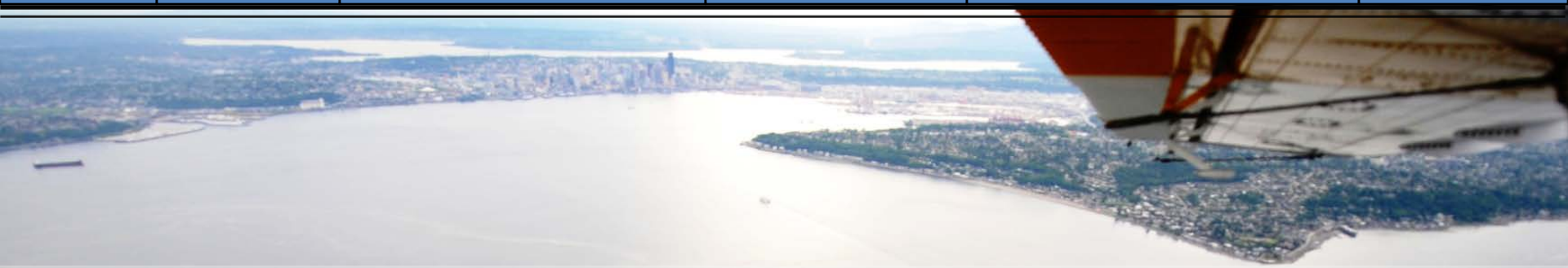
Publication No. 12-03-075

DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound



Noctiluca sp.

Surface Conditions Report

June 12, 2012

Guest Contributors:

Harmful Algal Blooms: *Vera Trainer, p. 6-7*

Flow Cytometry: *Francois Ribalet and Jarred Swalwell, p. 29-30*

Start here

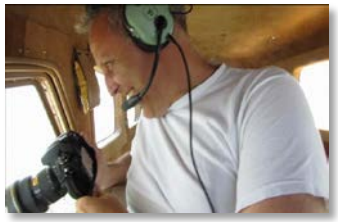
Up-to-date observations of visible water quality conditions in Puget Sound and the Strait of Juan de Fuca

Marine conditions from 6-12-2012 at a glance

LONG-TERM MARINE MONITORING UNIT

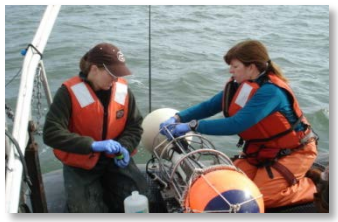
Mya Keyzers
Laura Friedenberg

Skip Albertson



Dr. Christopher Krembs

Dr. Brandon Sackmann



David Mora
Suzan Pool

Previous Eyes Over Puget Sound reports: www.ecy.wa.gov/programs/eap/mar_wat/eops/

Marine Flight 3 (Central Sound)

Washington Conservation Corps volunteer Natalie Tacconi

Summer is here and Puget Sound is in bloom! The water looked amazing from the plane as we saw orange, green, and red blooms everywhere. These masses of plankton form thick, colorful streaks in the water. In some cases we sampled in the middle of a bloom, which allowed us to grab a sample for plankton identification, which we sent to Gabriela Hannach at King County for species information.

Bloom near Elliott Bay Photo Courtesy of Natalie Tacconi

Personal flight impression, 6-12-2012

While flying near Commencement and Elliott Bays, we saw large masses of the dinoflagellate, *Noctiluca*. High densities of *Noctiluca* look like bright orange swirls from the air (see next page)

On the way to Sinclair Inlet from Eagle Harbor we saw another conglomeration of *Noctiluca* in Port Blakely. The water sampling and sensor data collection was a success and we were all excited to be out on the water during these massive blooms. We are curious to see how the blooms will look next month!

Noctiluca bloom near Commencement Bay

Noctiluca bloom in Port Blakely

Background Photo Courtesy of Natalie Tacconi

Species corner: *Noctiluca* and the spring bloom

Phytoplankton ID contribution: Gabriela Hannach, King County Environmental Lab

Noctiluca is 0.5 mm across, with a tentacle that helps in the movement of food particles.

Although *Noctiluca scintillans* (left) does not produce any harmful toxins, the cells can accumulate ammonia that may be harmful to fish when released into the surrounding water.

Noctiluca is a large dinoflagellate that often causes blooms in Puget Sound. It feeds on particulate matter, especially other algae which when abundant will fuel the bloom.

Diatom blooms continue in Puget Sound and are likely feeding the *Noctiluca* populations. *Rhizosolenia* (background image), a needle-like diatom, is currently very abundant in the Sound.

50 µm

Sound Toxins, NOAA's Northwest Fisheries Science Center

Mobile Harmful Algal Bloom Rapid Response Laboratory (HAB LAB)

•Project investigators from NOAA (Vera Trainer), University of Maine (Mark Wells), Western University in Ontario, Canada (Charles Trick), Romberg Tiburon Center of the San Francisco State University (William Cochlan) and their research teams are using the HAB LAB to conduct a project titled "The Ecophysiology and Toxicity of *Heterosigma akashiwo*" in Puget Sound.

•The project will characterize the toxins and the environmental conditions that promote toxin production. This will lead to actions that mitigate the impact of *Heterosigma akashiwo* on farmed fish.

Guest: Vera Trainer (NOAA)

What's blooming in Puget Sound this summer? Phytoplankton species can form dense blooms and discolor the water. link

• A network of volunteers across Puget Sound conducts weekly phytoplankton monitoring that alert researchers and managers of Heterosigma bloom locations as well as any other unusual bloom events.

• Volunteers include fish farmers, shellfish growers, environmental learning centers, beachwatchers, Native tribes and private citizens.

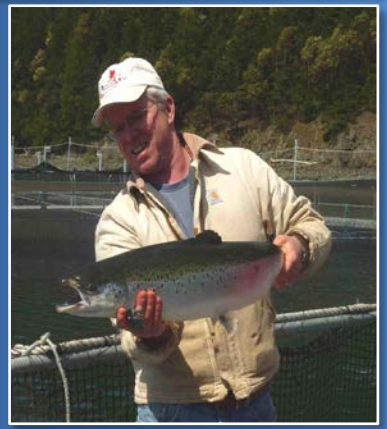
• The partnership is called Sound Toxins and communicates via a database and by e-mail.

www.soundtoxins.org

Studying why and when toxin production is tuned on

NOAA research vessel ***Noctiluca*** (L – R): Dr. Mark Wells, Brian Bill, Dr. Vera Trainer, Emily Olesin, Nick Adams

Kevin Bright, America Gold Seafoods holding salmon at Cypress Island farm



Dr. Mark Wells tests the effects of trace metals on the growth and toxicity of *Heterosigma*

- Red streaks are often caused by a harmless flagellate called *Noctiluca*. Most of the time red water does not mean that toxins are present.
- Root-beer colored water could be flagellates such as *Gymnodinium*, *Protoperidinium*, and *Heterosigma*.
- Most of these flagellates are harmless but some can cause human sickness or death.
- Toxins are often transferred to humans who eat shellfish that accumulate toxins by filter feeding.
- *Alexandrium* produces saxitoxin, known to cause paralytic shellfish poisoning in humans.
- *Heterosigma akashiwo* has killed millions of farmed fish in Puget Sound since 1989. *Heterosigma* kills fish with no apparent impact on other animals or humans.

Weather patterns from 5-29-2012 to 6-12-2012

Meteorological conditions typically explain up to half of the variance in observed marine variables (Moore et al. 2008), particularly in shallower waters like those of South Puget Sound. I summarized the specific conditions prevalent during the past two weeks, from north to south. Source: http://www-k12.atmos.washington.edu/k12/grayskies/nw_weather.html

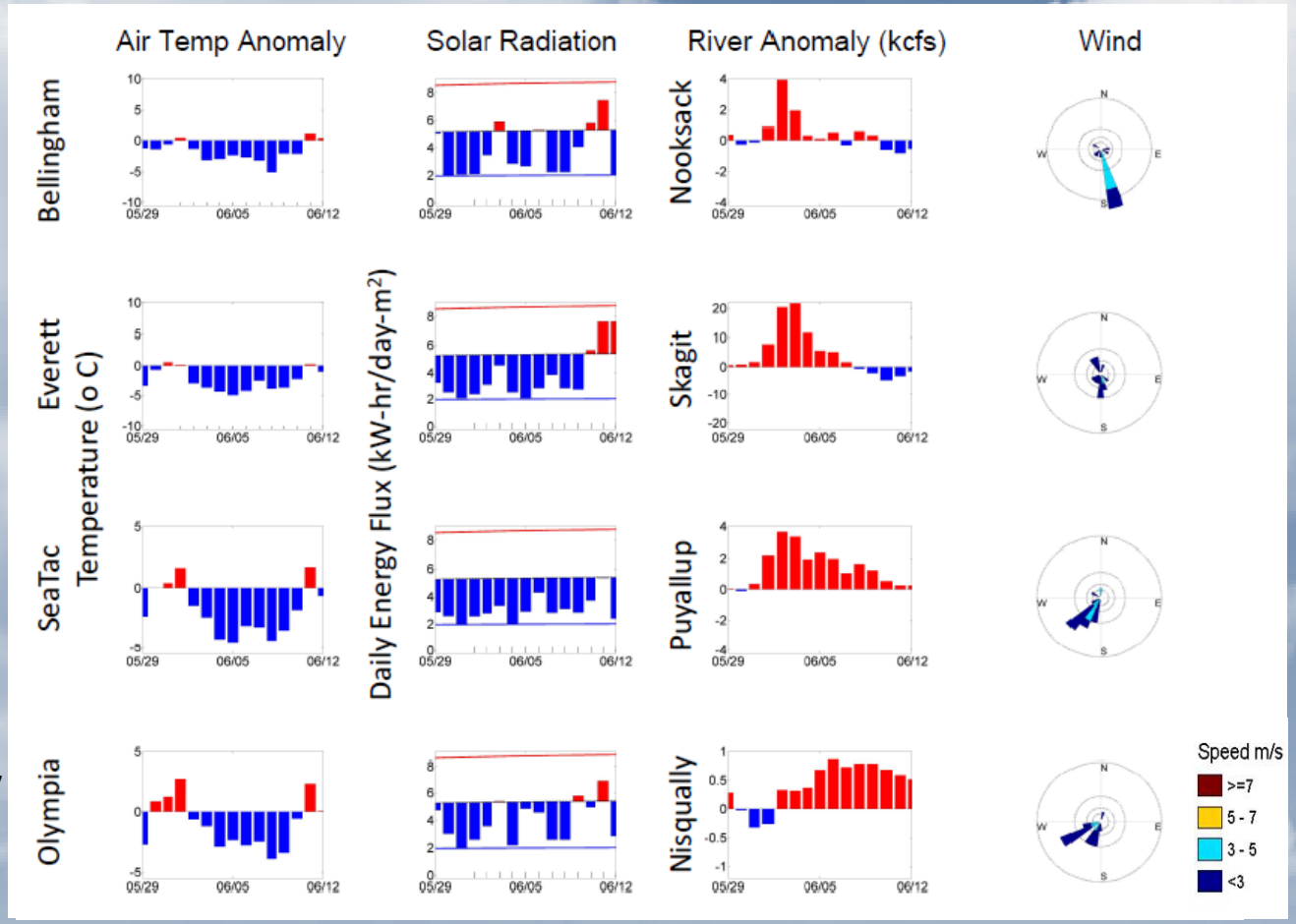
Summary:

Air temperatures during the past few weeks have generally been below average.

Sunshine has been weaker than normal, except in the past several days, which could be triggering blooms.

Rivers have been running above normal, however this trend is tapering off as flows decrease.

Winds have been predominantly from the south.



Moore et al. 2008. Local and large-scale climate forcing of Puget Sound oceanographic properties on seasonal to interdecadal timescales. Limnol. Oceanogr., 53(5), 1746–1758

Summary: Aerial photography 6-12-2012

Very large *Noctiluca* bloom in Central Sound. Strong red-brown bloom and turquoise in Case Inlet. Macro algae in Carr Inlet. Oil sheen in Sinclair Inlet.

Start here

Noctiluca bloom in the news

Noctiluca reaching the shoreline 6-11

Front

Mixing and Fronts: 3 8 14

Fronts between Bainbridge Island and West Seattle, and in Squaxin Passage

Plume

Suspended sediment:

Budd Inlet – sediment mixing with algae bloom

Bloom

Visible blooms: 7 8 9 10 11 12

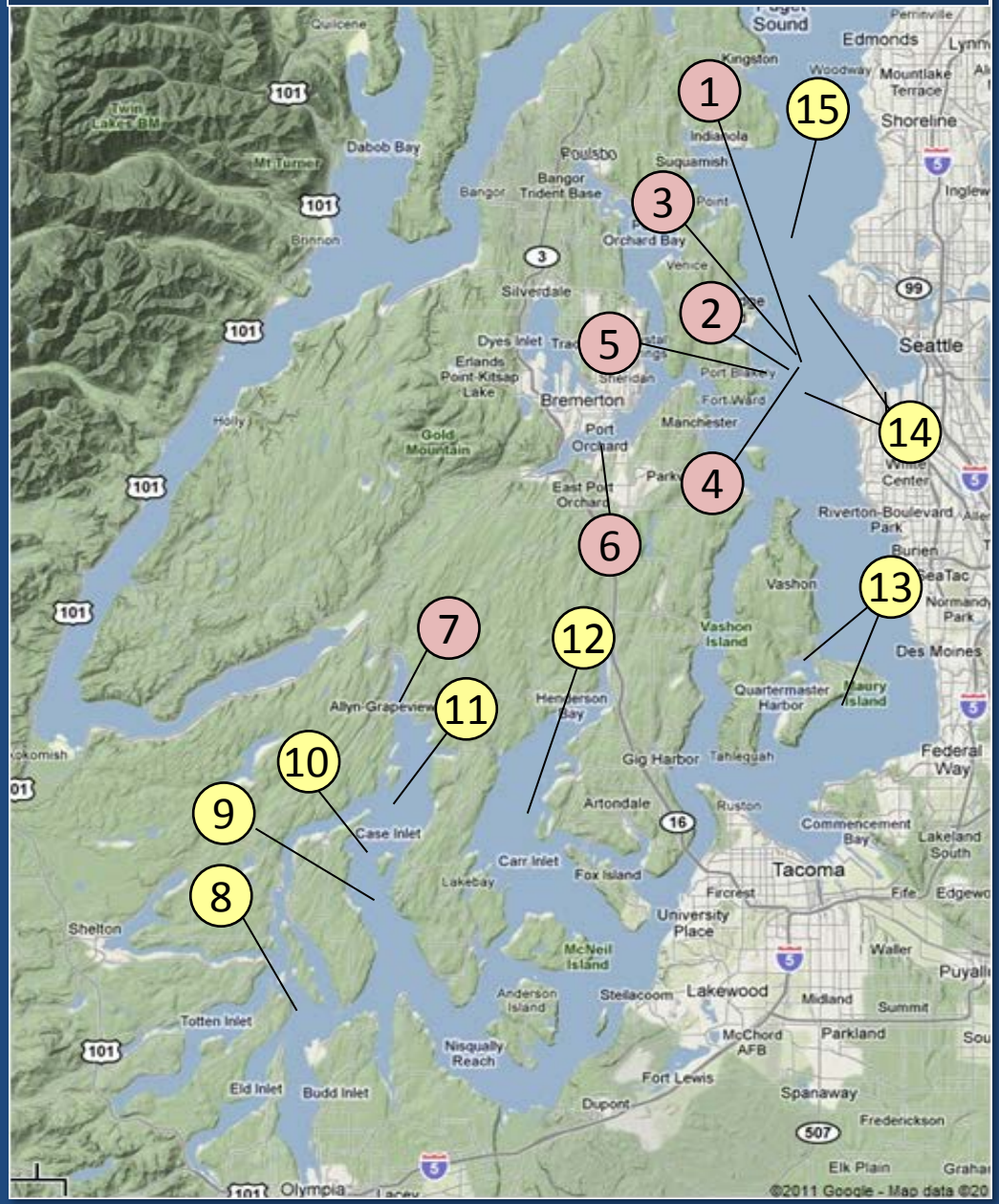
Red-brown and turquoise in Case Inlet. Red-brown Squaxin Passage. Olive to green in Sinclair Inlet.

Debris

Debris 1 2 3 4 5 8 11 12 13 15

Abundant in Central Sound and usual locations in South Sound (Squaxin Passage, Case and Carr Inlet)

High tides : 1:11 PM, Low tides: 7:06 AM , 6:08 PM



Aerial photography navigation guide

6-12-2012

Click on numbers

Flight Information:

Morning flight:
Limited to poor visibility, calm

Evening flight:
Limited visibility, calm

Observation Maps:

Central Sound

South Sound

Aerial photography 6-12-2012

Large *Noctiluca* bloom in Central Sound. Location: West Seattle (Central Sound), 8:06 AM

Aerial photography 6-12-2012

Large *Noctiluca* bloom in Central Sound. Location: West Seattle (Central Sound), 8:06 AM

Aerial photography 6-12-2012

Large *Noctiluca* bloom in Central Sound. Location: Bainbridge Island (Central Sound), 8:07 AM

Large *Noctiluca* bloom in Central Sound. Location: Bainbridge Island (Central Sound), 8:07 AM

Large *Noctiluca* bloom in Central Sound. Location: Bainbridge Island (Central Sound), 8:08 AM

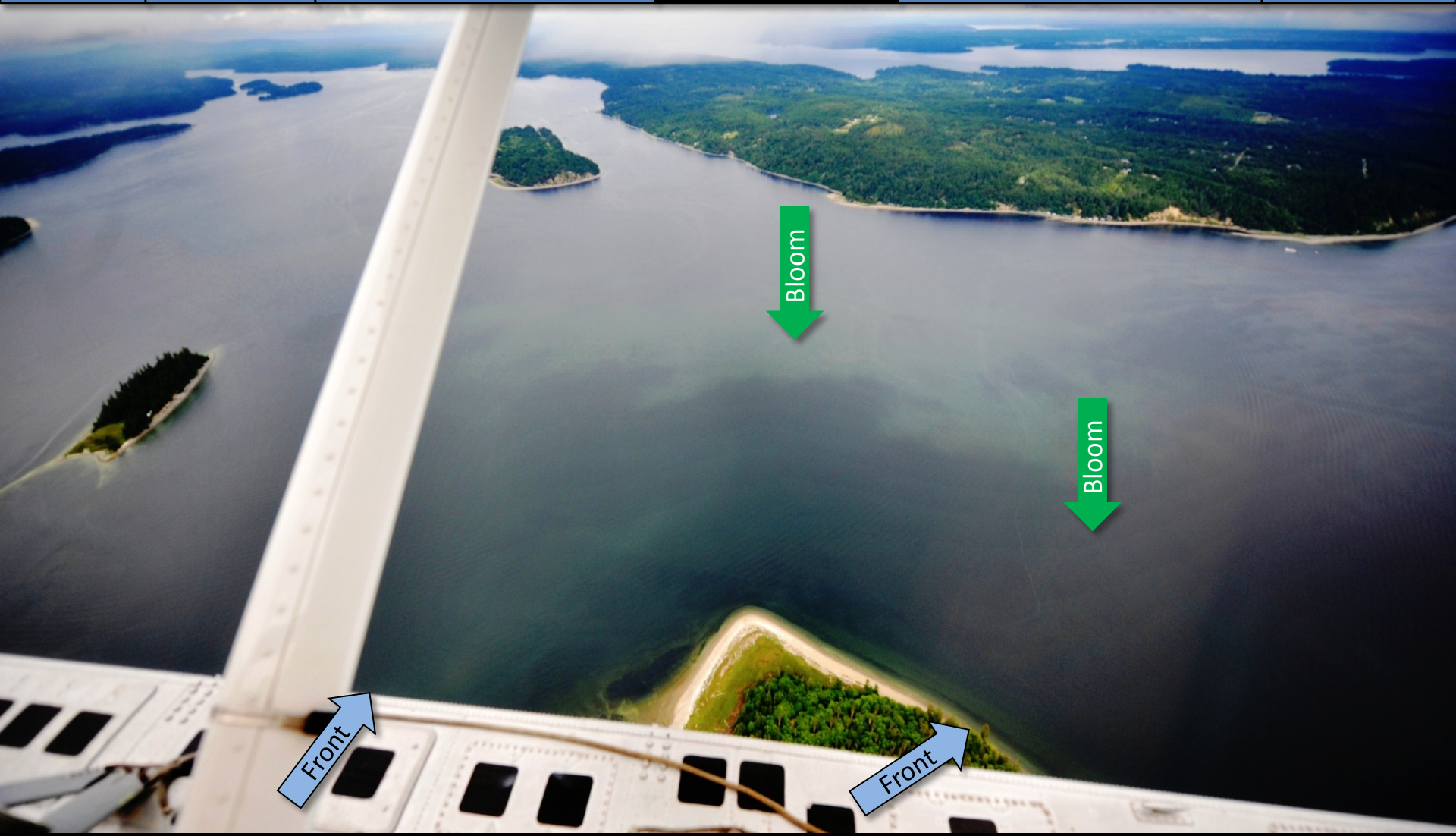
Green algae bloom and oil sheen. Location: Sinclair Inlet (Central Sound), 8:14 AM

Aerial photography 6-12-2012

Brown-red algae bloom & flying under cloud layer. Location: Case Inlet (South Sound), 8:23 AM

Different water masses with algae coming from Squaxin Passage (South Sound), 3:58 PM

Aerial photography 6-12-2012



Red-brown and turquoise blooms near Herron Island, Location: Case Inlet (South Sound), 4:01 PM

A

Red-brown and turquoise blooms near Herron Island,
Location: Case Inlet (South Sound), 4:02 PM

Fronts and debris lines between Tacoma Narrows and Colvos Passage.
Location: South Central Sound, 2:48 PM

Floating macro-algae patches (too small to see on image) and red-brown bloom.
Location: Carr Inlet (South Sound) 4:07 PM

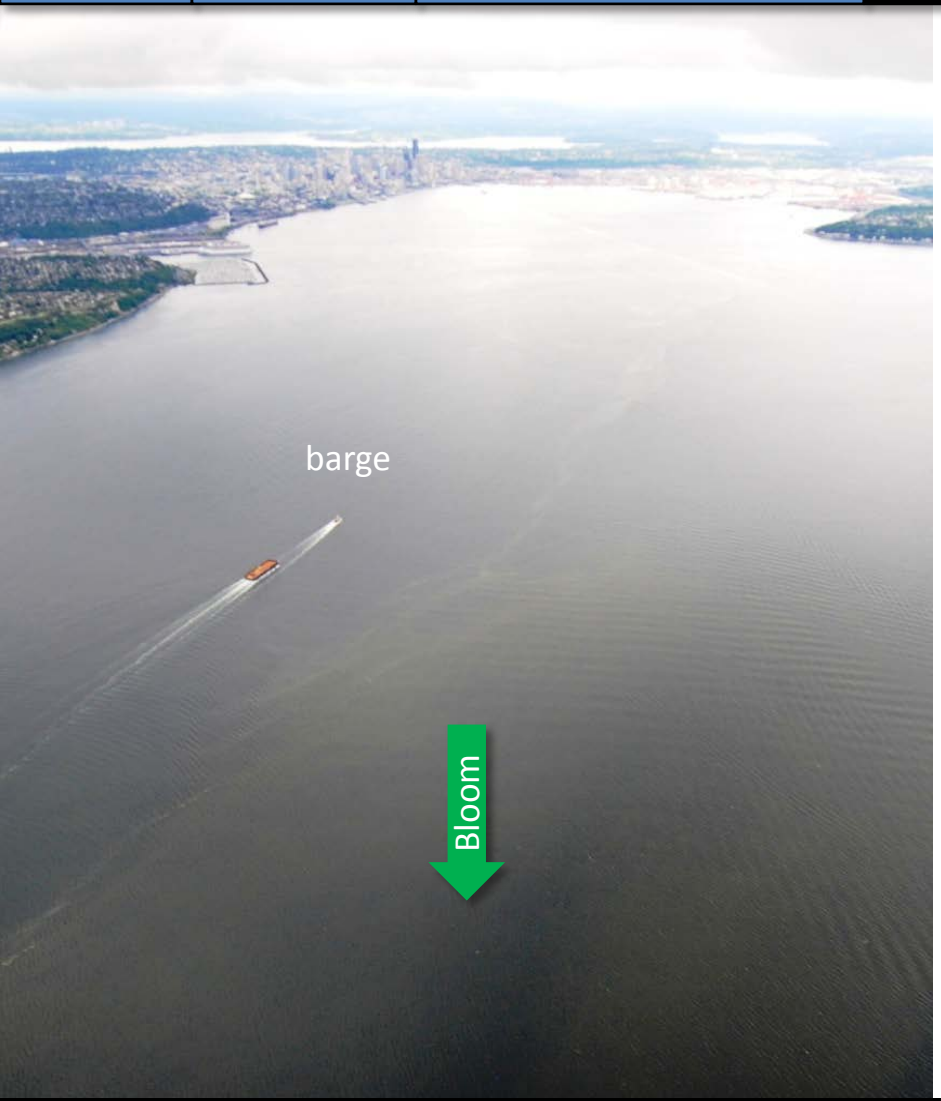
Aerial photography 6-12-2012

A

B

Noctiluca bloom drifting towards shore Location: (A) Quartermaster Harbor - Vashon Island, (B)East Passage, (Central Sound), 4:15 PM

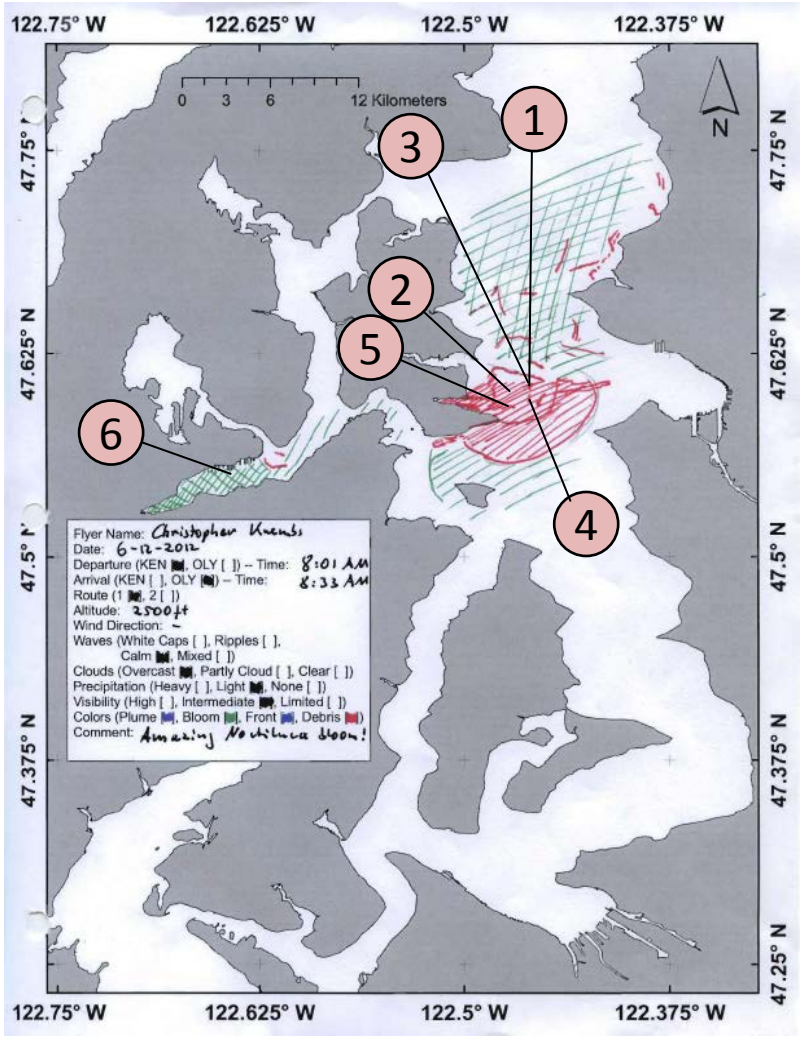
Aerial photography 6-12-2012



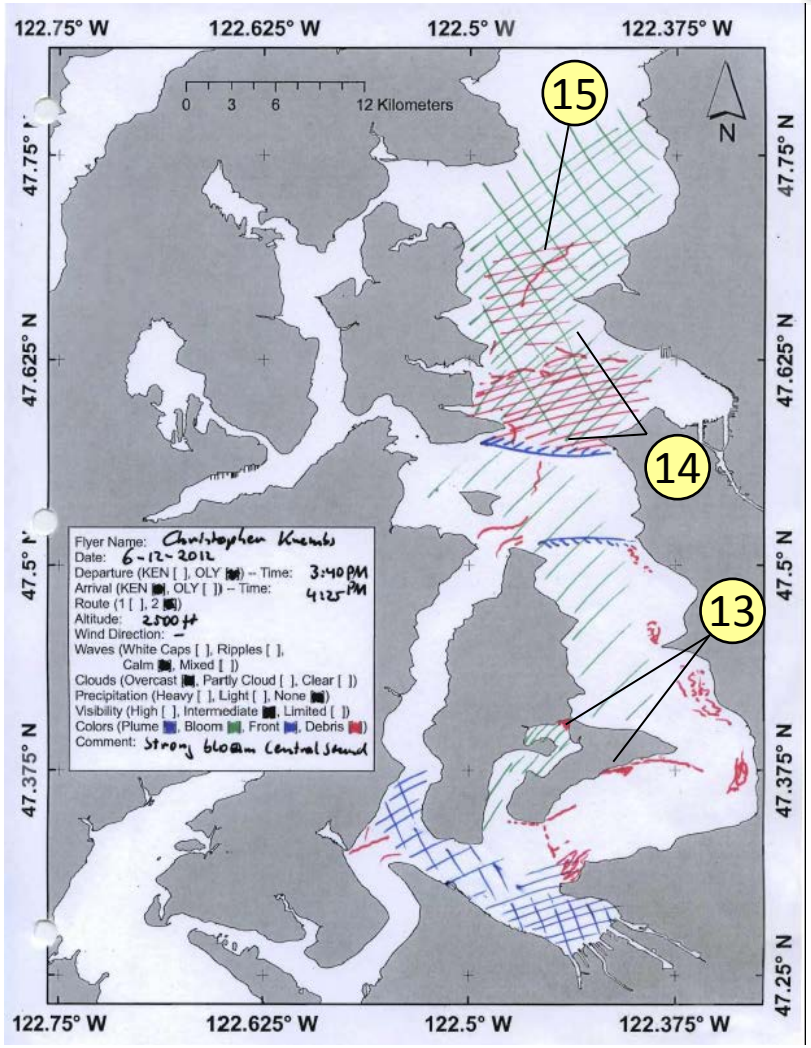
Large *Noctiluca* bloom between Bainbridge Island and Elliott Bay (Seattle): Location: Central Sound , 4:20 PM

Strong algae bloom between Bainbridge Island and West Point (Seattle): Location: Central Sound , 3:01 PM

Morning



Evening



Numbers on map refer to picture numbers for spatial reference

DEPARTMENT OF ECOLOGY
State of Washington

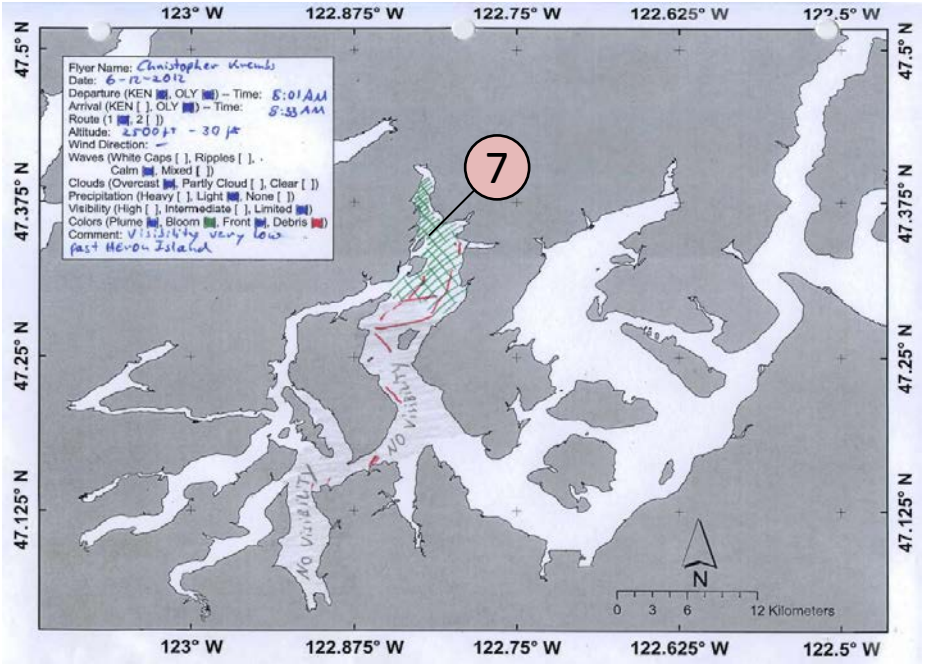
Aerial photography

Observations in South Sound: 6-12-2012

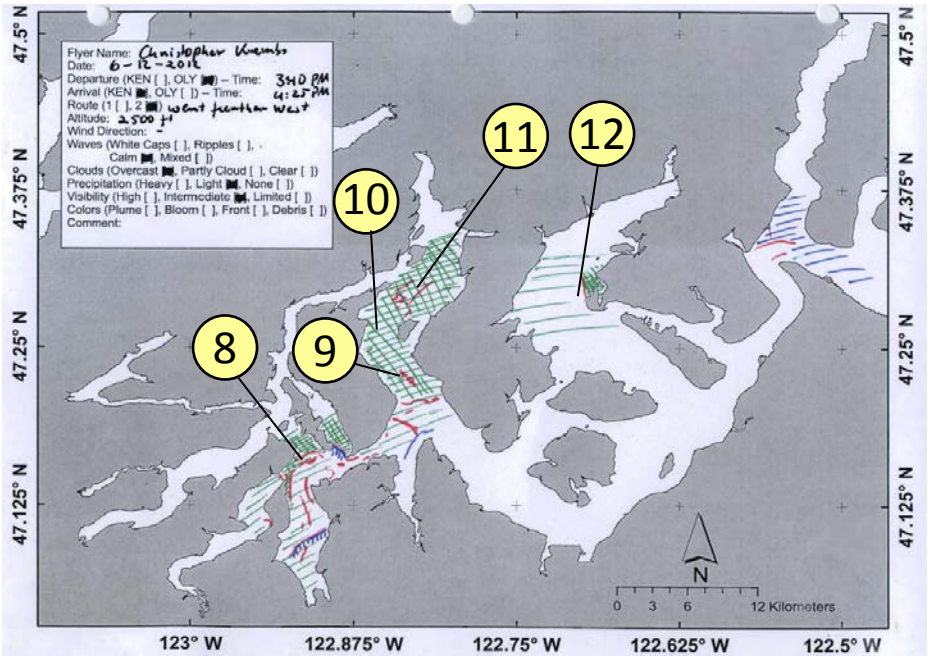
Navigate

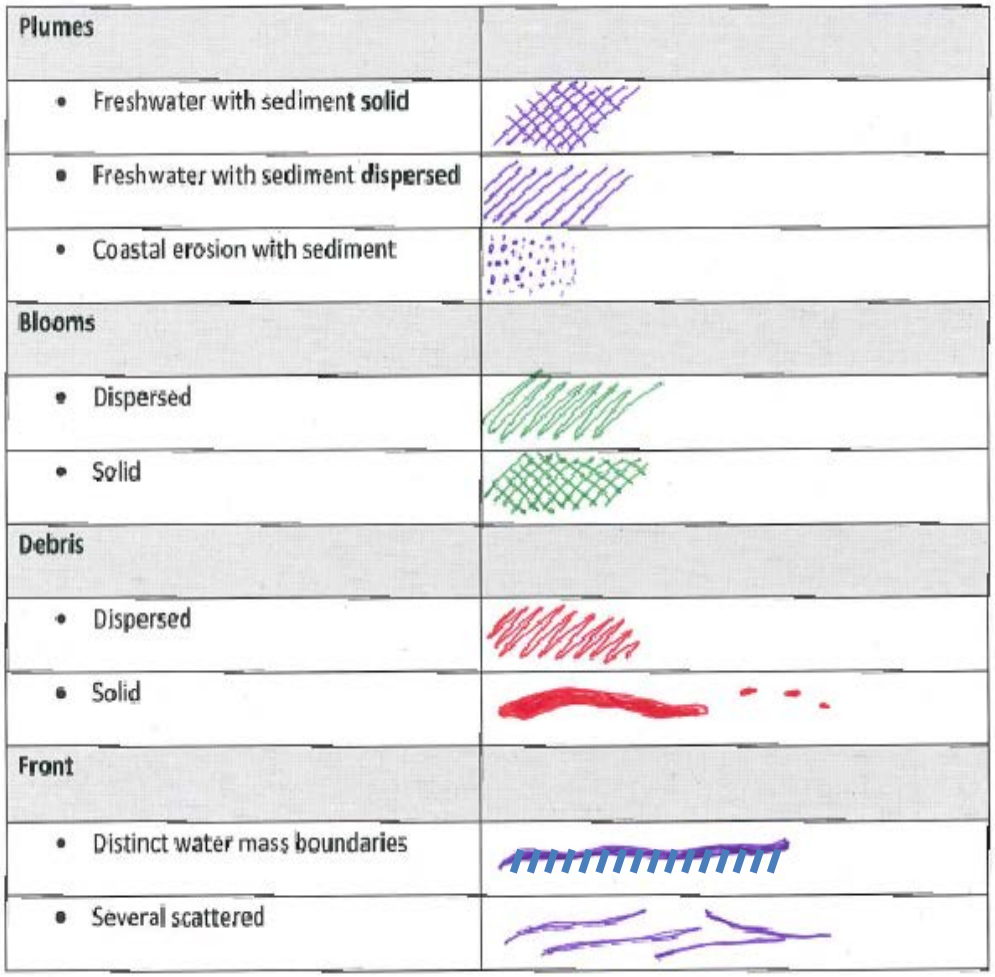
Numbers on map refer to picture numbers for spatial reference

Morning (limited visibility)



Evening

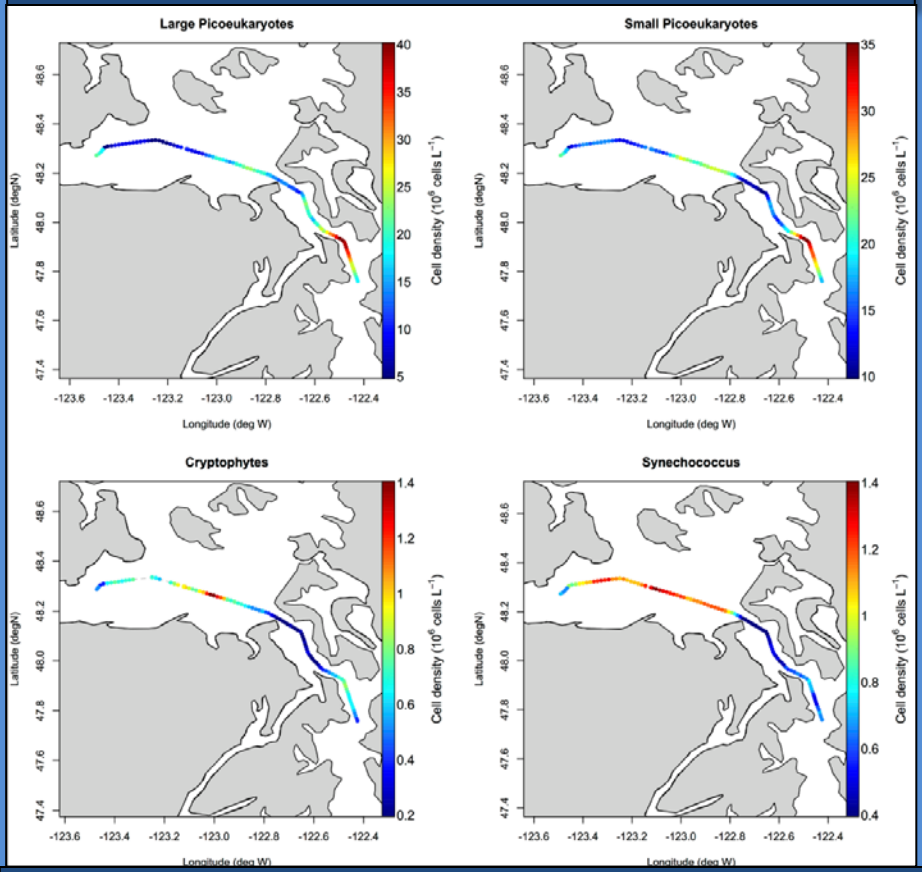




Comments:
Maps are produced by observers during and after flights. They are intended to give an approximate reconstruction of the surface conditions on scales that connect to and overlap with satellite images in the section that follows.

SeaFlow cytometer, (Armbrust Lab)

SeaFlow cytometer



5/16/12 - Cell density (10^6 cells per liter) of 4 phytoplankton populations at 4.5 meters depth along cruise track from Central Sound into Strait of Juan de Fuca.

SeaFlow cytometer

Guests: Francois Ribalet and Jared Swalwell

I study how the environment shapes the distribution and abundance of phytoplankton in the ocean.

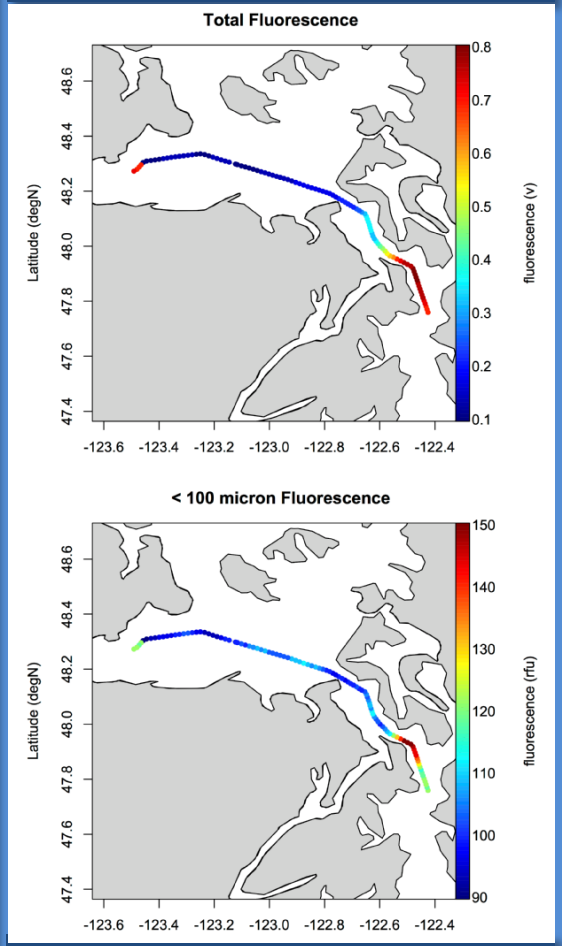
I develop new instrumentation to study the complex structure of microbial communities in the oceans.

We use our underway flow cytometer named **SeaFlow** to examine how physical and chemical gradients influence the distribution, abundance and activity of phytoplankton communities. Our long-term goal is to determine the selective forces and mechanisms that shape patterns of community structure and function in the oceans.

SeaFlow cytometer, (Armbrust Lab)

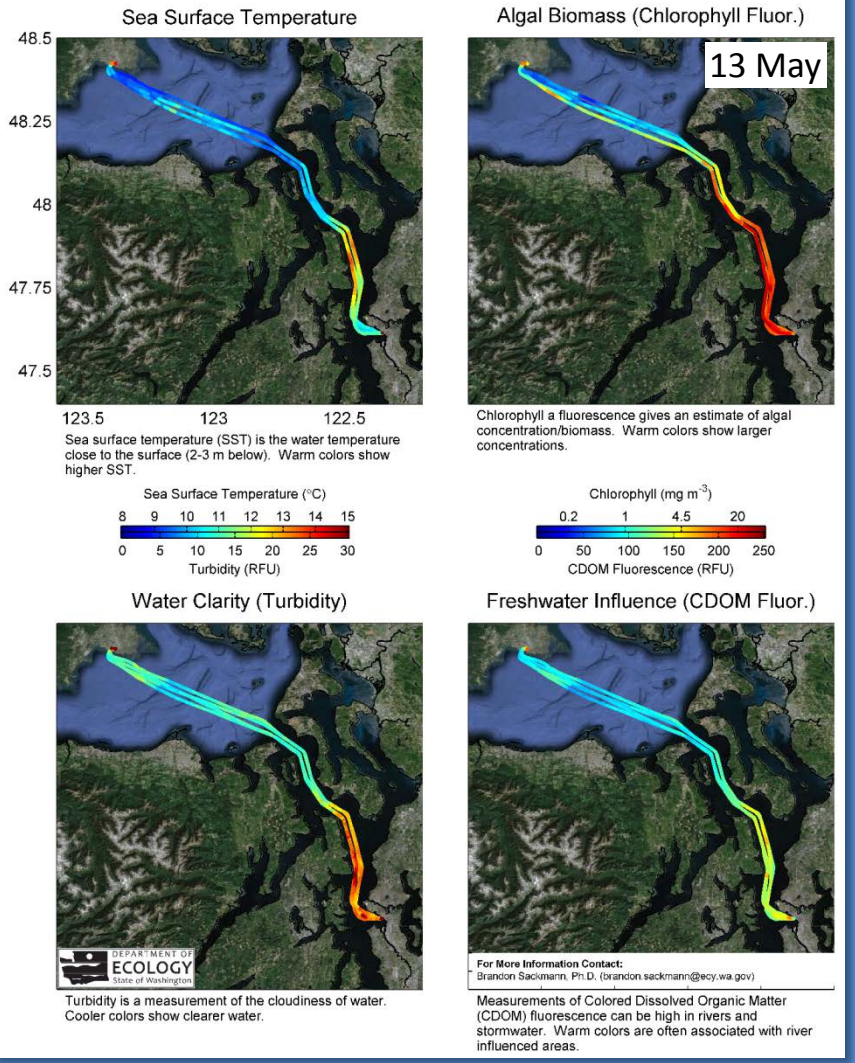
Combining data from disparate sensors and sampling platforms provides valuable insight (near real-time) into environmental forces that shape the phytoplankton community structure in Puget Sound.

SeaFlow cytometer



5/16/12 – Bulk fluorescence of unfiltered (Total) and 100 micron filtered seawater at 4.5 meters depth.

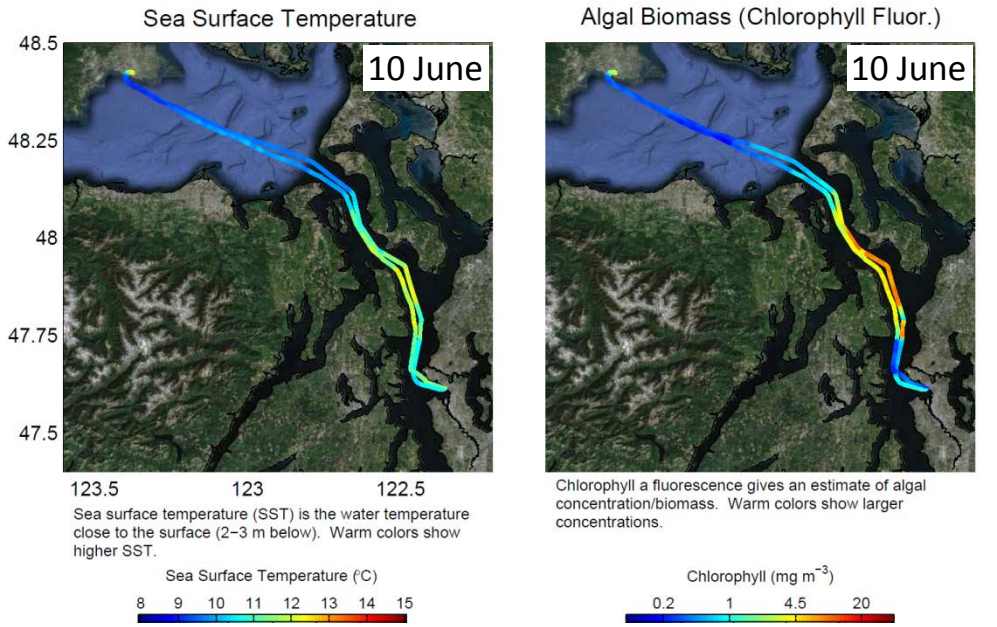
Victoria Clipper



Daily ferry and satellite observations in Central Sound, 6-10-2012*

Contact: brandon.sackmann@ecy.wa.gov

MERIS True Color image used for spatial context (19 February 2011). Image is not coincident with ferry data shown on right.



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.

*Thermosalinograph testing interrupted data collection on 11 June; Clipper did not run on 12 June.

--- Daily 'Quick-Look' Products Available ---

(http://www.ecy.wa.gov/programs/eap/mar_wat/eops/clipper.html)

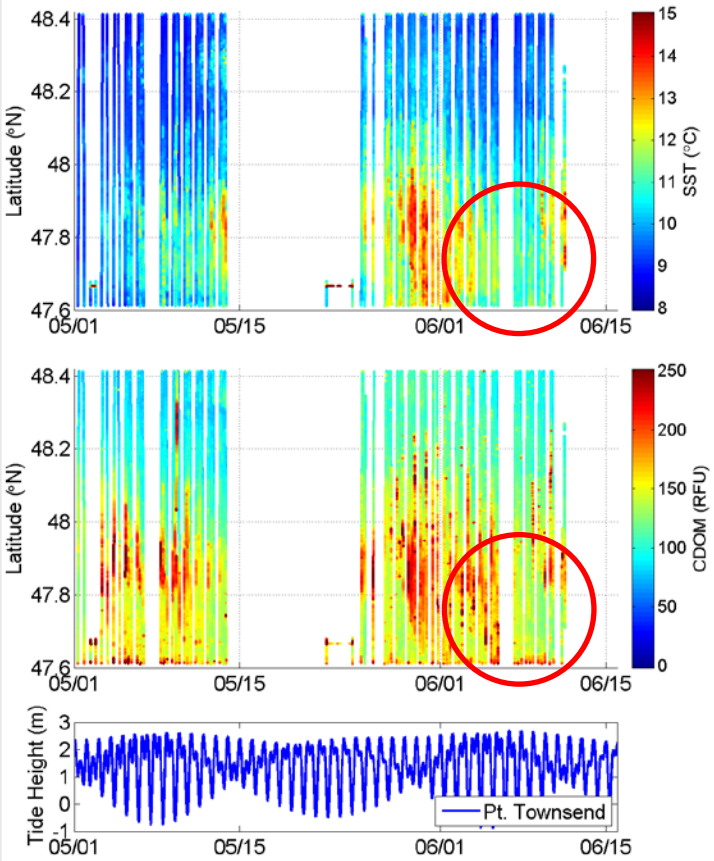
Ferry & satellite observations, 4-15-2012 to 5-13-2012

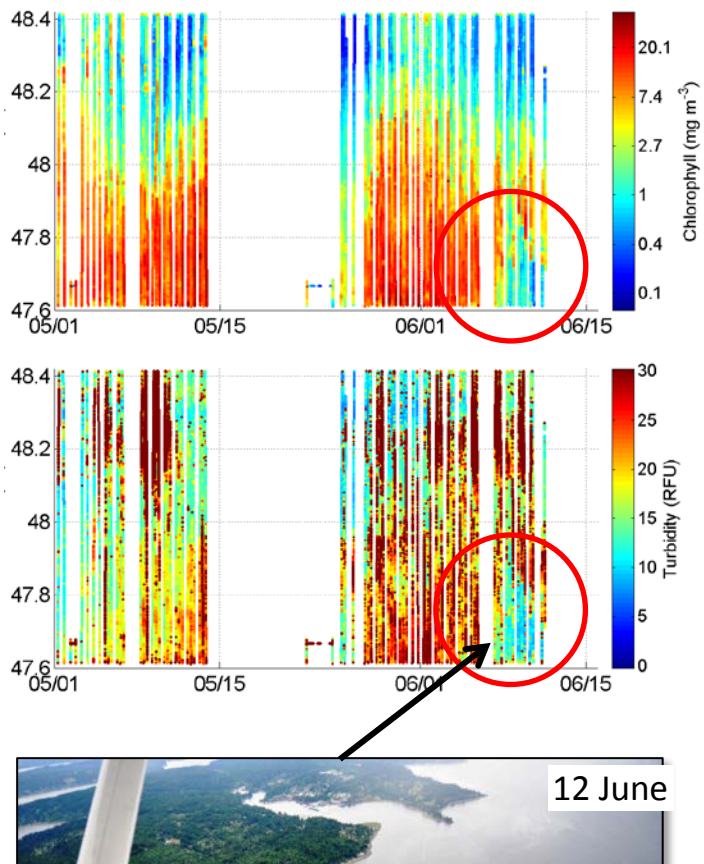
The widespread *Noctiluca* bloom in Central Sound *(observed south of Edmonds from 47.6-47.75N)* was associated with 3 conditions:

1) Clearer water (reduced fluorescence and turbidity); possibly the result of increased grazing by *Noctiluca*

2) Cooler sea surface temperatures

3) Lower CDOM concentrations





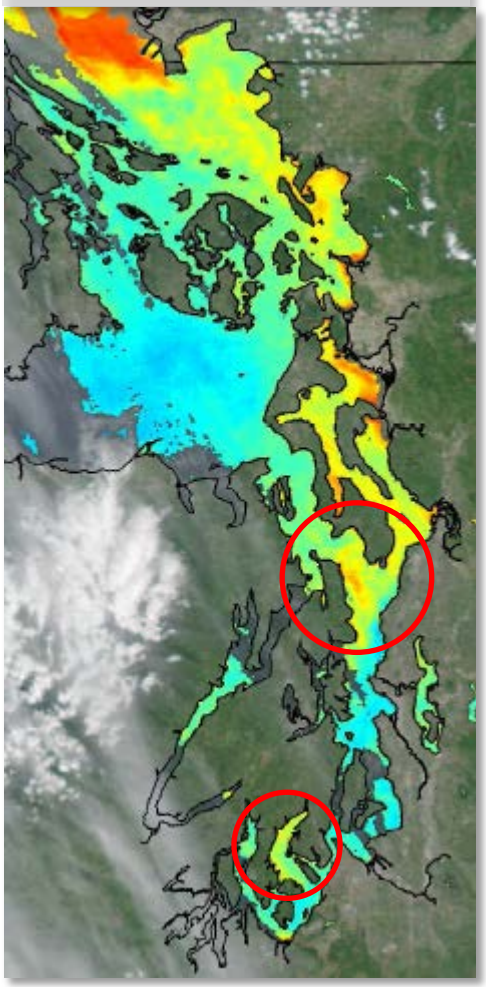
Ferry & satellite observations

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.

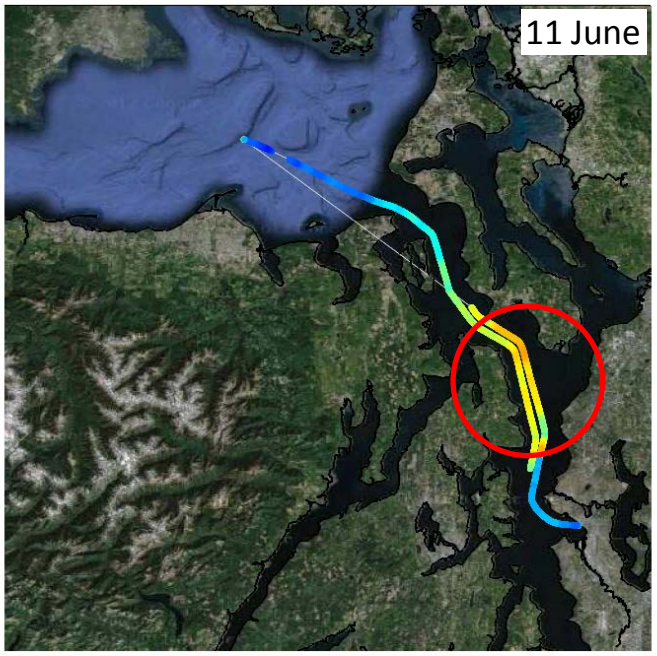
MODIS-Aqua
11 June 2012 @ 14:05 PDT

Chlorophyll *a*



Chlorophyll (mg m^{-3})

0.2 1 4.5 20



Mooring observation and trends 5-30-2012 to 6-12-2012

In Whidbey Basin, higher DO levels correlated with lower salinity and warmer water. In Central Sound, surface waters are cooler and saltier.

Mukilteo, Whidbey Basin near Everett: At near-bottom (12-16 m; NB), the overall trend was towards warmer and less saline water.

Mean values & trend over past 2 weeks:

NB: DO: 9.0 mg/L (↑ 0.1 mg/L)
Temp: 9.6°C (↑ 0.8°C)
Salinity: 28.4 PSU (↓0.20 PSU)

Surface: Temp: 11.3°C (↓0.2°C)
Salinity: 23.8 PSU (↓0.7 PSU)

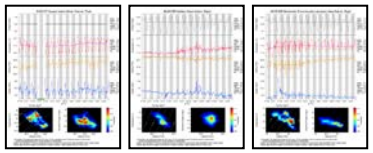
Manchester, Central Sound: At near-surface (1.1-5.7 m), the overall trend was towards saltier and cooler water.

Mean values & trend over past 2 weeks:

NB: not reporting

Surface: Temp: 10.6 °C (↓ 0.8°C)
Salinity: 28.3 PSU (↑ 0.8 PSU)

Real-time data online (click)

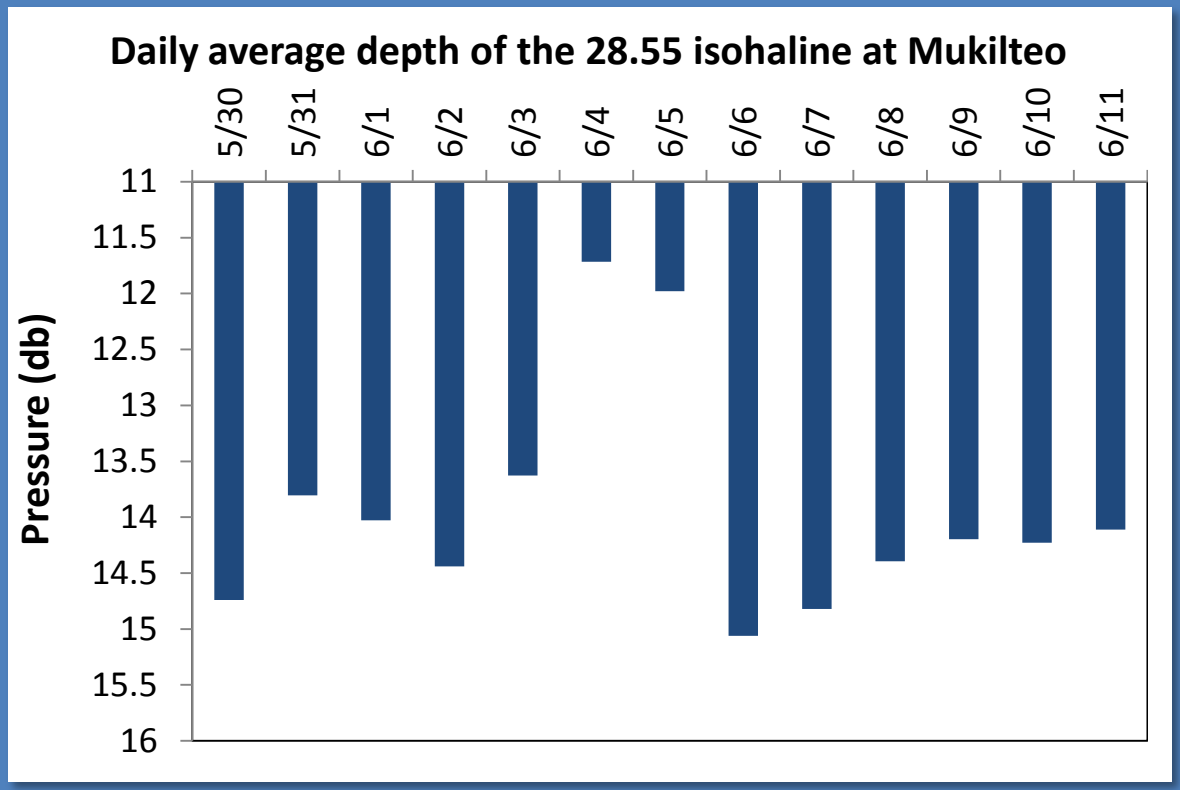


Mooring observation and trends 5-30-2012 to 6-12-2012

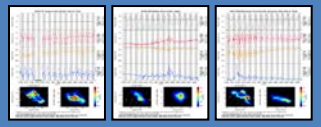
Go to our mooring site at: http://www.ecy.wa.gov/programs/eap/mar_wat/moorings.html

Summary: : The thickness of the 28.55 showed a similar pattern as the previous month, varying with high river flow, spring tide and wind effects.

We currently report the thickness of the freshwater layer between Whidbey Basin and Central Basin to understand freshwater input to Puget Sound.

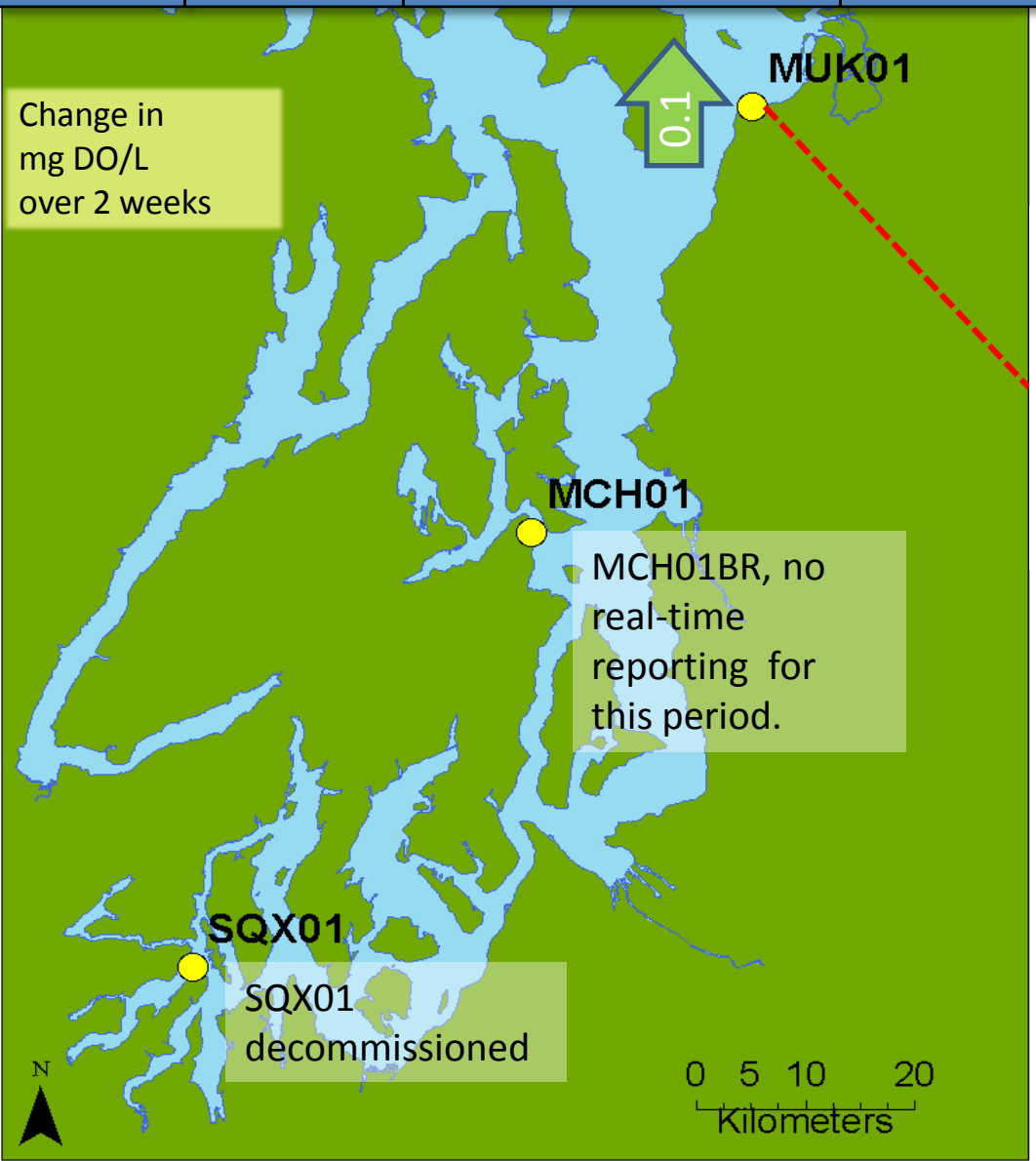


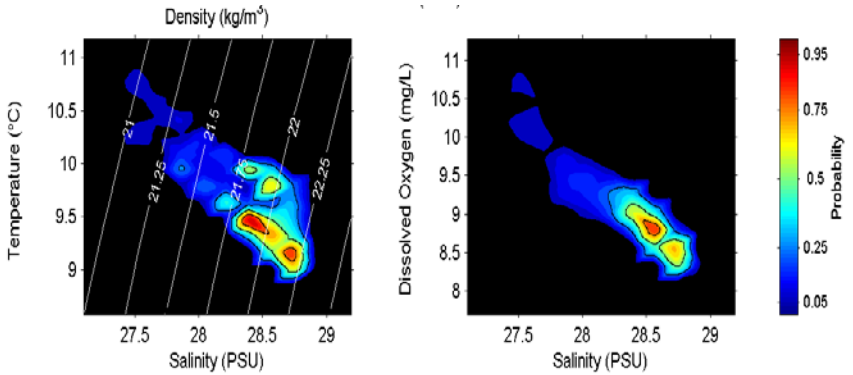
We track the depth of the isohaline where salinity is 28.55 (±0.05) to measure the thickness of the freshwater layer at our Mukilteo station. The sensor experiences tidal pressure variations of 11.8 to 15.6 meters (or dbar).



Real-time data online (click)

Mooring observation and trends 5-30-2012 to 6-12-2012





Left Panel: Probability of finding a specific density over the past two-week period. High probability shown in warm colors.

Right Panel: Dissolved oxygen concentration in relation to salinity. High probability shown in warm colors.

Get data from Ecology's Monitoring Programs

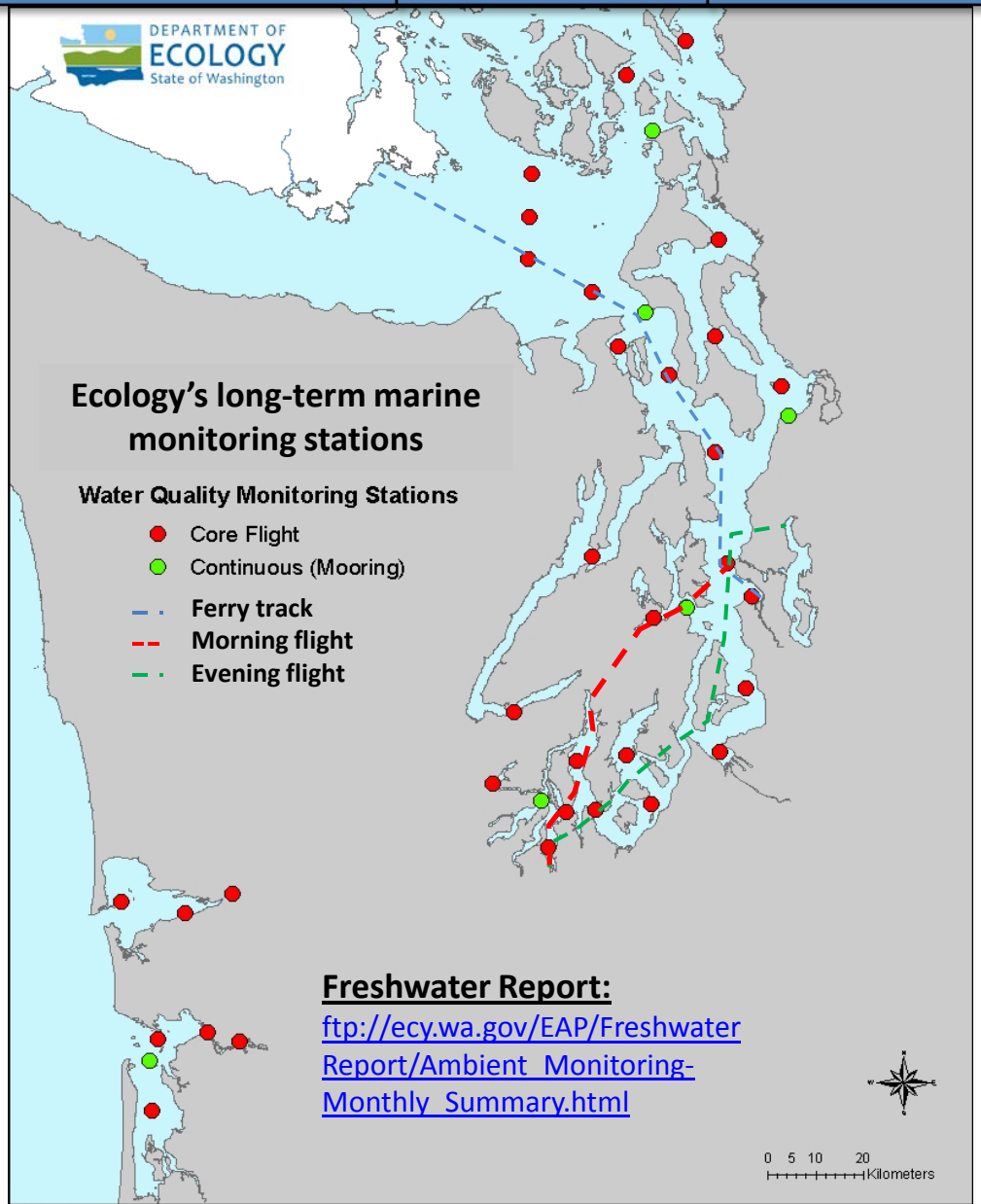
Field log	Weather	Water column	Aerial photos	Ferry and Satellite	Moorings

Long–Term Monitoring Network

christopher.krembs@ecy.wa.gov

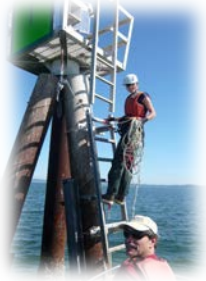
Access core monitoring data:

http://www.ecy.wa.gov/apps/eap/marinewq/mwdataset.asp



Real–Time Sensor Network

brandon.sackmann@ecy.wa.gov



Access mooring data:

http://www.ecy.wa.gov/programs/eap/mar_wat/moorings.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.

Dr. Christopher Krembs
ckre461@ecy.wa.gov

Marine Monitoring Unit
Environmental Assessment Program
WA Department of Ecology

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