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DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound

Surface Conditions Report, *June 6, 2017*

Start here

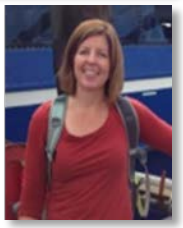
Up-to-date observations of water quality conditions in Puget Sound and coastal bays

Marine conditions from 6-5-2017 at a glance

LONG-TERM MARINE MONITORING UNIT

Mya Keyzers
Allison Brownlee

Skip Albertson



Julia Bos

Dr. Christopher Krembs (Editor)

Tyler Burks

Editorial assistance provided by: Allison Brownlee, Carol Maloy

Personal Field Impression 6-5-2017

What types of data do we collect below the surface?

We have a new marine technician! Allison Brownlee has come from the City of San Diego where she collected and analyzed oceanographic data for their expansive ocean monitoring program. Allison joins Mya Keyzers in the marine waters field crew who monitor Puget Sound and the coastal estuaries by both sea plane and boat!

We use a SeaBird CTD (Conductivity, Temperature, Depth) profiler with added sensors to measure a suite of water column parameters:

- Temperature
- Salinity/Conductivity
- Dissolved oxygen
- PAR (Light)
- Transmissivity
- Fluorometry
- Turbidity
- pH

Surrounding the sensors are water-sampling Niskin bottles that we can program to collect water samples at discrete depths. We analyze:

- Nutrients
- Chlorophyll *a*
- TN (Total nitrogen)
- TOC (Total organic carbon)
- POC (Particulate organic carbon)
- PN (Particulate organic nitrogen)
- Dissolved oxygen
- Salinity

Eyes Under Puget Sound 6-5-2017

Critter of the Month – The Tube-Dwelling Anemone

Dany Burgess & Angela Eagleston
Marine Sediment Monitoring Team

Photo courtesy of Mike Munroe

Pachycerianthus fimbriatus

Puget Sound is blooming with plankton right now, and this month's flower-like critter is a reminder that the benthos has "blooms" of its own! Meet the tube-dwelling anemone, a delicate blossom at the bottom of Puget Sound.

Fun Facts!

- The only tube anemone found in Puget Sound
- Secretes a thread-like material to create its own black, slimy tube
- Main predator is the giant nudibranch (photo below)
- Can live up to 10 years

Photo courtesy of John Yasaki

Learn more about the tube-dwelling anemone and other critters on Ecology's EcoConnect blog here

Climate Influences leading to 6-5-2017

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.

Summary:

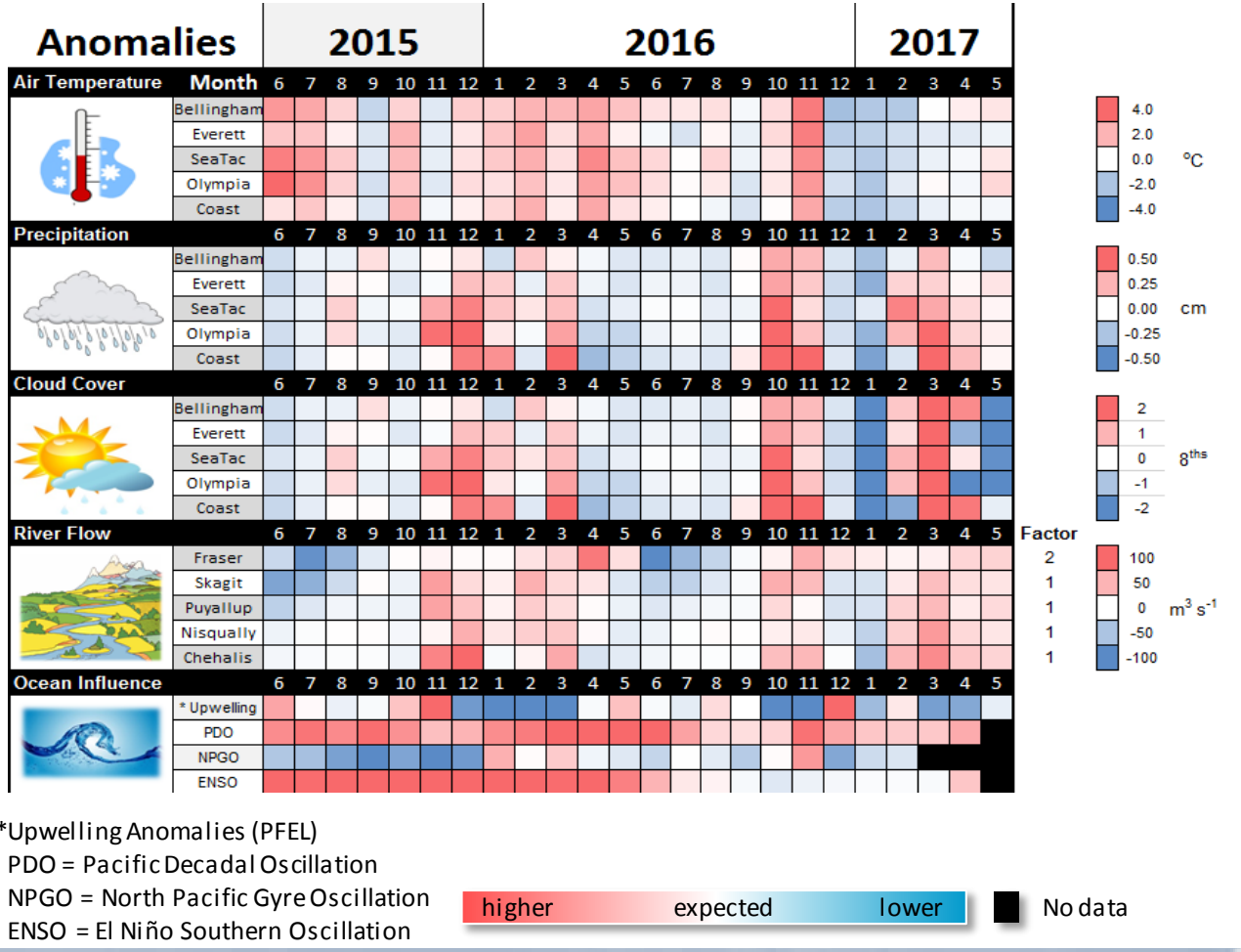
Air temperatures have been slightly warmer after a cool winter/spring.

Precipitation levels have been near normal, capping a wet spring.

Sunshine levels have been above normal except near the coast (opposite of cloud cover).

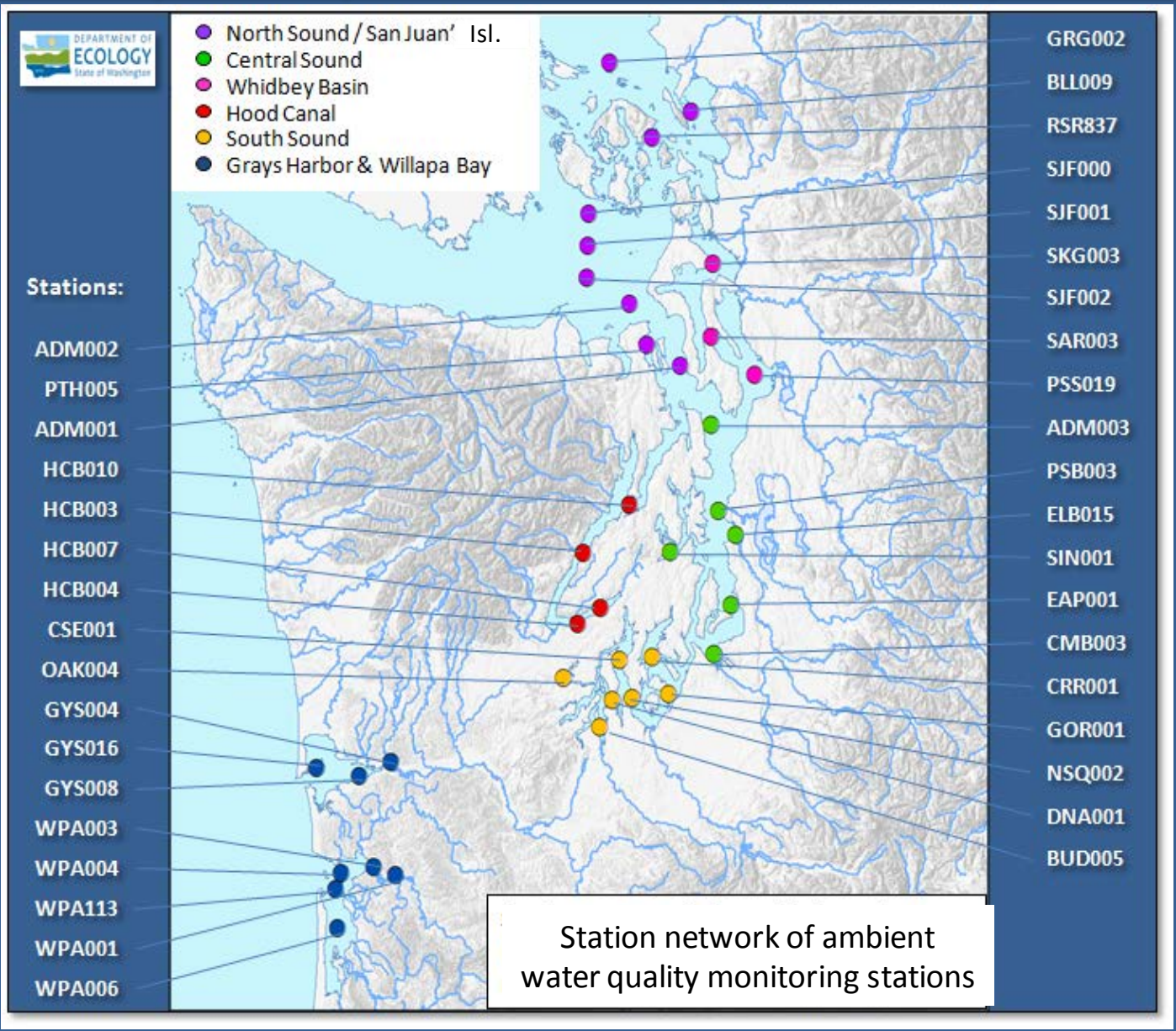
River flows are all above normal due to snow melt and warmer temperatures.

Downwelling has been strong, though normal in May. ENSO and PDO are trending warmer.



*Upwelling Anomalies (PFEL)
PDO = Pacific Decadal Oscillation
NPGO = North Pacific Gyre Oscillation
ENSO = El Niño Southern Oscillation

Our long-term marine monitoring stations in Washington



Station network of ambient water quality monitoring stations

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

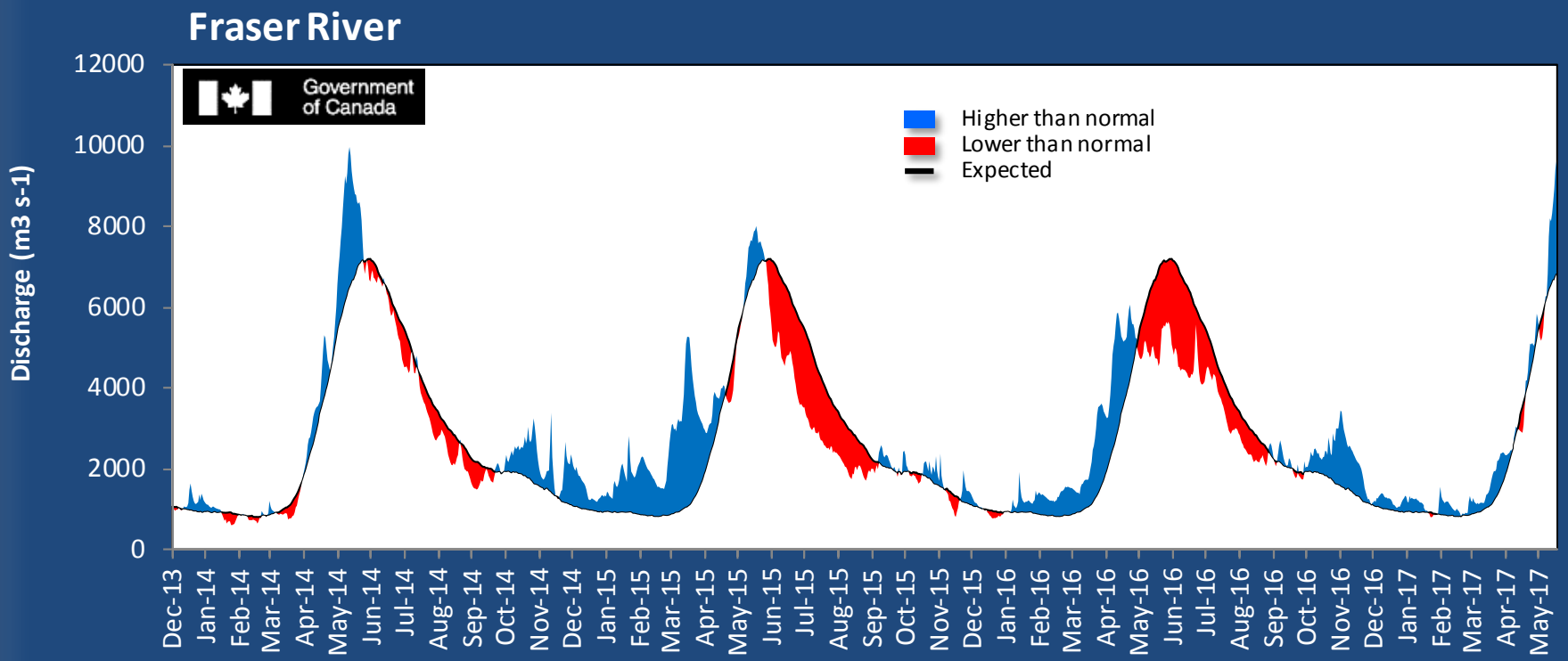
Start here

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**

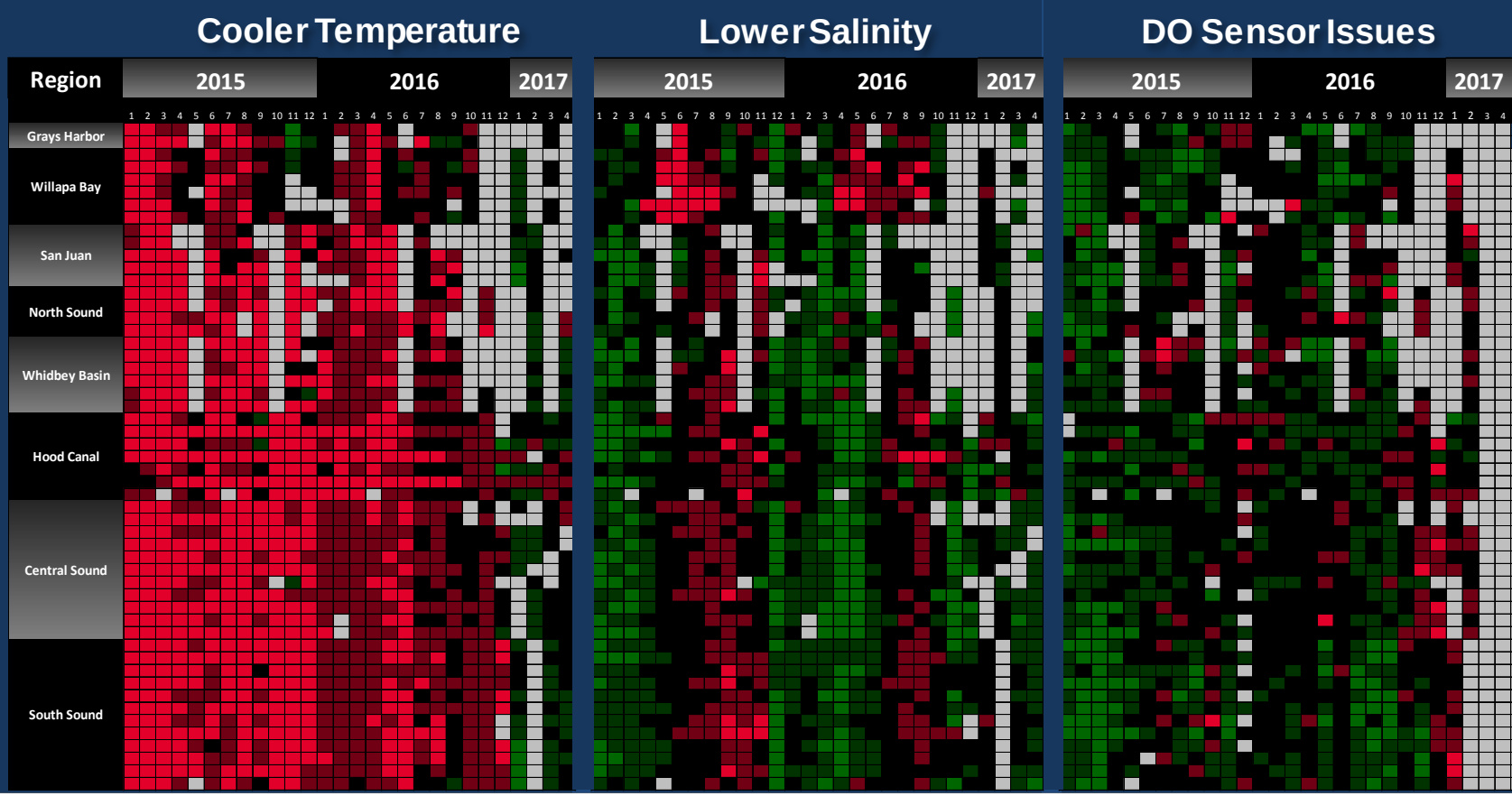
How well is Puget Sound exchanging its water?

Year 2016 had record-breaking global temperatures. The year 2017 is looking much better. Frazer River flows are normal or higher than normal in June and similar to the year 2014. This means that water renewal in Puget Sound has returned to normal conditions this early summer.



Physical conditions tracked in historical context

With the onset of 2017, the remarkably high water temperatures from 2015 & 2016 disappeared except in South Hood Canal deep water. **Record winter and spring rains** have created significantly fresher conditions. Bad weather from Jan. – Apr., 2017 caused us to miss quite a few stations. In addition, our rigorous QA/QC caught some sensor issues in oxygen, resulting in data gaps.



= 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

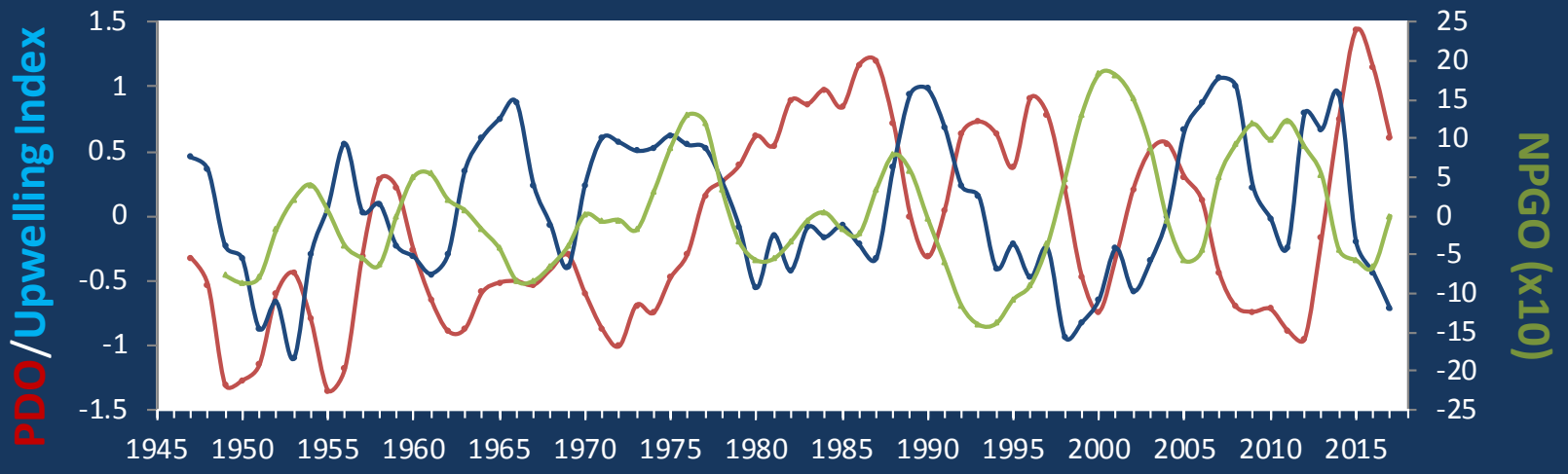
The ocean affects water quality: Ocean Climate Indices

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

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

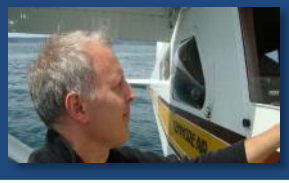
c) *North Pacific Gyre Oscillation Index (**NPGO, productivity**)* *(explanation)*

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 low (Upwelling Index anomaly), and (c) surface productivity along the coast is near normal (NPGO).

Summary: Aerial photography 6-5-2017



Some jellyfish aggregations in finger inlets of South Sound. Unusual yellow-green blooms in bays near the Kitsap Peninsula. Blooms in green, brown and red brown near estuaries of the Skagit, Stillaguamish and Puyallup Rivers. Red blooms in some rivers of Willapa Bay at the coast.

Start here

South Fork Palix River, Bay Center, Willapa Bay

Humpback Whale in Case Inlet

Front

Mixing and Fronts:
Tidal eddies near Hope Island, numerous internal waves in Whidbey Basin.

Jellyfish:
Some patches in Budd, Eld, Totten, and Sinclair Inlets.

Plume

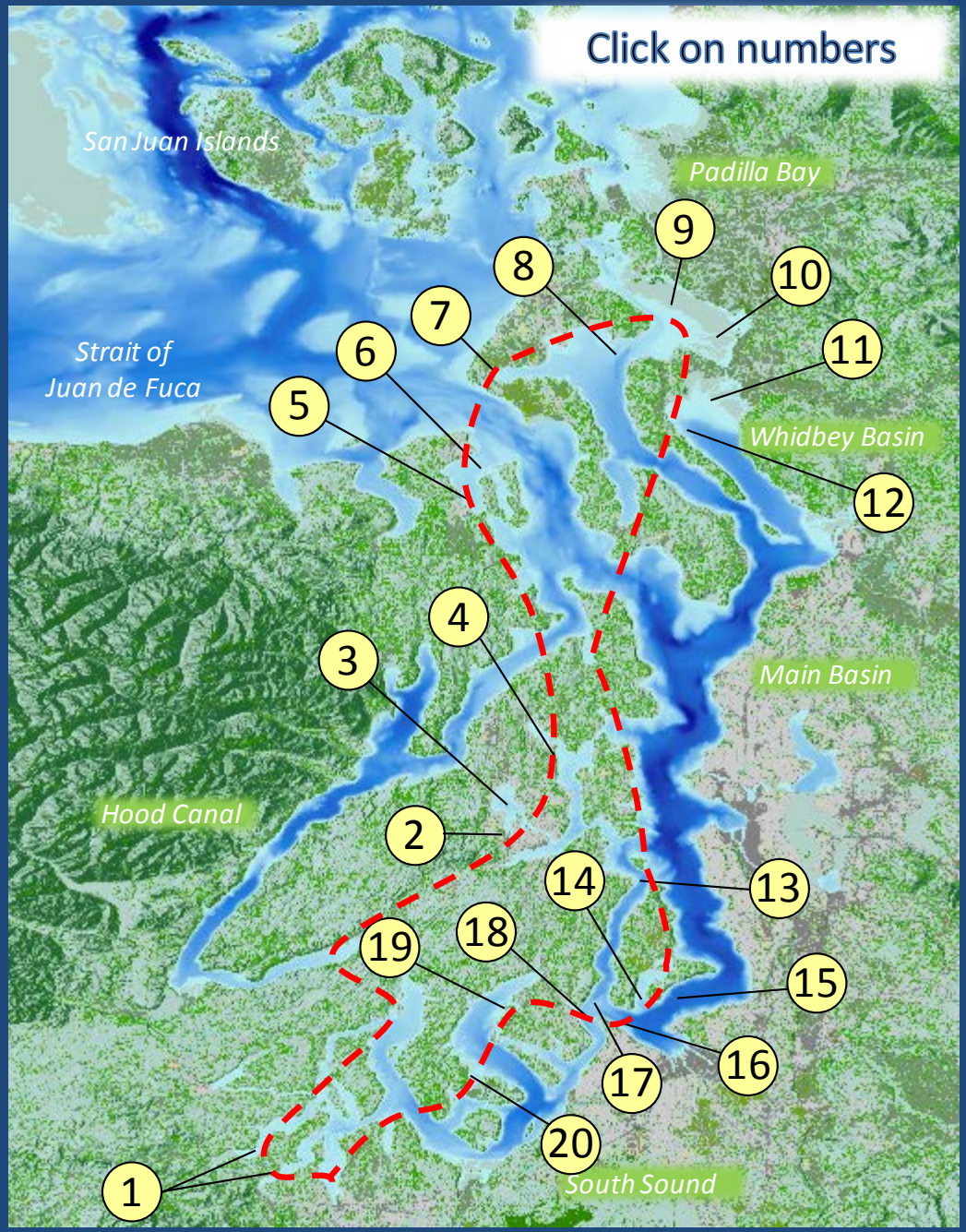
Suspended sediment:
Glacial flour near the Skagit and Puyallup rivers.

Bloom

Visible blooms:
Red-brown blooms in Commencement, Port Townsend Bays.
Yellow green blooms in Oyster Bay and parts of Liberty bay,
Red bloom in rivers of Willapa Bay.
Dark green water in Puget Sound suggesting high productivity.

Debris

Debris:
Macro-algae in Dyes Inlet, Colvos Passage and Pickering Passage.



Aerial photography and navigation guide

Date: 6-5-2017

Tide data (Seattle):

Time	Height (ft)	High/Low
02:35 AM	11.09	H
09:37 AM	0.69	L
4:29 PM	9.23	H
9:30 PM	5.40	L

Flight Information:

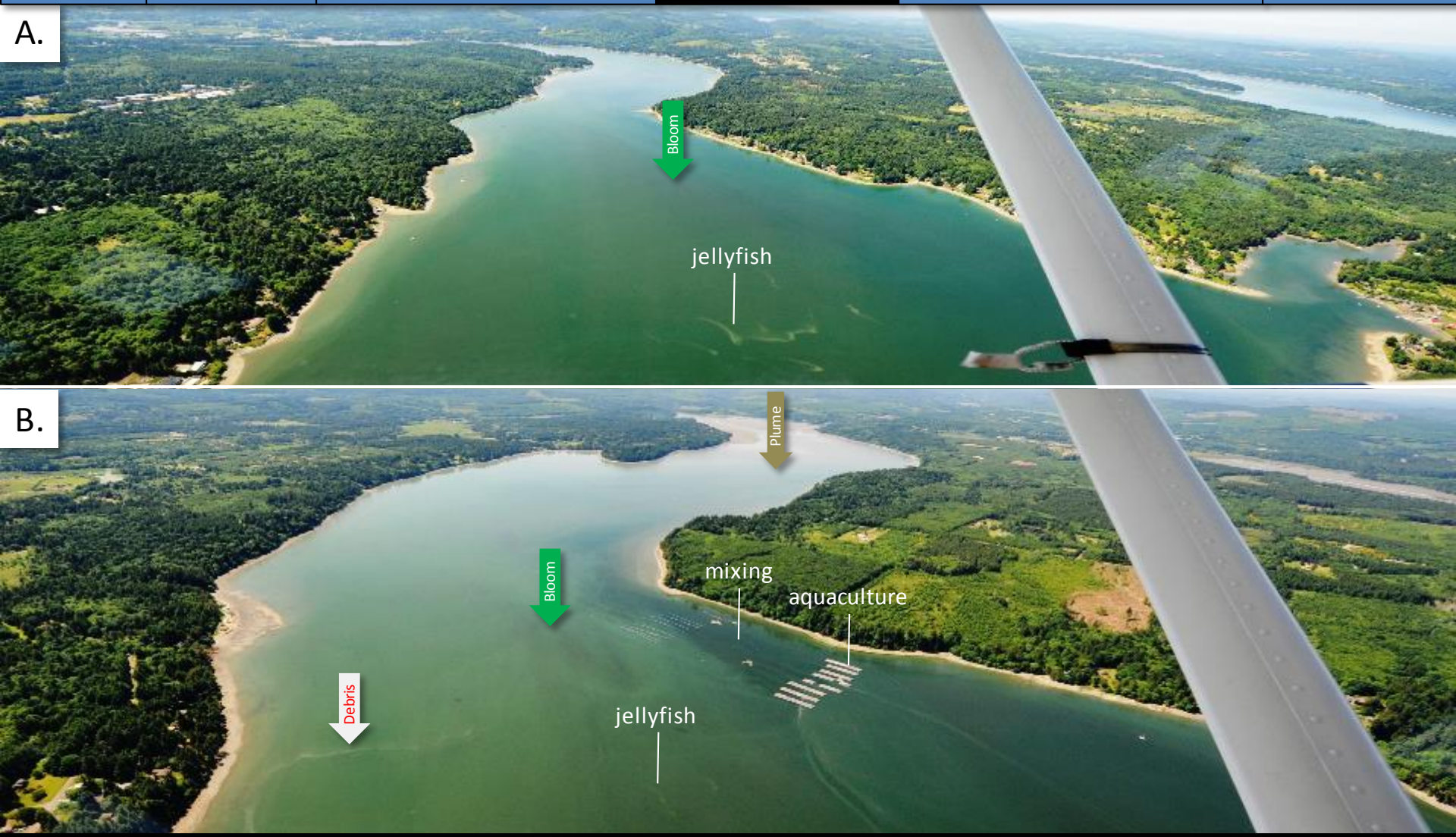
Sunny increasingly cloudy and hazy towards the end of the flight

Flight route

Observation Maps:

Central and North Sound

South Sound



A. Jellyfish patches and small bloom. B. Aquaculture and effects on surface layer during incoming tide.
Location: *A.* Eld Inlet, B. Totten Inlet (South Sound), 1:02 PM.

Bright yellow-green bloom.

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

Macro algae accumulating along tidal frontline.

Location: Off Windy Point/Dyes Inlet (Central Sound), 1:29 PM.

Bright yellow-green bloom.

Location: Off Keyport Saltwater Park, Liberty Bay (Central Sound), 1:32 PM.

Bloom and freshwater plume near Skunk Island.

Location: *Port Hadlock,* Port Townsend Bay (Central Sound), 1:46 PM.

Bloom extending into Kilisut Harbor.

Location: Port Townsend Bay (Central Sound), 1:49 PM.

Skagit Sediment plume extending into Penn Cove.
Location: Penn Cove (Whidbey Basin), 1:54 PM.

A train of internal wave traveling towards Skagit Bay.

Location: Entrance to Skagit Bay (Whidbey Basin), 1:59 PM.

Fed by meltwater in the mountains, the Skagit River is the largest freshwater contributor to Puget Sound.

Location: North Fork Skagit River, Skagit Bay (Whidbey Basin), 2:01 PM.

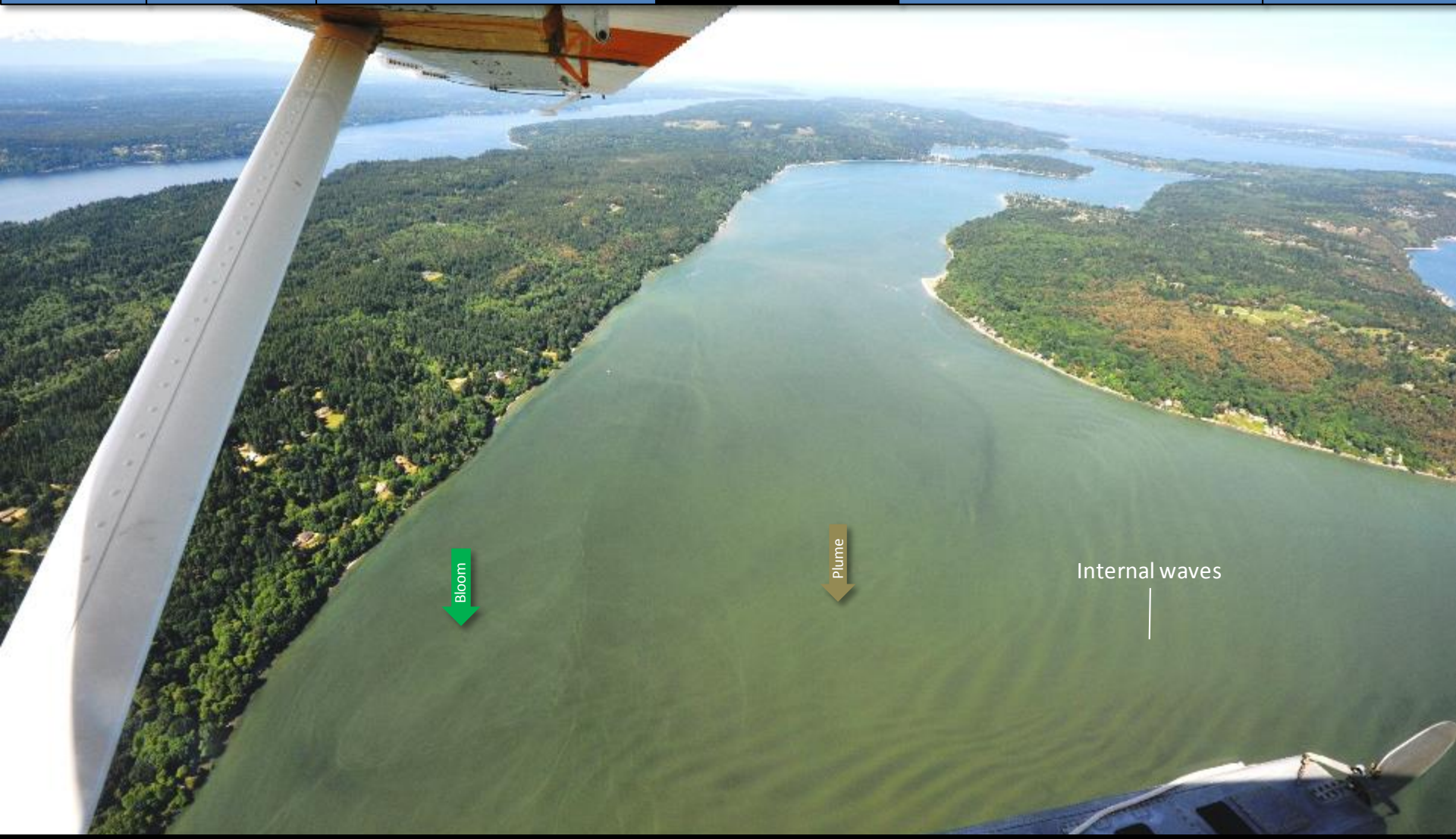
Patches of algae bloom in shallow, highly stratified water of Skagit Bay.
Location: Totten Inlet (South Sound), 2:02 PM.

Bloom in shallow stratified water of the Stillaguamish River Estuary.
Location: Totten Inlet (South Sound), 2:06 PM.

Internal waves running northward curving in shallow water of Camano Island.

Location: Port Suzan (Whidbey Basin), 2:08 PM.

Tidal front and macro-algae at the entrance and inside Colvos Passage.
Location: Point Vashon, Point Southworth, Colvos Passage (Central Sound), 2:30 PM.

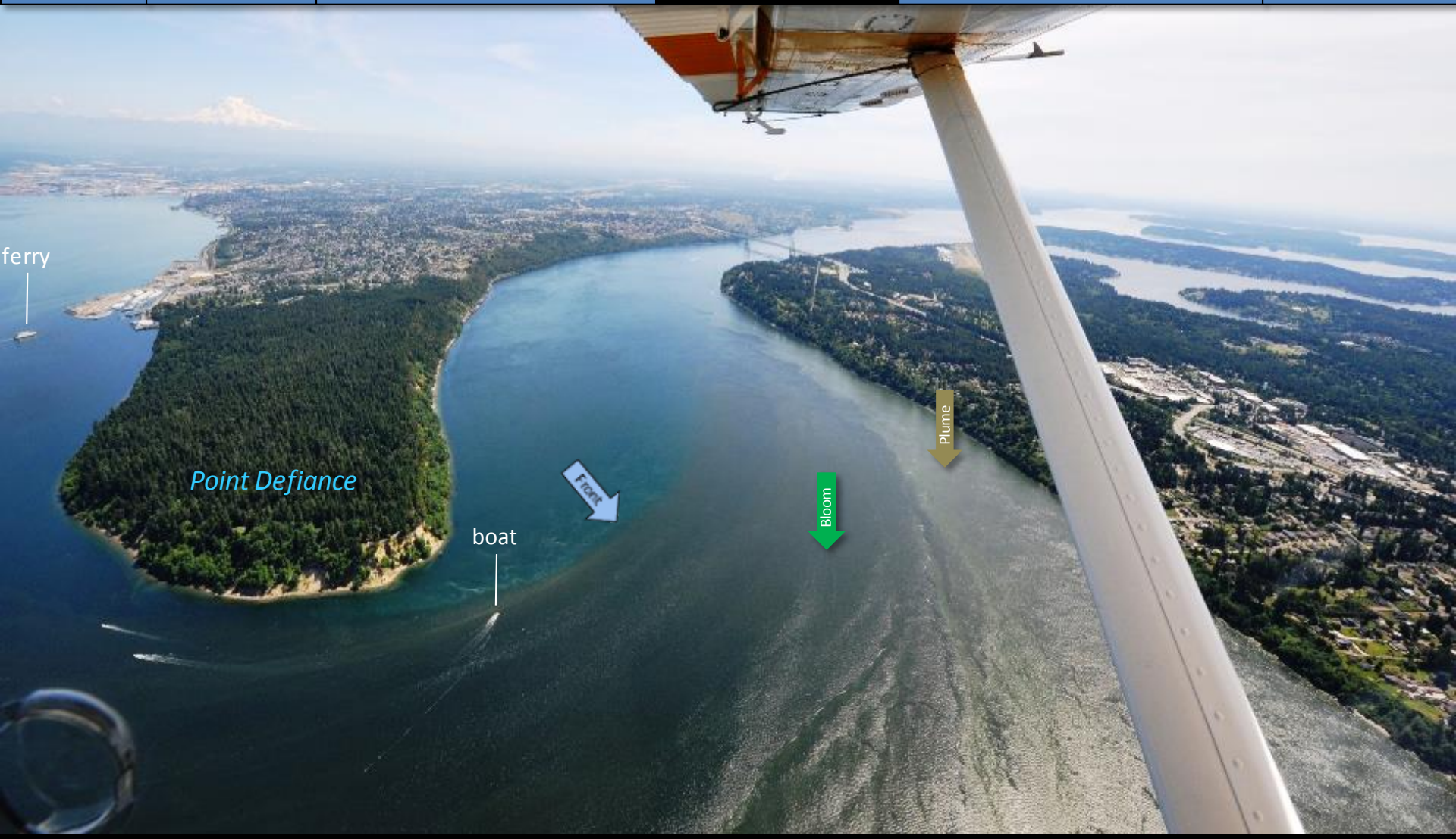


Internal waves can be seen in sediment rich water of Puyallup River extending into Quartermaster Harbor.
Location: Vashon Island (Central Sound), 2:36 PM.

Puyallup River plume rich in glacial flower entering Commencement Bay.
Location: Commencement Bay (Central Sound), 2:36 PM.

Red-brown bloom in sediment-rich freshwater plume of the Puyallup River.
Location: Point Defiance (Central Sound), 2:37 PM.

Sediment plume of the Puyallup River at the entrance to Colvos Passage.
Location: Point Defiance (Central Sound), 2:38 PM.



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

Schools of fish.

Location: Raft Island, Carr Inlet (South Sound), 2:41 PM.

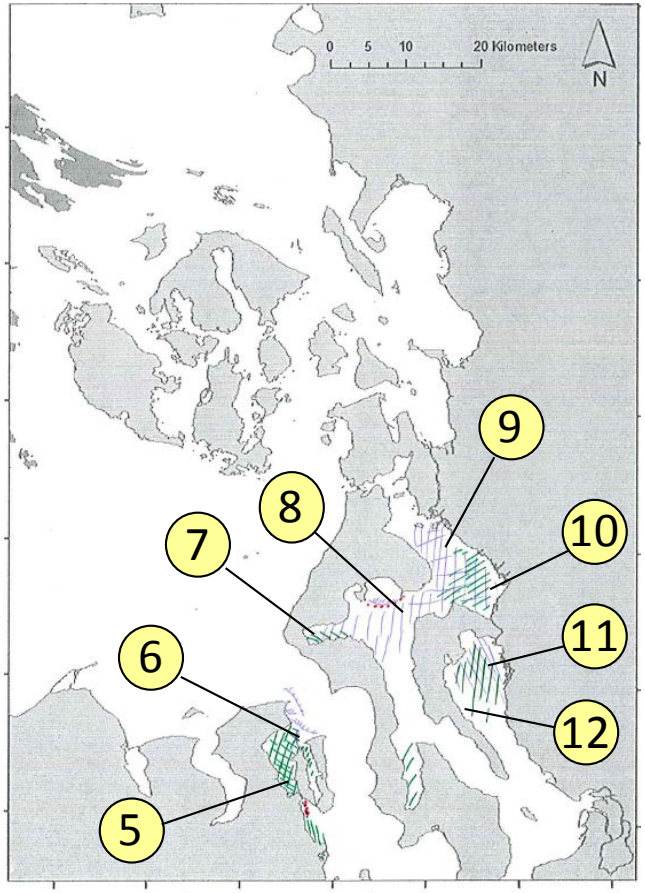
Aerial photography 6-5-2017

Bloom and organic material accumulating along tidal fronts.

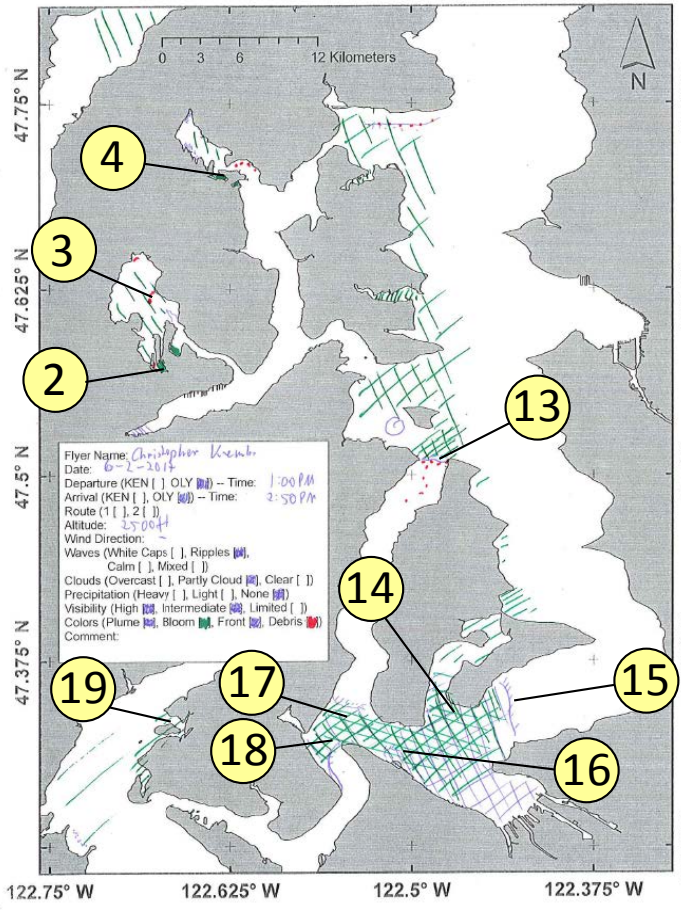
Location: Pitt Passage (South Sound), 2:45 PM.

Date: 6-5-2017

North Sound



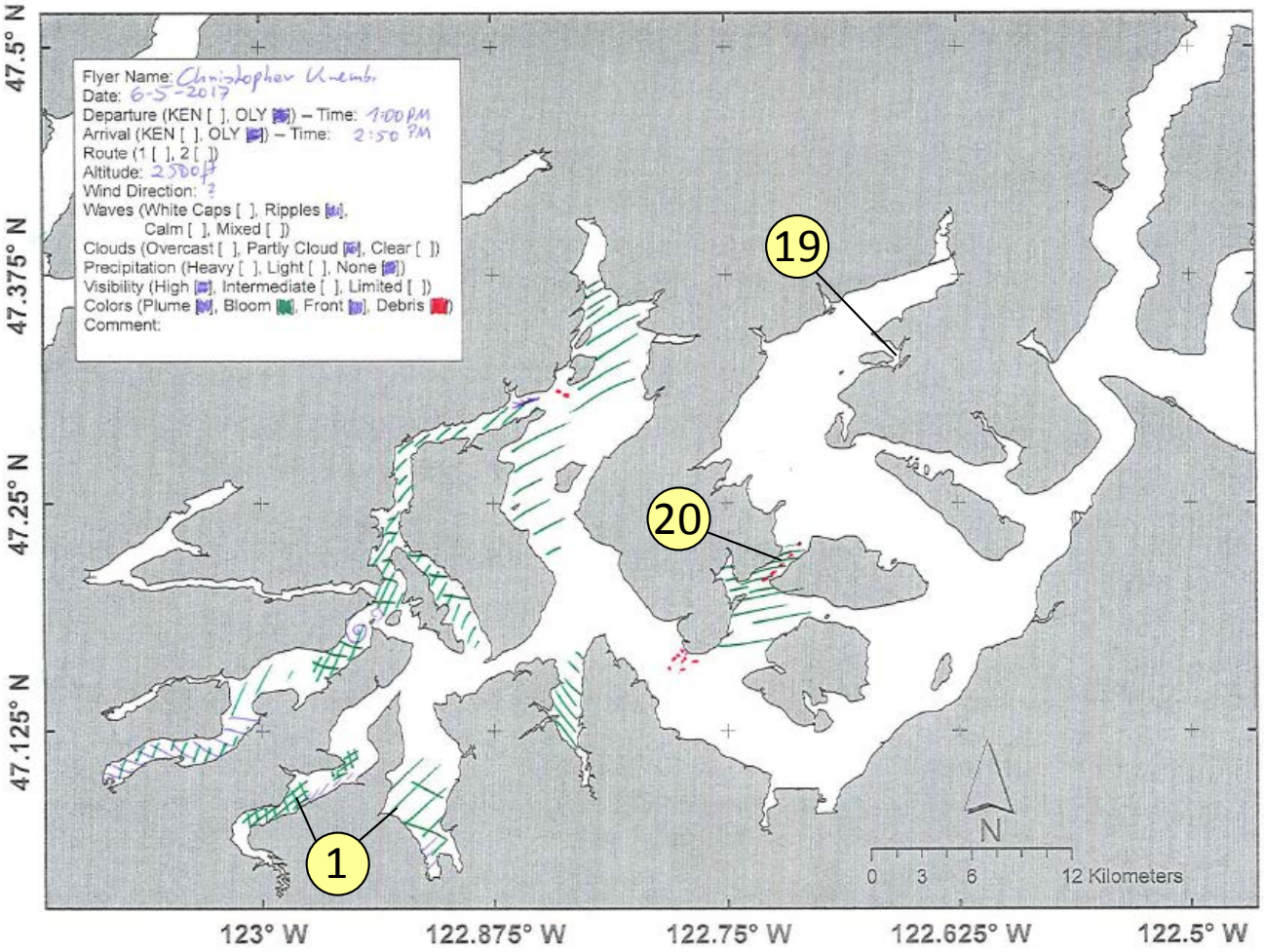
Central Sound



Numbers on map refer to picture numbers for spatial reference

Date: 6-5-2017

South Sound



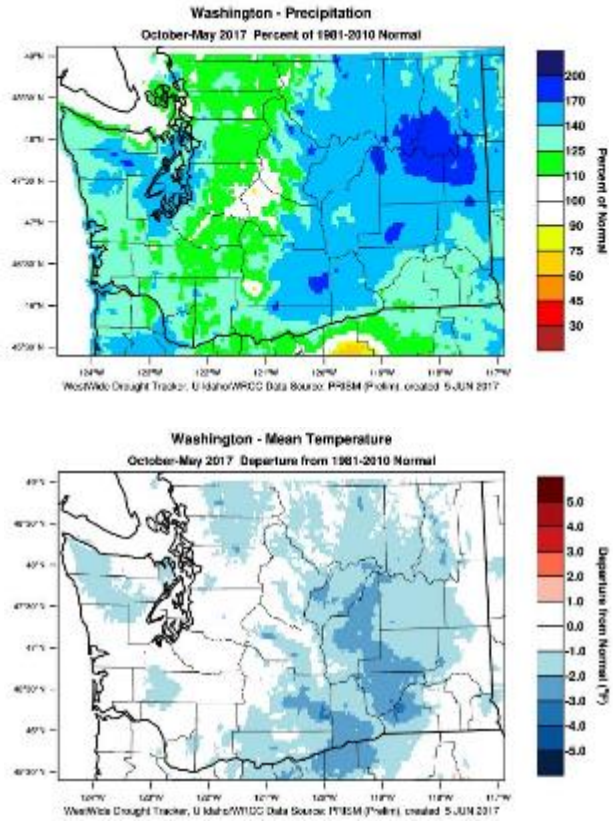
Numbers on map refer to picture numbers for spatial reference

Snowpack and stream flows are presently good

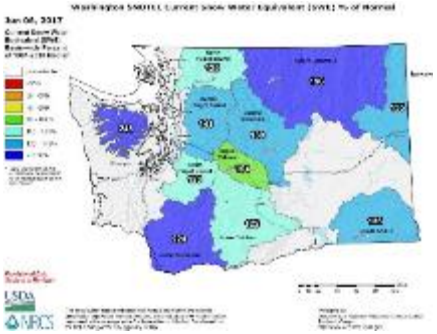
Tyler Burks, Ecology

Cold and wet conditions in the first half of 2017 has set the stage for a favorable supply of freshwater to the marine environment. Key things to watch for in the coming months will be snowpack melt rates, and also how rain-dominated watersheds respond as we progress through the summer.

A.



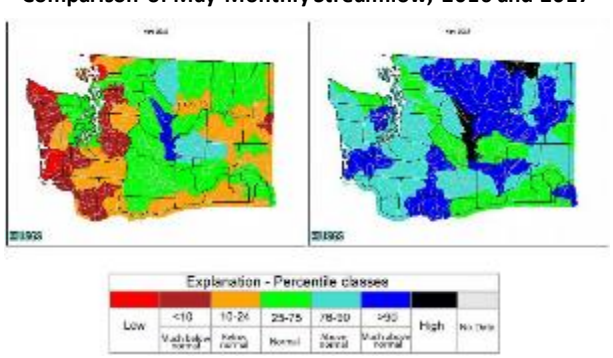
B.



A. During the first half of water year conditions were favorable for a building snowpack and predominantly above normal streamflow conditions. **Precipitation reached nearly 200% of normal in parts of Puget Sound,** while temperatures ranged from normal to 2 °F below normal.

B. **Presently, a cool spring has allowed the snowpack to persist at an average of 160% for watersheds draining to Puget Sound.**

C.



C. In 2016, despite near normal snowpack conditions at higher elevations, a very warm spring lead to early streamflow peaks and eventual deficits in Puget Sound. By May of last year (left) streamflow had already reached levels below the 10th percentile, while in other areas streamflow remained normal.

In 2017 (right), due to a robust snowpack and mild spring temperatures, streamflow conditions have ranged from normal to much above normal for watersheds draining to Puget Sound.

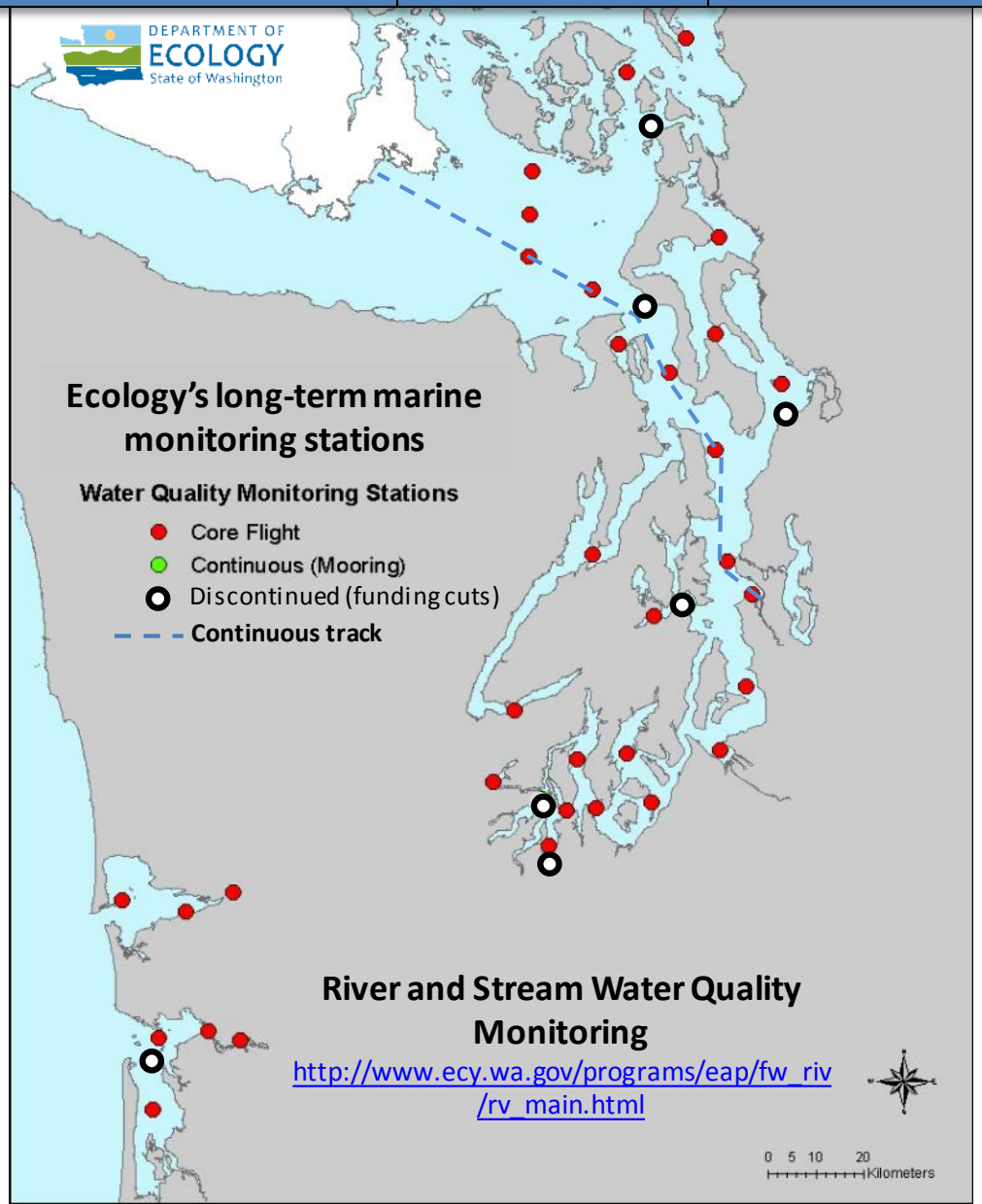
Get data from Ecology's Marine Monitoring Programs

Field log	Climate	Water column	Aerial photos	-	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 historic mooring data:
http://www.ecy.wa.gov/programs/eap/mar_wat/data.html

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.

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Marine Monitoring Unit
Environmental Assessment Program
WA Department of Ecology

Many thanks to our business partners: Clipper Navigation, Swantown Marina, and Kenmore Air.