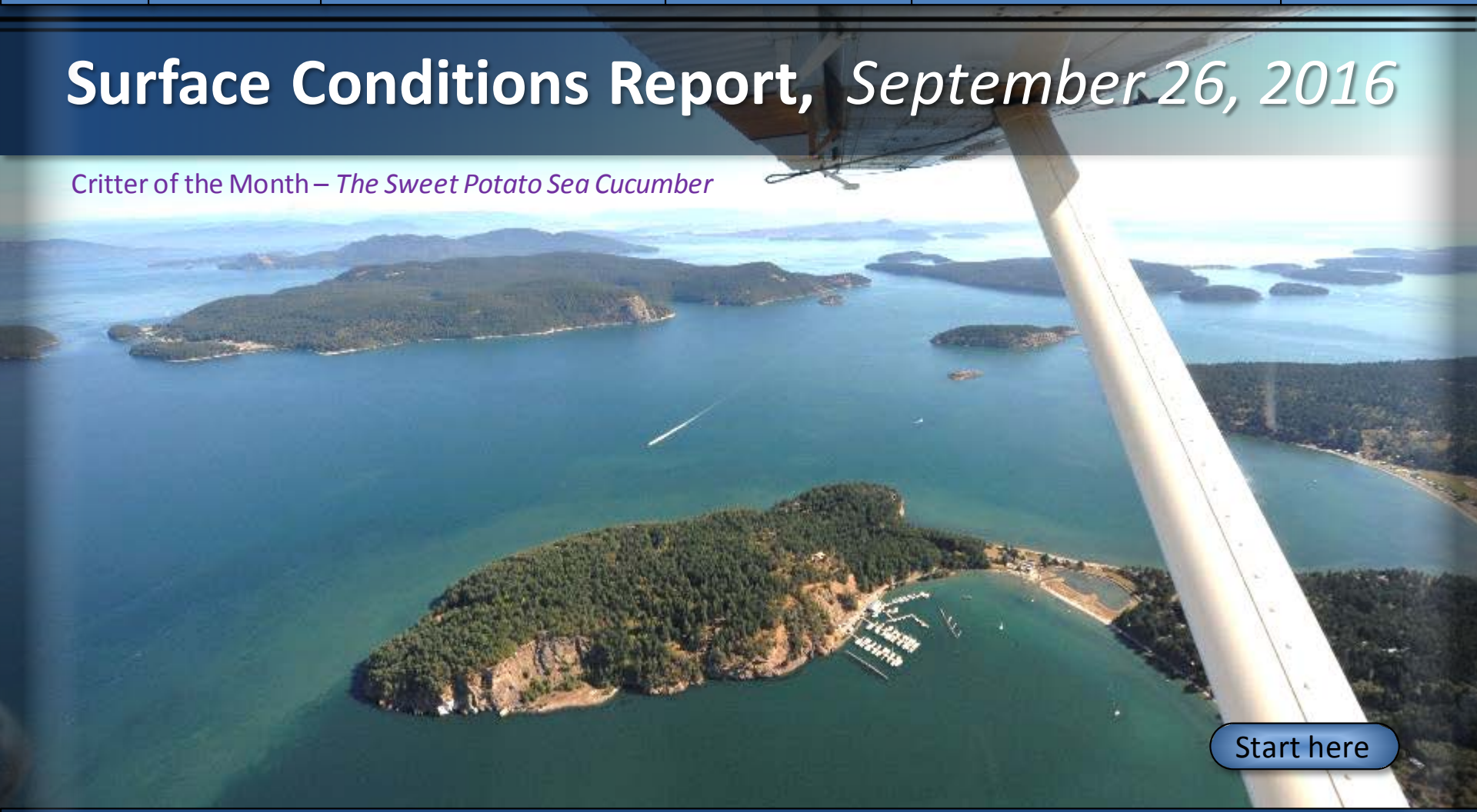
Publication No. 16-03-077

DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound

Surface Conditions Report, *September 26, 2016*

Critter of the Month – *The Sweet Potato Sea Cucumber*



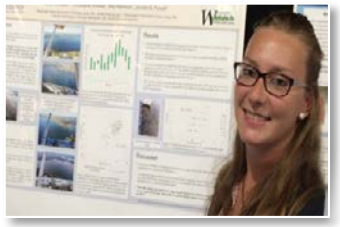
Start here

Scuba info

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

Marine conditions from 9-26-2016 at a glance

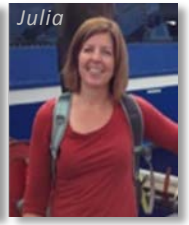
LONG-TERM MARINE MONITORING UNIT



Mattie Michalek

Skip Albertson

Dr. Christopher Krembs (Editor)



Julia Bos
Suzan Pool

Jim Shedd

Editorial assistance provided by: Suzan Pool, Carol Maloy

Critter of the Month – The Sweet Potato Sea Cucumber

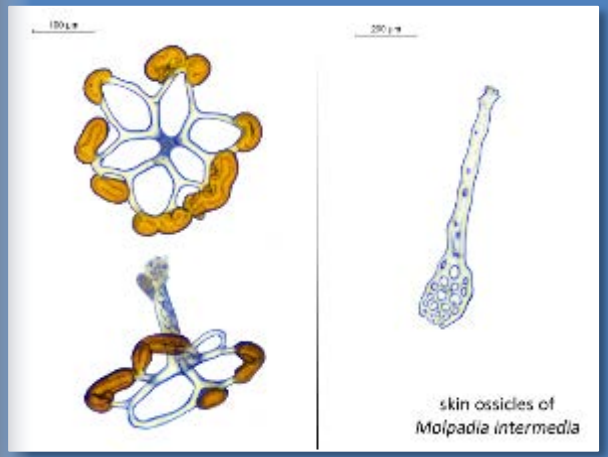
Angela Eagleston & Dany Burgess
Marine Sediment Monitoring Team

Molpadia intermedia

This critter sounds like a vegetable and looks a bit like a breakfast sausage, but the structures in its skin make it special! Find out what makes this plump mud-dweller an important part of Puget Sound benthic communities.

Fun Facts!

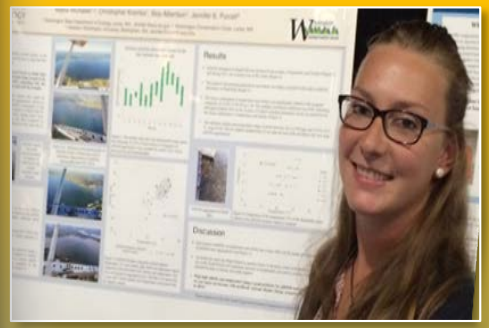
- Their skeleton is composed of tiny particles called ossicles.
- They eat upside down with their faces buried in the mud.
- They are smooth and shiny because they lack tube feet.



Learn more about *Molpadia* and other critters on Ecology's EcoConnect blog here.

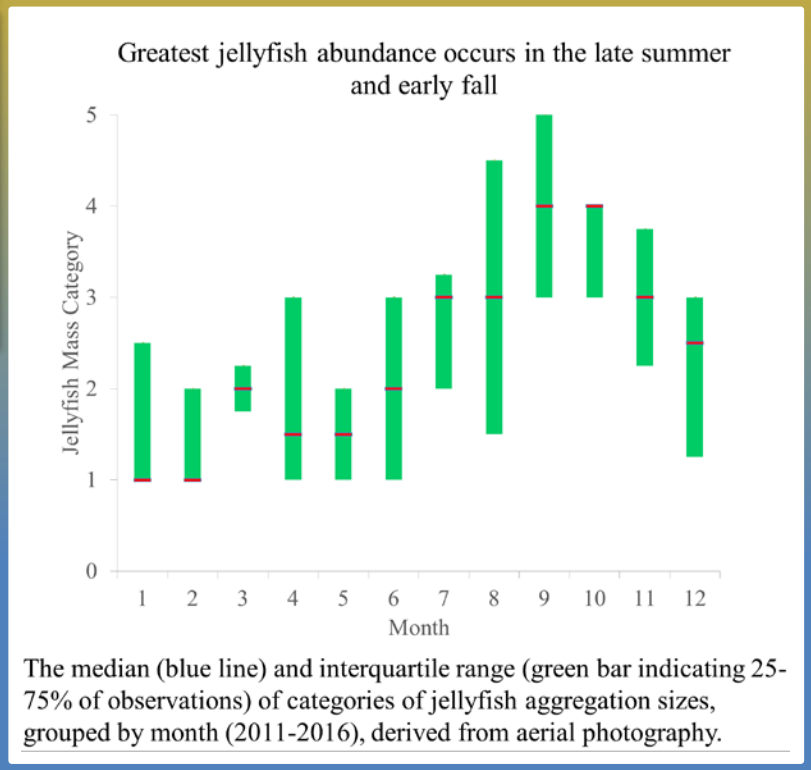
September is jellyfish season in South Sound!

Washington Conservation Corps

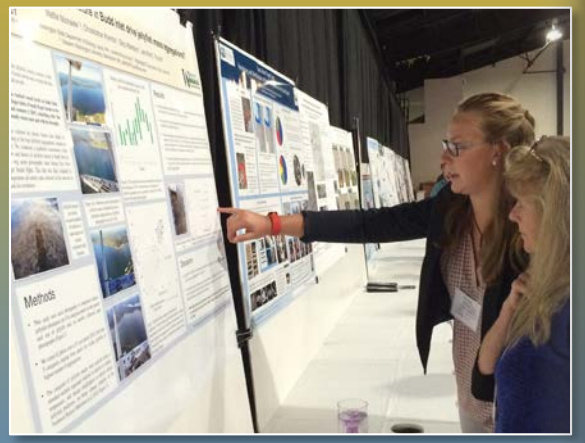


Our WCC intern, Mattie Michalek, presented a project on the large jellyfish masses we have been seeing in Budd Inlet. Mattie analyzed photos from monthly EOPS flights over the last 6 years. She assigned jellyfish images to 5 categories to indicate how abundant the jellyfish mass aggregations (smacks) were.

Jellyfish biomass reached record levels in Budd Inlet and other finger inlets of South Puget Sound in the fall of 2014 and summer of 2015, coinciding with 'the Blob' of unusually warm water and with the drought.



The median (blue line) and interquartile range (green bar indicating 25-75% of observations) of categories of jellyfish aggregation sizes, grouped by month (2011-2016), derived from aerial photography.



Mattie presented her study results at the 2016 South Sound Science Symposium: "Do salinity and temperature in Budd Inlet drive jellyfish mass aggregations?"

View poster

The divers' page, visibility 9-26-2016

What was the visibility in the water for divers?

August

	Best	/Depth	Least	/Depth
1)	10	/ 25	6	/ 3
2)	25	/ 82	6	/ 20
3)	21	/ 82	17	/ 7
4)	34	/ 51	7	/ 10
5)	21	/ 61	14	/ 15
6)	22	/ 84	10	/ 8
7)	36	/ 41	16	/ 10
8)	12	/ 25	2	/ 8
9)	21	/ 98	18	/ 16
10)	14	/ 72	5	/ 13
11)	26	/ 75	3	/ 5
12)	6	/ 48	4	/ 5
13)	19	/ 31	16	/ 10
14)	18	/ 80	13	/ 15
15)	13	/ 85	11	/ 3
16)	3	/ 44	1	/ 13

Find depths with high and low visibility

- **Best visibility** was about 35 feet or more around Seacrest Park in Elliott Bay.
- **Poor visibility** occurred in many places of Puget Sound within the first 10 feet of the surface.
- In August, visibility took a downturn perhaps in response to abundant sunshine and resultant planktonic blooms.
- Elliott Bay decreased visibility from 42 ft to 36 ft since July.
- We use transmissometer readings from our CTD package and convert them into horizontal visibility.

This is a new feature and we are soliciting feedback (salb461@ecy.wa.gov). Eventually we will feature the most recent data.

Climate Influences leading to 9-26-2016

Climate and natural influences, including weather, rivers, and the adjacent ocean, can affect our marine waters. Graphics are based on provisional data and are subject to change. http://www.ecy.wa.gov/programs/eap/mar_wat/weather.html, page 26.

August Summary:

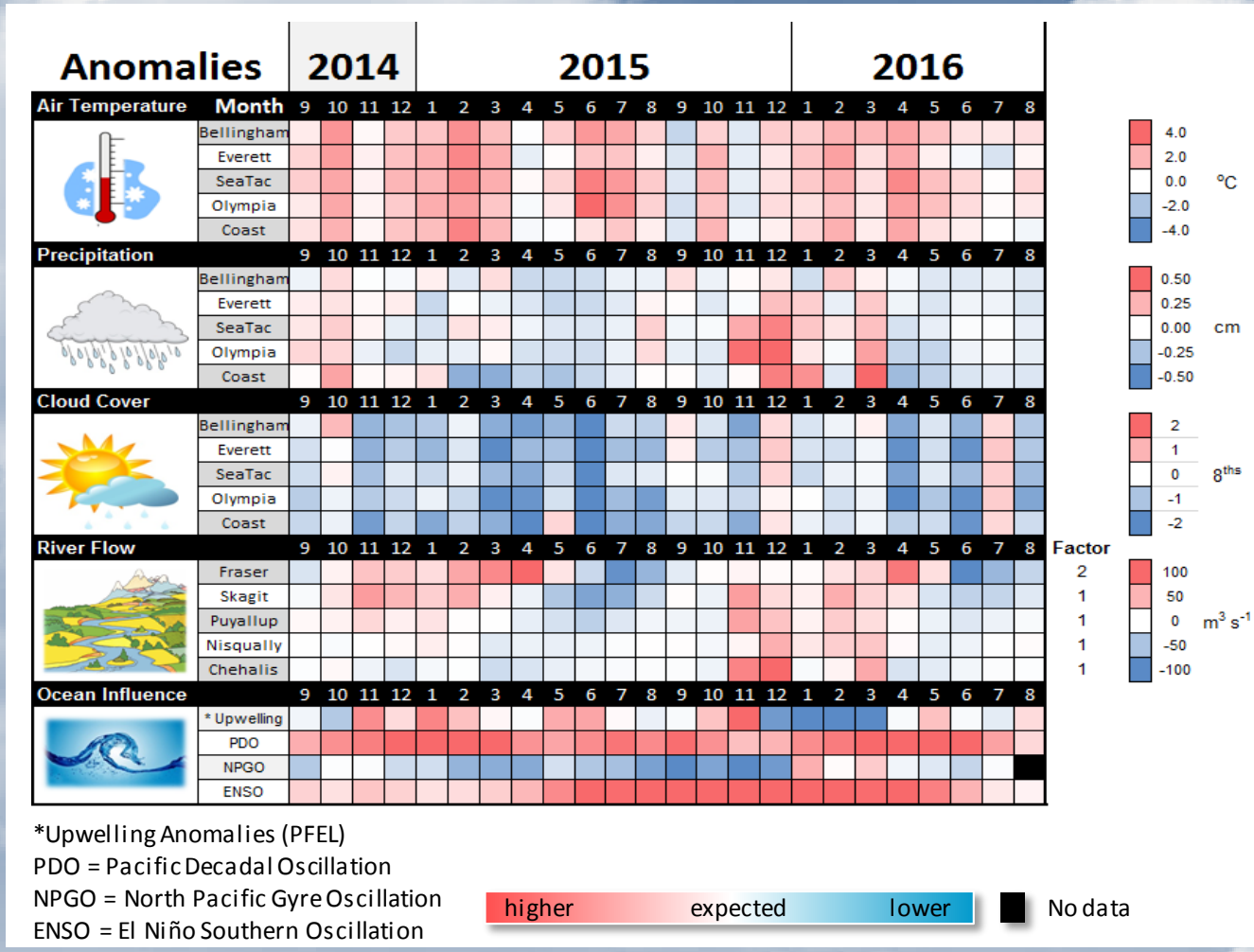
Air temperatures were slightly above normal.

Precipitation was below normal.

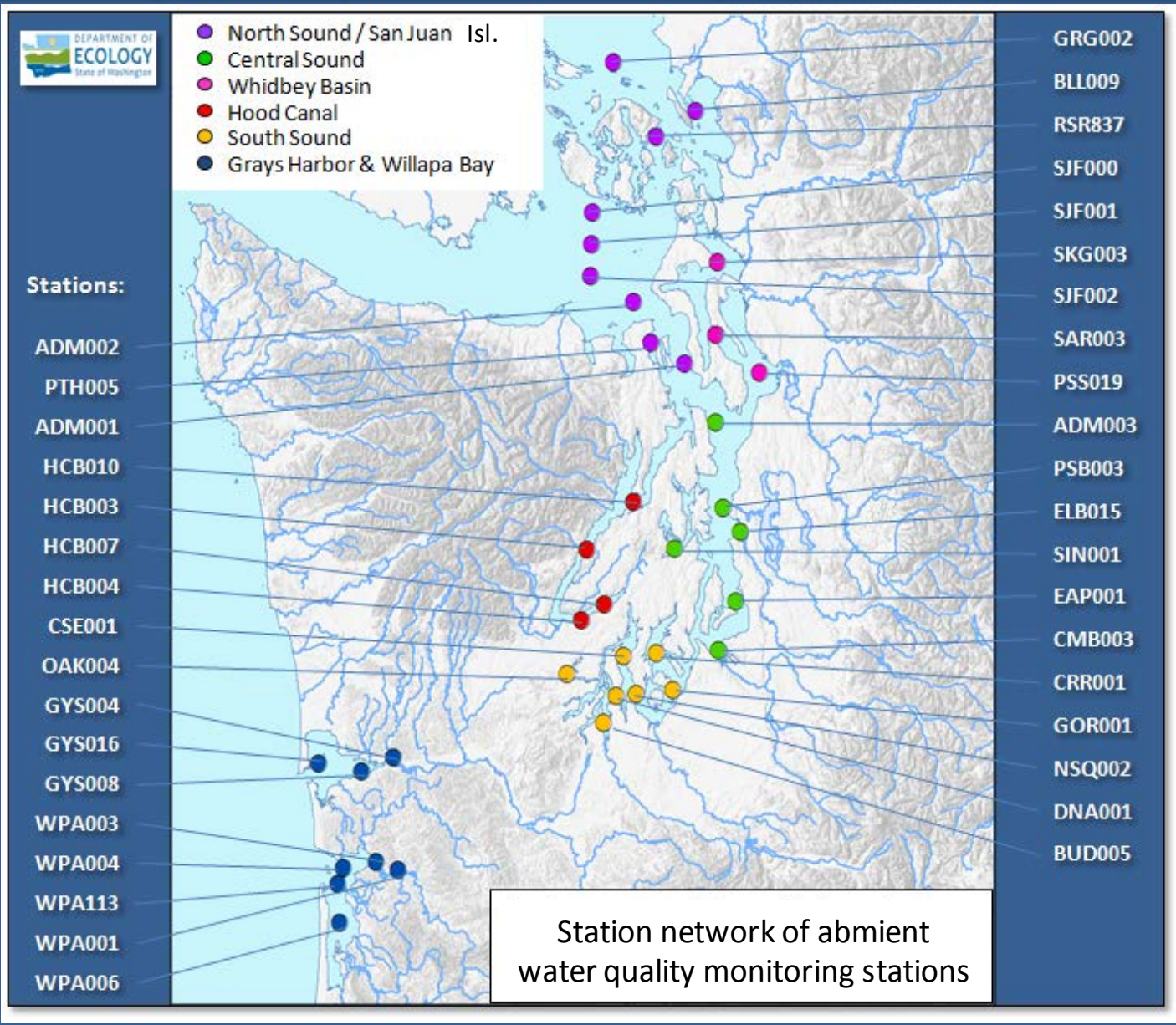
Sunshine levels were higher.

River flows were still below normal, particularly to the north (Nisqually River is regulated).

Upwelling, ENSO, and PDO are above normal.



Our long-term marine monitoring stations in Washington



Station network of abmient water quality monitoring stations

We use a boat and a chartered float plane equipped with a CTD package to access our monthly monitoring stations.

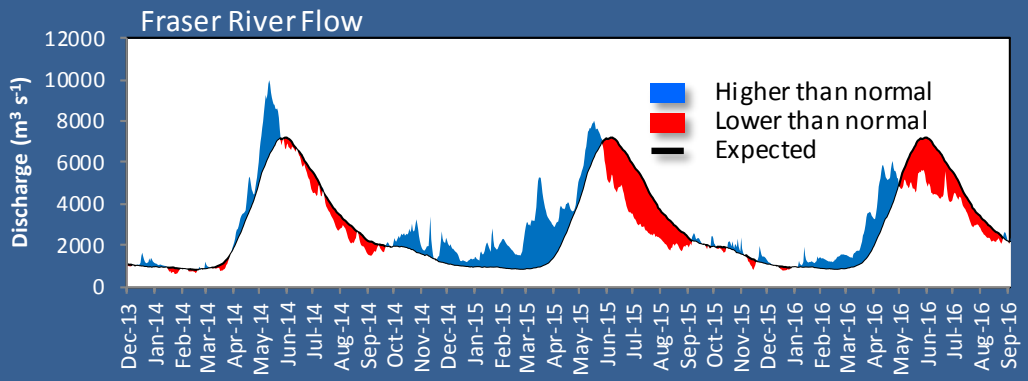
Start here

We communicate data and environmental marine conditions using:

1. **Marine Water Condition Index (MWCI)**
2. **Eyes Over Puget Sound (EOPS)**
3. **Anomalies and source data**

How well is Puget Sound exchanging its water?

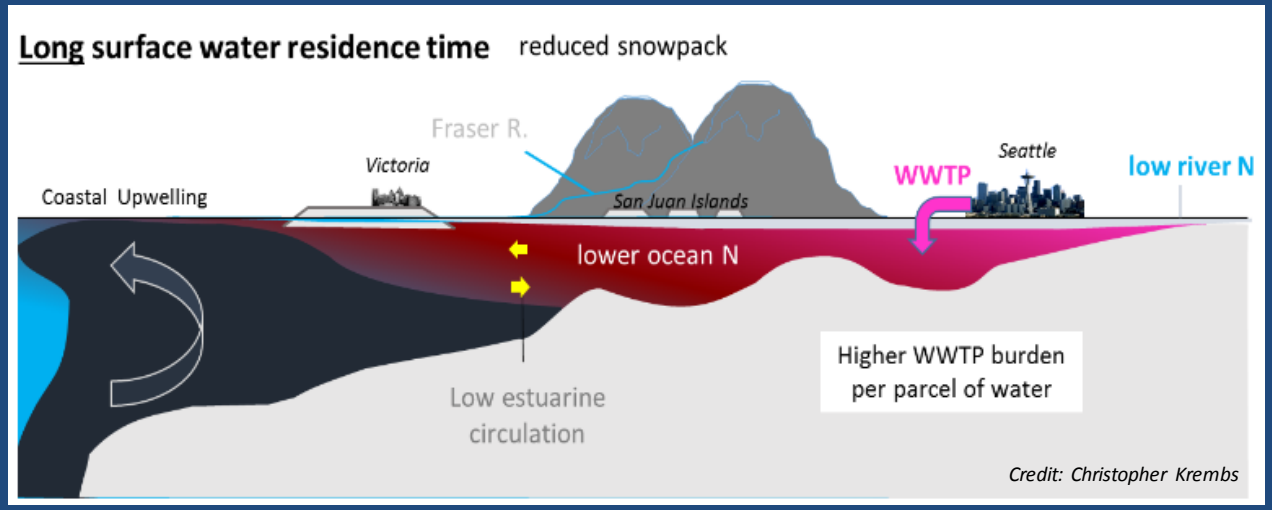
Year 2016 continues to have record-breaking global temperatures. In our region, the Fraser River flow has plummeted. Estuarine circulation is important because water temperatures in Puget Sound are still warmer than normal! The Fraser River is the largest freshwater source for the Salish Sea, significantly affecting and driving estuarine circulation.



Government of Canada

In winter and spring 2016, the Fraser River and other rivers discharged prematurely. This year's Fraser River summer flow has been extremely low in response to warm winter temperatures and lack of snowpack in BC. Very low summer flows inhibit the renewal of water in Puget Sound. The flow is now normalizing.

Source: http://wateroffice.ec.gc.ca/index_e.html



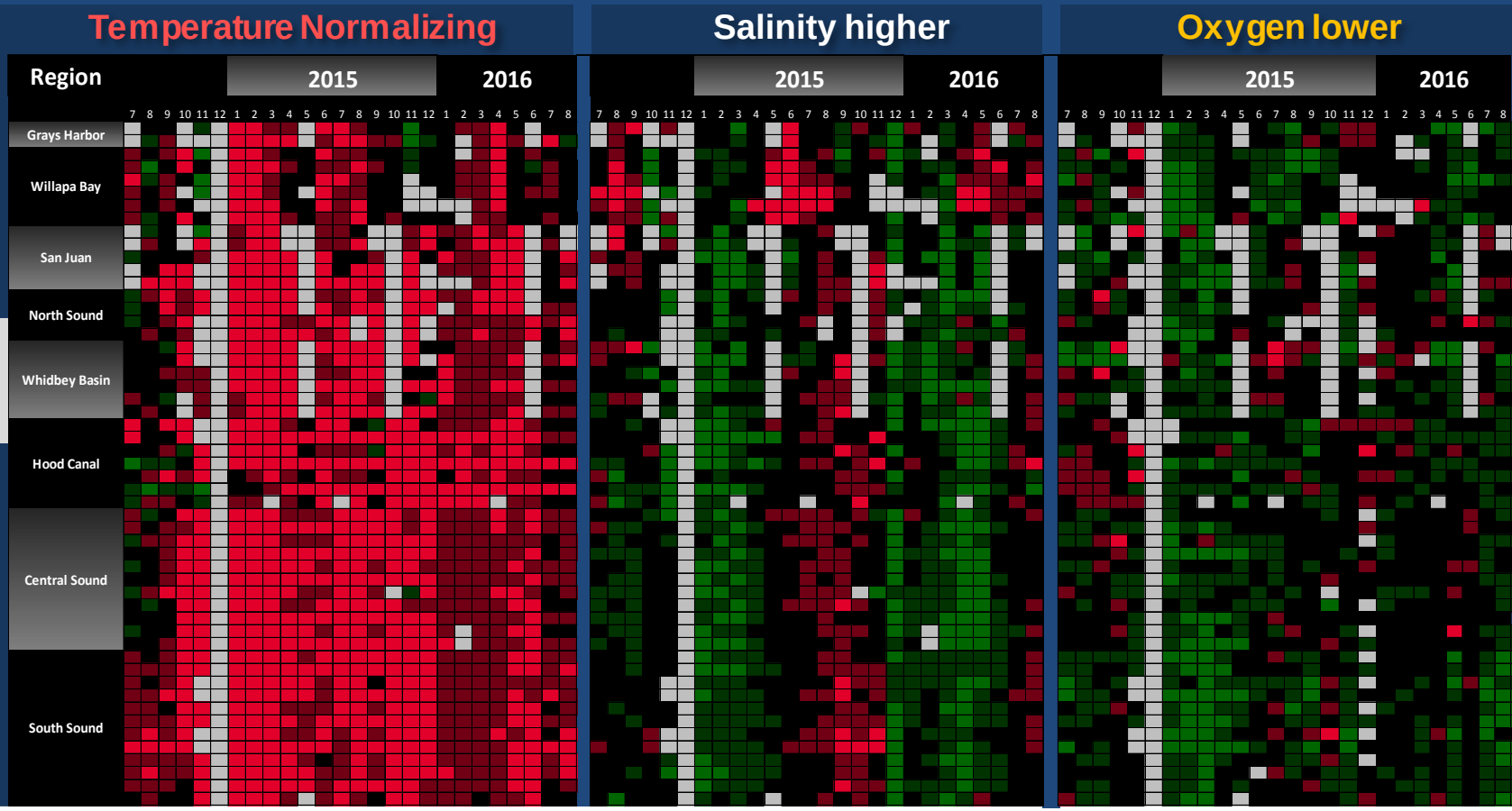
Very low Fraser River flow this summer meant stagnant water in the Salish Sea and reduced exchange with coastal water.

As a consequence, water warmed and pollution had a chance to accumulate.

Physical conditions tracked in historical context

After nearly 2 years of record-breaking water temperatures, Puget Sound temperatures and salinity are not quite to expected ranges in August. Lower oxygen conditions continue in southern Puget Sound. At the coast, salinity is higher due to very low river flows (see page 37).

Explore profiles at all stations



= higher than expected (>IQR, n=13)
= higher than previous measurements
= expected (=IQR, n=13)
= no data
= lower than expected (<IQR, n=13)
= lower than previous measurements

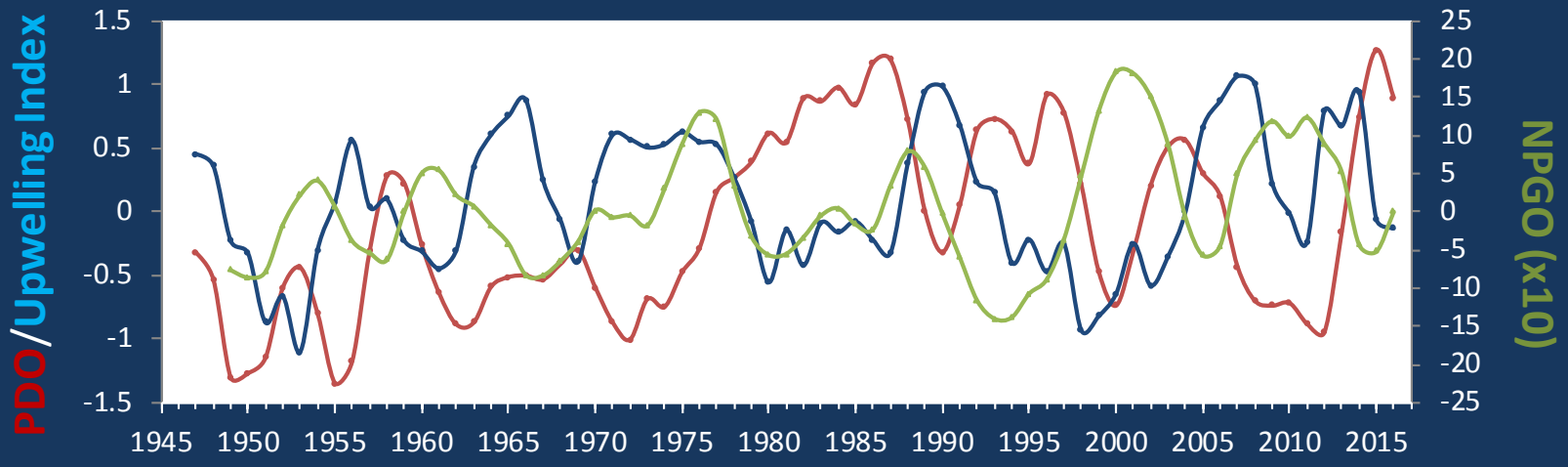
The ocean affects water quality: Ocean Climate Indices

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

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

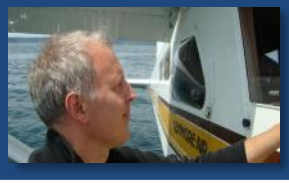
c) *North Pacific Gyre Oscillation Index (**NPGO, productivity**)* (explanation)

Three-year running average of PDO, Upwelling, and NPGO indices scores



Ocean boundary conditions long-term variability: (a) water is still warm (PDO), (b) upwelling of low oxygen and high nutrient ocean water are normal (Upwelling Index anomaly), and (c) surface productivity along the coast is normalizing (NPGO).

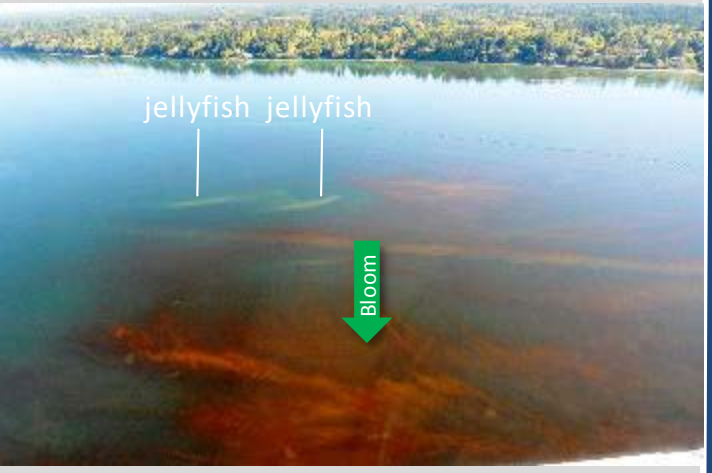
Summary: Aerial photography 9-26-2016



Large jellyfish aggregations were in finger Inlets of South Sound. Red-brown and green-brown blooms were widespread in many bays across Puget Sound and around the San Juan Islands. In contrast, Central Sound had clear water with lower algal activity.

Start here

Blooms in Budd Inlet with striking intensity



Sinclair Inlet with red-brown bloom

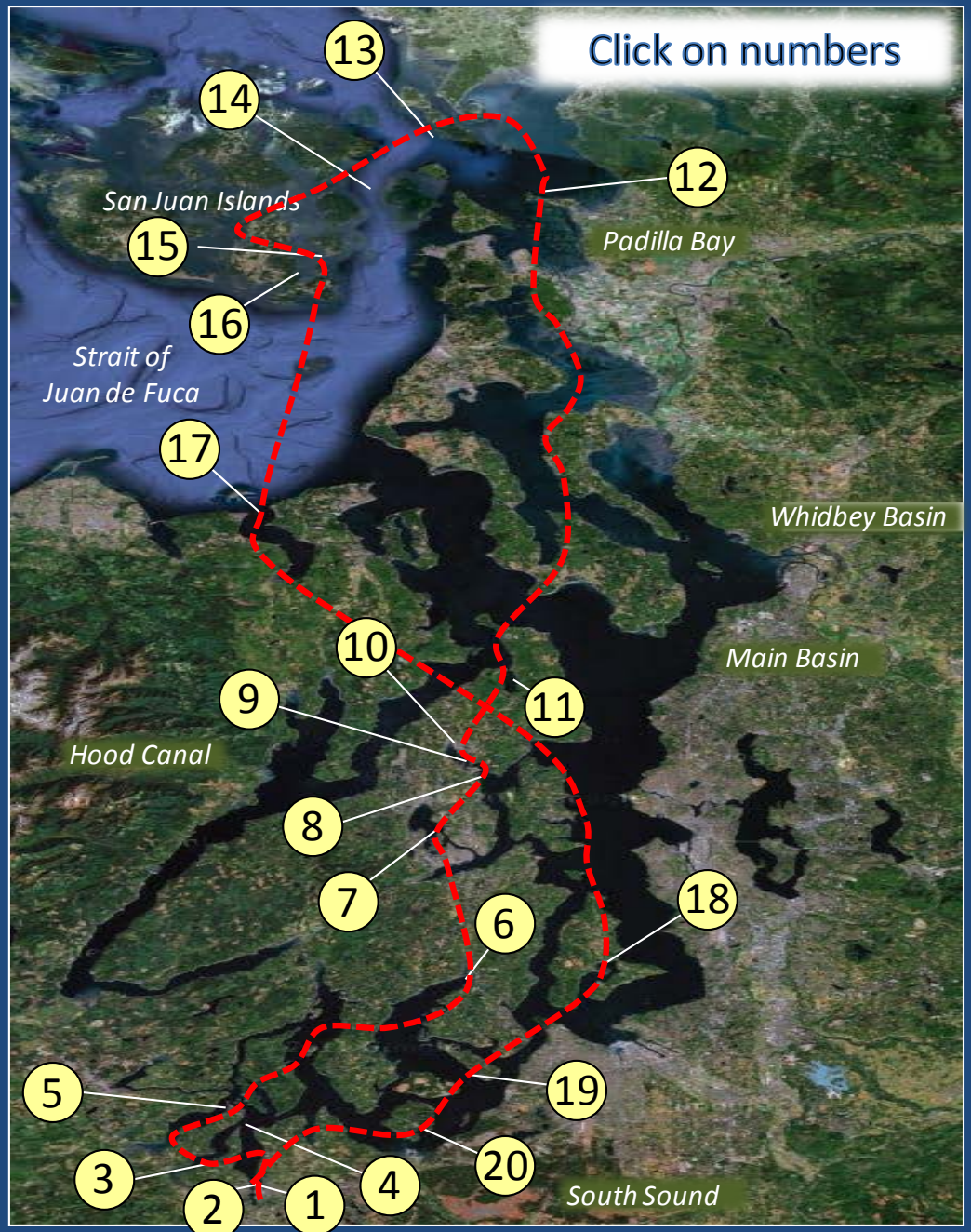
Mixing and Fronts:
Many and large tidal eddies outlined by blooms of different colors.

Jellyfish:
Very numerous in Budd, Eld, and Totten Inlets. Not seen in other inlets.

Suspended sediment:
Near shore suspended sediments mostly due to strong tidal activity. Some regional river input of suspended sediment.

Visible blooms:
Strong red-brown blooms in South Sound and in Sinclair, Liberty, and Samish Bays. Brown-green blooms seen around tidal eddies. In Totten, Eld, and Dyes Inlets.

Debris:
Large organic debris rafts in Budd and Case Inlets and Nisqually Reach.



Aerial photography and navigation guide

Date: 9-26-2016

Tide data (Seattle):

Time	Height (ft)	High/Low
01:29 AM	9.13	H
08:02 AM	0.75	L
03:29 PM	10.94	H
09:27 PM	4.55	L

Flight Information:

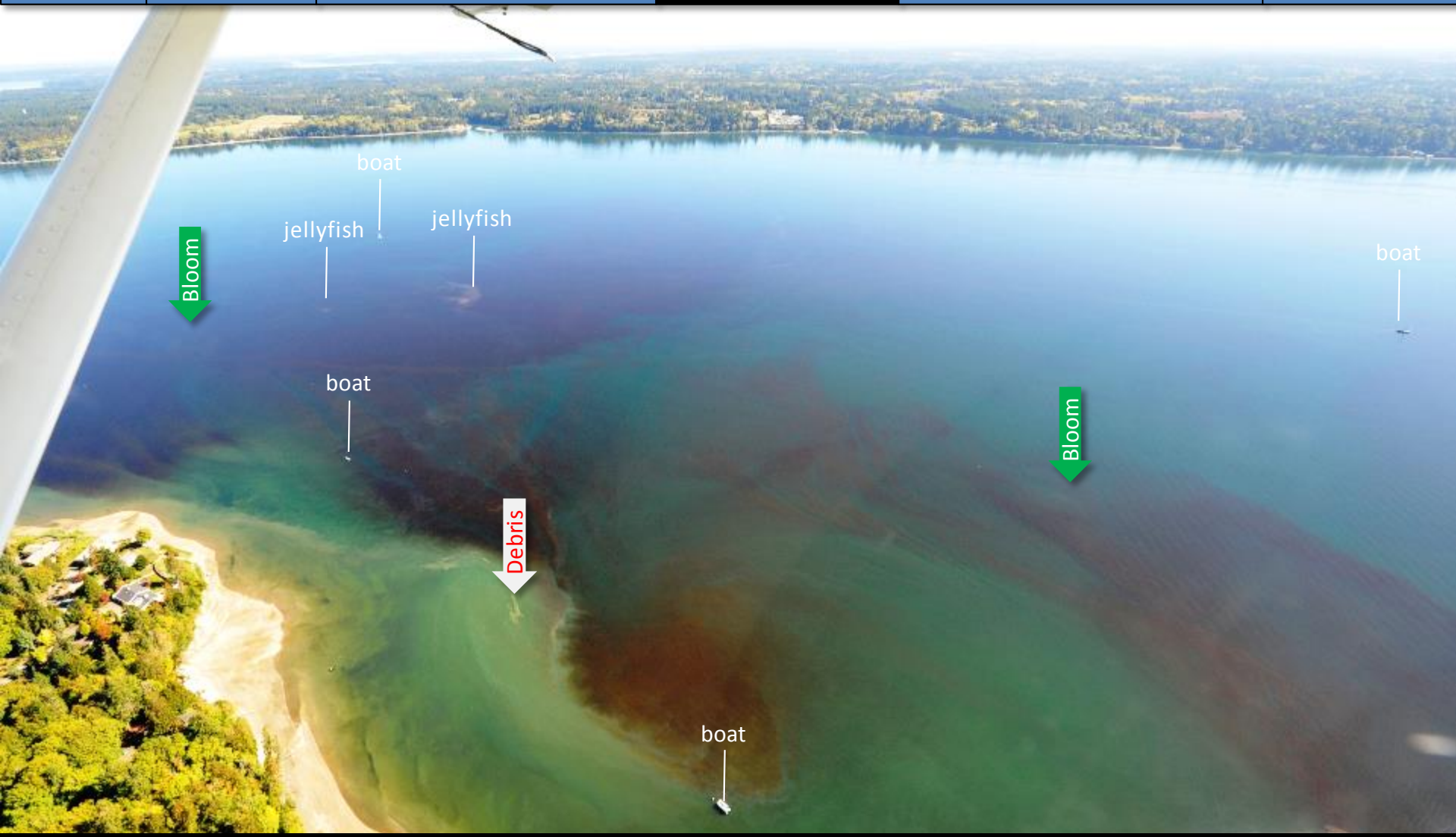
Sunny, very good visibility

Flight route

Observation Maps:

Central and North Sound

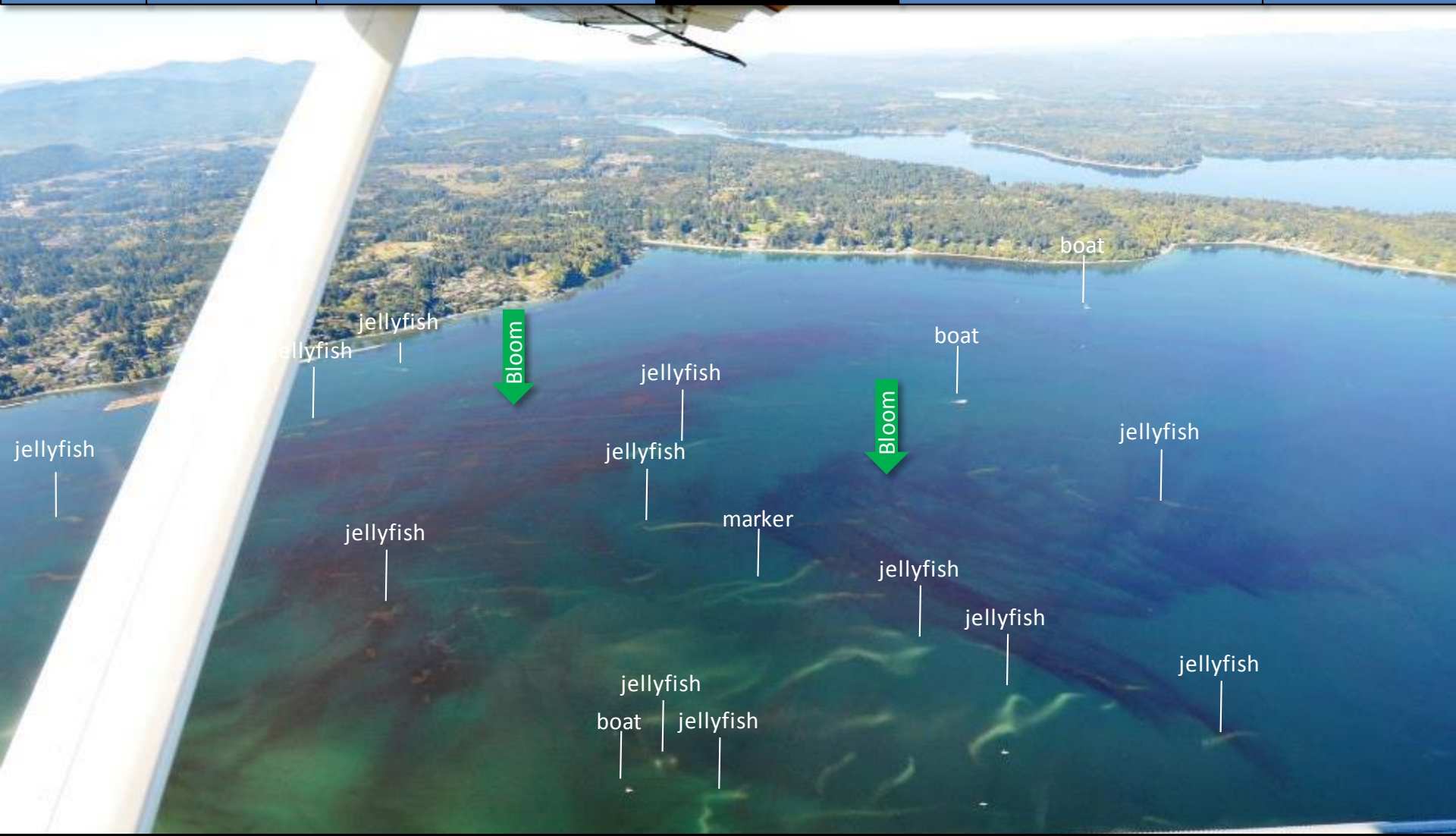
South Sound



Strong red-brown bloom, jellyfish patches, and organic debris at surface.

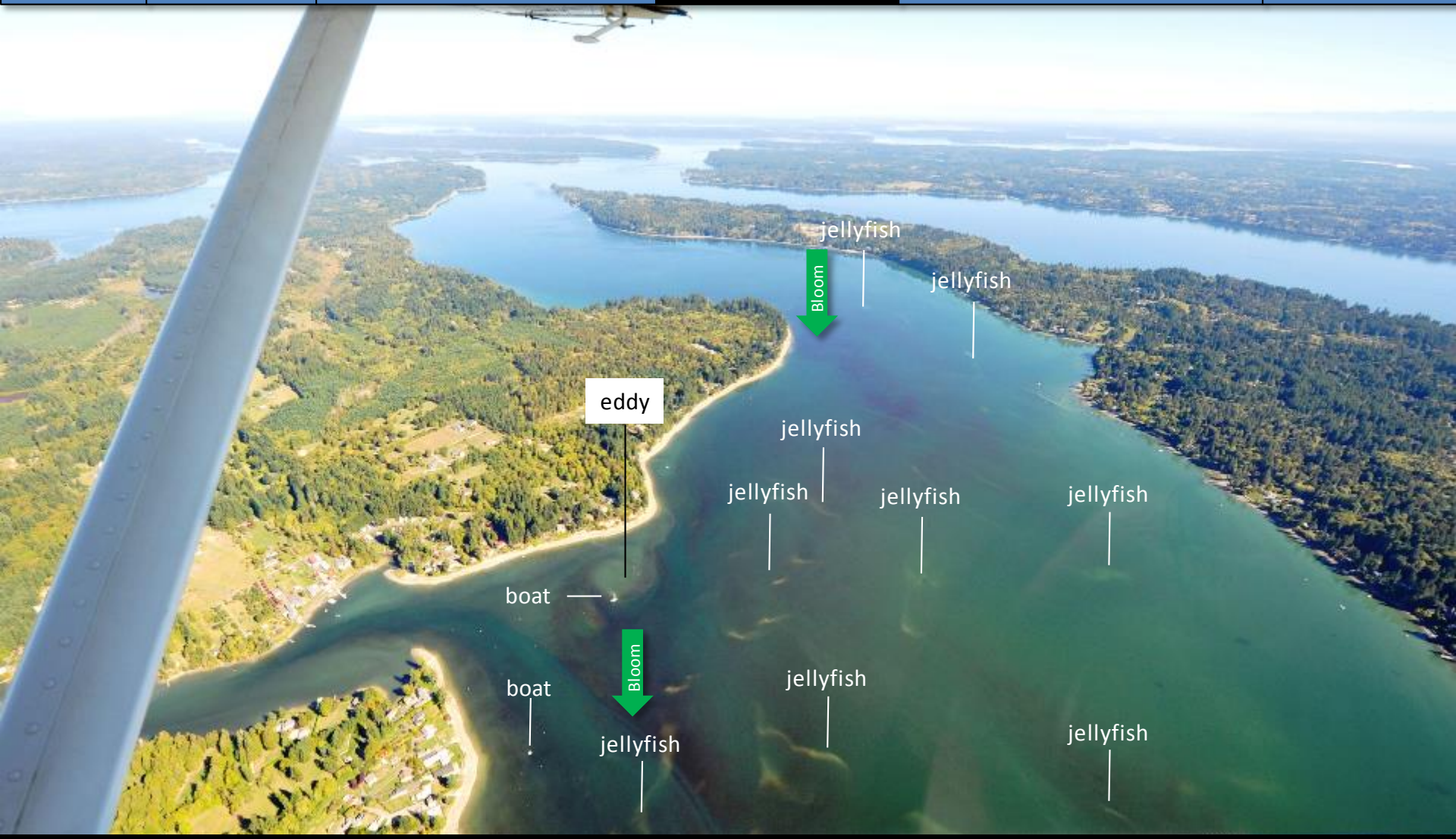
Location: Near Big Tykle Cove, Budd Inlet (South Sound), 12:28 PM.

Aerial photography 9-26-2016



Two differently colored red-brown blooms and abundant jellyfish patches.

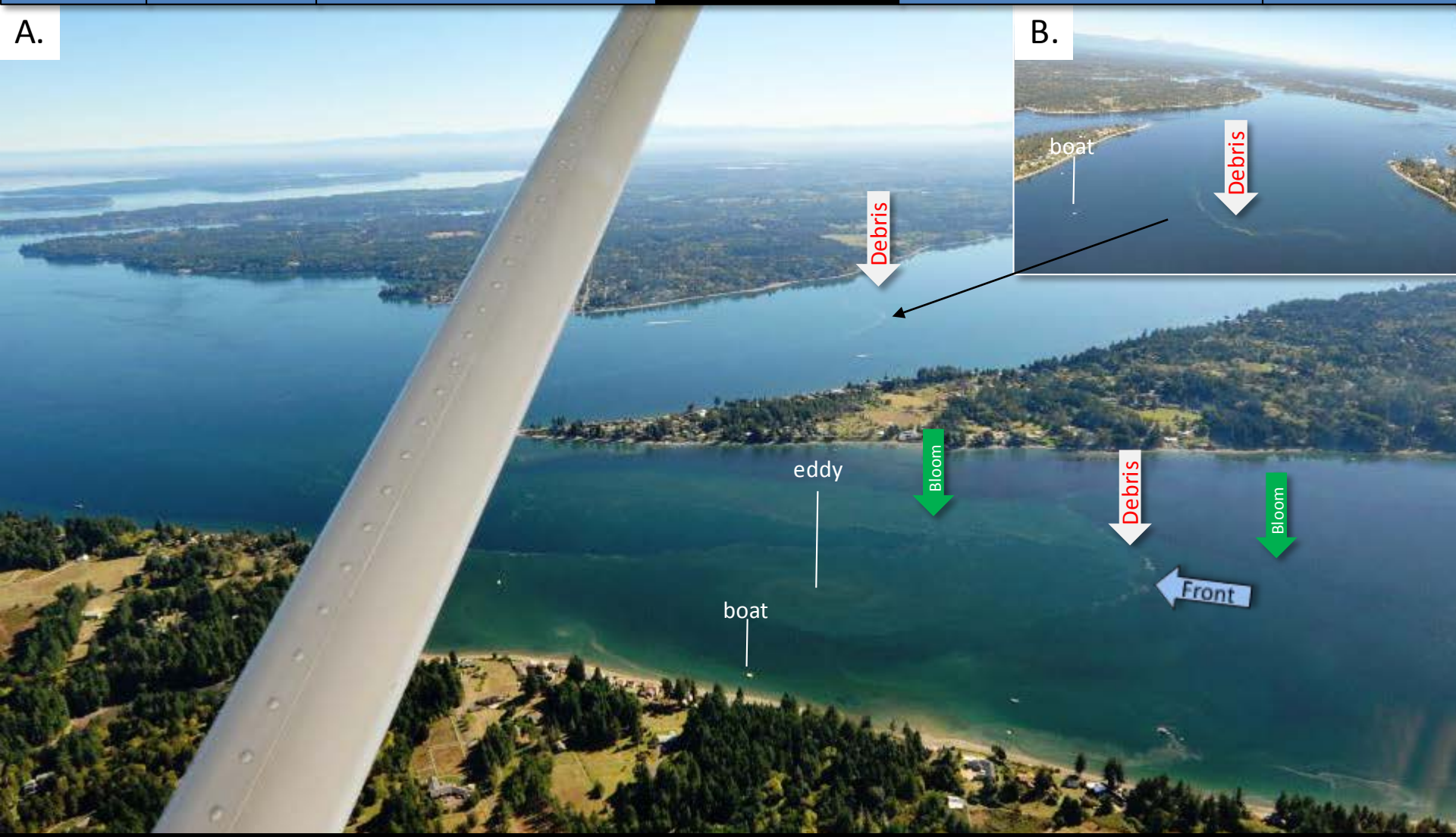
Location: Across Butler Cove, Budd Inlet (South Sound), 12:31 PM.



Strong red-brown bloom and abundant jellyfish patches. Tidal eddy.

Location: Young Cove, Eld Inlet (South Sound), 12:35 PM.

Aerial photography 9-26-2016



A. Red-brown and green blooms around tidal eddy during incoming tide. B. Large patch of organic debris.
Location: A. Eld Inlet, B. Budd Inlet (South Sound), 12:37 PM.

Tidal currents and eddies with different colored blooms (green and red-brown) during incoming tide.
Location: A. Carlyon Beach, Totten Inlet, B. Hope Island (South Sound), 12:39 PM.

Strong red-brown bloom and abundant jellyfish patches.

Location: Henderson Bay and Burley Lagoon, Carr Inlet (South Sound), 12:49 PM.

Aerial photography 9-26-2016

Tidal currents and eddies with different colored blooms (green and red-brown) during incoming tide.

Location: Dyes Inlet (Central Sound), 12:57 PM.

Red-brown bloom in shallow embayment near Keyport.

Location: Keyport, entrance to Liberty Bay (Central Sound), 1:00 PM.

Aerial photography 9-26-2016

Large tidal eddy and water with different colored blooms.

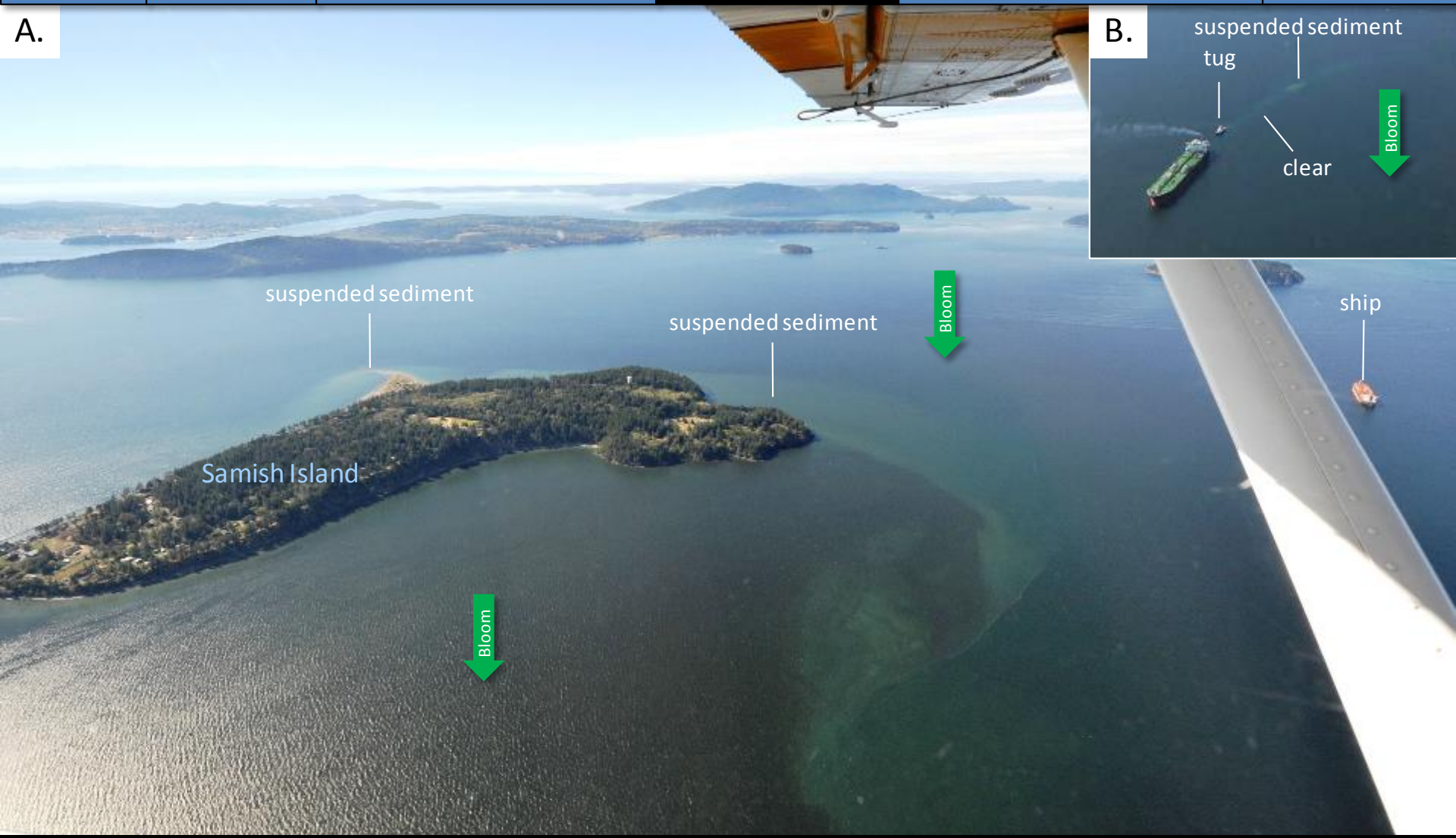
Location: Liberty Bay (Central Sound), 1:01 PM.

Red-brown bloom with adjacent river plume.
Location: Liberty Bay (Central Sound), 1:02 PM.

Aerial photography 9-26-2016

Red-brown bloom and flood tide setting off eddy. River plume with suspended sediment on eastern shore.

Location: Port Gamble (Hood Canal), 1:06 PM.



A. Red-brown bloom and suspended sediment next to Samish Island. B. Ship slowed by tug reveals that bloom is only at surface. Location: Samish Bay (North Sound), 1:31 PM.

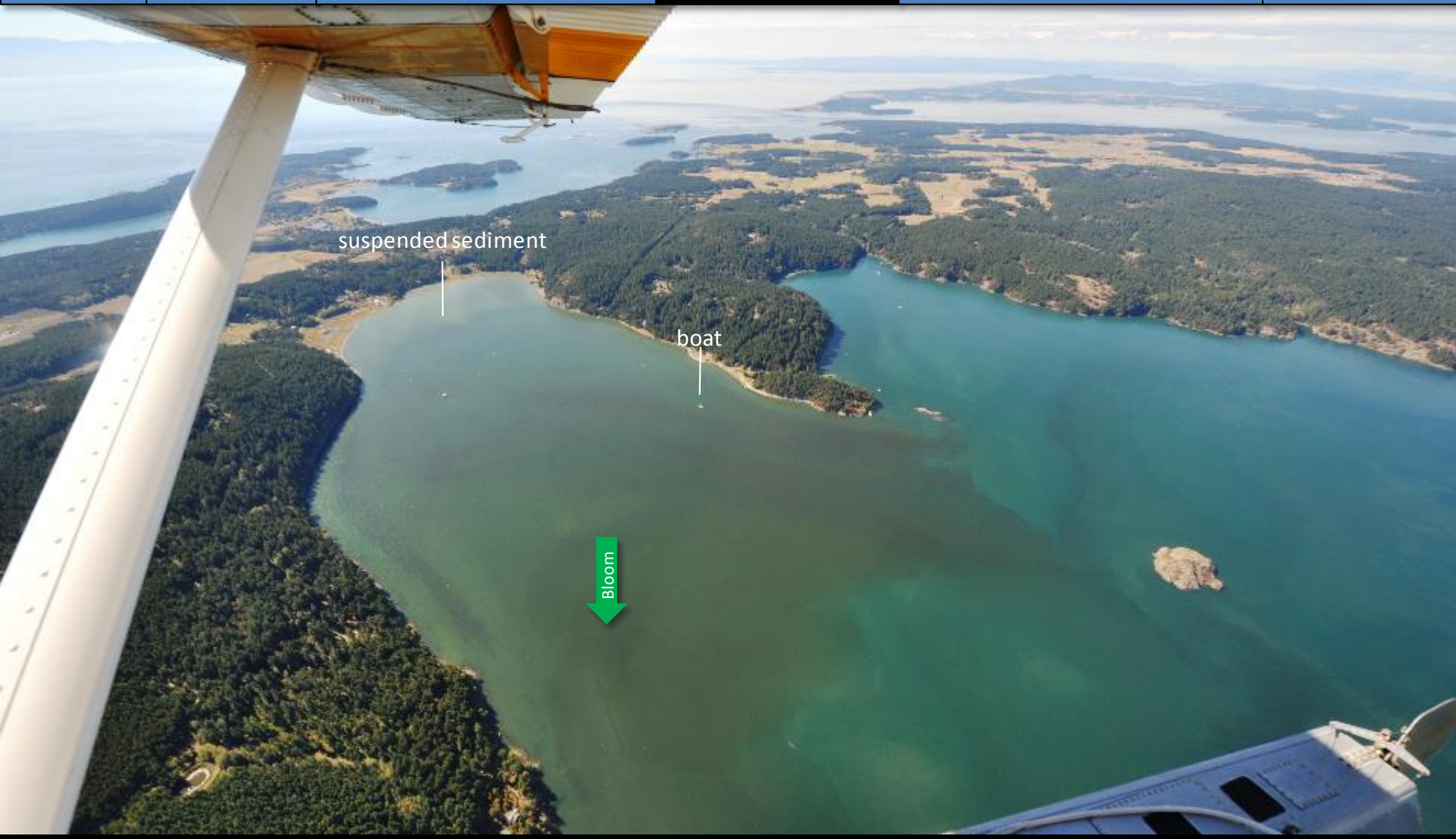
Jet from Samish Bay flowing north alongside Lummi Island. Fraser River plume/bloom and front.
Location: Lummi Island, Rosario Strait (North Sound), 1:36 PM.

Aerial photography 9-26-2016

Fraser River plume/bloom meeting flood tide which causes turbulent mixing.

Location: Rosario Strait (North Sound), 1:39 PM.

Fraser River plume/bloom mixing into eddy in Lopez Sound.
Location: Mud Bay, Lopez Sound (North Sound), 1:47 PM.



Red-brown bloom and suspended sediment.

Location: Mud Bay, Lopez Sound (North Sound), 1:47 PM.

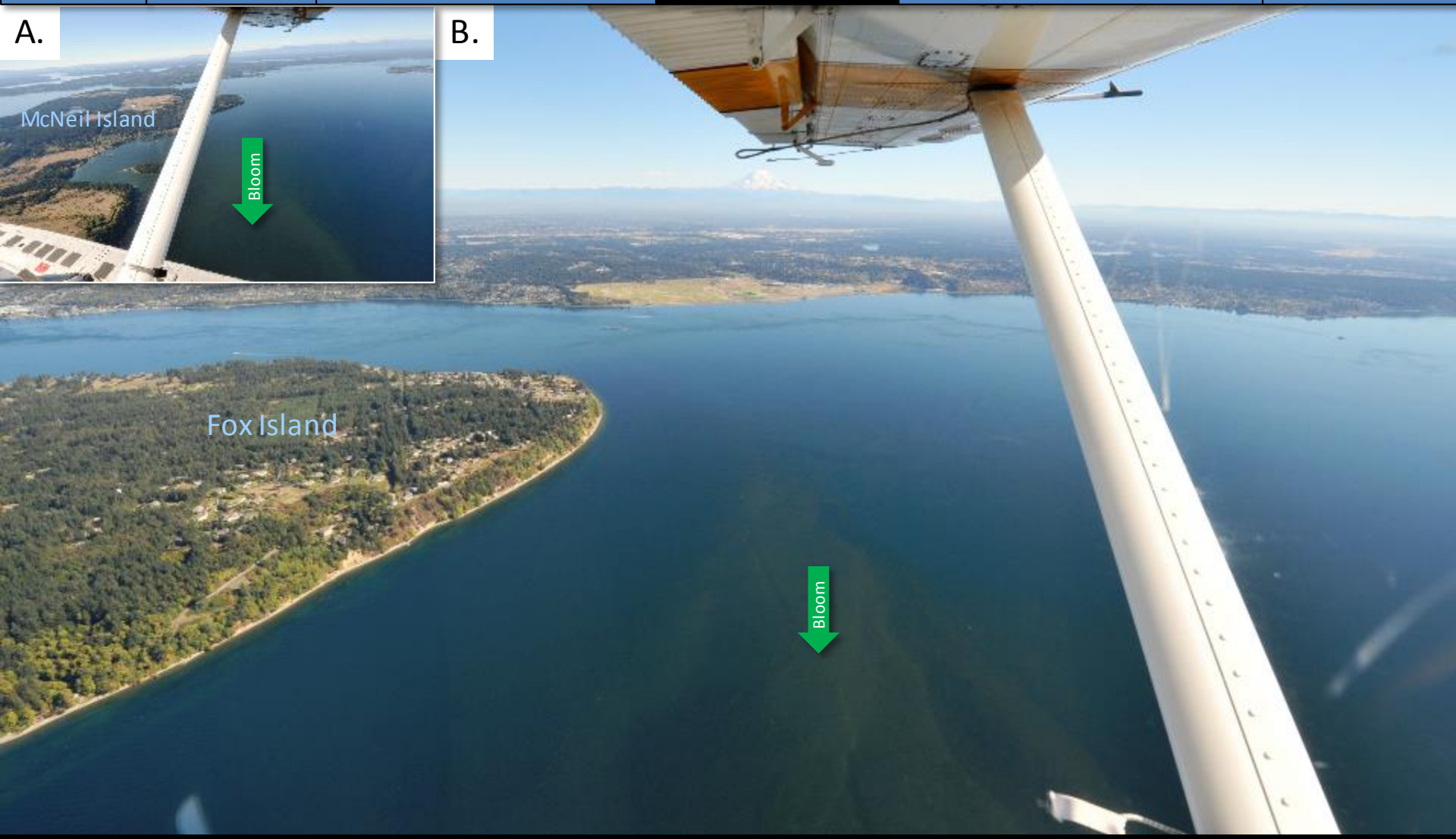
Strong red-brown filling Discovery Bay and extending to the bay entrance.
Location: A. West Side, B. East Side Discovery Bay (North Sound), 2:01 PM.

Aerial photography 9-26-2016

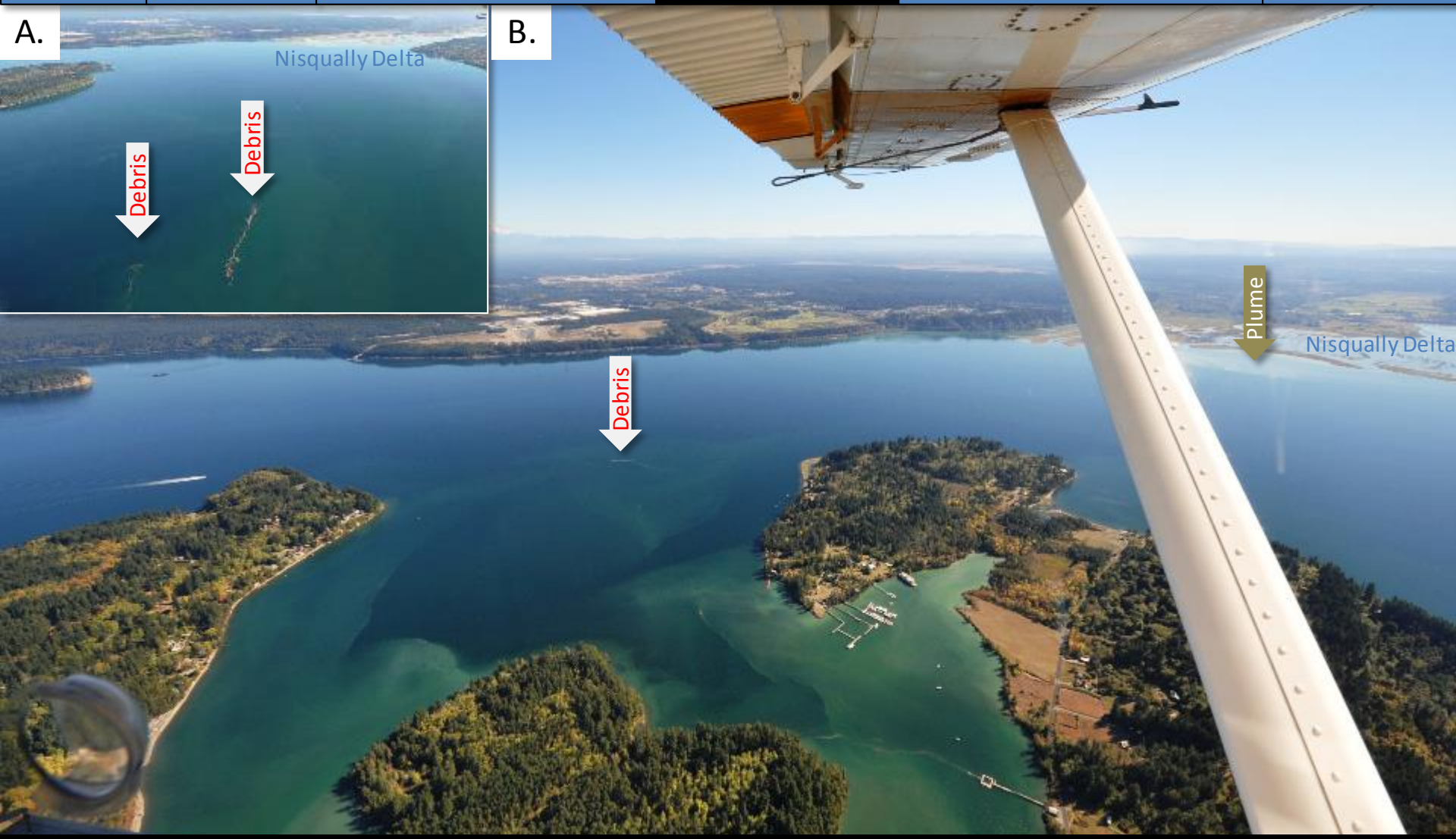
Green and red-brown blooms show how patchy blooms can be.

Location: Quartermaster Harbor (Central Sound), 2:30 PM.

Aerial photography 9-26-2016



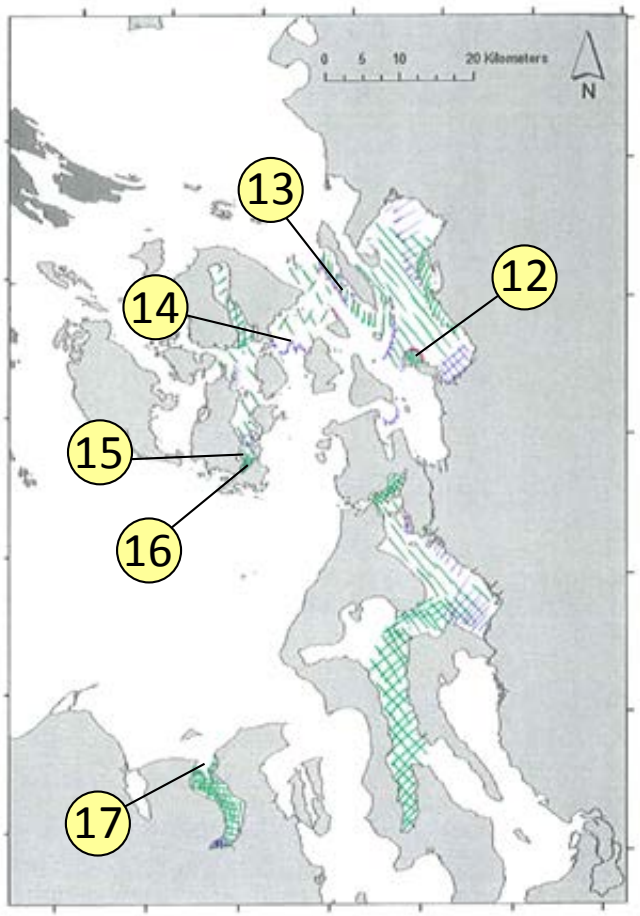
Green-brown bloom leaving Carr Inlet in a meandering ribbon between McNeil and Fox Islands.
Location: Carr Inlet (South Sound), 2:39 PM.



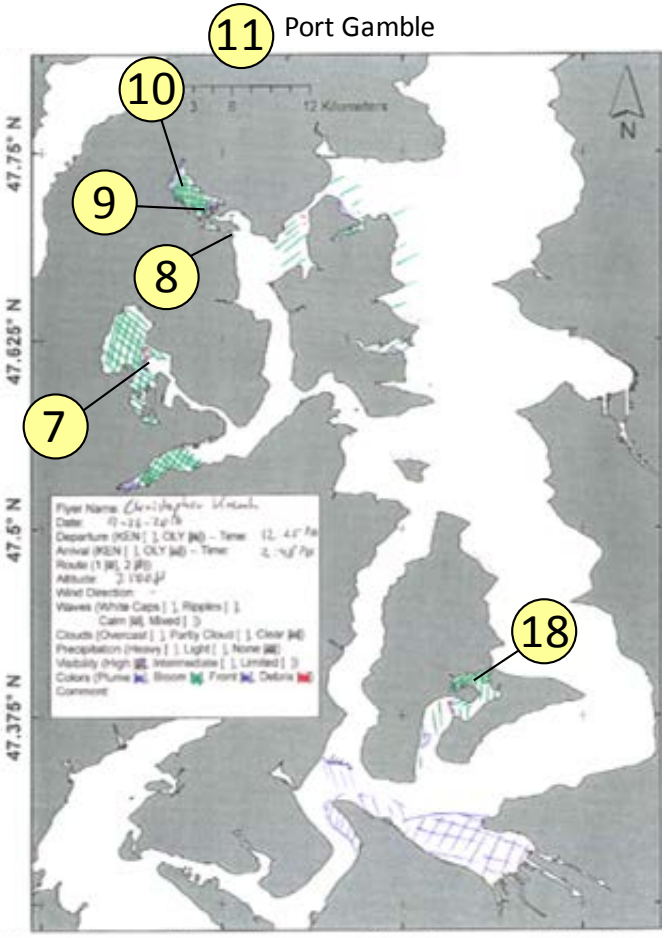
A. Large organic debris patch and B. Plume/bloom trapped in Oro Bay.
Location: Anderson Island (South Sound), 2:43 PM.

Date: 9-26-2016

North Sound



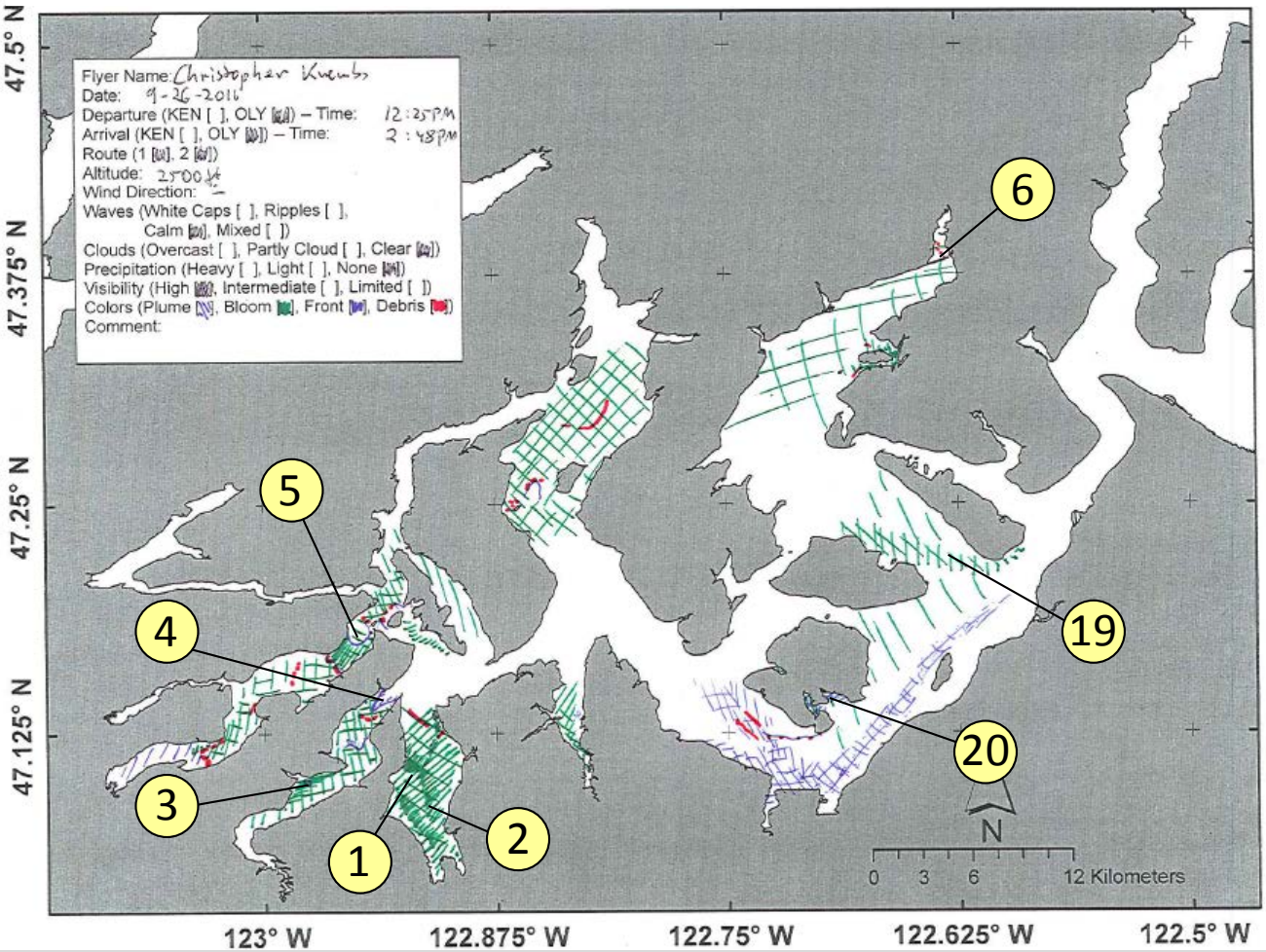
Central Sound



Numbers on map refer to picture numbers for spatial reference

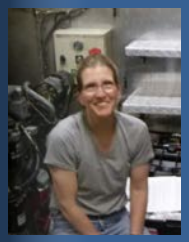
Date: 9-26-2016

South Sound



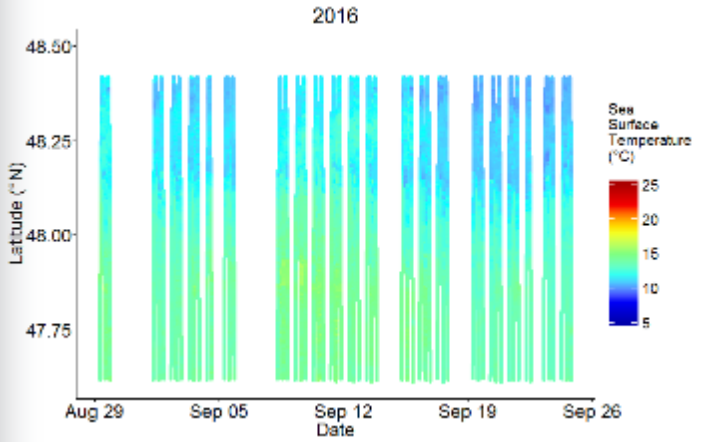
Numbers on map refer to picture numbers for spatial reference

Continuous monitoring September 2016

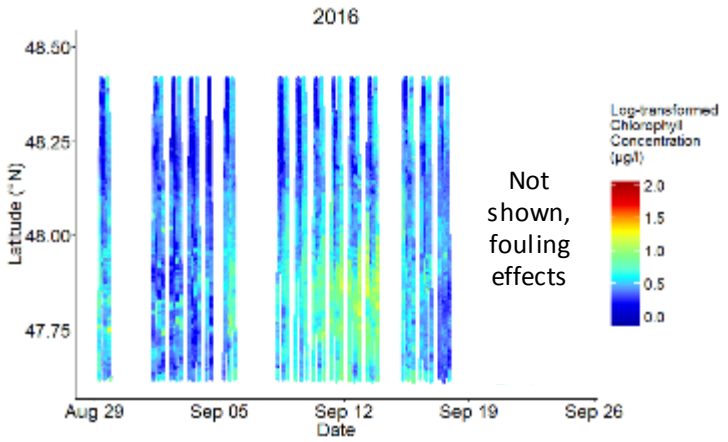


Summary of *Victoria Clipper IV* ferry data:
Water temperatures continue to be warm, and Central Basin is still warmer than the Juan de Fuca Strait. Algal concentrations are decreasing across Central Basin with some short-term growth in mid-September. Turbidity is slightly higher in the Strait than Puget Sound, likely caused by Fraser River sediment outflow.

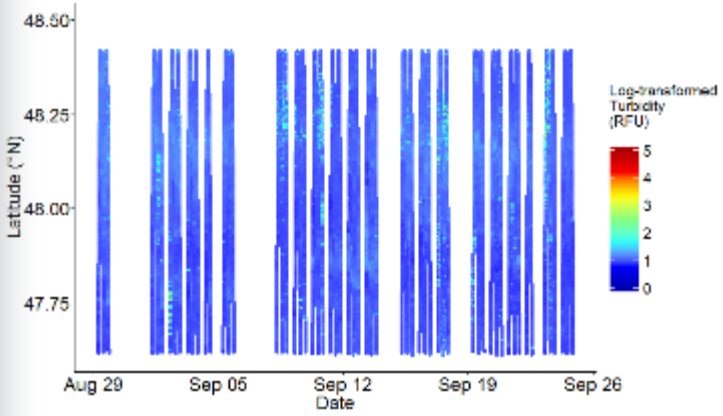
A.



B.



C.



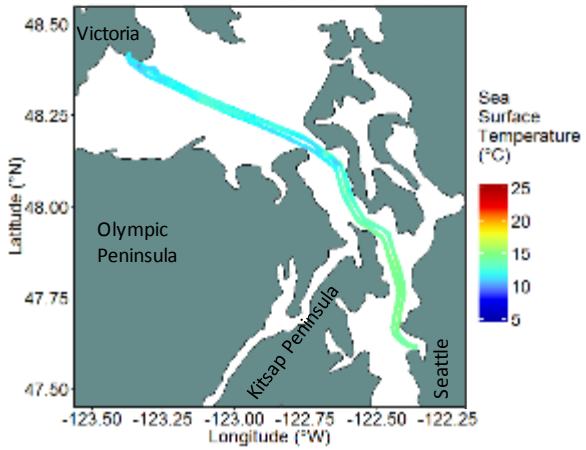
The *Victoria Clipper IV* carries sensors in its sea chest. The sensors allow us to plot transects of:

A. Temperature
B. Chlorophyll
C. Turbidity

Over time, we see the dynamics of these variables in surface water between Seattle and Victoria, BC.

Continuous monitoring September 2016

A.



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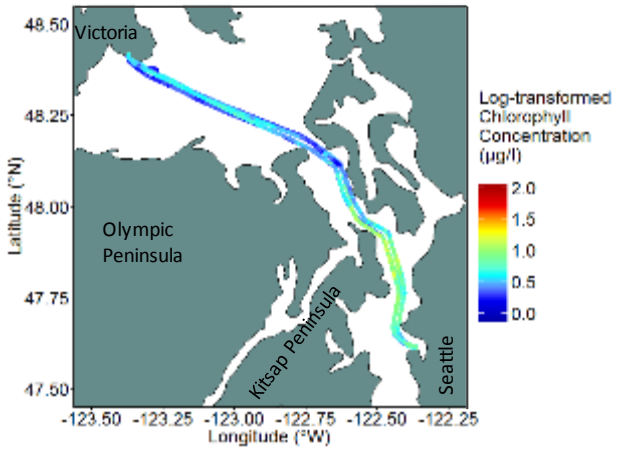
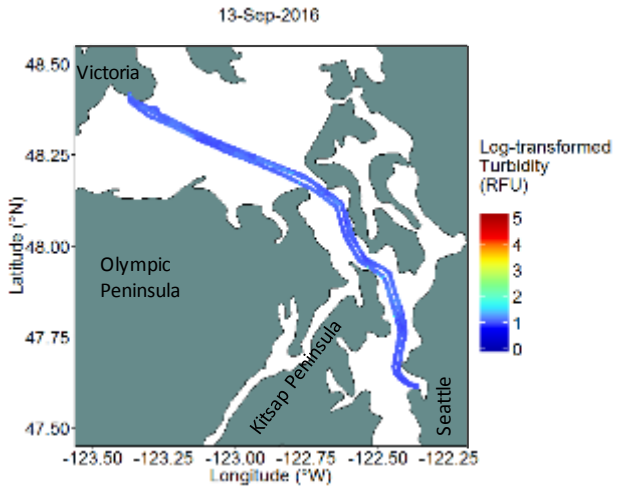


C.



Figures show daily data from sensors installed on the ferry which measure near-surface waters at 5-sec intervals while the Victoria Clipper IV transits between Seattle and Victoria, BC.

A. Sea Surface Temperature: Water is warmer in Central Basin than the Strait.

B. Chlorophyll: Concentrations are higher in Puget Sound than in the Strait.

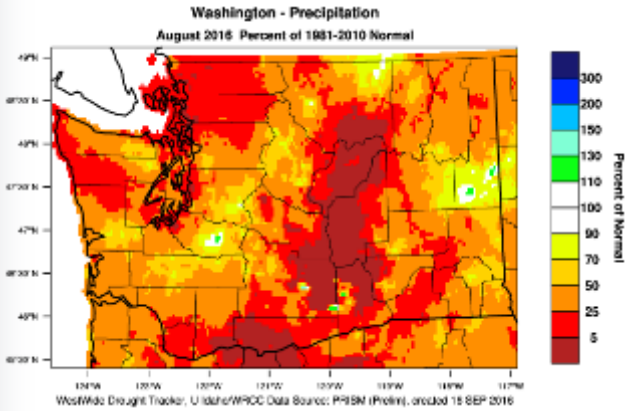
C. Turbidity: Turbidity is low on the entire route.

How have streamflows fared over Summer 2016?

Jim Shedd, Ecology

In August, many stream flows were below-normal from drier and warmer conditions. Precipitation in September improved streamflows in Puget Sound .

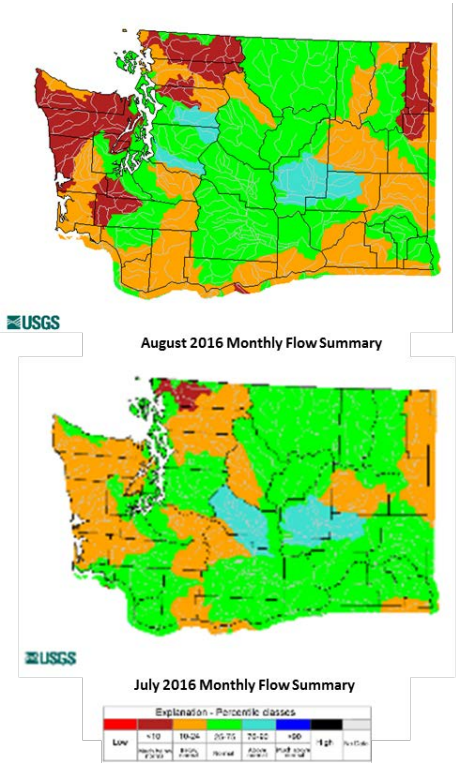
A.



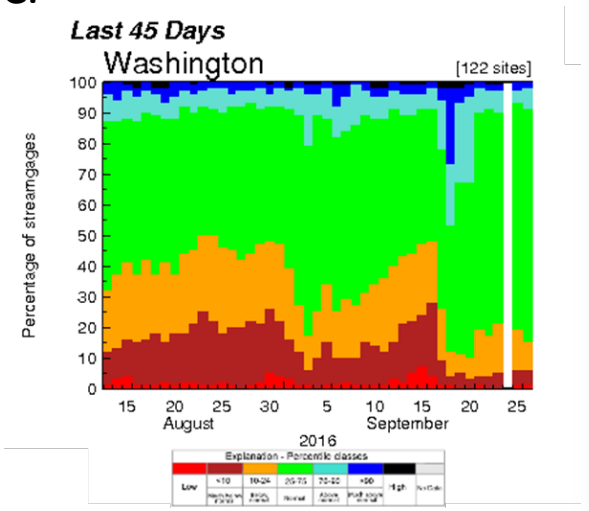
A. Well below normal precipitation in the Puget Sound basin in August resulted in declining streamflows after conditions temporarily had improved in July.

B. Particularly low river flows occurred in the Olympics and north Cascades in August. (See page 9 inceasing salinity in coastal bays)

B.



C.



C. In August, about 30 to 50% of streams were below normal for most of the month.

In September, streamflows increased over the second half of the month. Currently about 75% of the state's streamflows are within the normal range.

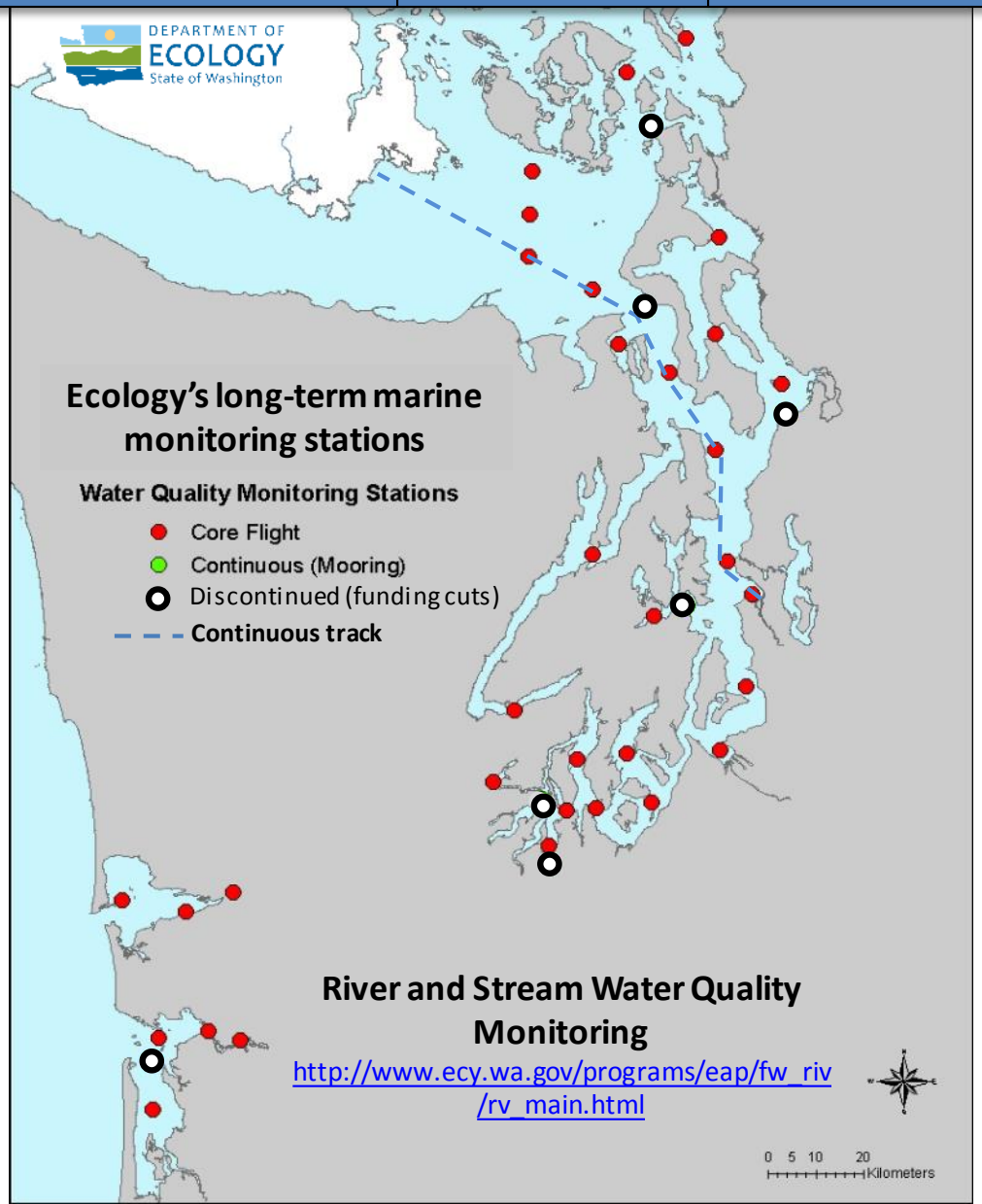
Get data from Ecology's Marine Monitoring Programs

Field log	Climate	Water column	Aerial photos	Continuous monitoring	Streams

Long–Term Monitoring Network

christopher.krembs@ecy.wa.gov

Access core monitoring data:
https://fortress.wa.gov/ecy/eap/marinewq/mwdataset.asp



Real–Time Sensor Network

Suzan.Pool@ecy.wa.gov

Access mooring data:
ftp://www.ecy.wa.gov/eap/Mooring_Raw/Puget_Sound/

You may subscribe or unsubscribe to the Eyes Over Puget Sound email listserv by going to:
http://listserv.wa.gov/cgi-bin/wa?A0=ECOLOGY-EYES-OVER-PUGET-SOUND

We are looking for feedback to improve our products.

Dr. Christopher Krembs
christopher.krembs@ecy.wa.gov

Marine Monitoring Unit
Environmental Assessment Program
WA Department of Ecology

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