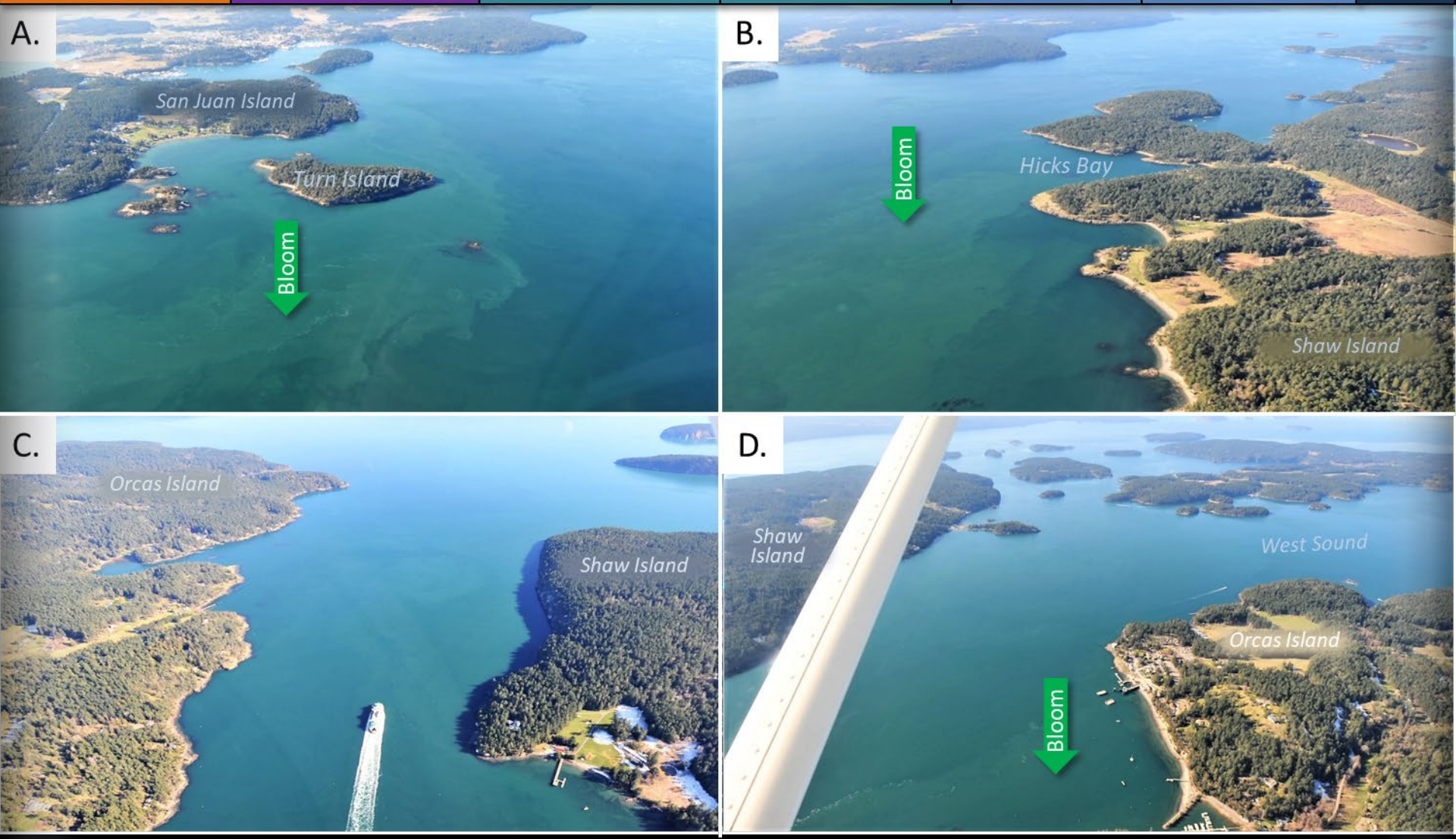
A-D. Local differences in the color of surface water, with bloom in Birch Bay.
Location: Birch Bay (North Sound), 1:10 PM

Aerial photography 2-25-2022

Internal waves traveling onshore off Birch Point.
Location: Birch Bay (North Sound), 1:11 PM

Aerial photography 2-25-2022

Different surface water mixes off Matia Island. Location: San Juan Islands (North Sound), 1:12 PM

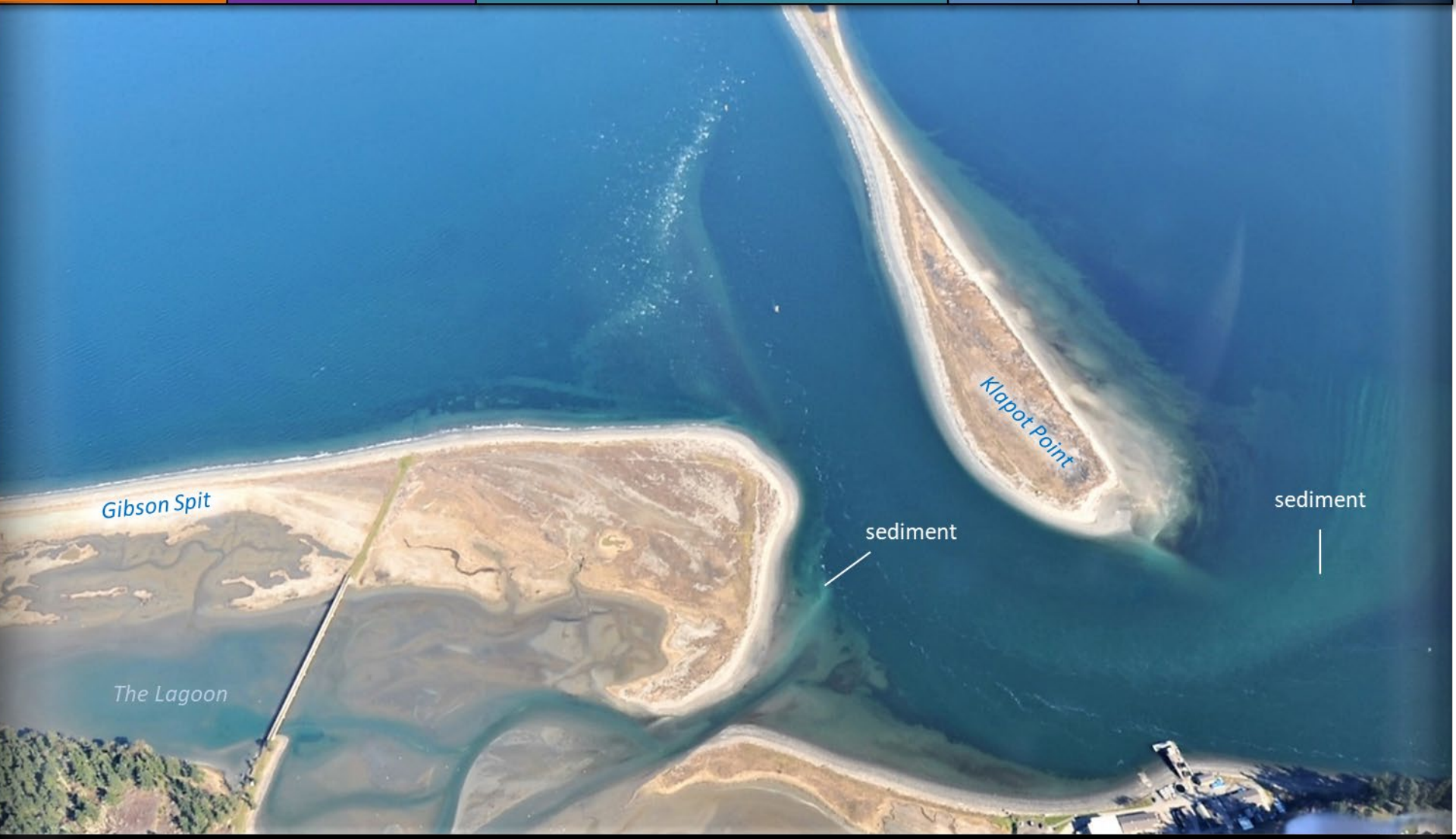


A-B. Strong tidal mixing of surface water containing a bloom. C-D. Beginning of a bloom. Location: A-B. south and C-D. north of Shaw Island (North Sound), 1:29 PM

Aerial photography 2-25-2022

Looking east over Fisherman Bay, in a beautiful setting of islands.
Location: Lopez Island (North Sound), 1:30 PM

Aerial photography 2-25-2022



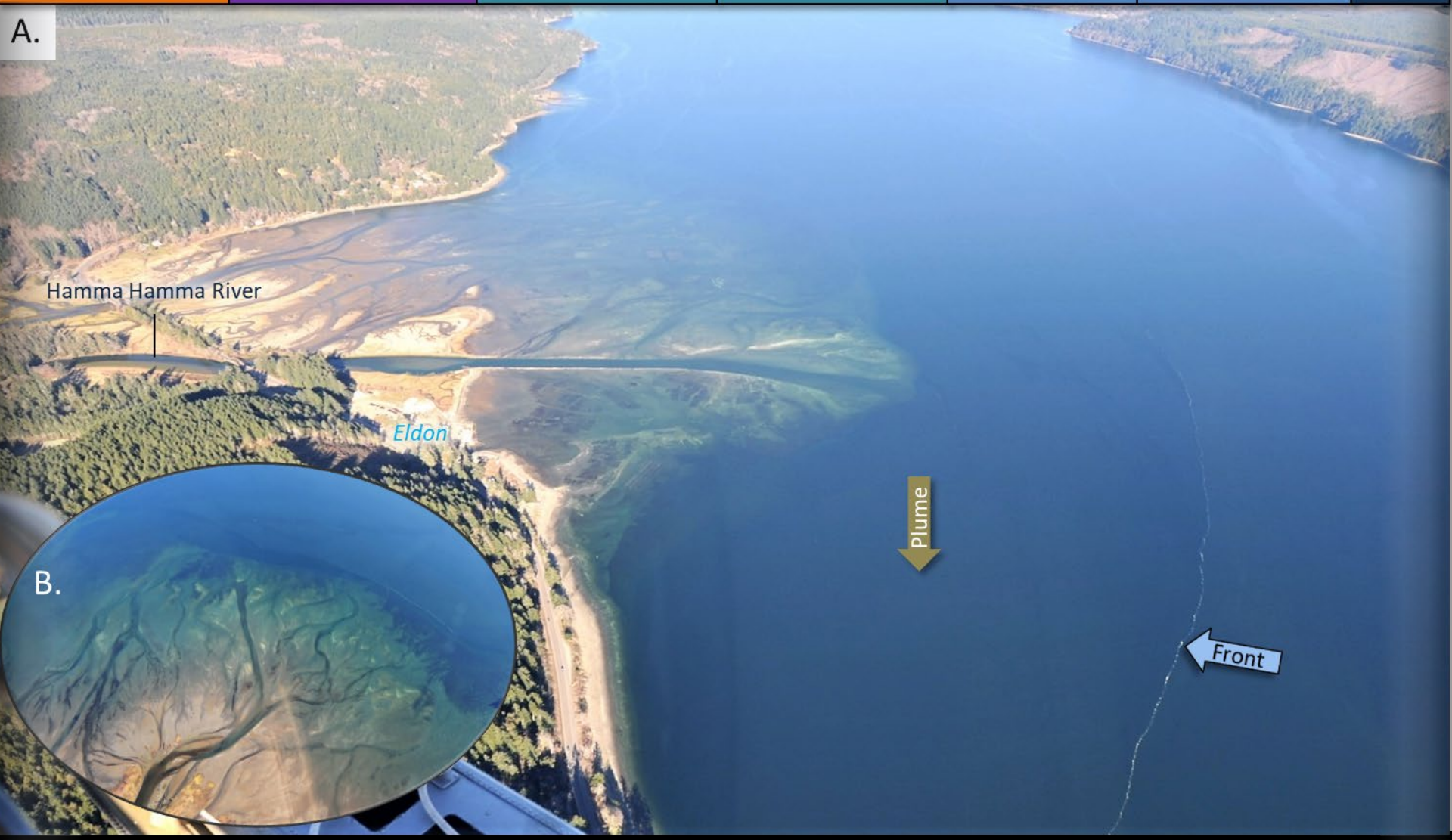
Incoming tide and suspended sediment.
Location: Sequim Bay (North Sound), 1:46 PM

Aerial photography 2-25-2022

A. Barge and many boats in Glen Cove. B. Beginning bloom. C. Plume of boggy water from Chimacum Creek. D. Southern tip of Port Townsend Bay. Location: Port Townsend Bay (North Sound), 1:54 PM

Aerial photography 2-25-2022

Faint indication of herring, potentially spawning.
Location: Quilcene Bay (Hood Canal), 2:04 PM



Hamma Hamma River delta and freshwater plume extending into Hood Canal.
Location: Eldon (Hood Canal), 2:11 PM

Aerial photography 2-25-2022

A newer oyster nursery system used to grow seed in Chapman Cove.
Location: Oakland Bay (South Sound), 2:33 PM

Aerial photography 2-25-2022

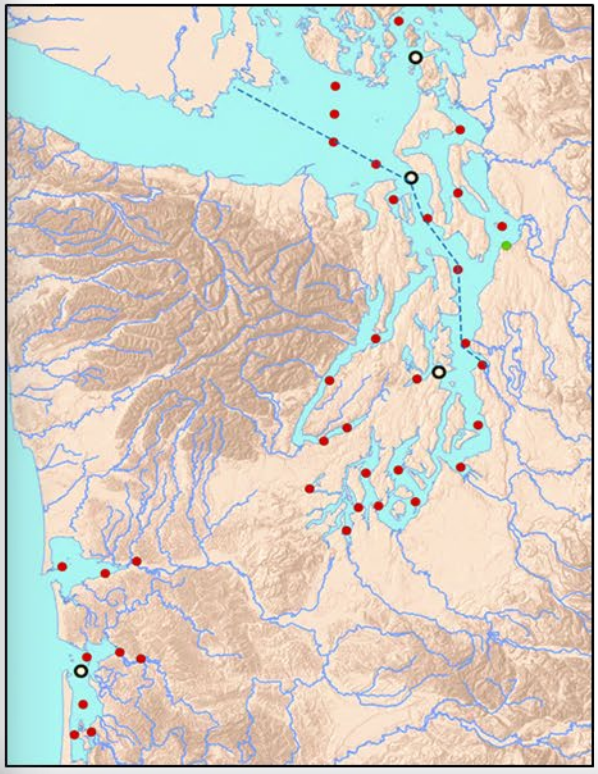
A. Front at edge of Deschutes River plume, B. Port of Olympia.
Location: Budd Inlet (South Sound), 2:41 PM

Cockpit of the De Havilland Beaver

Watch a video of one of Kenmore's seaplanes flying on a different mission over Seattle, here

Long-term monitoring data from Puget Sound and coastal bays

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



Get your data

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