



Eyes Over Puget Sound

[Summary](#)[People](#)[2011](#)[2012](#)[2013](#)[2014](#)[2015](#)[2016](#)[2017](#)[2018](#)[2019](#)[2020](#)[2021](#)[2022](#)[Data](#)

A decade in review...



Edition no. 100

A place where observations, people, adventure, art, and science meet

Times are changing...

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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We have reached 100 editions!

EOPS successfully helped us overcome a **dilemma of long-term monitoring programs**.

Presentation

Times are changing. We will be switching to a web integrated camera platform to inform you faster and more effectively on present surface conditions in Puget Sound.

A time capsule. The 100 published EOPS reports are in PDF format visually documenting conditions in the time period of 2011 to 2022.

We hope you will continue to make use of our images to inspire students, research, and environmental protection.



We thank you for your interest and positive feedback over the years, which enabled us to create this unique perspective in your own backyard.

I hope we see you on a new platform in the future under the same name: **“Eyes Over Puget Sound”**

Dr. Christopher Krembs (photographer of EOPS)

The story and future of Eyes Over Puget Sound report will be different

People with ideas...

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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Our field teams see amazing things on the water that we wanted to share.

“It all started over lunch with Brandon and Christopher envisioning what would be possible if one could marry satellite images with aerial photos taken during Ecology’s routine monitoring flights. Later they expanded on these ideas and figured out how to add one additional piece to the puzzle by adding en route ferry data to the program – many thanks to our partners at the Victoria Clipper!”



S. Pool, using ferry data, Read poster



Brandon Sackmann

[Read book chapter](#)

Combining scales of observations from satellites to aerial photos to surface transect measurements.

Supporting a vision...

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



A new idea needs
support to bring it to
life.



Creative communication

Advocacy & Management support

Agency support

Sandy Howard

Carol Maloy

Rob Duff

Thank you to great leadership that fostered innovative approaches to marine monitoring

Public Attention...

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
ECOS Award														
Encyclopedia of Puget Sound														
Encyclopedia of Puget Sound														
Book Chapter														
King 5 News														
King 5 News														
Kiro 7 News														
Kiro 7 News														
Kitsap Sun														
Kitsap Sun														
Kitsap Sun														
KOMO News														
KUOW														
KUOW														
Seattle Times														
Ecology blog														
Journal of Olympia														
KGMI														
Patch														
Symposia														

Giving Puget Sound water quality a face while sharing outreach material

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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Monitoring is a long-term commitment carried by many.

As the decades go by, it is time to reflect upon the evolution of the marine monitoring program. We would like to acknowledge and thank the marine monitoring staff that have built the foundation for marine flights and moorings since 1973. Many good times have been had, and we have come a long way. The data speak a story!



Brad Hopkins



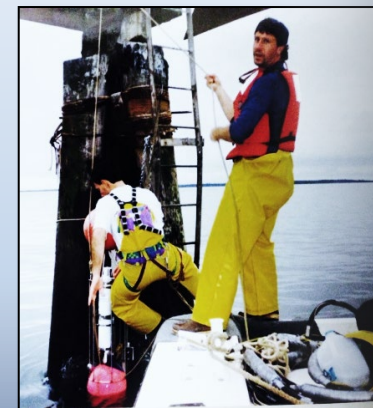
Skip Albertson,
Bernie Strong



Carol Falkenhayn Maloy



Jan Newton



Casey Clishe, John Summers

1973

1999

Dale Norton
Joe Joy
Brad Hopkins
Eric Egbers
Greg Cloud

Gerald McDonald
Will Abercrombie
Dale Clark
Sharon Chase
Ann Haines
Shirley Prescott

Carol Janzen
Wayne Heath
Bernie Strong
Lisa Eisner
Sharon Bell
Mark Golliet
Skip Albertson

Angie Thomson
Casey Clishe
Margaret Edie
Carol Maloy
Jan Newton
Chris Moore

Sandra Weakland
Julia Bos
Eric Siegel
Kara Van Voorhis
John Summers
Anne Petrenko

Julia Bos,
Stephanie Jaeger



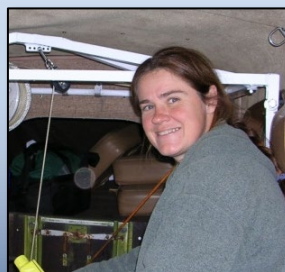
Ingredients to success:

Consistent data quality comes with a commitment to detail, supporting staff, detailed documentation, transparency, ongoing data and method scrutiny, and a passion to improve.

Jessica Archer



Lynn Schneider

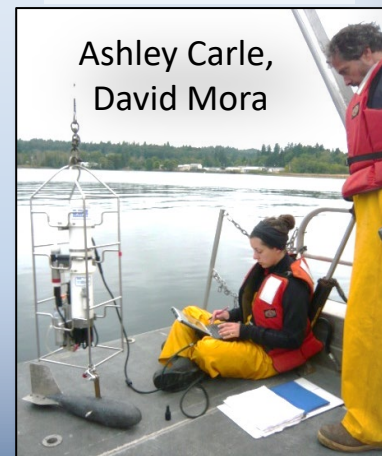


Simone Hoffer,
Ryan McEliece



Zack Holt

Ashley Carle,
David Mora



2000  2014

Judah Goldberg
Rick Reynolds
Katherine Cox
Noel Larson
Brion Dolan
Brian Grantham

Stephanie Jaeger
Jessica Archer
Lynn Schneider
Ryan McEliece
Adrienne Stutes
Simone Hoffer

Jessica Bennett
Marissa Jones
Mya Keyzers
Zack Holt
Christopher Krembs
Brandon Sackmann
David Mora

Ashley Carle
Laura Hermanson
Suzan Pool
Julianne Ruffner
Christopher Clinton
Clifton Herrmann
Brooke McIntyre

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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A maturing program:

As monitoring datasets continue to grow in value and volume, the continued investment into data management, documentation, and relentless scrutiny of data quality become increasingly important and complex.



Mya Keyzers



Laura
Hermanson



Allison Brownlee



Suzan Pool



Holly
Young



Natalie
Coleman



Micah
Horwith



Stephen Gonski



Elisa
Rauschl



Christopher
Krembs



Chris Jendrey

2015  2022

*Mattie Michalek
Nichole Marks
Allison Brownlee
Juhi LaFuente*

*Stephen Gonski
Tyler Ransier
Grace McKenney
Ventus Pearce*

*Elisa Rauschl
Natalie Coleman
Micah Horwith*

*Chris Jendrey
Holly Young
Suzan Pool*

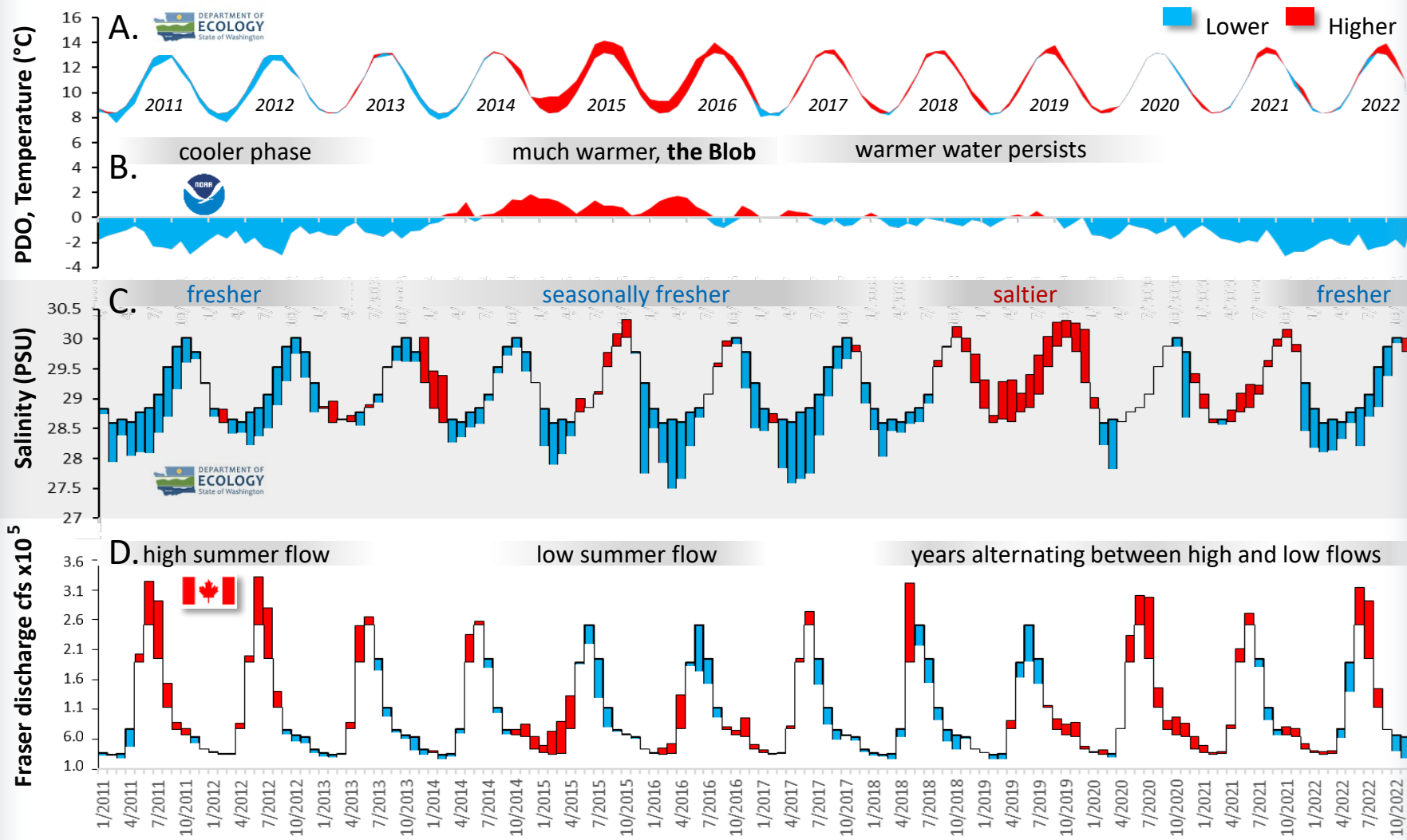
Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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The Blob, a marine heatwave in the Pacific Ocean, go to next page

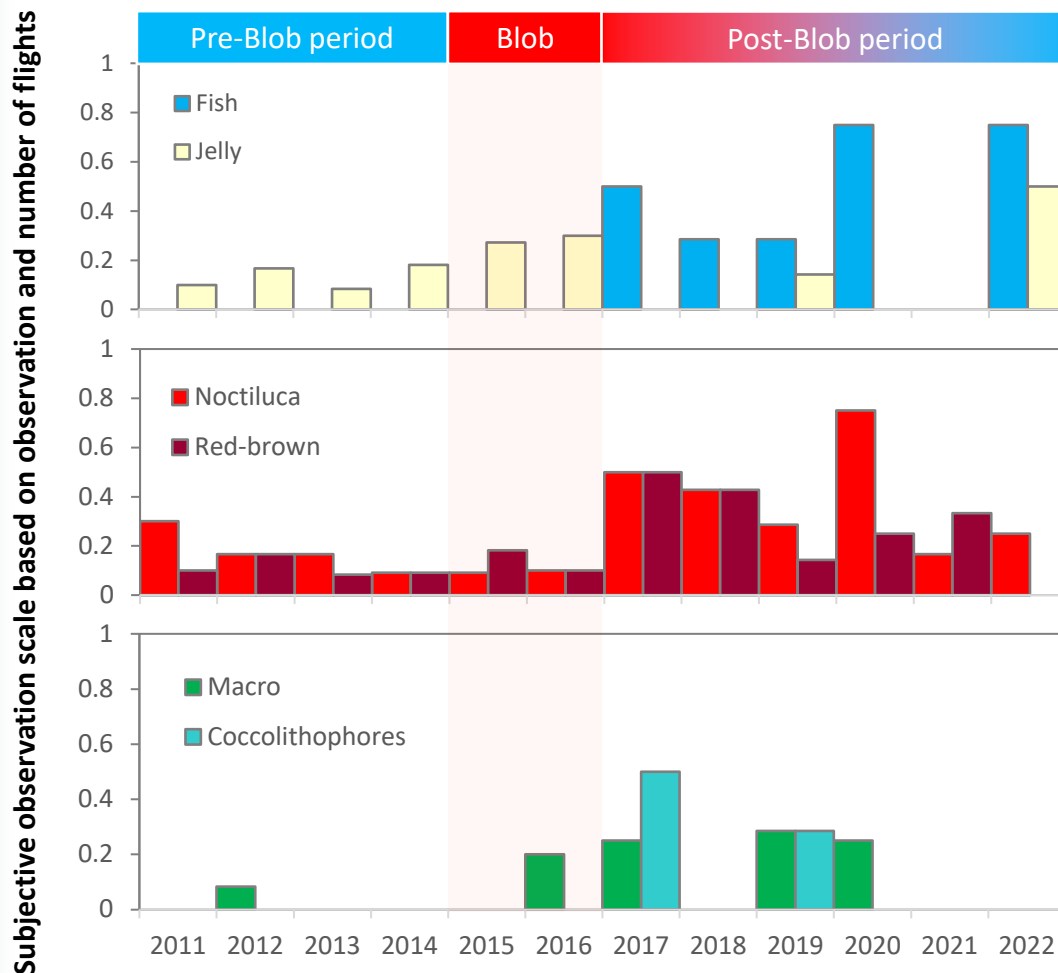
2011-22 Puget Sound before, during, and after the Blob

2011	Noctiluca abundant, we see our first jellyfish smacks
2012	Noctiluca and its grazing impact, red blooms, jellyfish
2013	Noctiluca in masses and diverse places
2014	Sediment from Oso landslide , jellyfish on the rise
2015	Jellyfish masses, Noctiluca, blooms, and sediment
2016	Jellyfish masses, Noctiluca, macroalgae, and blooms
2017	After the blob, diverse big blooms, macroalgae, fish
2018	Bright red blooms, Noctiluca, macroalgae, and fish
2019	Coccolithophore, Noctiluca, macroalgae, and fish
2020	Abundant fish, people contributing amazing pictures
2021	Noctiluca, and many blooms in bright colors, geese
2022	Abundant fish, jellies are back, and sediment

Snow and rivers respond to periods of increased temperatures. The Blob B. from 2015 to 2016 seen as high Pacific Decadal Oscillation Index values (PDO) raised water temperatures A., changed the Fraser River discharge D., and lowered surface salinities C. in Puget Sound, followed by a saltier period two years later in 2018-19.



Marine Monitoring programs are in a position to use an abundance of observations and formulate hypotheses to further engage science on pressing climate related issues. In the following decadal review, we illustrate the effect of a two-year climate disturbance, the Blob, on surface observations in the larger Puget Sound region.



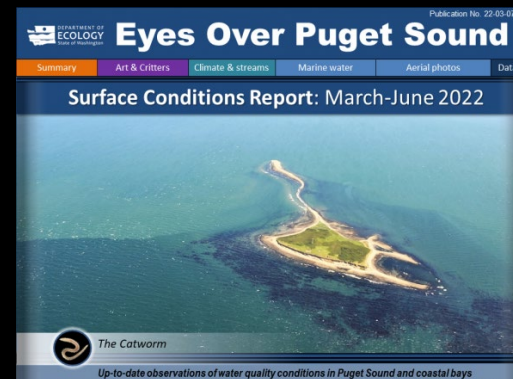
A decade of aerial documentary can reveal patterns despite limited observations over space and time. For example, it appears that Puget Sound responds to a large disturbance characterized by a period of warm water: the Blob.

We noted a transition from abundant jellyfish to schools of anchovies for many terminal inlets. Likewise, the frequency and extent of Noctiluca and other red colored blooms increased temporarily after 2016. Likewise, so did macroalgae and coccolithophore blooms. While subjective, this is an interesting ecosystem response.

What we presented at the 2018 Salish Sea Ecosystem Conference, [read here](#)

2022

A third year of La Niña weather and changes at Kenmore Air made flying for aerial photography challenging. Due to the La Niña, the winter of 2022 was especially cold and wet, resulting in a good snowpack. Low air temperatures, rain, and late snow accumulation in the mountains pushed back the discharge of meltwater to Puget Sound in stark contrast to the Blob years, where snow melted and discharged into Puget Sound prematurely. Jellyfish patches were small in South Sound. Central Sound saw more oxygenated conditions. By June, a high number of schooling fish appeared in South Sound and Whidbey Basin. By late summer, weak upwelling off the coast meant likely less nutrient-rich upwelled water to Puget Sound and could be a possible explanation of low productivity and clearer water. By October, smoky air from forest fires confined our flight to southern and central Puget Sound where we documented some remnant blooms as well as jellyfish.



Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Patches of jellyfish and a red-brown and turquoise blooms. Location: Budd Inlet (South Sound), 11:57 AM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Puyallup River plume seen from the river side.
Location: Commencement Bay (Central Sound), 12:47 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



*High number of schooling fish. On the image, we count more than 85 schools (marked with white vertical lines).
Location: Case Inlet (South Sound), 12:05 PM*

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Strong discoloration of water in Port Susan by bloom and sediment. Fronts surrounding the Stillaguamish River plume. Location: Port Susan (Whidbey Basin), 12:46 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Green bloom mixed with nearshore suspended sediment.

Location: Similk Bay (Whidbey Basin), 12:56 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Eddy and suspended sediment in Outer Bay. Greener water in Inner Bay.

Location: Lopez Sound (San Juan Islands), 1:13 PM



People contribute their observations



Summary

People

2011

2012

2013

2014

2015

2016

2017

2018

2019

2020

2021

2022

Data

A.



B.



Tomato soup on the waterfront (Russel Barsh for KWIAHT, May 11, 2022)
theorcasonian.com/tomato-soup-on-the-waterfront/


Photo courtesy of Anita Holliday

A repeating observation of Noctiluca blooms in East Sound, Orcas Island.

A. Mya Keyzers, 7/14/2021. B. Anita Holliday, 5/11/2022.

2021

The year 2021 was generally drier and warmer including a heat wave in June. Higher river flows followed a rainy and cloudy fall. In 2021, EOPS aerial images continued to capture the diversity of phenomena on the water, with support from its wonderful contributors who documented visible water quality issues across the larger Puget Sound region. With our Artists Corner and story maps on critters in the mud, we hope to continue to inspire, educate, and motivate our community to keep curious and watchful eyes over the environment.




DEPARTMENT OF
ECOLOGY
State of Washington

Publication No. 22-03-070

Eyes Over Puget Sound

Overview
Art & Critters
Awesome people
New tools
Combined factors
Aerial photos
Data


Surface Conditions Report: 2021 in review




Eyes Over Puget Sound
Surface Conditions Report: February 3, 2021




Eyes Over Puget Sound
Art & Critters: Flower



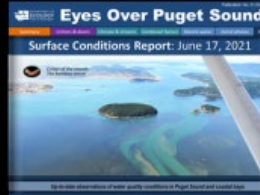
Eyes Over Puget Sound
Surface Conditions Report: Sept 8, 2021



Eyes Over Puget Sound
Surface Conditions Report: March 11, 2021



Eyes Over Puget Sound
Surface Conditions Report: April 1, 2021



Eyes Over Puget Sound
Surface Conditions Report: June 17, 2021

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

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

A.



A. Large flock of geese floating in open water. B. Geese landing in formation in open water. Read more [here](#)
Location: A. Padilla Bay, B. Skagit Bay (North Sound), 1:35 PM

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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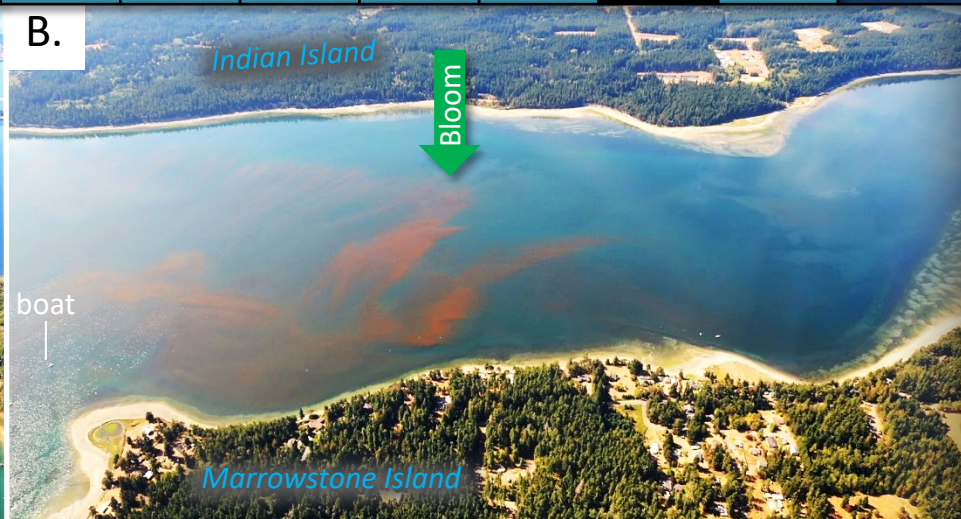
*Bloom along front in Mosquito Bay originating in Horseshoe and Mitchell Bays.
Location: San Juan Island (San Juan Islands), 1:24 PM*

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



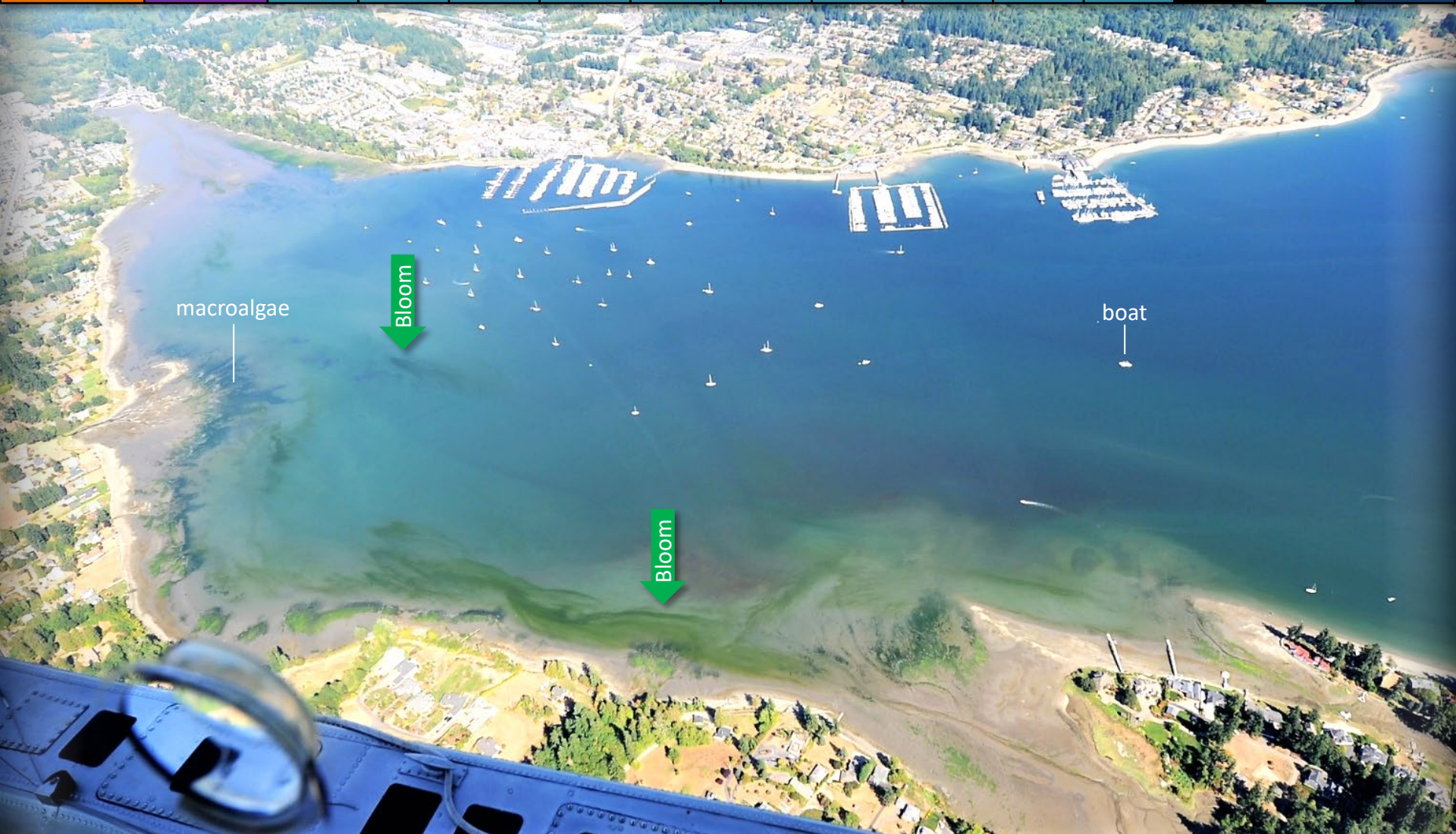
Strong red-brown bloom.
Location: Budd Inlet (South Sound), 11:34 AM

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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Very red-brown bloom spanning the entire length of Kilisut Harbor, from the entrance of the bay to Scow Bay.
Location: Marrowstone Island (Central Sound), 1:50 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



macroalgae

Bloom

boat

Bloom

Bright-green bloom patches in shallow portions of Liberty Bay.
Location: Liberty Bay (Central Sound), 2:02 PM

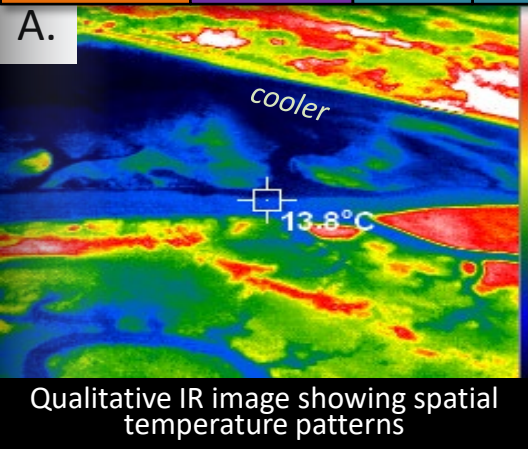
Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



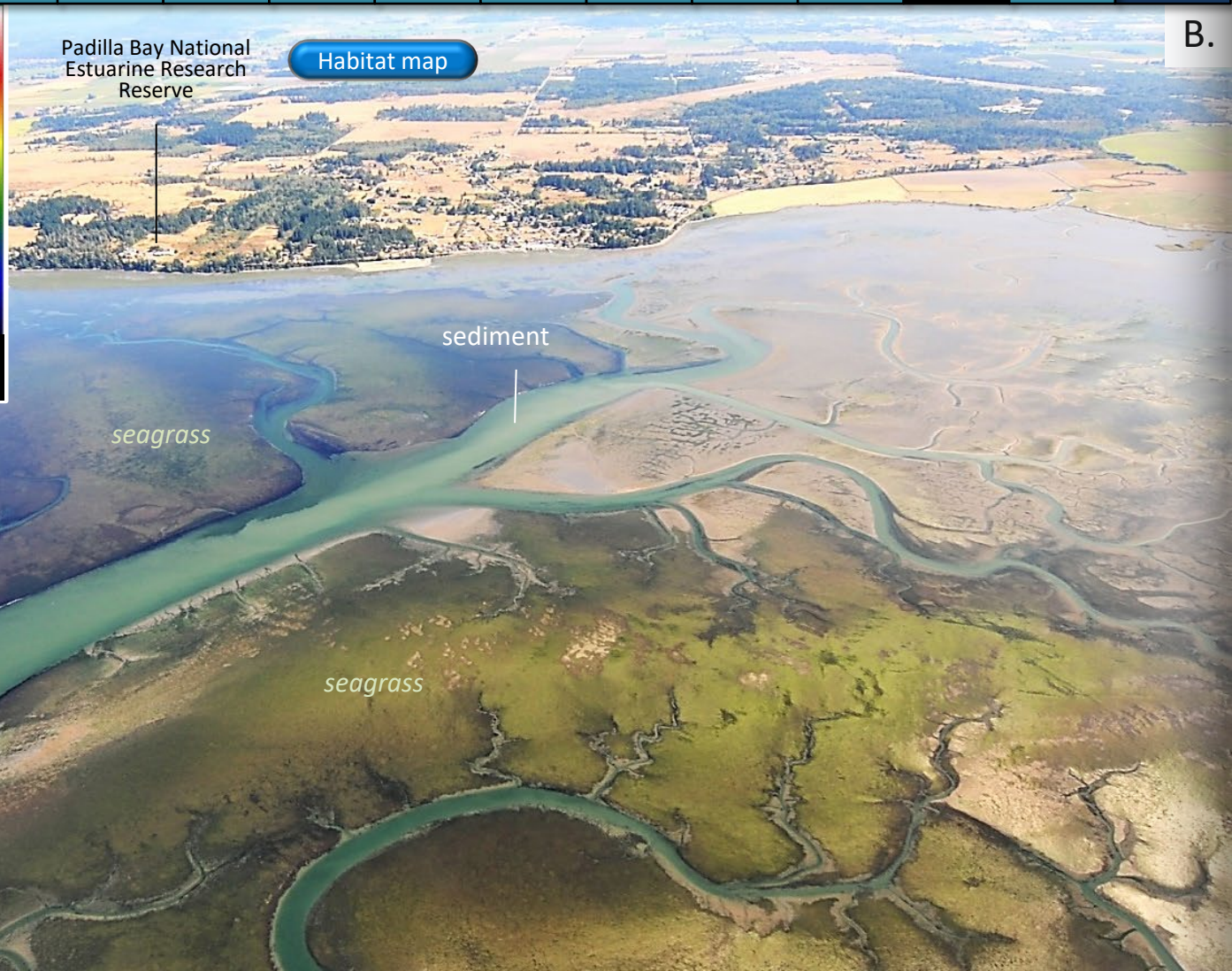
*Strong red-brown bloom with turquoise water mixing in from Chapman bay.
Location: Henderson Inlet (South Sound), 2:30 PM*

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

A.



B.



Padilla Bay seagrass experiences much cooler temperatures north of the tidal gully. Sediment from south of the gully discolors the water. Location: Padilla Bay (North Sound), 12:35 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

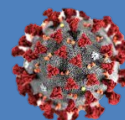
Noctiluca reported on 7/2/2021 near Alki Point (ERTS #707751)



*Puyallup River plume with glacial flour, bloom, and orange organic debris (likely Noctiluca) accumulating at front.
Location: East of Maury Island (Central Sound), 2:22 PM*

2020

Critters in the sediment and water are a testament that life continues in beautiful ways, and it's worth going for a dive in Puget Sound when the water is clear. Despite wildfires and a lot of smoke during a dry late summer, precipitation and flows of major rivers were as expected, or even above normal, for most of the year. With volunteers sending in images on the water we can say that 2020 was a productive year for Puget Sound. Schools of herring were abundant, Noctiluca blooms were big and numerous, and large amounts of decaying organic material washed onto beaches.



The COVID-19 pandemic of 2020 resulted in an information gap in our work between March and September. Our field crew restored full capacity and data collection, and aerial photography resumed in September.

Publication No. 21-03-070

Eyes Over Puget Sound

Summary Stay connected COVID Stories Critters & Divers Climate and streams Aerial photos Info

Eyes Over Puget Sound
Surface Conditions Report: March 16, 2020
Picture of the month: The humpback colony

Eyes Over Puget Sound
Surface Conditions Report: October 26, 2020
One fully shunting herring

Eyes Over Puget Sound
Surface Conditions Report: September 28, 2020
Herring share their observations

2020 in Review

Up-to-date observations of visible water quality conditions in Puget Sound and the Strait of Juan de Fuca

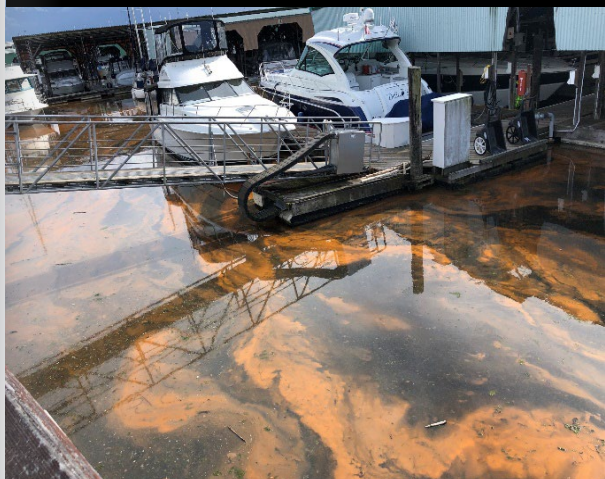


People contribute their observations



Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

Des Moines Marina, 6/7/20 (Robin Beck)



Three Tree Point, 6/7/2020 (Elisa Rauschl)



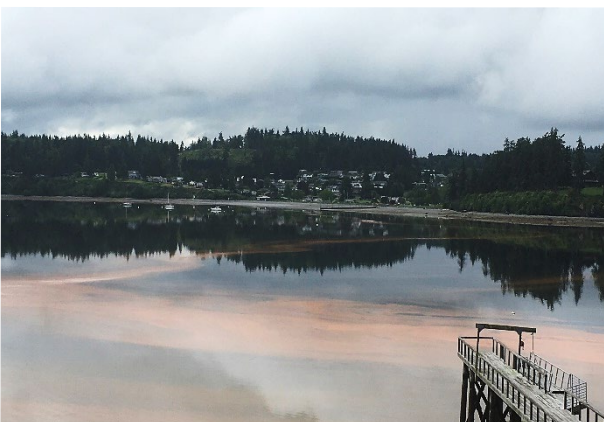
Lincoln Park 6/10/2020 (Ben Budka)



Chuckanut Bay, Bellingham Bay, 8/4/2020
(Steve Tuckerman)



Holmes Harbor, 6/16/2020 (Christine Goodwin)



Saddlebag Island, 8/11/2020 (Kathryn Sobocinski)



Noctiluca is a putative eutrophication indicator that thrives when excess organic material is present.



People contribute their observations



Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

A.

Bowman Bay, 7/16/2020 (Julie Morse)



B.

Allyn-Grapeview, Case Inlet, 7/29/2020 (Michael Joffe)



Algae blooms can come in all colors, sometimes bright yellow-green as in A. Bowman Bay, or B. brown-red such as the *Protoceratium reticulatum* bloom in Case Inlet which persisted for several months.



People contribute their observations



Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

Redondo, 9/1/2020 (Cliff Coomber)



Dash Point State Park, 8/30/2020 (Katharine Ellingson)



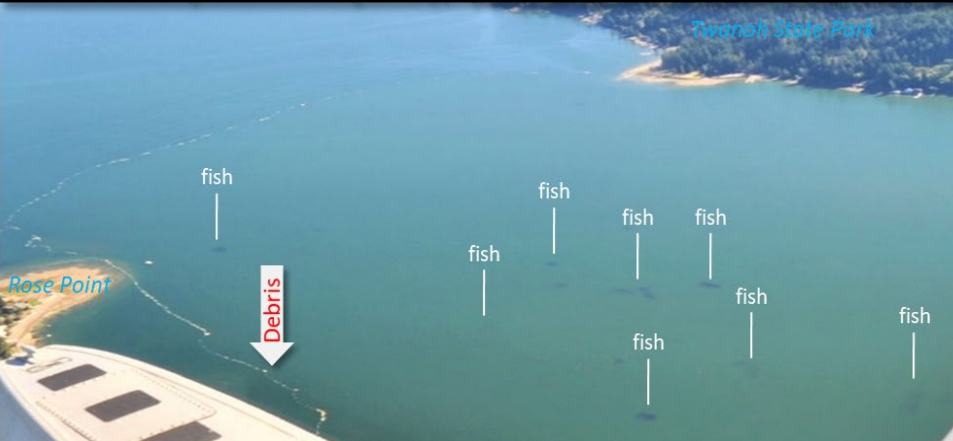
Tramp Harbor Docton, 8/27/2020 (Karlista Rickerson)



Tramp Harbor, *Protoceratium reticulatum* bloom in August (Karlista Rickerson)

When organic material and debris from excessive amounts of algae die, it washes onshore as mucus.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Schools of fish near the surface.
Location: Twanoh State Park, (Hood Canal)

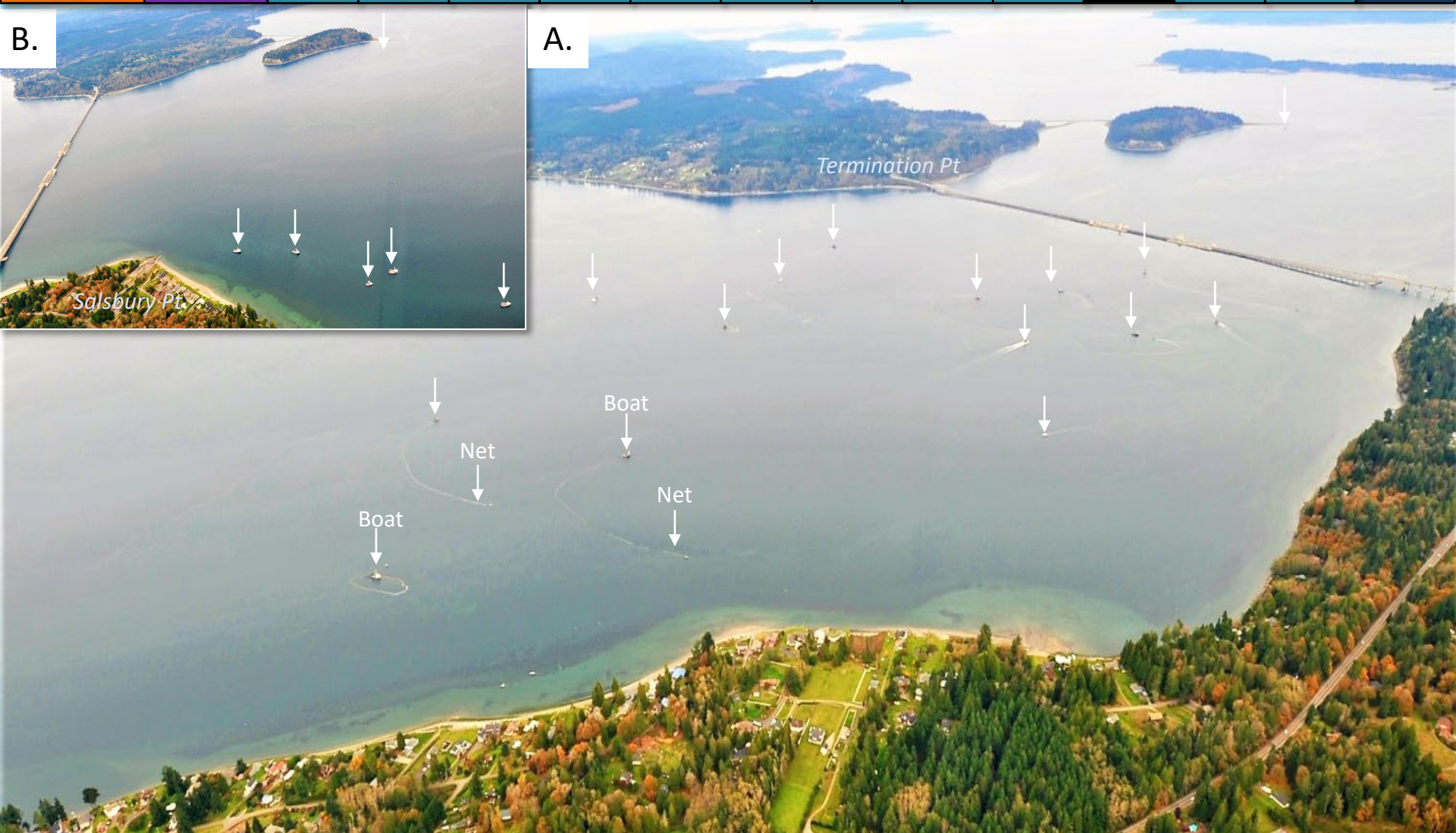


Several large schools of fish around Point Jefferson.
Location: Port Madison (Central Sound)



Isolated red-brown bloom surrounded by schools of fish.
Location: North Bay, Case inlet
(South Sound)

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A. A dozen fishing vessels harvest the annual chum salmon run south of the bridge, B. while others are waiting north of the bridge. Location: Hood Canal Bridge, (Hood Canal)

2019

2019 started with snow, and a summer drought kept river flows low. As a result, salinities in Puget Sound were elevated year-round. Warmer surface water temperatures in spring gradually extended to greater depth by late summer. The spring bloom was strong, and South Sound provided optimal conditions for anchovies that showed up in high numbers. A coccolithophore bloom stained Hood Canal turquoise, and Port Angeles and Discovery Bay were colored red-brown by strong blooms. Noctiluca and macroalgae, both known eutrophication indicators in coastal regions, were abundant in Central Sound, and extended into South Sound and Whidbey Basin. Large numbers of jellyfish occurred in Quartersmaster Harbor, Sinclair Inlet, and parts of Orcas Island.



Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

Scientists catch anchovies in shallow and deep water of Case Inlet

Todd Sandell, DFW



Phillip Dionne, DFW

Steve Jeffries, DFW

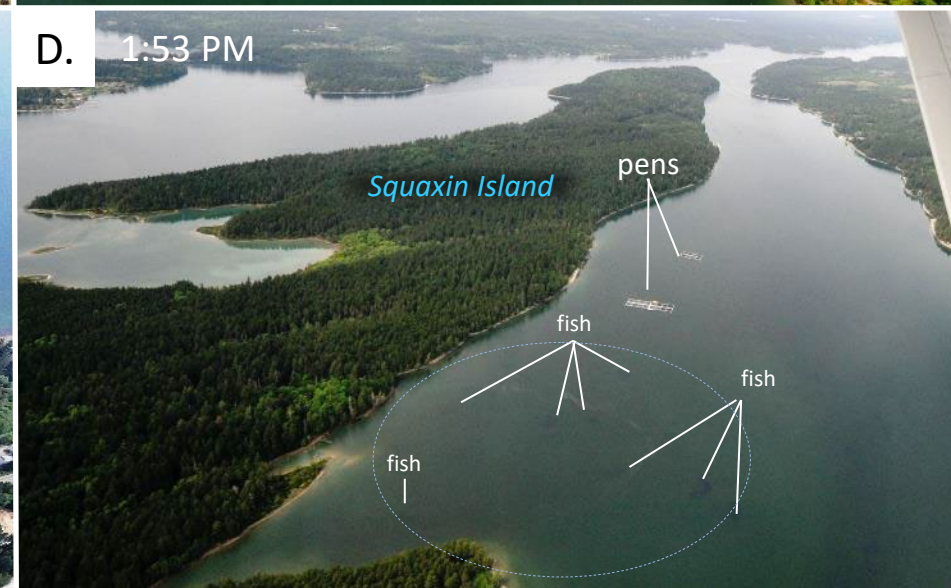
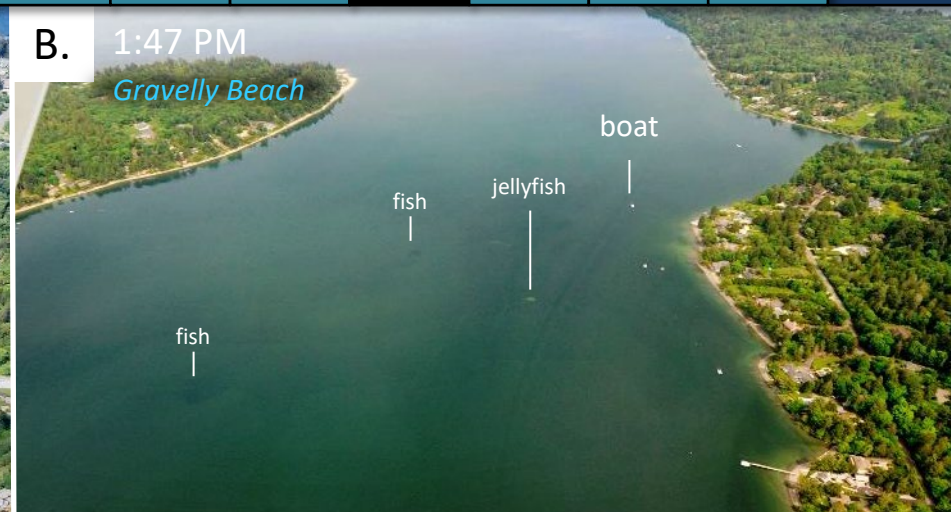
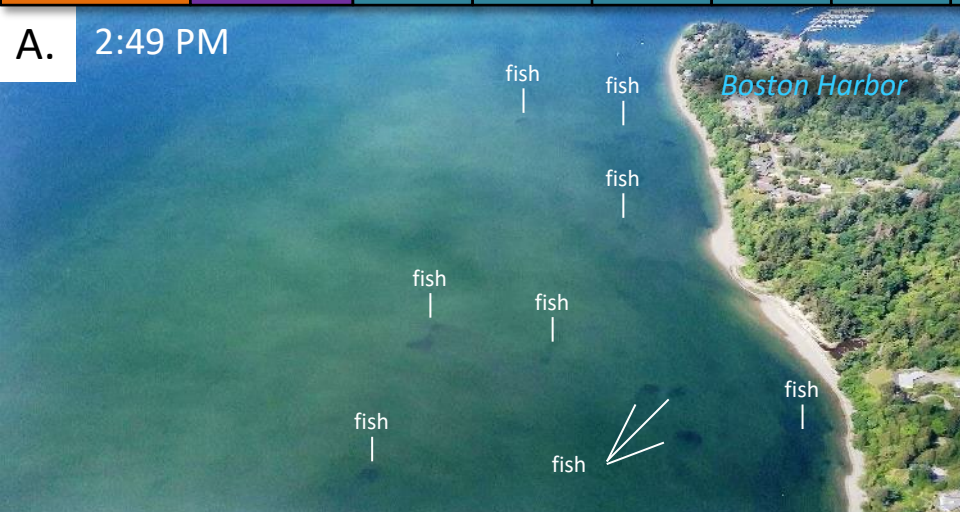


beach seining

juvenile anchovy

Large numbers of juvenile anchovy began to appear in South Sound with warmer water in the fall of 2015 and have been present in annual fall surveys since then. Here is an example of 250K juvenile anchovies caught with only one net set.

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Schools of fish in shallow regions of South Sound.

Location: A. Budd Inlet, B. Eld Inlet, C. Case Inlet (North Bay), D. Peale Passage (South Sound)

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



We share people's experiences with Noctiluca on the water. Thank you for the great contributions.
Location: A. Des Moines Marina, B. Holmes Harbor, C. Edmonds, D. Port Blakely, E. Central Sound

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



*Large Noctiluca bloom stretching from Poverty Bay to West Point.
Location: Shorewood (Central Sound), 2:15 PM*

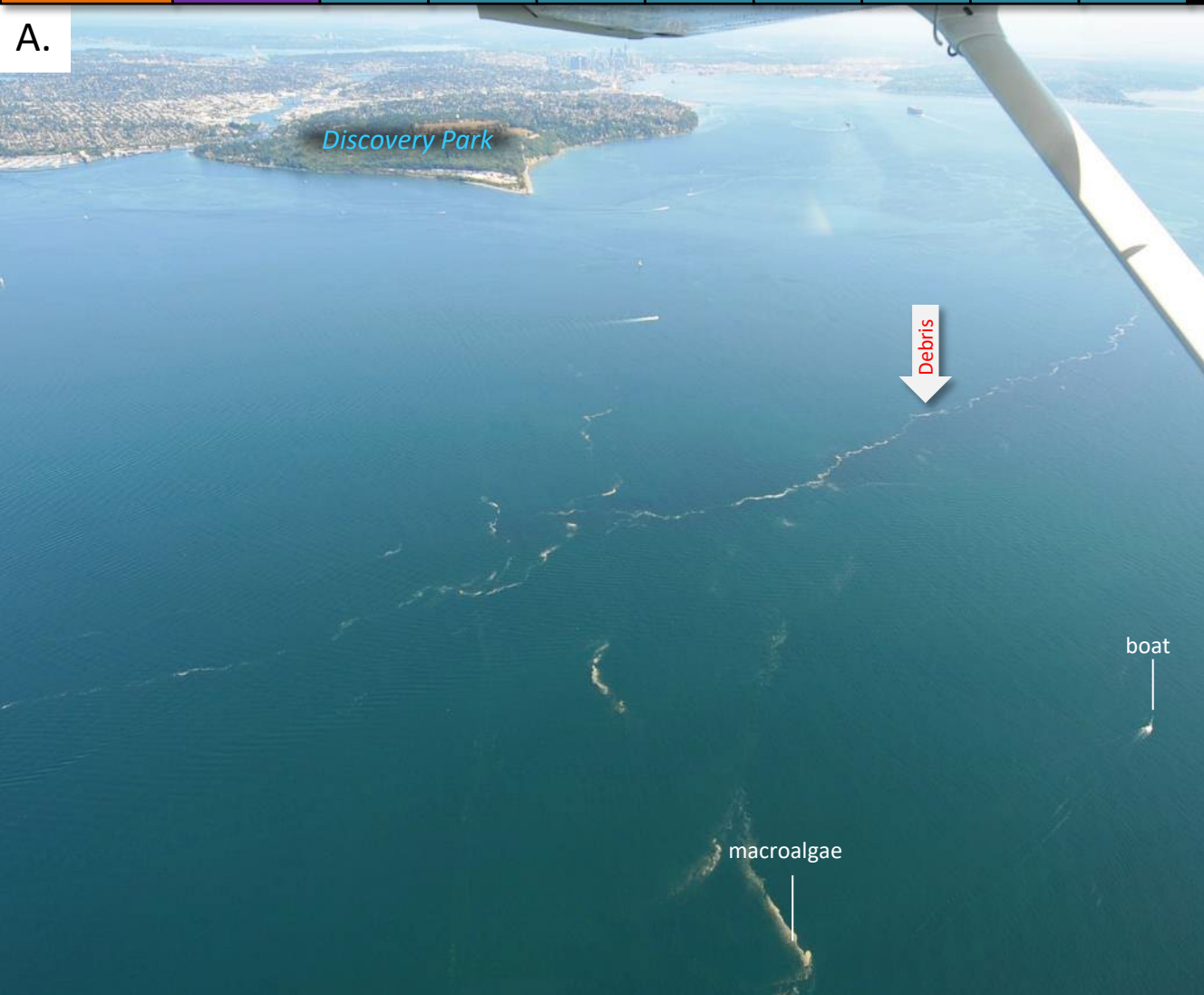
Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Large rafts of macroalgae stretching along the shores of Manchester.
Location: Manchester (Central Sound), 2:41 PM

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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A.



B.



C.



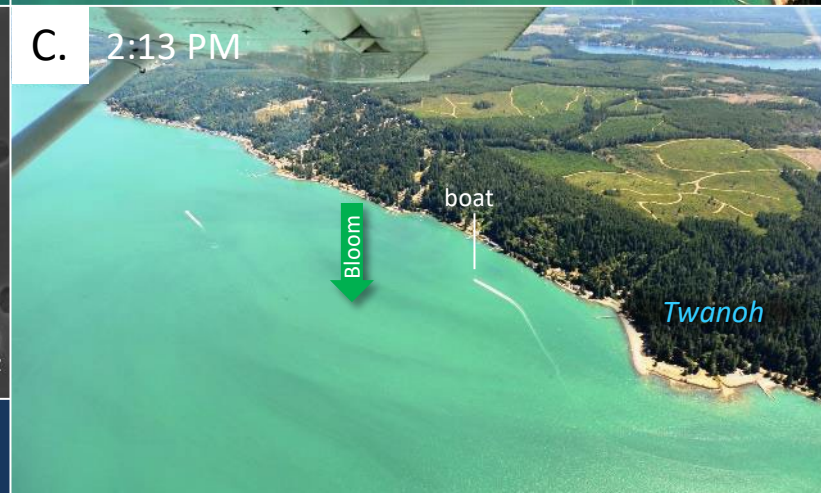
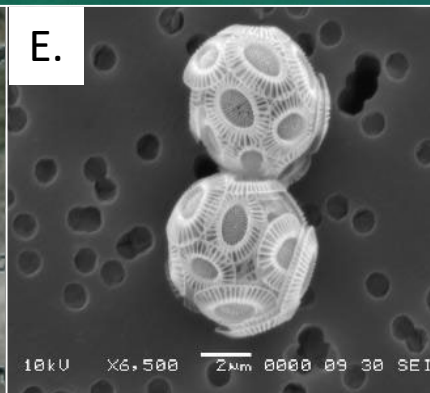
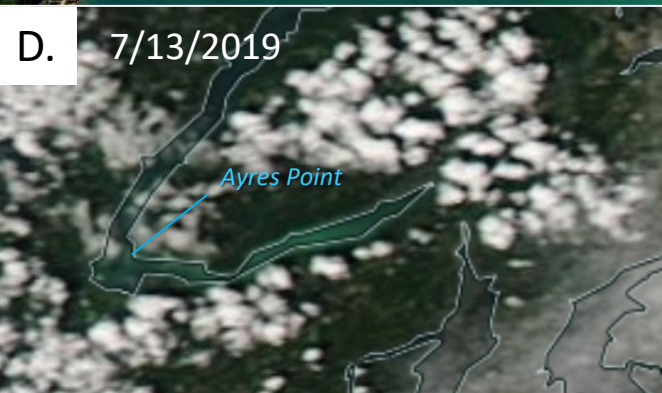
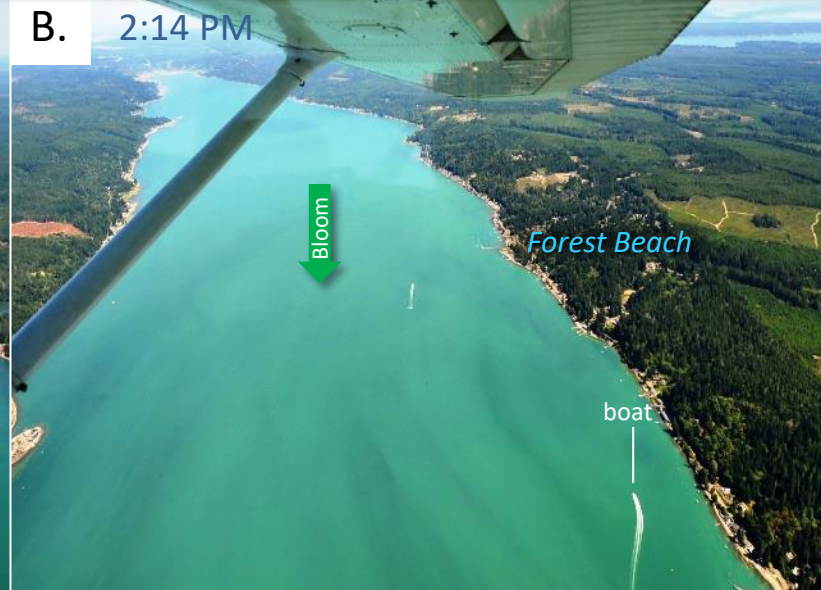
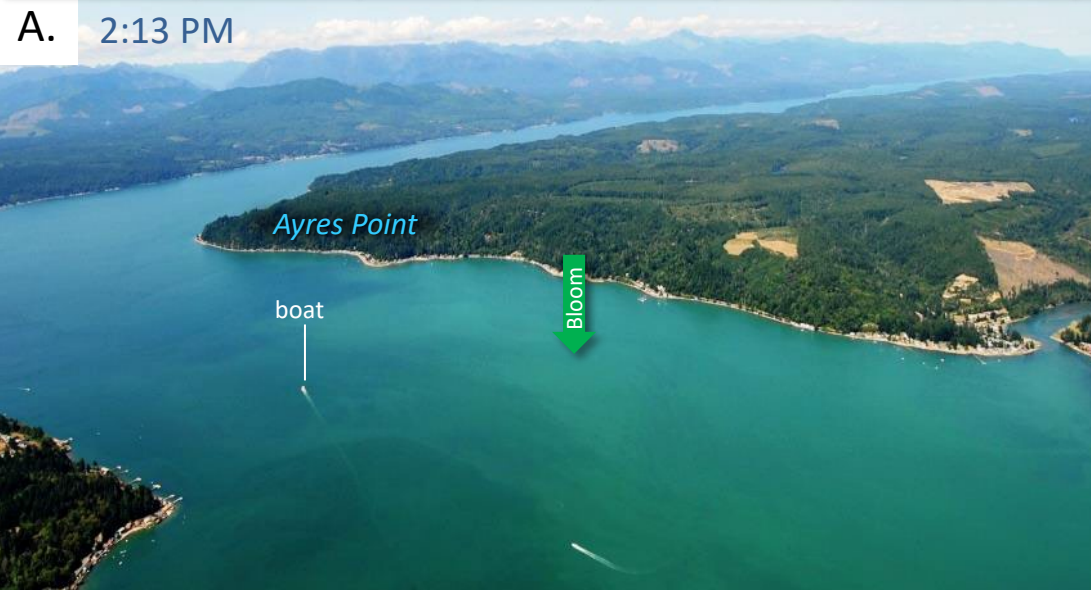
D.



A. & B. Large rafts of macroalgae. C. Macroalgae washing onto beaches. D. Beachgoers touching macroalgae.

Location: A. Across Discovery Park, B. Blakely Harbor, C. Burien, D. Dash Point (Central Sound), 2:39 PM

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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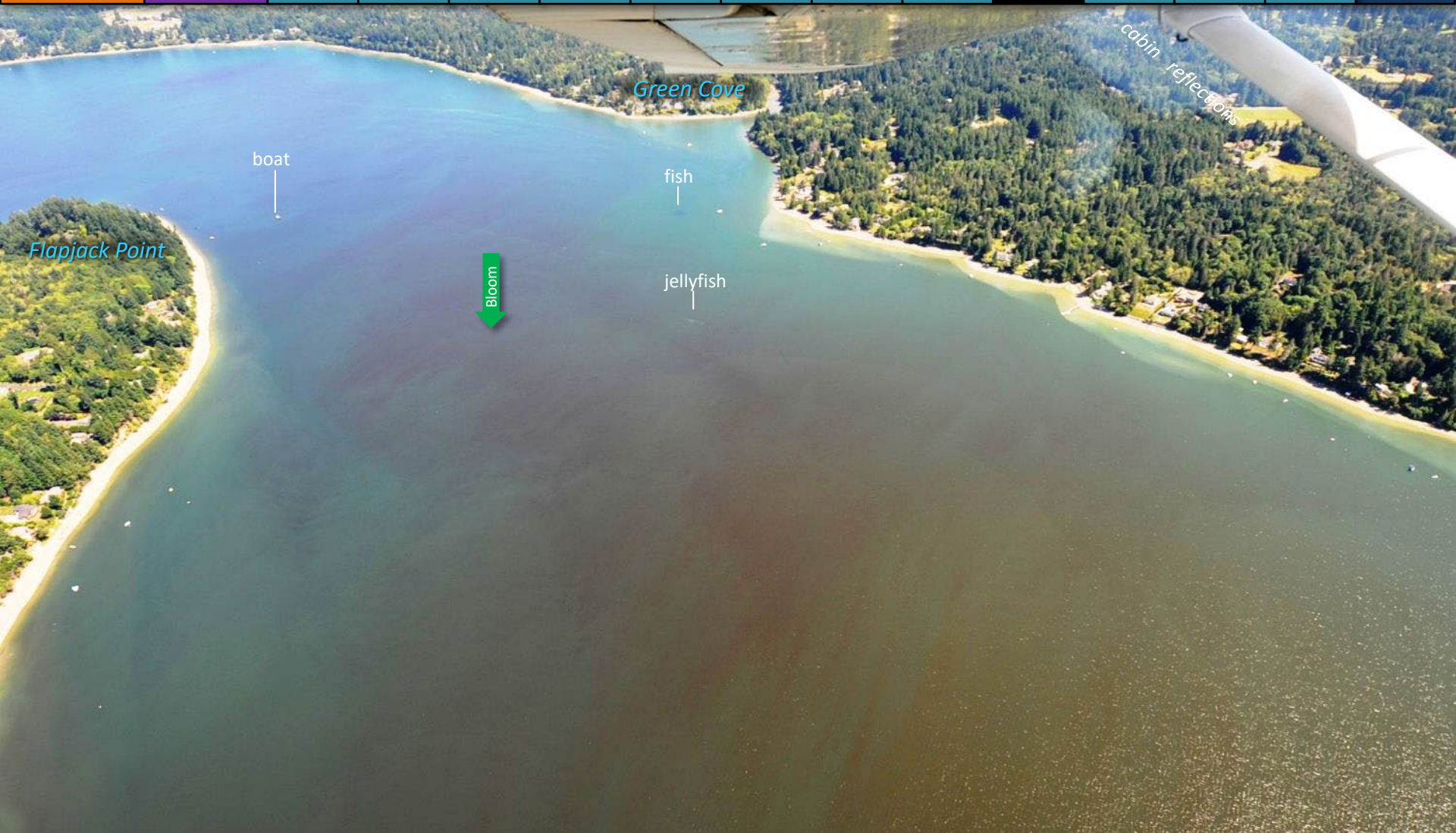


D. NASA satellite image southern Hood Canal

E. Microscopic coccolithophore

*Strong coccolithophore bloom stretching from Union (A) to Lynch Cove (B). C. Twanoh State Park.
Location: A–D. Southern Hood Canal (Hood Canal)*

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Red-brown bloom, schooling fish, and a patch of jellyfish.

Location: Eld Inlet (South Sound), 1:49 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Red-brown bloom and very turbid water.
Location: Quartermaster Harbor (Central Sound), 2:20 PM

2018

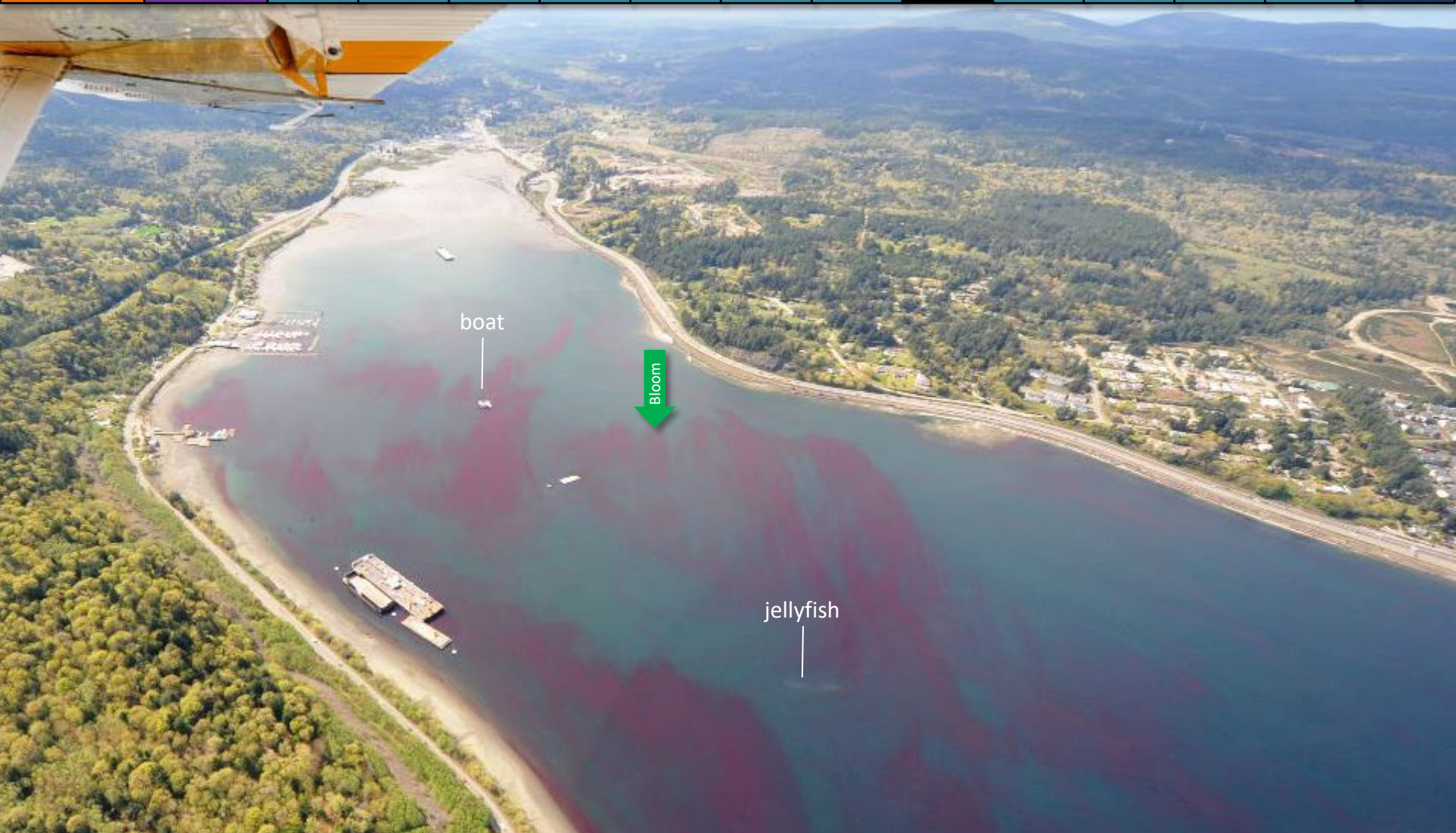
In 2018, water temperatures were slightly warmer than normal. Aerial photos revealed many spawning herring and baitfish as well as algal blooms. We also saw abundant macroalgae, a persistent Noctiluca bloom, and countless red blooms. Were these observations related to the cool, wet spring followed by a warm, dry, and sunny summer? Or did the neutral boundary conditions in the Pacific Ocean also play a role? A full summary is available in the report.

Publication No. 19-03-070



The screenshot shows the 'Eyes Over Puget Sound' website interface. At the top is the Department of Ecology logo and the title 'Eyes Over Puget Sound'. Below the title is a navigation bar with tabs: 'Food for thought', 'Climate and streams', 'Fish and food', 'Aerial photos', and 'Info'. The main content area features a large central image of two people looking through binoculars at the water, with the text '2018 Review' overlaid. To the left of this image are several smaller thumbnail images of aerial water quality observations. To the right is a section titled 'Sharing views of your own backyard' featuring a video of a person with a camera. At the bottom of the page, a banner reads 'Up-to-date observations of visible water quality conditions in Puget Sound and the Strait of Juan de Fuca'.

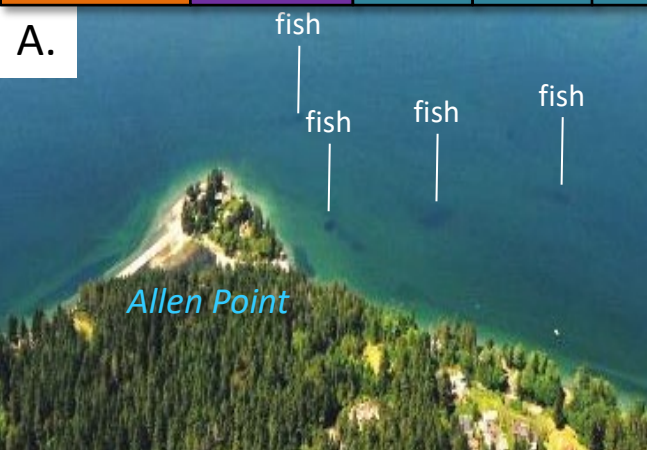
Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Bright red-brown-purple bloom with an occasional jellyfish patch.

Location: Sinclair Inlet (Central Sound), 1:49 PM

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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Many patches of schooling fish.

Location: A. Near Allen Point. B. Near Purdy Sand Spit (South Sound), 12:00 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



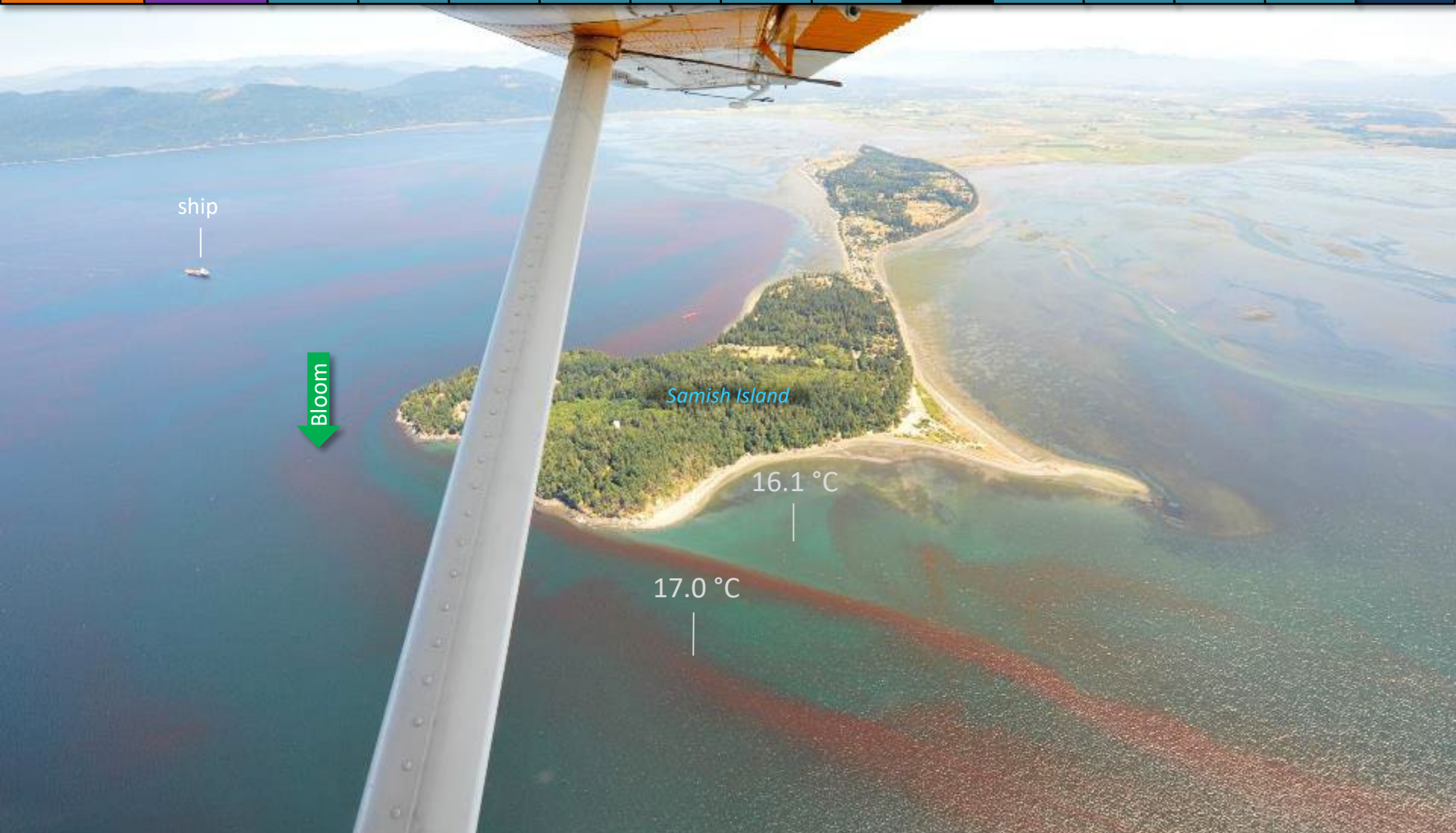
Large ribbons of Noctiluca and macroalgae accumulating at the surface.
Location: Poverty Bay (Central Sound), 1:34 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Large mats of macroalgae accumulating off beaches in southwestern portions of Carr Inlet.
Location: Carr Inlet (South Sound), 1:03 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

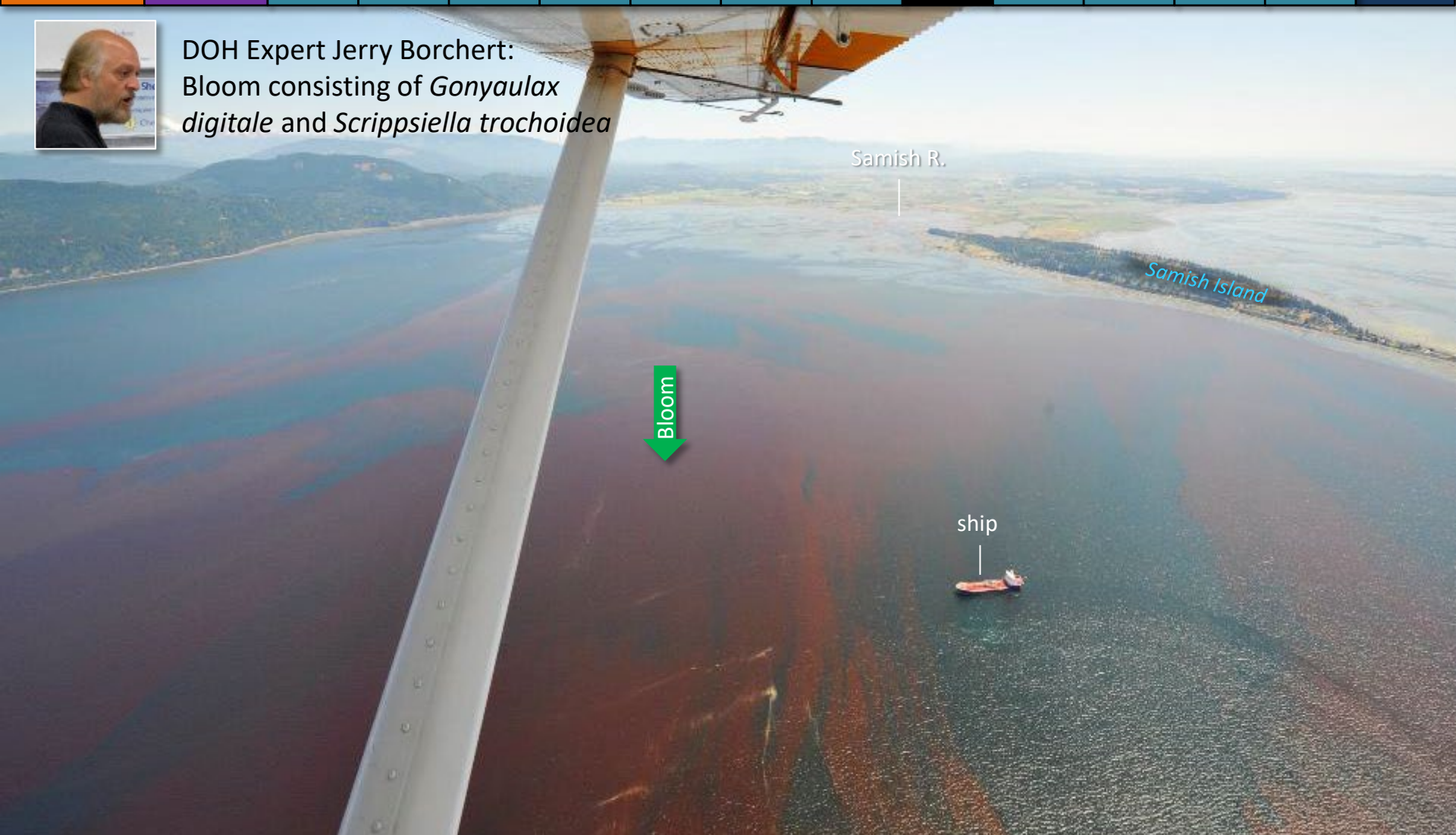


Red-brown bloom extending in long ribbons from Samish Bay into Padilla Bay.
Location: Samish Island (North Sound), 2:01 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

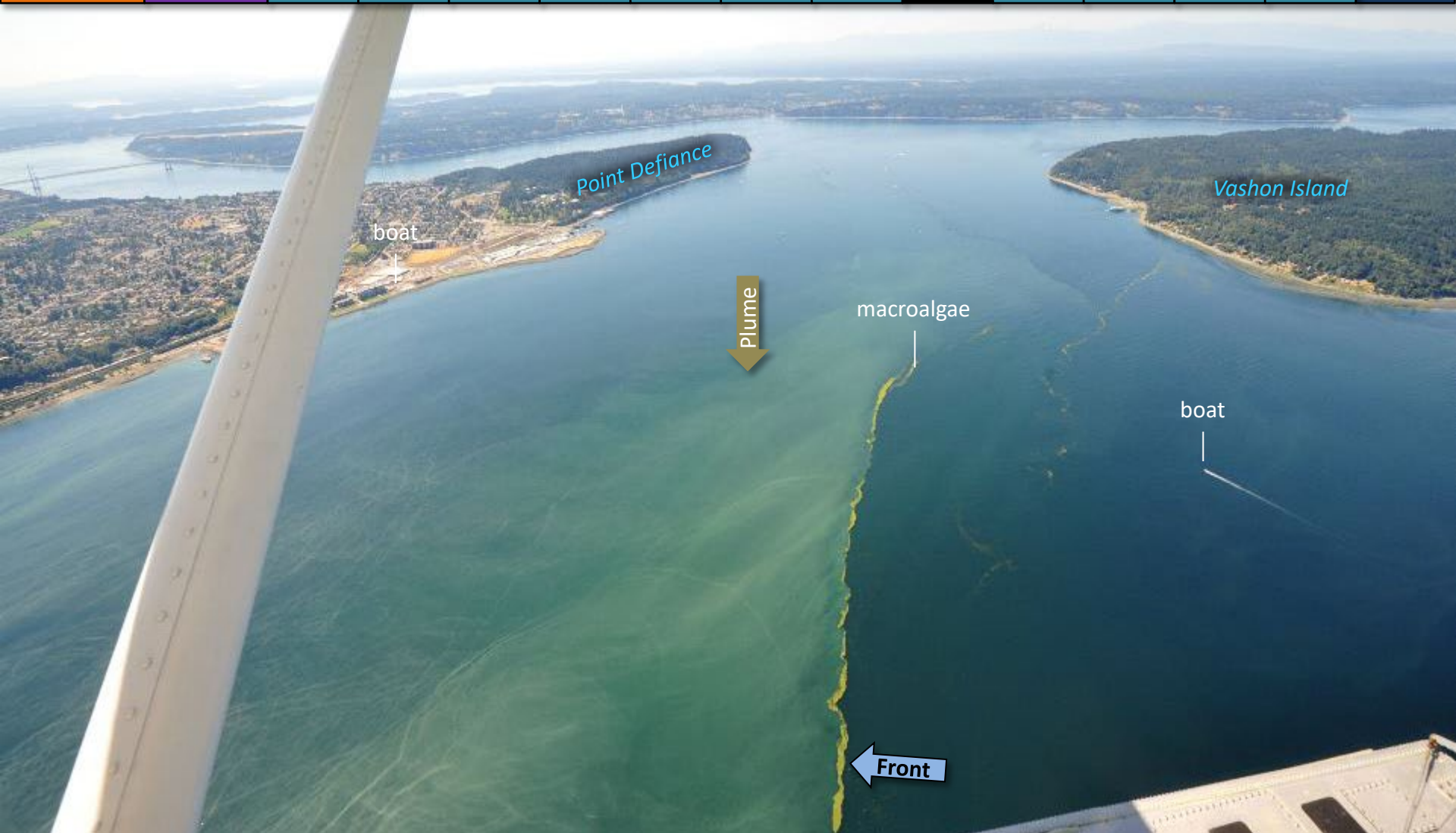


DOH Expert Jerry Borchert:
Bloom consisting of *Gonyaulax digitale* and *Scrippsiella trochoidea*



Large and very patchy red-brown bloom.
Location: Samish Island (North Sound), 2:03 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Large mats of macroalgae accumulating along edges of Puyallup River plume.
Location: Commencement Bay (Central Sound), 3:12 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



*Vivid red-brown bloom covering large portions of Sequim Bay north to Pitship Point.
Location: Sequim Bay (Strait of Juan de Fuca), 1:26 PM*

2017

In early 2017, cooler and wetter conditions combined with high river flows set the stage for a favorable supply of freshwater, creating significantly fresher marine conditions in Puget Sound. By July, above normal sunshine resulted in intense and unusual blooms in Hood Canal (coccolithophores) and South Sound inlets. Large mats of macroalgae drift at the surface. Many schools of fish are visible, yet jellyfish are remarkably absent. By August, despite a dry summer, water is still fresher than in the past 17 years, lasting well into October. By the end of 2017, large-scale climate, weather patterns, and stream flows finally returned to normal.

Fall of 2017 is presented in this winter report



Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Bright yellow-green bloom.

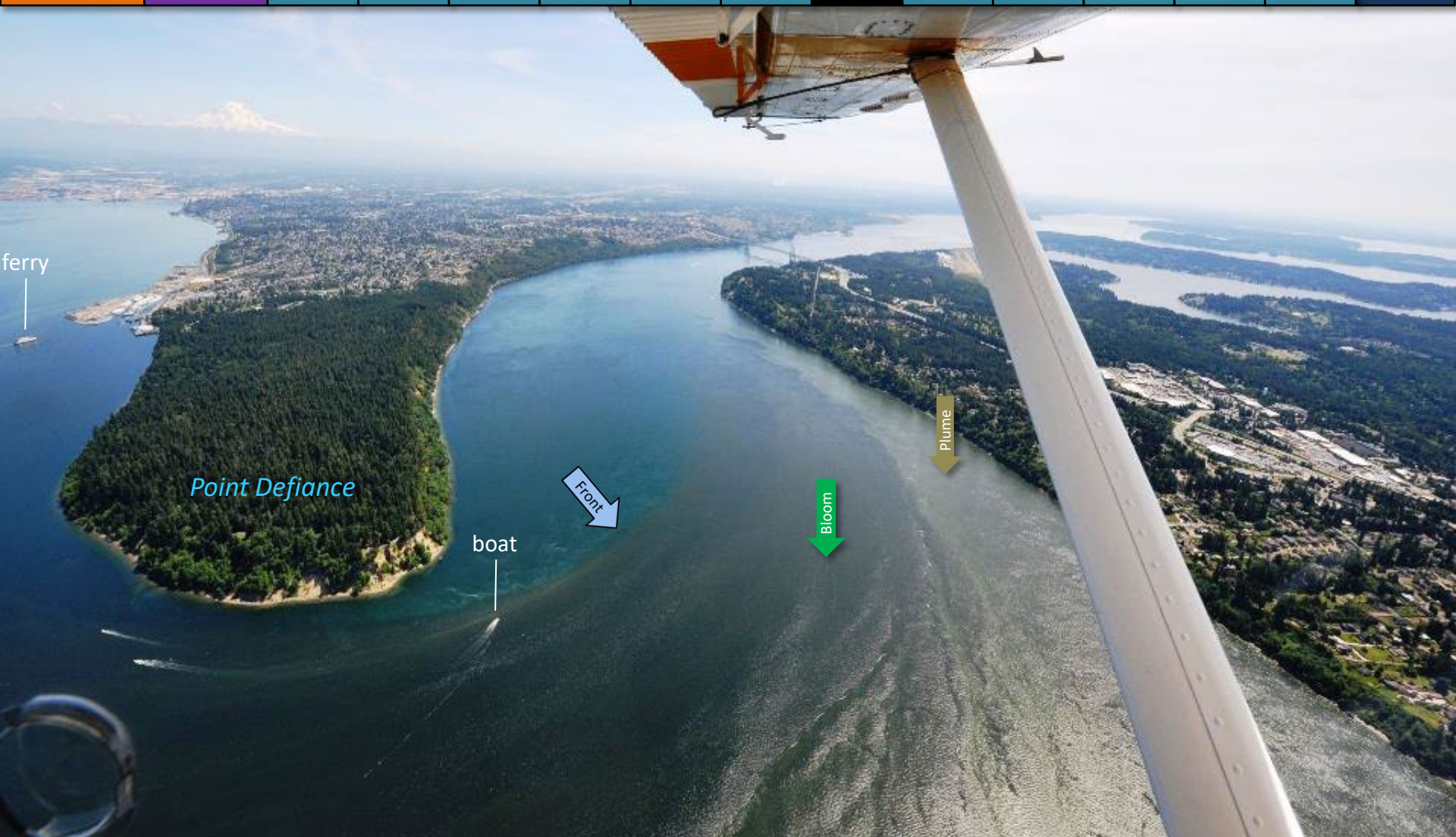
Location: Oyster Bay/Dyes Inlet (Central Sound), 1:27 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



A train of internal waves traveling towards Skagit Bay.
Location: Entrance to Skagit Bay (Whidbey Basin), 1:59 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



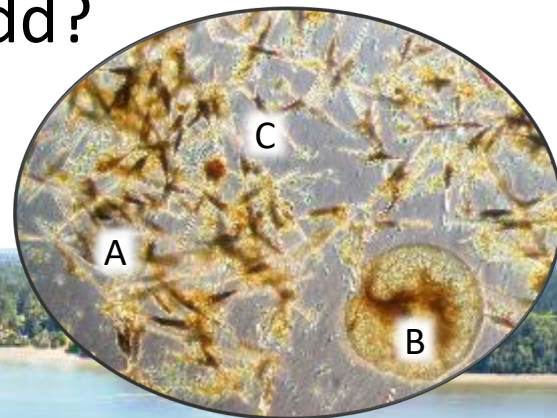
*Sediment plume from the Puyallup River and red-brown bloom entering the Tacoma Narrows.
Location: Gig Harbor (Central Sound), 2:38 PM.*

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

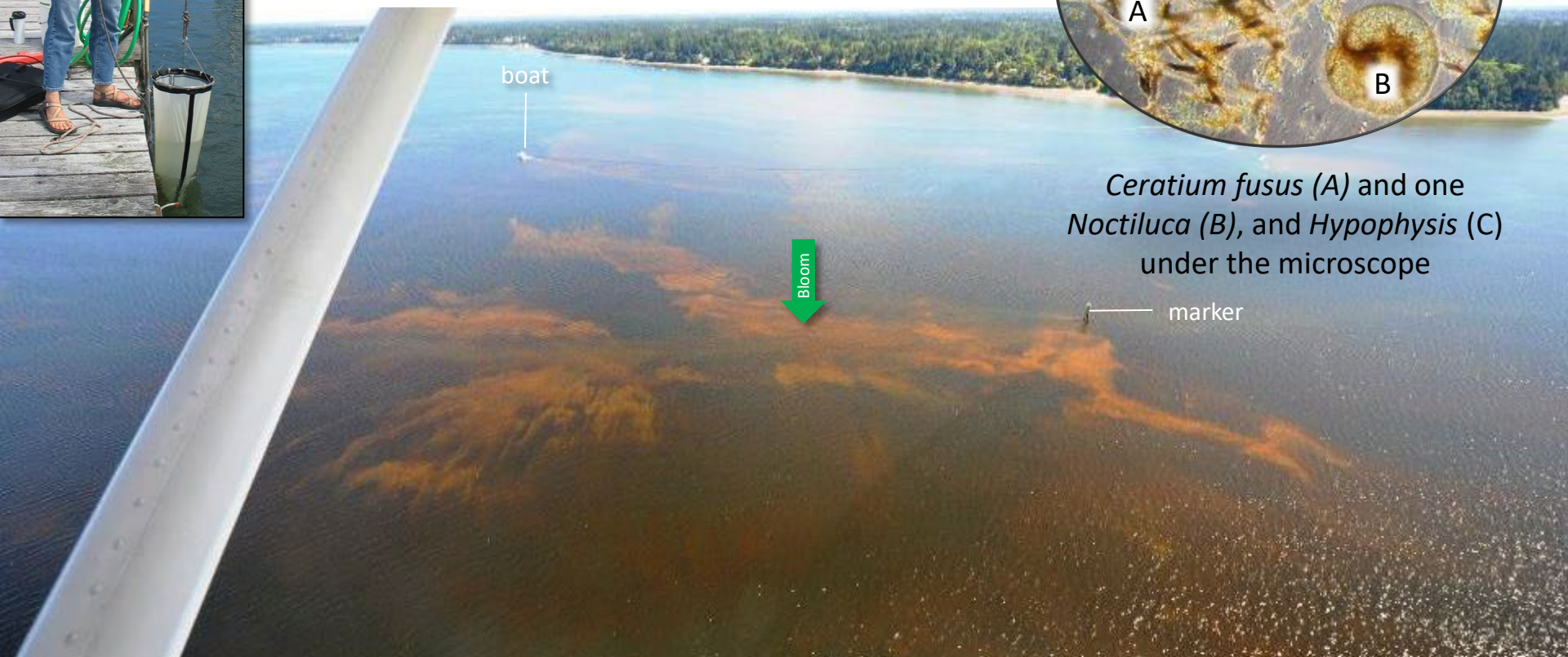


What's Blooming in Budd?

Aimee Christy collected a 3m net tow sample from 2 lower Budd Inlet locations during the bloom and observed a thick tangle of *Ceratium fusus* (100X magnification).



Ceratium fusus (A) and one *Noctiluca* (B), and *Hypophysis* (C) under the microscope



Large, very patchy orange-brown bloom.
Location: Budd Inlet (South Sound), 11:56 AM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Red-brown bloom and schools of fish off Young Cove.

Location: Eld Inlet (South Sound), 12:04 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Coccolithophore bloom, extending to Bangor. Other red-brown and brown purple bloom near surface.
Location: Near Dabob Bay (Hood Canal), 12:38 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Large mats of macroalgae near Puyallup River plume.
Location: Commencement Bay (Central Sound), 1:07 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Schools of fish and macroalgae in shallow water.
Location: Mayo Cove, Carr Inlet (South Sound), 1:17 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Schools of fish in red-brown bloom.
Location: Henderson Inlet (South Sound), 1:27 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Large red-brown bloom and front.

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

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

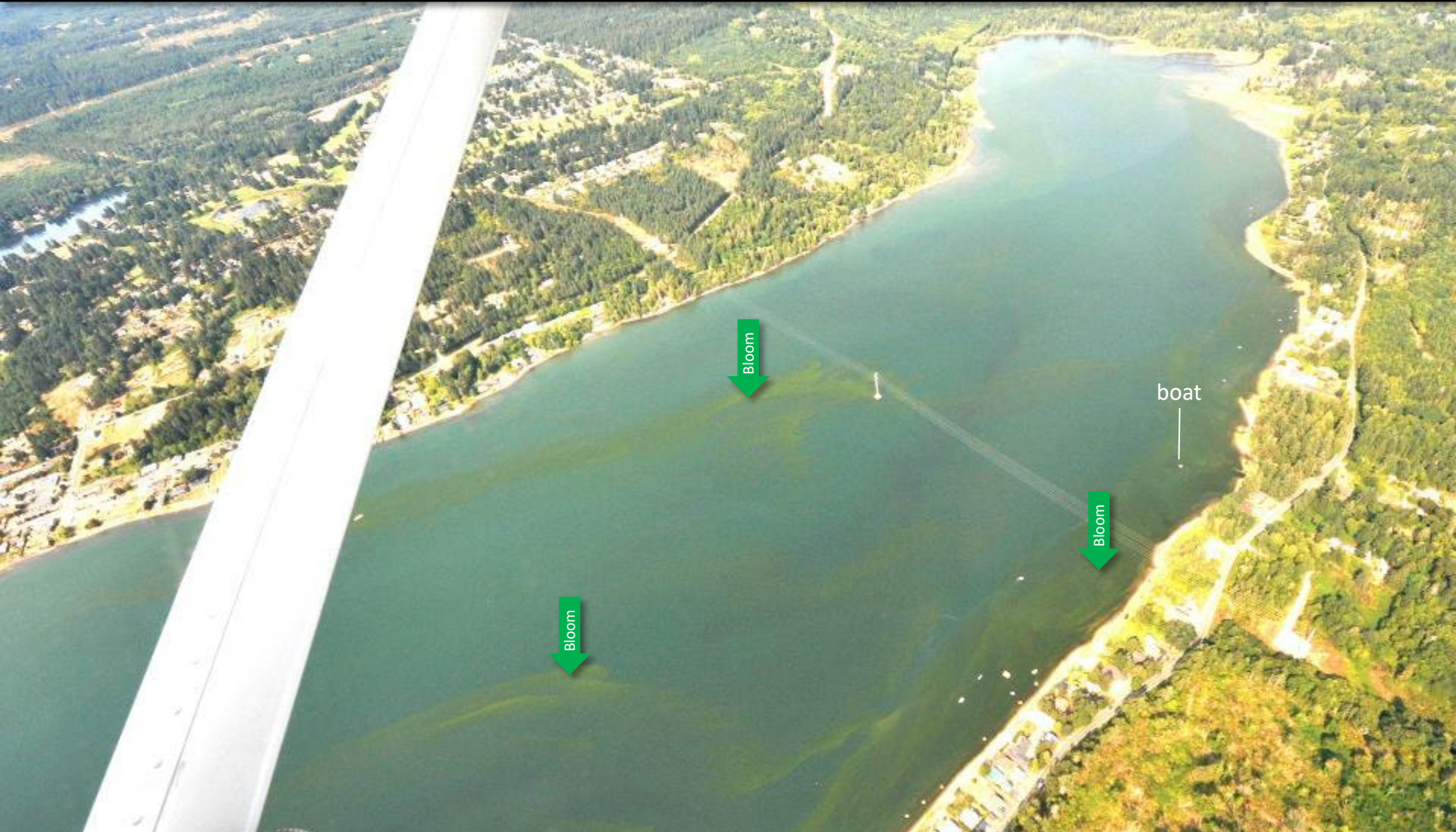


Red-brown bloom mixed in with water colored in green-ochre.

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

Aerial photography 8-28-2017

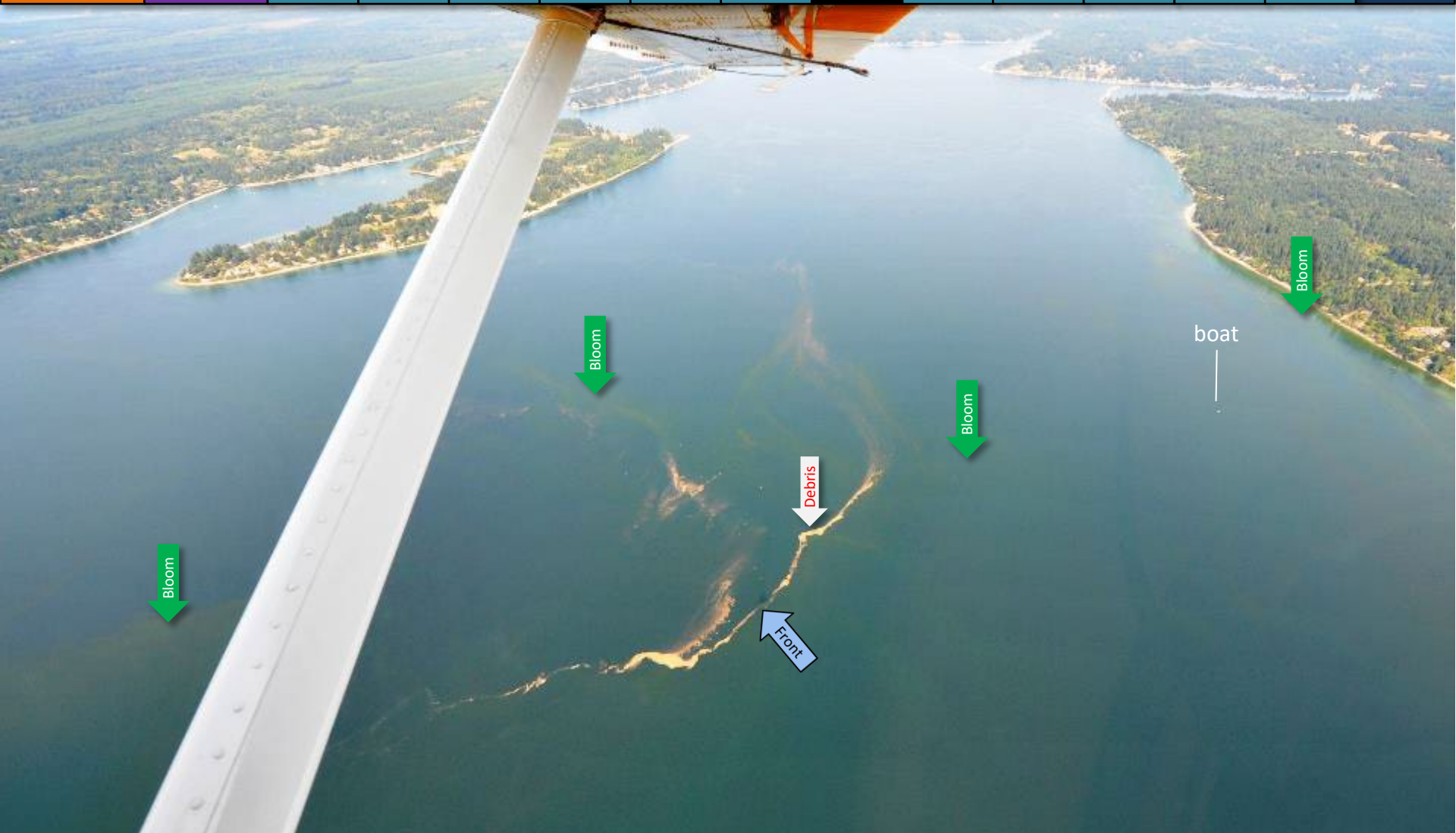
Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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Green bloom.

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

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



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

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



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

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



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

2016

The year 2016 in pictures: After two years of very warm air and record high water temperatures starting with the Blob (2015) and followed by El Niño (2016), temperatures have fallen and remain slightly warmer than normal in Puget Sound. Very low summer river flows (e.g., Fraser River) reflect climatic predictions for the NW. Record temperatures and low salinities occurred alongside observations of abundant jellyfish, floating macroalgae, and *Noctiluca* blooms. Surprisingly, only South Sound developed very low summer oxygen levels in 2016. In the fall, La Niña came with a punch, rain increased, and air temperatures dropped. Will this be an unusual La Niña?



Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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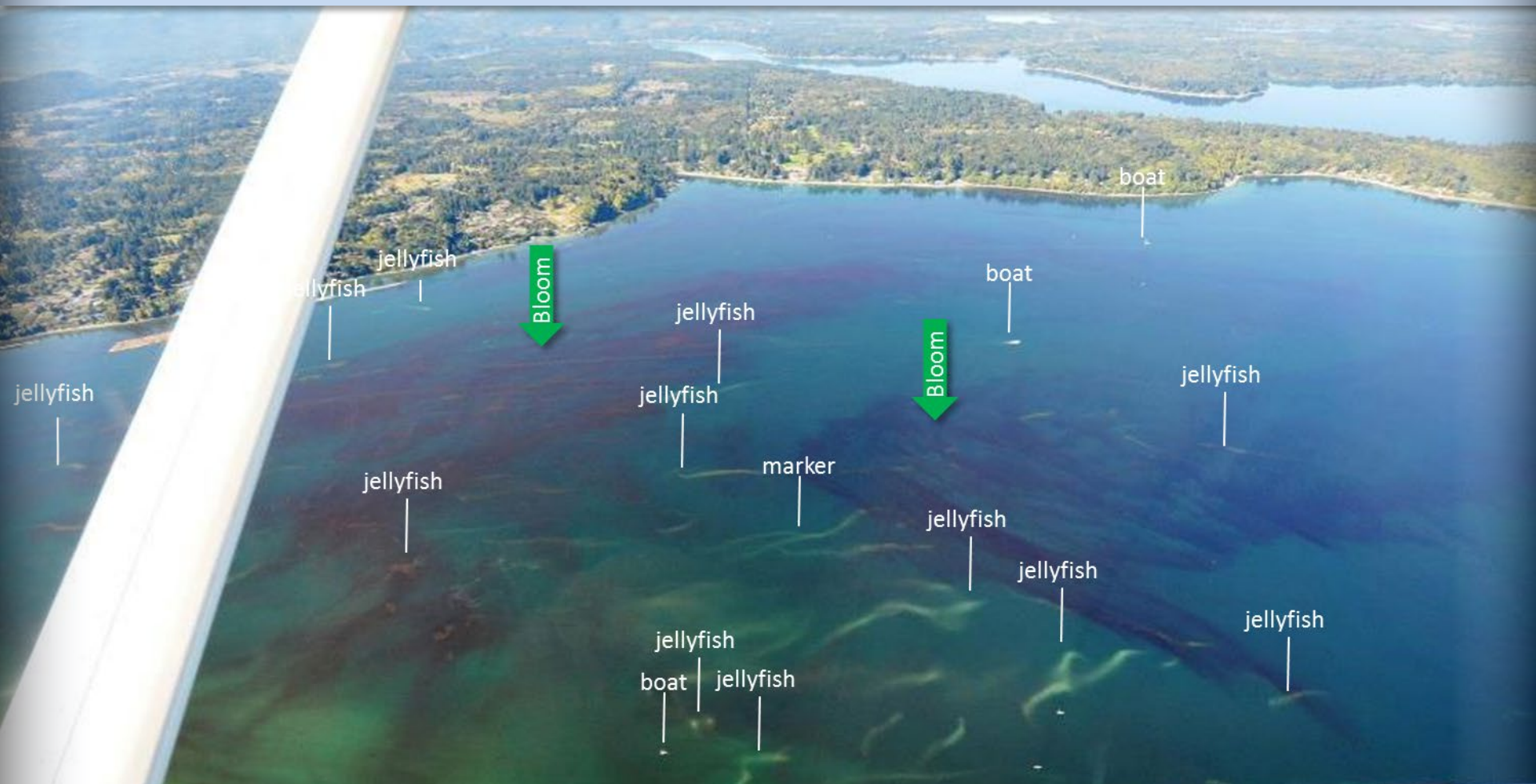
Where do all the macroalgae end up after July? A lot of the material ends up on beaches.



Algae washed up on beaches in thick layers and rotting.
Location: Edmonds Underwater Park, Snohomish County, July 2016.

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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Jellyfish and red-brown dinoflagellate blooms thriving in warm, stagnant water in late summer.



Two differently colored red-brown blooms and abundant jellyfish patches.
Location: Budd Inlet (South Sound), September 2016.

Summary	People	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Data
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Noctiluca thriving in eutrophic, stagnating water in many places, May-August 2016.



Noctiluca bloom, marine in Budd Inlet



Noctiluca bloom Pickering Passage, Case Inlet



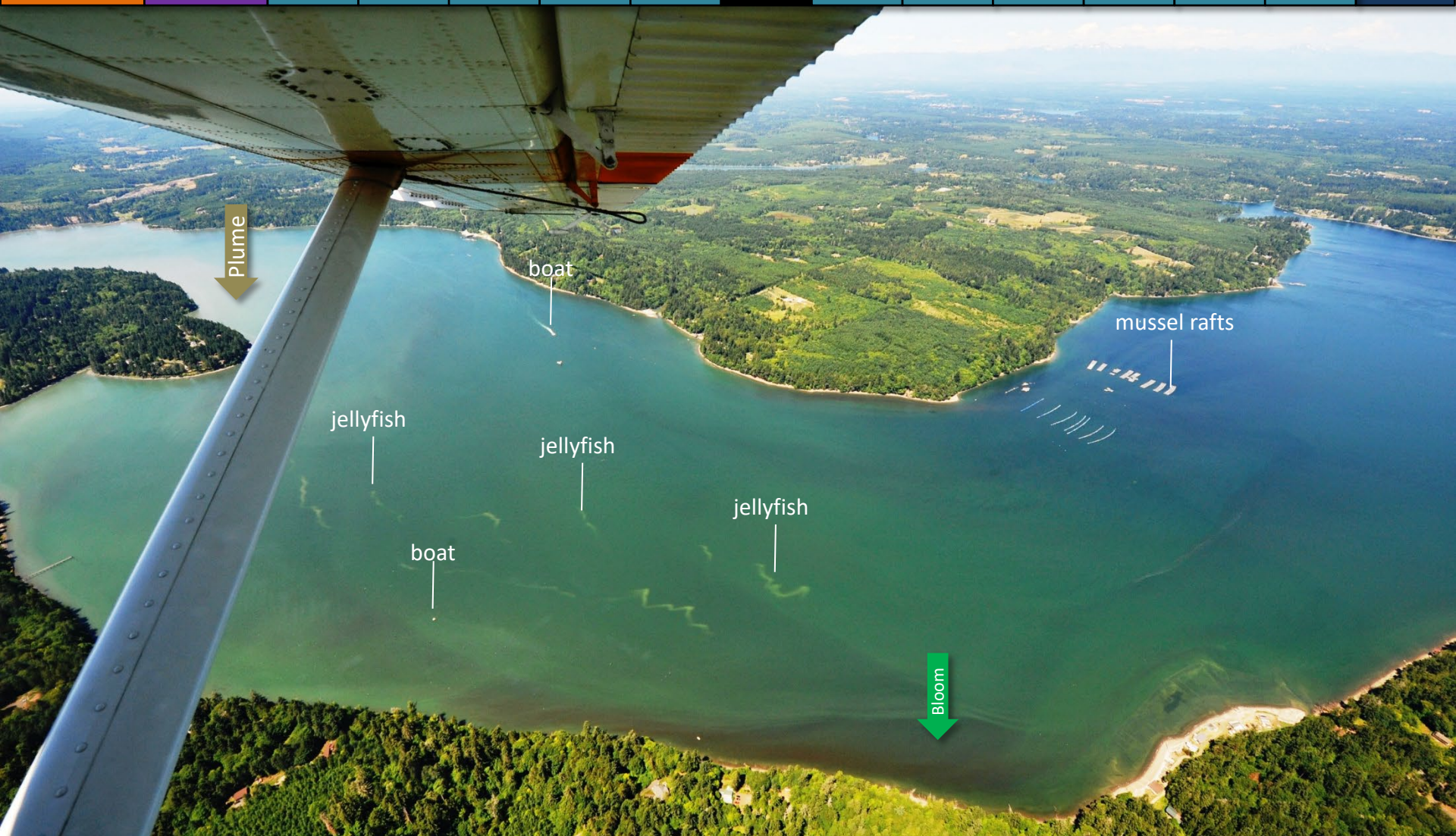
Noctiluca and organic material accumulating near Boston Harbor Entrance to Budd Inlet (South Sound),.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



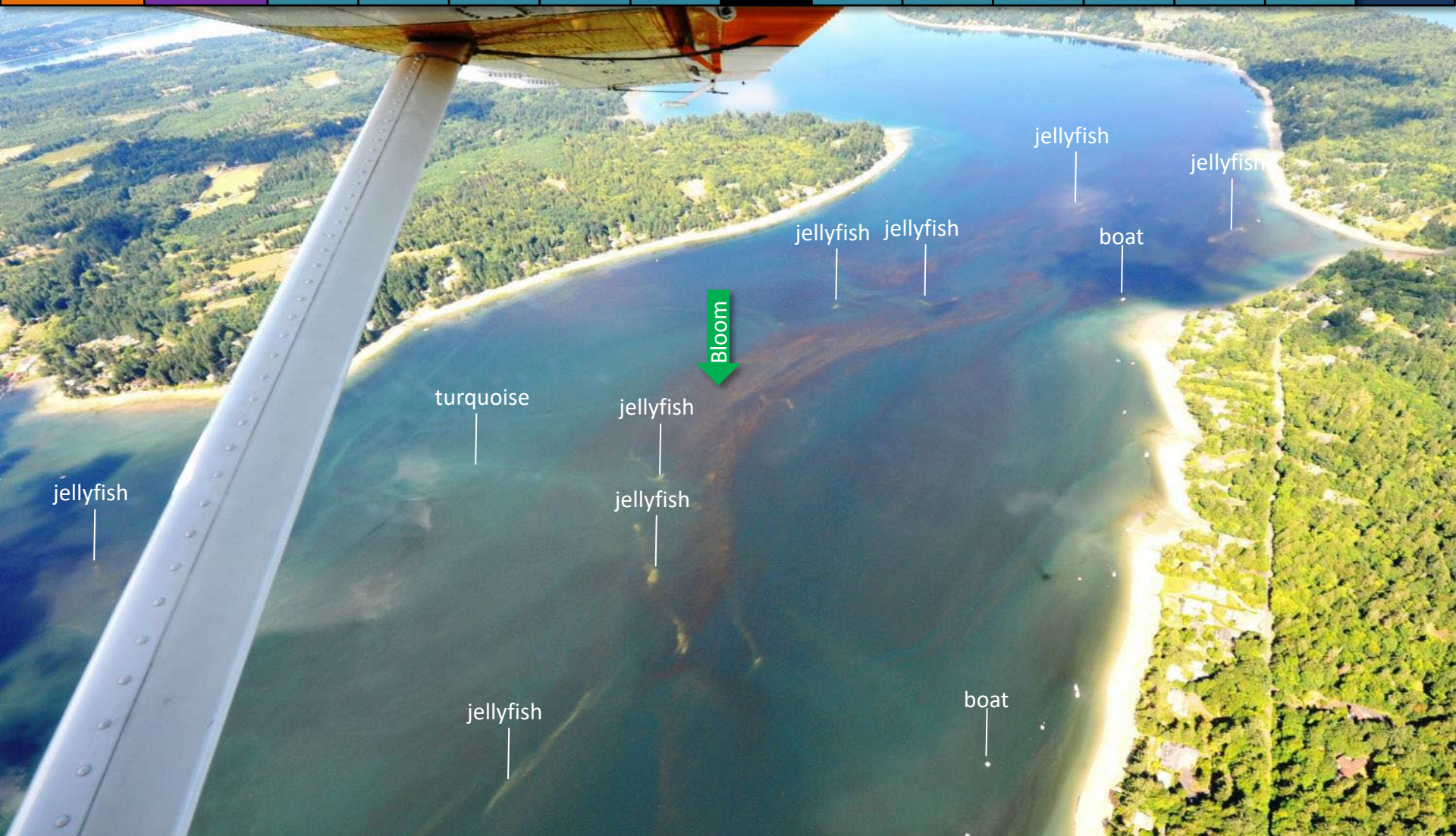
*Organic material accumulating in large ribbons along tidal front at the entrance to Budd Inlet.
Location: Across from Boston Harbor, Budd Inlet (South Sound), 12:51 PM.*

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



*Large patches of jellyfish, sediment-rich river plume, and red-brown bloom near eastern shore.
Location: Totten Inlet (South Sound), 12:59 PM.*

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



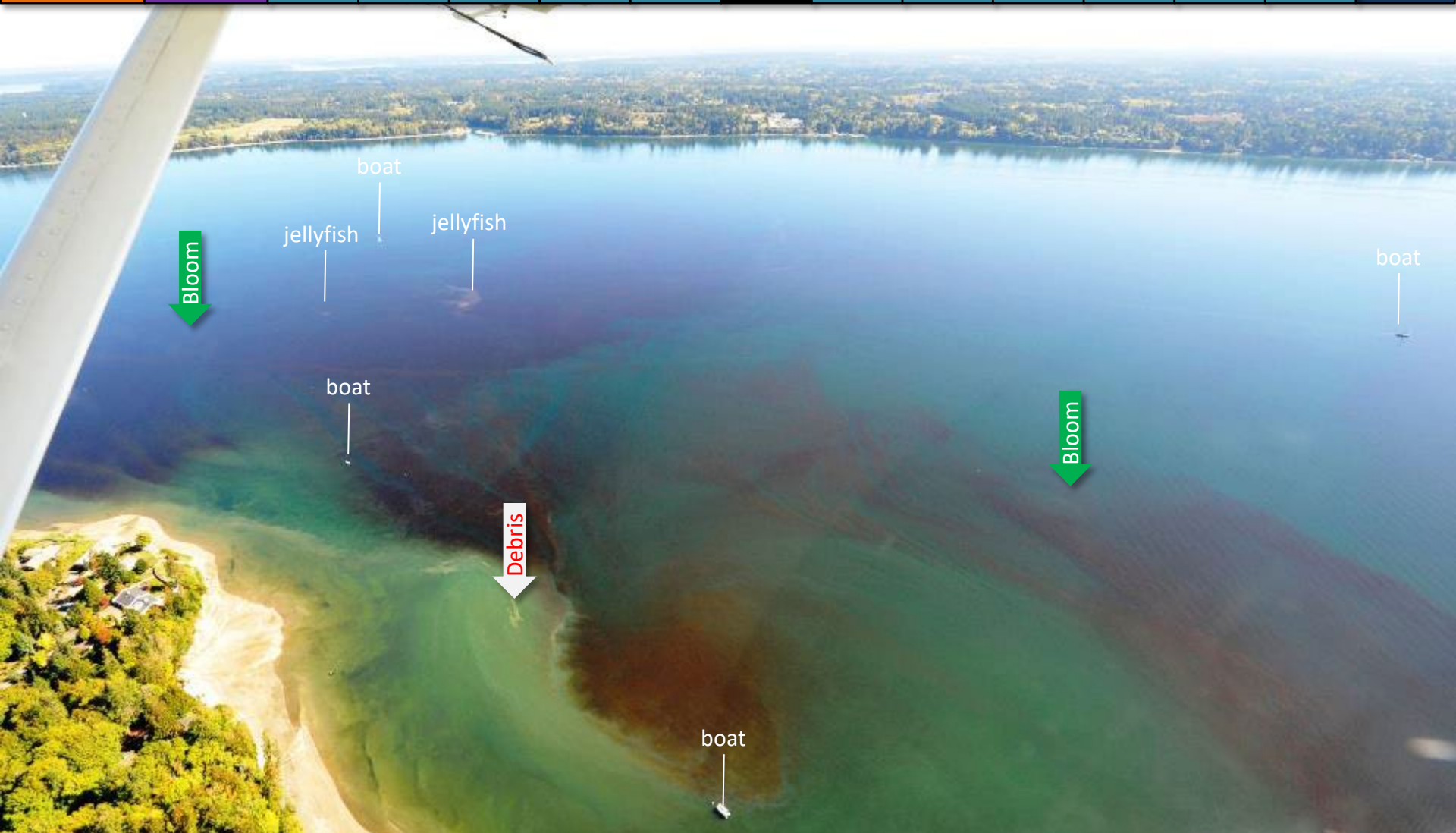
Red-brown bloom and large patches of jellyfish. Turquoise water is likely freshwater.
Location: Across from Young Cove, Eld Inlet (South Sound), 3:08 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Strong red-brown bloom, abundant jellyfish patches and organic debris at surface.
Location: Budd Inlet (South Sound), 2:25 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Strong red-brown bloom, jellyfish patches, and organic debris at surface.
Location: Near Big Tykel Cove, Budd Inlet (South Sound), 12:28 PM.

2015

The year 2015 in pictures: Jellyfish patches persisted through the entire year in response to the exceptionally warm water caused by the Blob. Sediment loads are high as snow melts fast in the winter of 2015. Unexpected phytoplankton species occur in some bays in spring. *Noctiluca*, jellyfish, and macroalgae appear in high numbers when rivers drop to record-low flows in early summer. Low river flows slow the renewal of in Puget Sound throughout summer and fall and jellyfish patches reach record highs.





Location: Kitsap Marina, Sinclair Inlet (Bremerton), 9:52 AM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



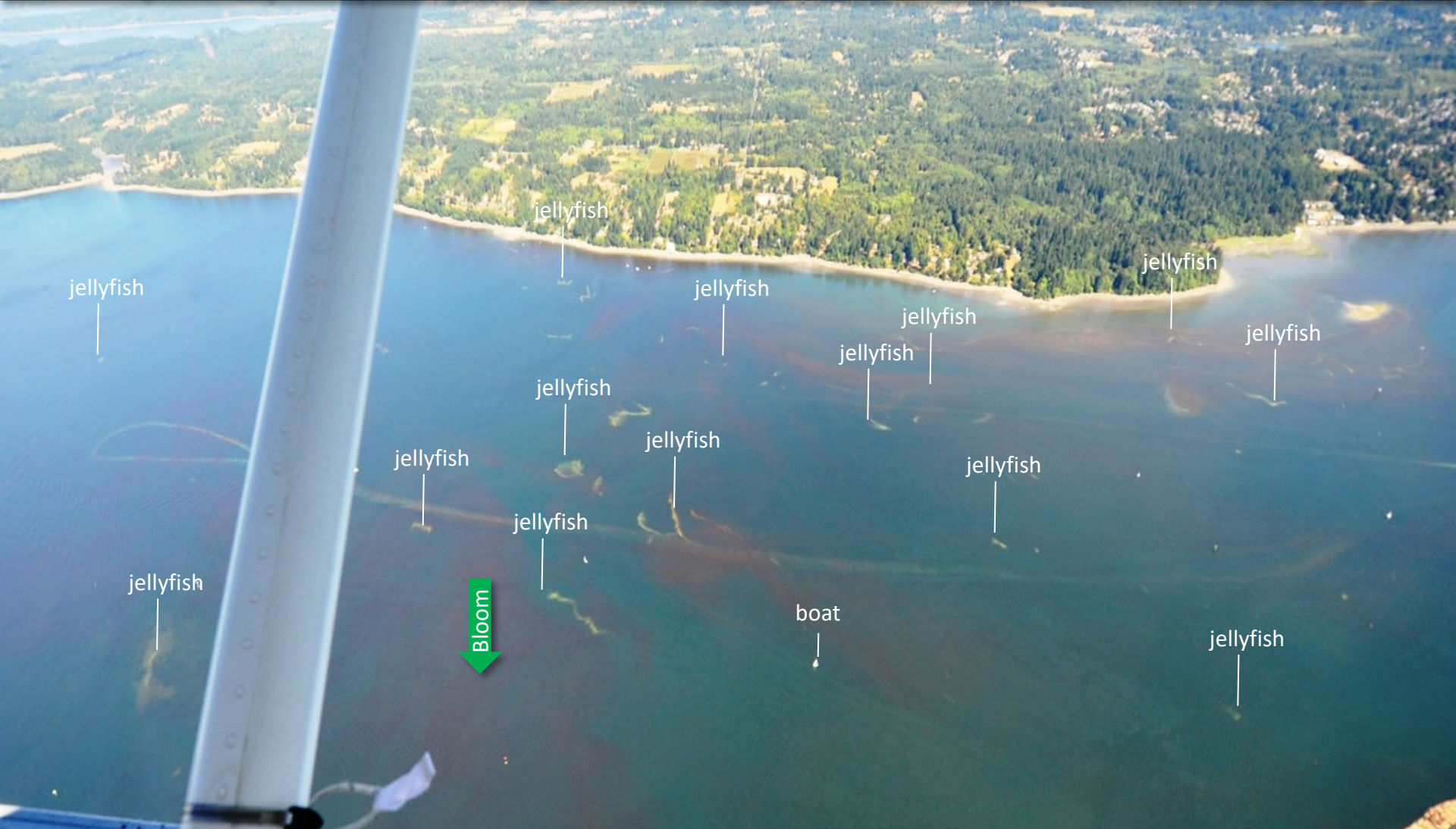
Large Noctiluca bloom surfacing and gathering in large quantities at tidal front.
Location: Commencement Bay (Central Sound), 3:32 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Sediment plume of Puyallup River with internal waves meandering into bay and mixing with a bloom.
Location: Commencement Bay (Central Sound), 3:28 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Numerous large patches of jellyfish in water containing red-brown algal bloom.
Location: Budd Inlet (South Sound), 3:12 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Extensive and multiple oil sheens (reported).
Location: Port Orchard, Sinclair Inlet (Central Sound), 3:05 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Boat wake shows thin sediment-rich layer at surface. Front and water carrying glacial flour off Lummi Island.
Location: Off Portage Island, Bellingham Bay (North Sound), 12:58 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Brown-colored Duwamish River plume with ferry tracks reveal the thin layer of suspended sediment across Elliott Bay. Location: Elliott Bay, Seattle (Central Sound), 2:46 PM.

2014

The year 2014 in pictures: In 2014, Puget Sound and Hood Canal behaved distinctly different in temperature and dissolved oxygen. In Puget Sound, generally warmer conditions, abundant and diverse algal blooms, and large pools of organic material persisted along with lower oxygen, high jellyfish abundances, and a lot of suspended sediment. On the other hand, Hood Canal was colder, more oxygenated, and algae blooms were rare. People and planes: past and present.

Publication No. 14-03-080



The image shows a screenshot of the 'Eyes Over Puget Sound' website. The header includes the Department of Ecology logo and the title 'Eyes Over Puget Sound'. Below the header is a navigation bar with tabs: 'Flight log', 'People', 'Water column', 'Aerial photos', 'Hypothesis', and a 'Start here' button. The main content area is a grid of 12 thumbnail images, each showing a different aerial view of Puget Sound. The central thumbnail is a large black box with the text '2014 Review'. The bottom of the page features the text 'Up-to-date observations of visible water quality conditions in Puget Sound and the Strait of Juan de Fuca'.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



*Large tidal eddy transporting suspended sediment from beach into Carr Inlet.
Location: Near Pitt Passage (Carr Inlet), 2:50 PM.*

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Orange-red bloom, likely Noctiluca, in East Sound.
Location: Orcas Island (San Juan Islands), 12:05 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



*Sediment-rich water leaving Port Susan at Camano Island during outgoing tide.
Location: Possession Sound (Whidbey Basin), 10:13 AM.*

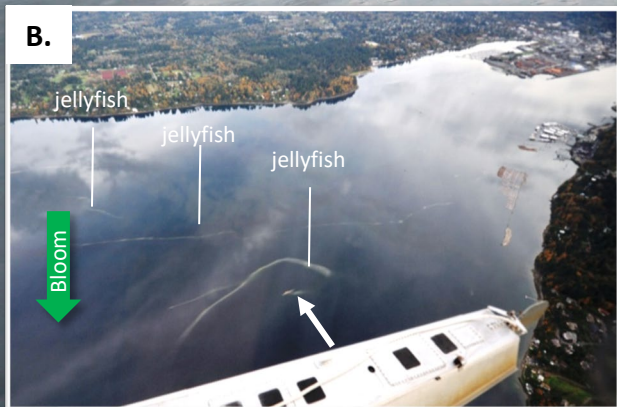
Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Intense yellow-green phytoplankton bloom inside bay.
Location: Fossil and Mud Bays, Sucia Island (San Juan Islands), 11:22 AM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

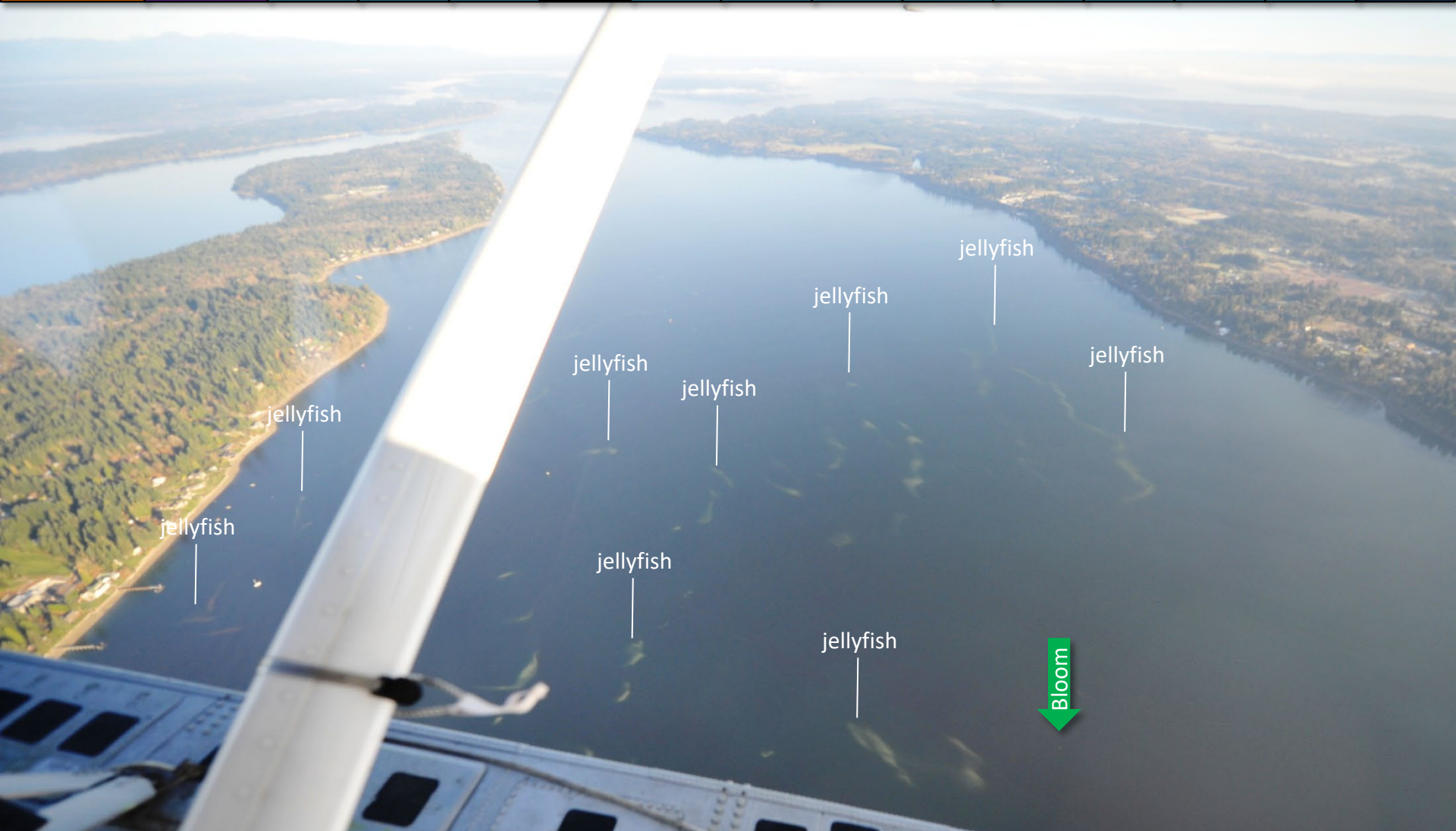
A.



Extensive smacks of moon jellies, both in size and density with pinkish tint.

Location: A. On the water; B. From air showing location on the water, Budd Inlet (South Sound), 3:50 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Numerous jellyfish smacks with underlying red-brown bloom.
Location: Off Little Tykle Cove, Budd Inlet (South Sound), 9:25 AM.

2013

The year 2013 in pictures: Low oxygen conditions persisted from January into August and broke a two-year anomaly of more favorable water quality conditions (lower temperature and salinity and higher dissolved oxygen). Dramatic *Noctiluca* blooms appeared one month earlier than normal (May), lasted for two months, and coincided with lower oxygen. Large jellyfish patches persisted over the winter but then were less visible for the rest of the year. Large drifting algal mats appeared in August.



Eyes Over Puget Sound

Publication No. 13-03-081

[Flight log](#)
[Water column](#)
[Aerial photos](#)
[Start here](#)

 <p>Surface Conditions Report January 15, 2013</p>	 <p>Surface Conditions Report February 26, 2013</p>	 <p>Surface Conditions Report March 25, 2013</p>	 <p>Surface Conditions Report April 8, 2013</p>
 <p>Surface Conditions Report May 24, 2013</p>	<h2>2013 Review</h2>		 <p>Surface Conditions Report June 17, 2013</p>
 <p>Surface Conditions Report August 21, 2013</p>	 <p>Surface Conditions Report September 11, 2013</p>	 <p>Surface Conditions Report October 1, 2013</p>	 <p>Surface Conditions Report November 25, 2013</p>

Up-to-date observations of visible water quality conditions in Puget Sound and the Strait of Juan de Fuca

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Large and intense red-orange-brown plankton bloom and river plume.

Location: Hood Canal, 3:33 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



The far reaches of the sediment-laden river plume of the Fraser River
Location: Patos Island State Park (northern San Juan Islands), 12:22 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Noctiluca bloom at surface in very long bands.

Location: Between Bainbridge Island and Elliott Bay (Central Basin), 5:27 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Noctiluca bloom at surface in large patch washing onto public beach.
Location: Alki Beach, West Seattle (Central Basin), 4:51 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Orange and red-brown bloom and patches of jellyfish near the surface.
Location: Eld Inlet (South Sound), 1:47 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

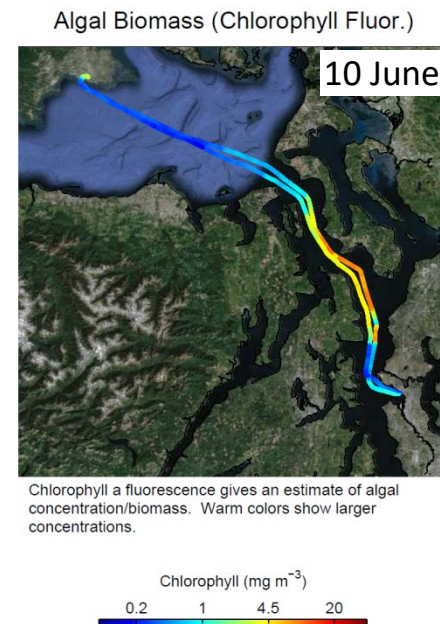
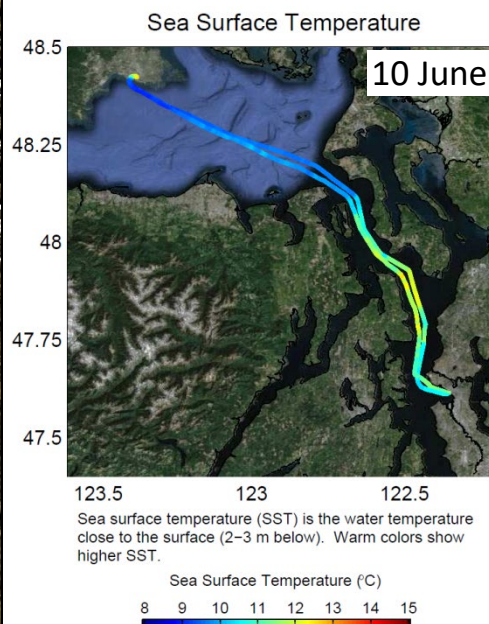


Fraser River sediment traversing and mixing dramatically with water in the San Juan Islands.
Location: Near Obstruction Island (San Juan Islands), 11:49 AM.

2012

The year 2012 began with a wet, late winter. Extensive freshwater plumes, rich in sediment, extend far into the waterways. Surface debris was abundant and jellyfish persisted through winter in Budd Inlet. Higher river flows continued into May when strong algal blooms appeared across South Sound, Central Basin and most smaller bays. By June, extensive orange *Noctiluca* streaks develop in Central Basin paralleled by a strong red-brown bloom in Case Inlet and one month later in Whidbey Basin. By July, water temperatures approach 15 °C. Macroalgae appear in Central Sound in August along with jellyfish. High jellyfish numbers persist into December in finger inlets of South Sound, which also saw red-brown blooms well into fall.

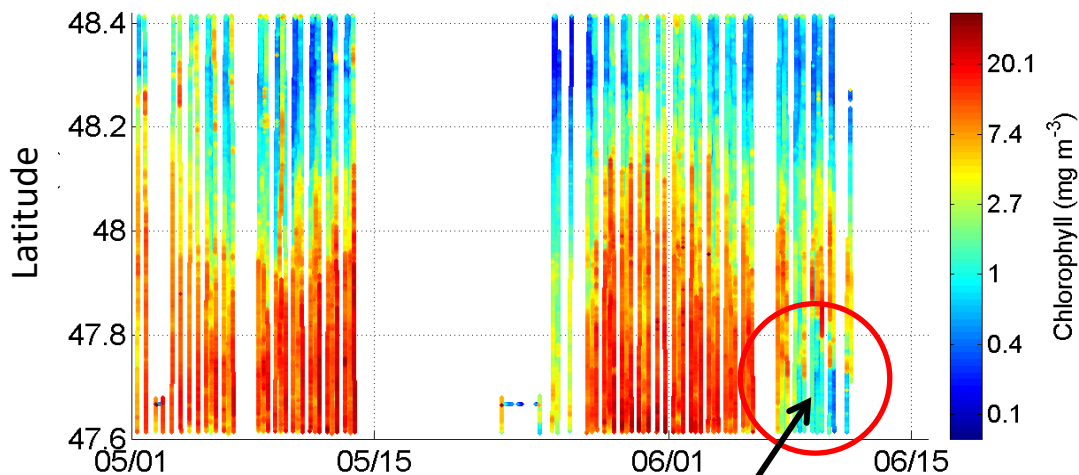




Current Conditions: Reduced fluorescence south of Edmonds; likely related to intense *Noctiluca* bloom. Temperatures near Triple Junction > 12°C; associated with freshwater entering Central Sound from Whidbey Basin.

The widespread *Noctiluca* bloom in Central Sound (observed south of Edmonds from 47.6-47.75N) was associated with 3 conditions:

- 1) Clearer water (reduced fluorescence and turbidity); possibly the result of increased grazing by *Noctiluca*
- 2) Cooler sea surface temperatures
- 3) Lower CDOM concentrations

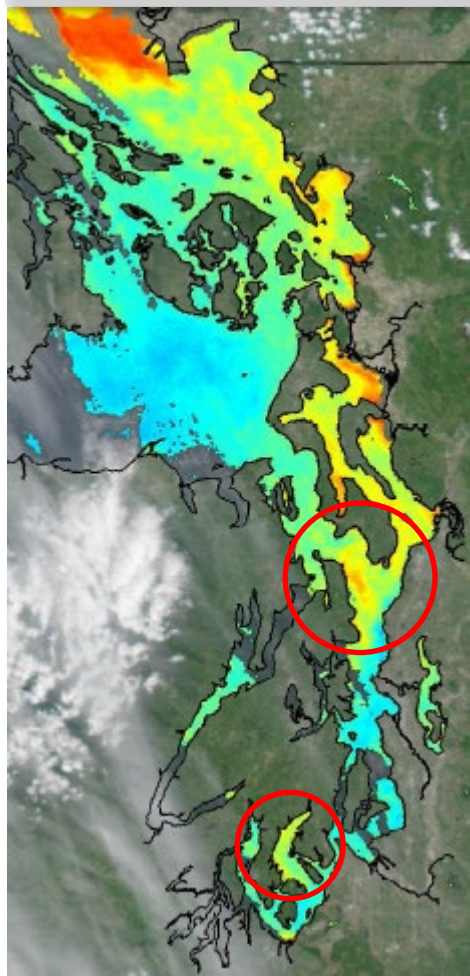


Modest fluorescence and satellite chlorophyll levels remain in Triple Junction, north of the area where *Noctiluca* was observed

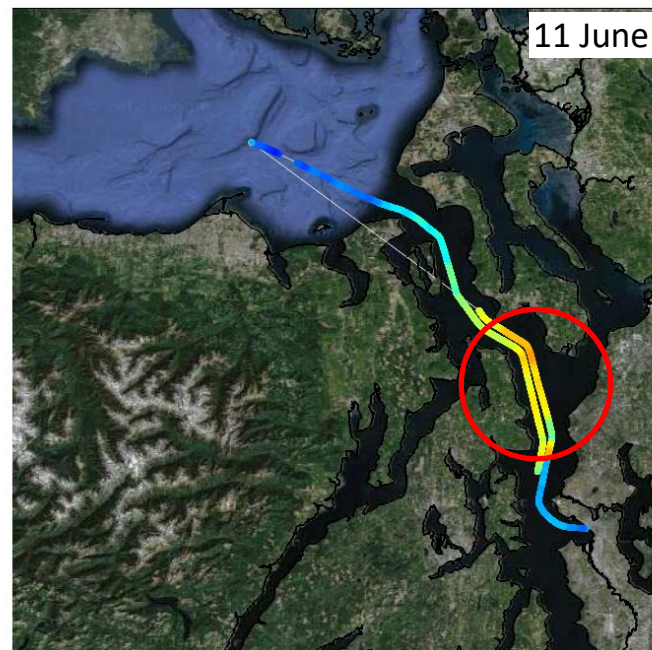
Elevated satellite chlorophyll levels also associated with blooms in Carr Inlet and Whidbey Basin.

Chlorophyll *a*

MODIS-Aqua
11 June 2012 @ 14:05 PDT



Chlorophyll (mg m^{-3})

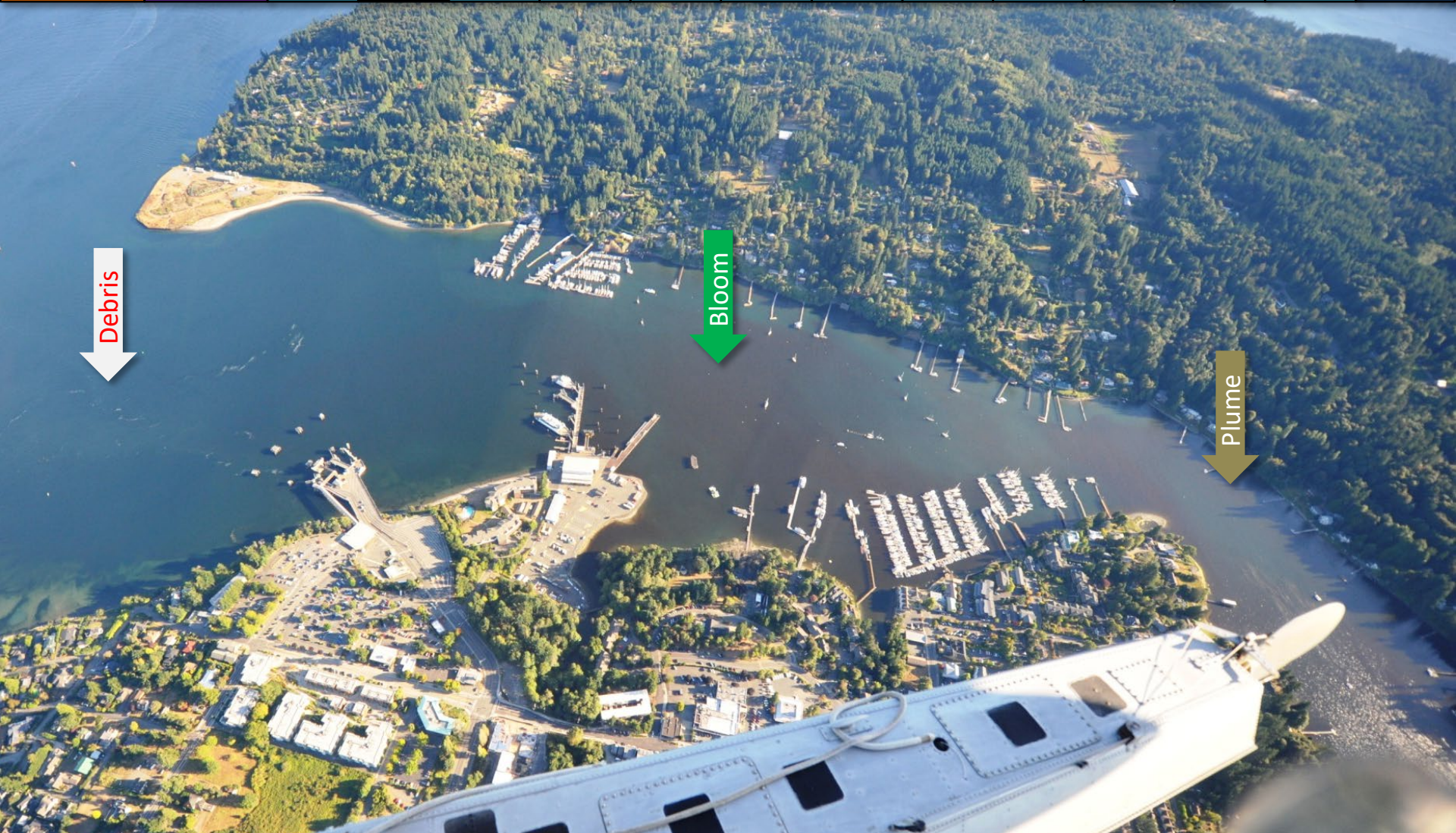


[Summary](#) [People](#) [2011](#) [2012](#) [2013](#) [2014](#) [2015](#) [2016](#) [2017](#) [2018](#) [2019](#) [2020](#) [2021](#) [2022](#) [Data](#)



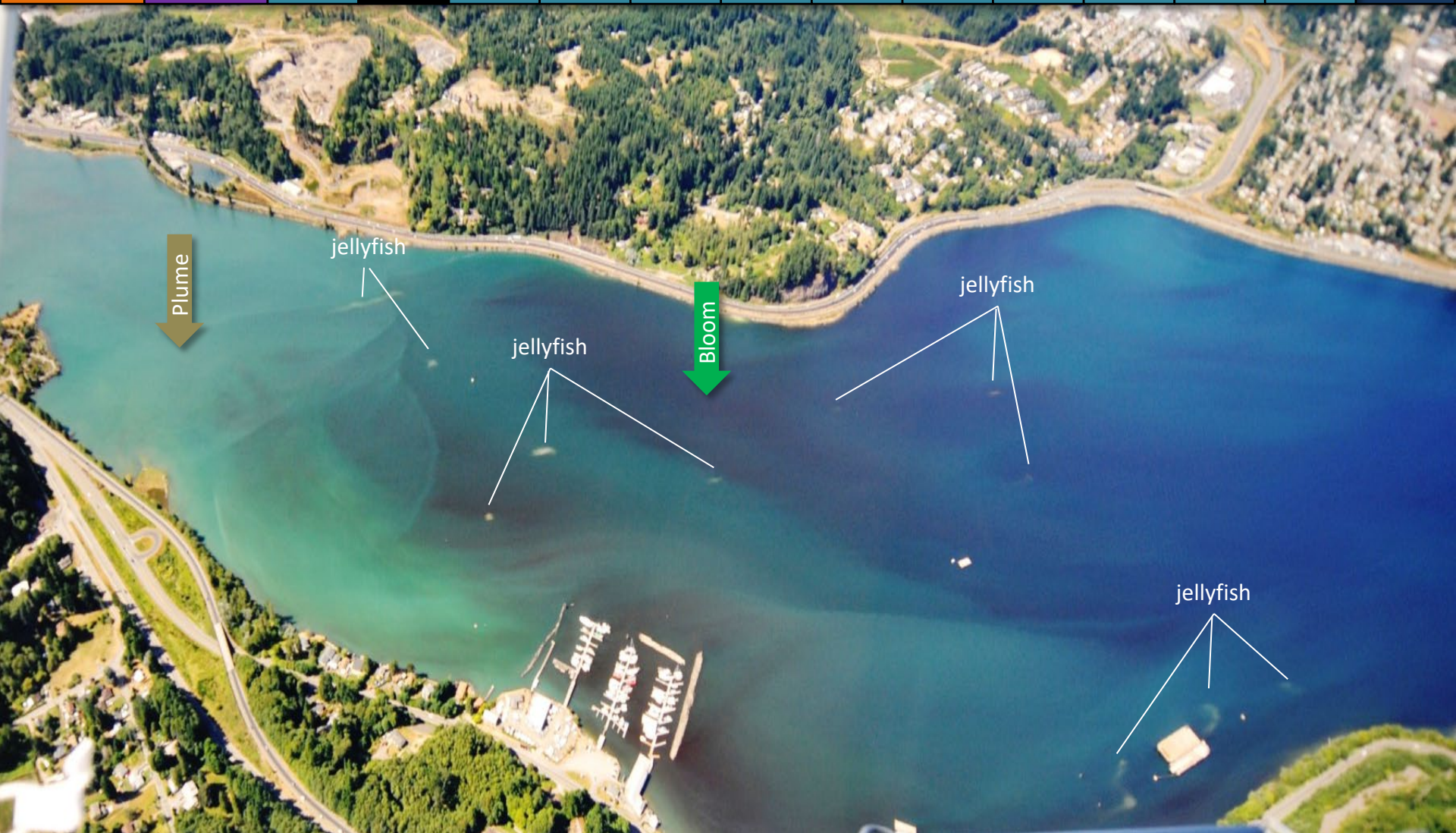
Jellyfish patches persist in South Sound Bays. Location: Eld Inlet, 10:52 AM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Red-brown colored algae blooms. Location: Eagle Harbor (Bainbridge Island) 5:45 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Jellyfish, red-brown and turquoise bloom. Location: Sinclair Inlet (Central Sound), 2:26 PM.

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Extensive red-brown bloom. Location: Case Inlet (South Sound), 4:33 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Red-brown and turquoise blooms, jellyfish (+ cloud reflections).

Location: Budd Inlet (South Sound), 4:56 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Puyallup River plume entering Tacoma Narrows. Location: Point Defiance (Tacoma) 5:38 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Noctiluca bloom east of Port Blakely. Location: Bainbridge Island (Central Sound), 8:07 AM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Puyallup river plume and algae bloom? Location: Vashon Island/Tacoma, 3:53 PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Eddy with suspended sediment. Location: McNeil Island (South Sound), 4:20 PM

2011

The year 2011 warmer and sunnier conditions give rise to enhanced oxygen production and algae growth in Whidbey and Central Basin, extending into South Sound from April through June. Macroalgae are abundant. By June, a massive *Noctiluca* bloom forms in Central Sound paralleled by a red-brown bloom in South Sound. By July, extensive macroalgae and phytoplankton blooms are present in Central and South Sounds, culminating in a kaleidoscope of diverse colors. By September, blooms have weakened but still persist in bays of South Sound, where they extend into October. In November, jellyfish appear in Budd Inlet in increasing numbers through December.

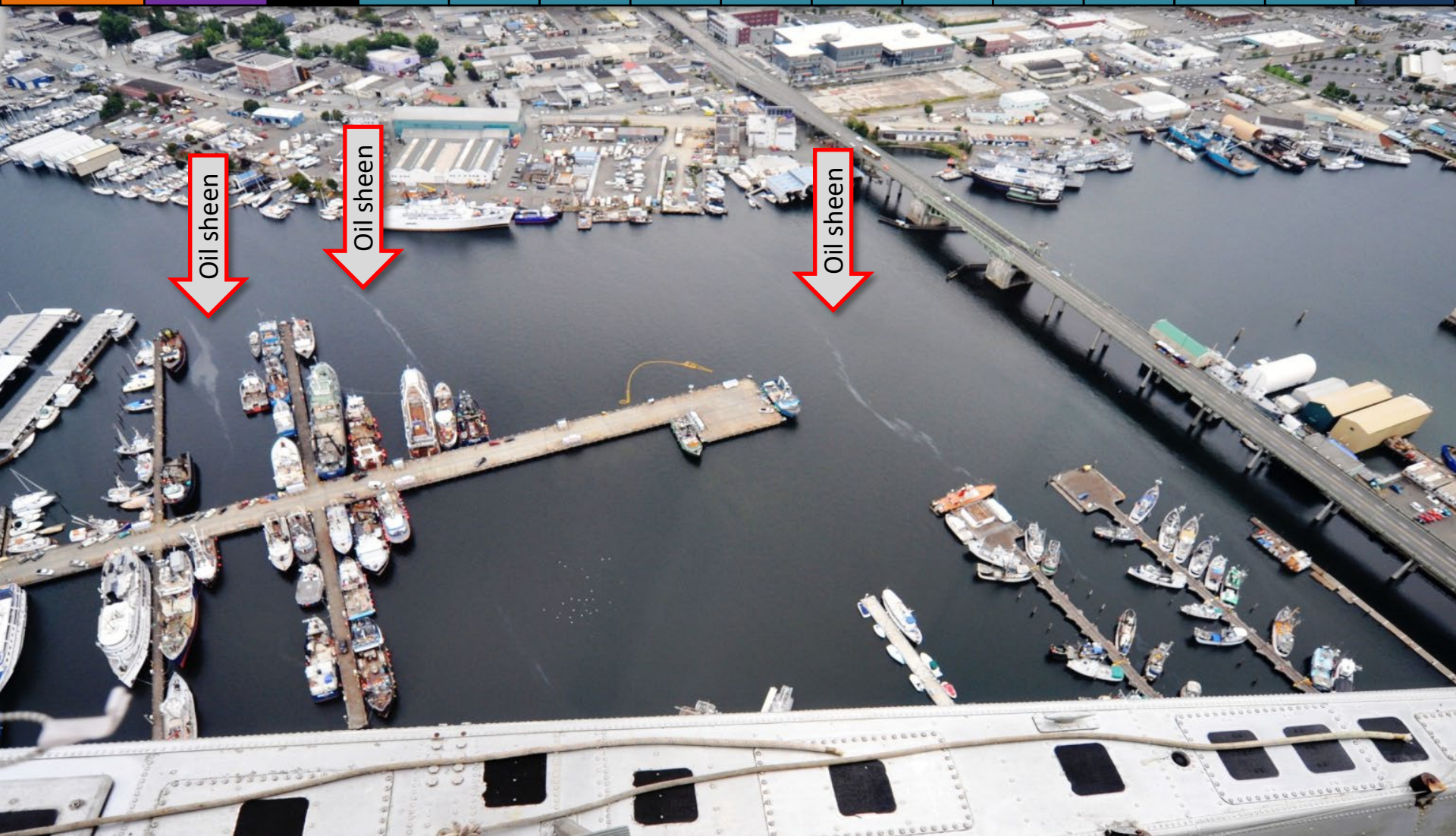


Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Aggregations of jellyfish (unconfirmed). Location: Western Sinclair Inlet, 9:12 AM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data



Oil sheen. Location: Ballard Bridge, Seattle, 8:30 AM

Summary

People

2011

2012

2013

2014

2015

2016

2017

2018

2019

2020

2021

2022

Data



Beach erosion. Location: Off Discovery Park, Seattle, 7:32AM

Summary

People

2011

2012

2013

2014

2015

2016

2017

2018

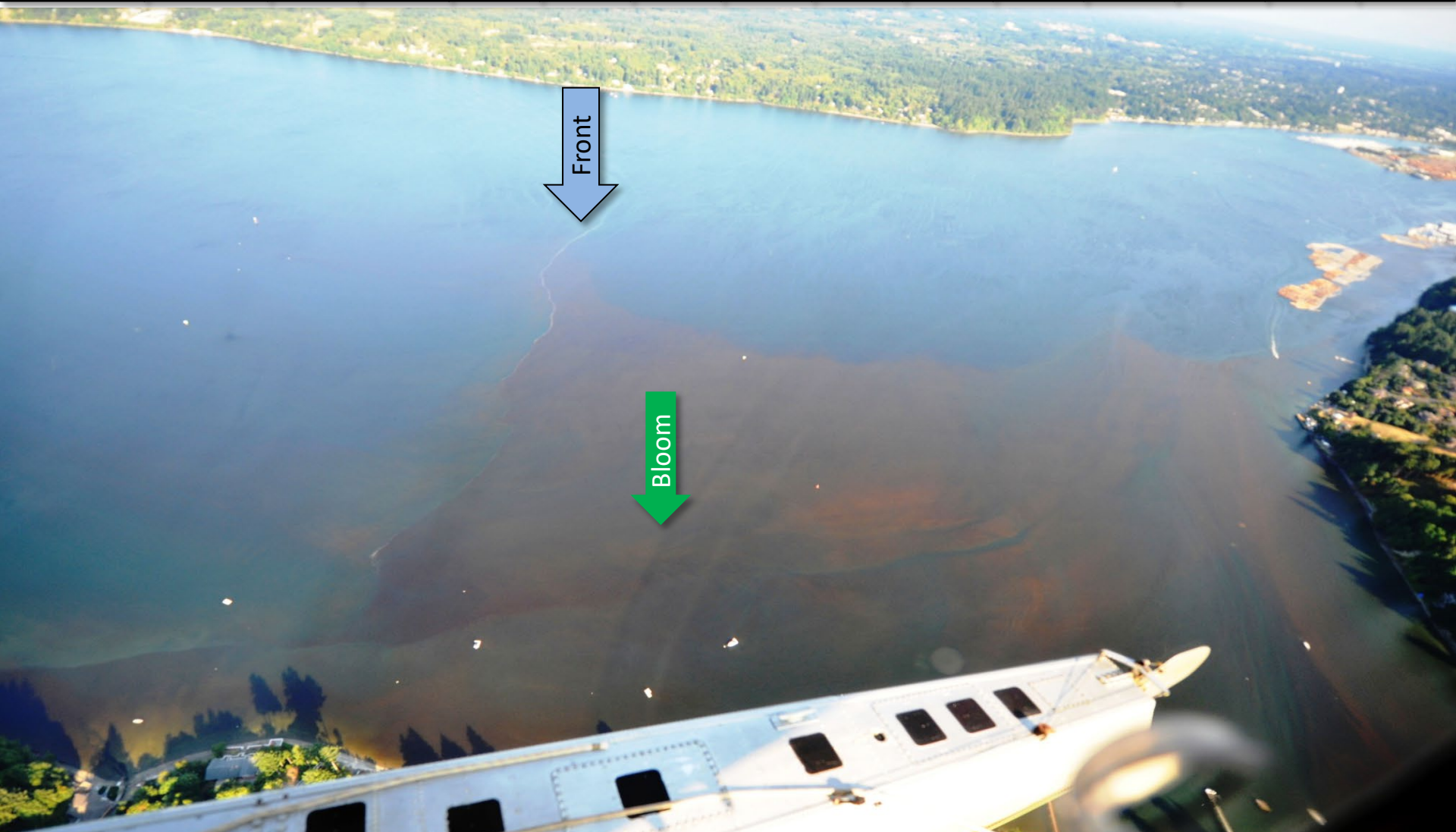
2019

2020

2021

2022

Data



Red-brown bloom. Location: Budd Inlet (South Sound), 4:40PM

Summary People 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Data

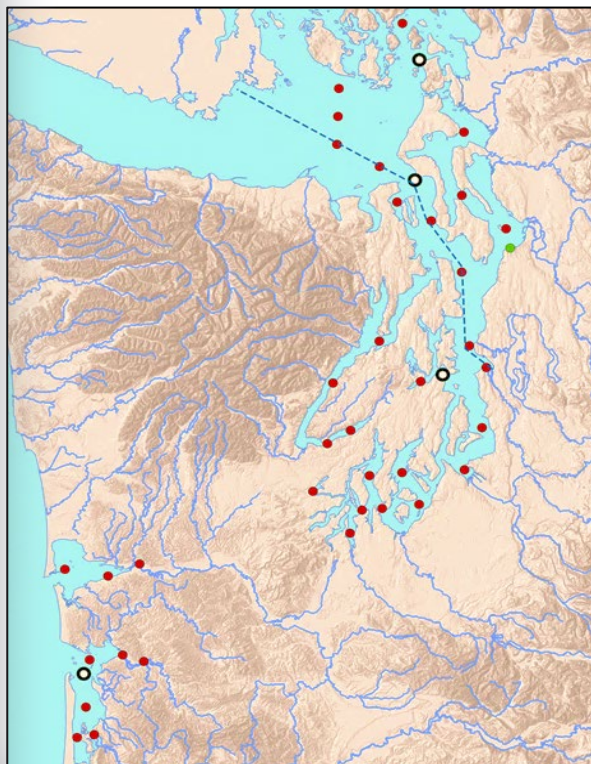
Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Noctiluca filaments drifting at the surfac, looking onto Des Moines.
Location: Vashon Island (Central Sound) 4:44 PM

Long-term monitoring data from Puget Sound and coastal bays

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



The Salish SeaCat



Natalie and Holly on our new Research Vessel

Get your data
from our online
database here