Publication No. 12-03-074

DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound

Surface Conditions Report

May 14, 2012

Guest Contributor: Gabriela Hannach, p. 5-6

Interview: KUOW reporter Ashley Ahearn

Start here

Story now on: KUOW.ORG

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

Marine conditions from 5-14-2012 at a glance

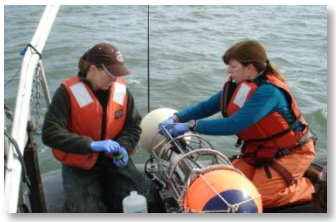
LONG-TERM MARINE MONITORING UNIT

Mya Keyzers
Laura Friedenberg

Skip Albertson

Dr. Christopher Krembs

Dr. Brandon Sackmann



David Mora
Suzan Pool
Julia Bos

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

Personal flight impression, 5-14-2012

Mya Keyzers talking about marine monitoring with KUOW reporter Ashley Ahearn.

Marine Flight 1 (Coast)

We started the day by meeting KUOW reporter Ashley Ahearn at the dock where she interviewed the marine flight team. We gave her a quick taste of the water sampling portion of our work and then we were off to collect samples on the coast.

Here is a link to her story where our own Dr. Christopher Krembs is quoted:

http://earthfix.opb.org/water/article/algae-boom-in-puget-sound/

Mya and Julia loading the plane with Ashley in the background getting a CTD cast demo from Laura.

Beautiful day at Grays Harbor.

Personal flight impression, 5-14-2012

Foam and debris bands in Eld Inlet.

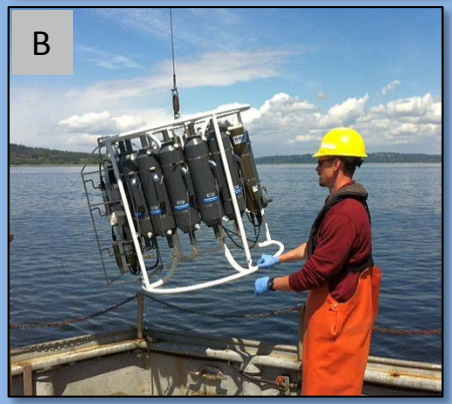
Foam and debris bands in Eld Inlet.

On the way to the Coast, we saw blooms, debris, and foam on the water's surface in the South Sound.

It was a successful flight. Morning conditions were excellent but by the late afternoon the wind had started to pick up, making flight operations more difficult.

Bloom with foam in Eld Inlet.

King County's Marine Phytoplankton Monitoring Program



(A) The Liberty, (B) and (C) water samples for analysis of phytoplankton are collected with Niskin bottles at two depths.

Marine phytoplankton monitoring programs like this one are rare. Most monitoring programs target harmful algal species and blooms.

Guest: Gabriela Hannach

King County manages a long-term marine monitoring program designed to assess water quality in the Central Puget Sound Basin.

link

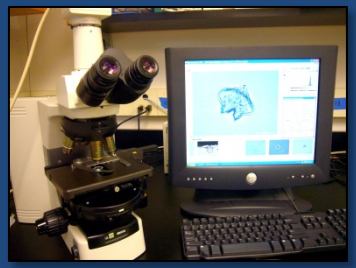
- The Marine Phytoplankton component measures relative abundances of phytoplankton taxa at 3 locations in central Puget Sound.

- Samples are collected biweekly from March to October at two open water stations (north and south) and at Quartermaster Harbor.

- Physical/chemical parameters are measured *in situ* and the samples are analyzed at the lab for nutrients and chlorophyll-*a*.

- An understanding of the dynamics of Puget Sound phytoplankton is necessary in order to predict how changes in climate and other stressors will impact its trophic structure.

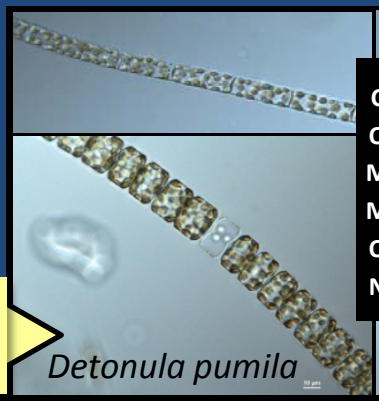
King County's Marine Phytoplankton Monitoring Program



We are developing an online image library of Puget Sound phytoplankton (ca. July 2012). We hope that many researchers will find it useful.
http://green.kingcounty.gov/marine/photos.aspx

Chain forming diatoms, in the genus *Chaetoceros* (top six images at right), typically dominate the spring bloom in Puget Sound. Other common chain-forming genera are (bottom four images, clockwise) *Leptocylindrus, Thalassiosira, Skeletonema* and *Detonula*.

In 2012, the spring bloom has seen an unusually high abundance of *Detonula pumila* (bottom left).



Photographs taken at 200-600x.

Weather patterns from 4-30-2012 to 5-14-2012

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

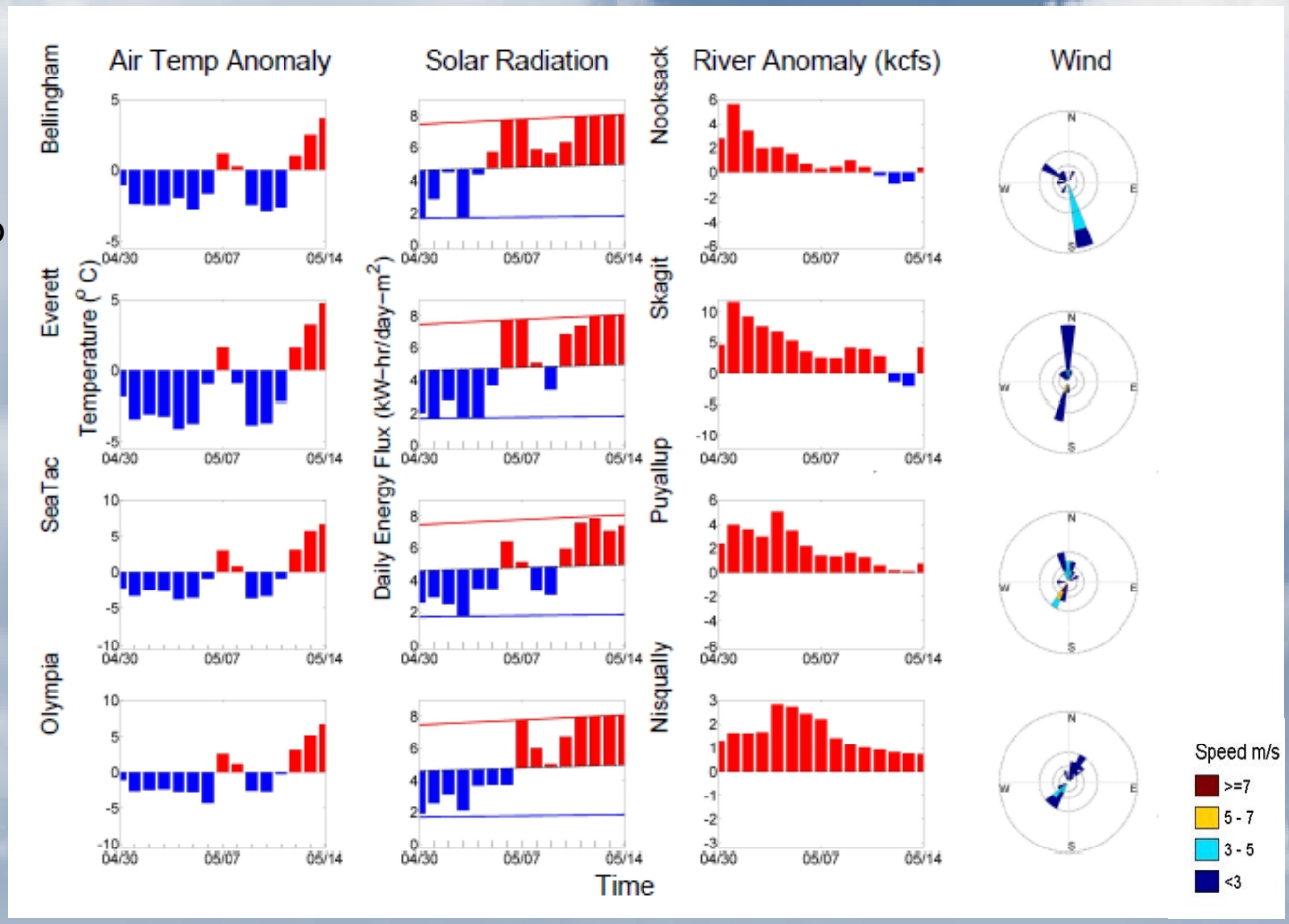
Summary:

Air temperatures during the past few days have been above average, but slightly cool prior to that.

Sunlight has been strong in the past week, but the first week of May was cloudier.

Rivers have been running above normal for the past two weeks, however flows are decreasing.

Winds are turning from winter-time southerlies to summer-time northerlies.



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 5-14-2012

Strong algal blooms in South Sound and Central Basin and all smaller bays. Abundant debris lines and foamy ship tracks. Oil sheen in Lake Union.

Start here

KUOW reporter Ashley Ahearn and pilot

Oil sheen in Lake Union, 8:38 AM

Front

Mixing and Fronts: 1 2 3 4 5 6 7

Tidal jet near McNeil Island, many fronts visible through water discoloration 9 10 11 14

Plume

Suspended sediment: 2 11

Sinclair Inlet, Elliott Bay, Commencement Bay and Budd Inlet with visible sediment near surface

Bloom

Visible blooms: 1 2 3 4 5 6 7

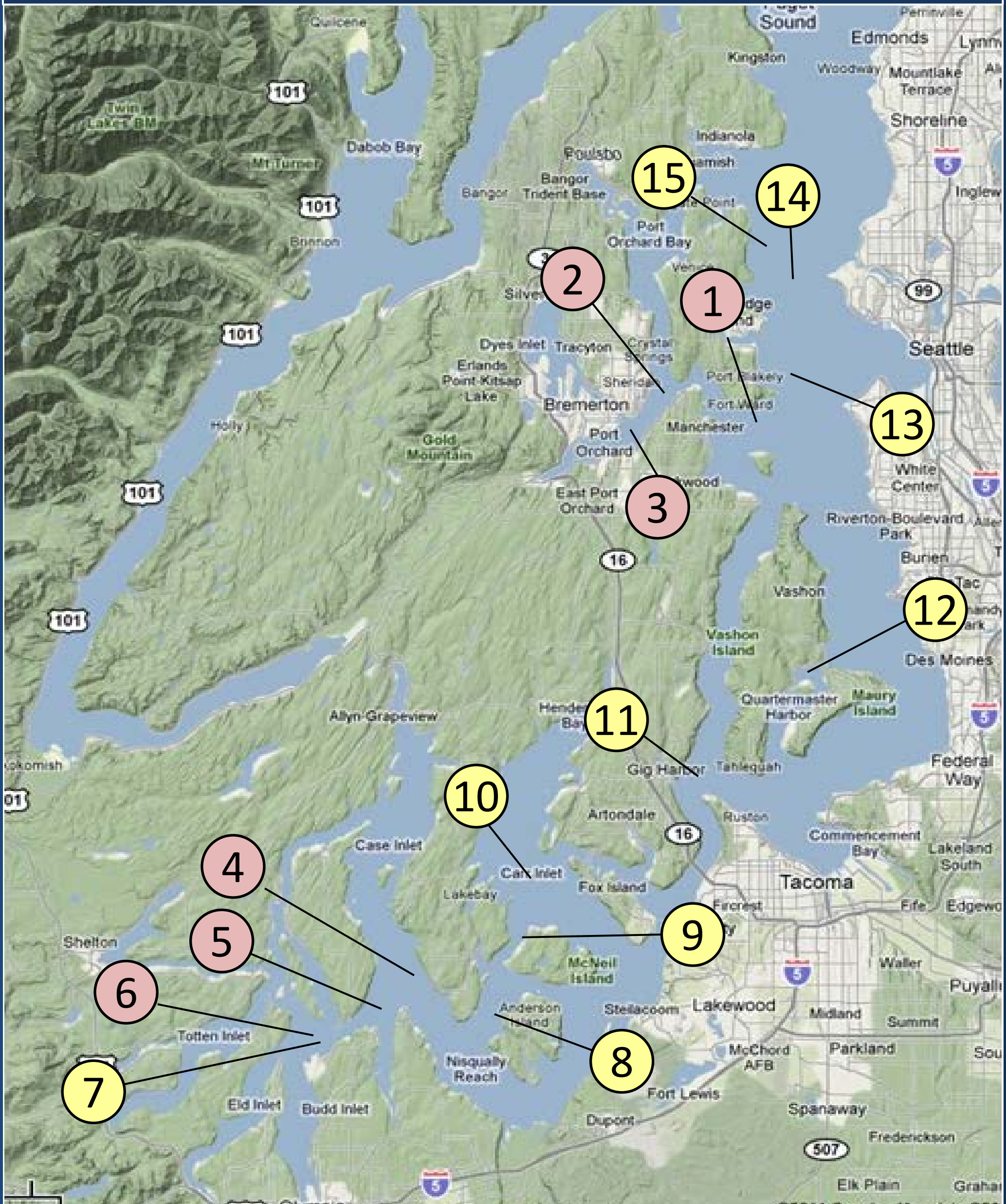
Extensive blooms of brown, turquoise, green and olive brown colors in all parts of South and Central Sound. 8 9 10 11 12 13 14 15

Debris

Debris 1 2 3 4 5 6 7 8 9 10

Long coherent debris and foam bands from blooms and ship traffic leaves visible tracks. 11 12 13 14 15

High tides : 12:58 AM, 1:27 PM   Low tides: 7:53 AM , 6:56 PM



Aerial photography navigation guide
5-14-2012

Click on numbers

Flight Information:

Morning flight:
Good visibility, calm

Evening flight:
Very good visibility, slight wind

Observation Maps:

Central Sound

South Sound

Large algae bloom in Central Sound. Location: Blake Island (Central Sound), 8:42 AM

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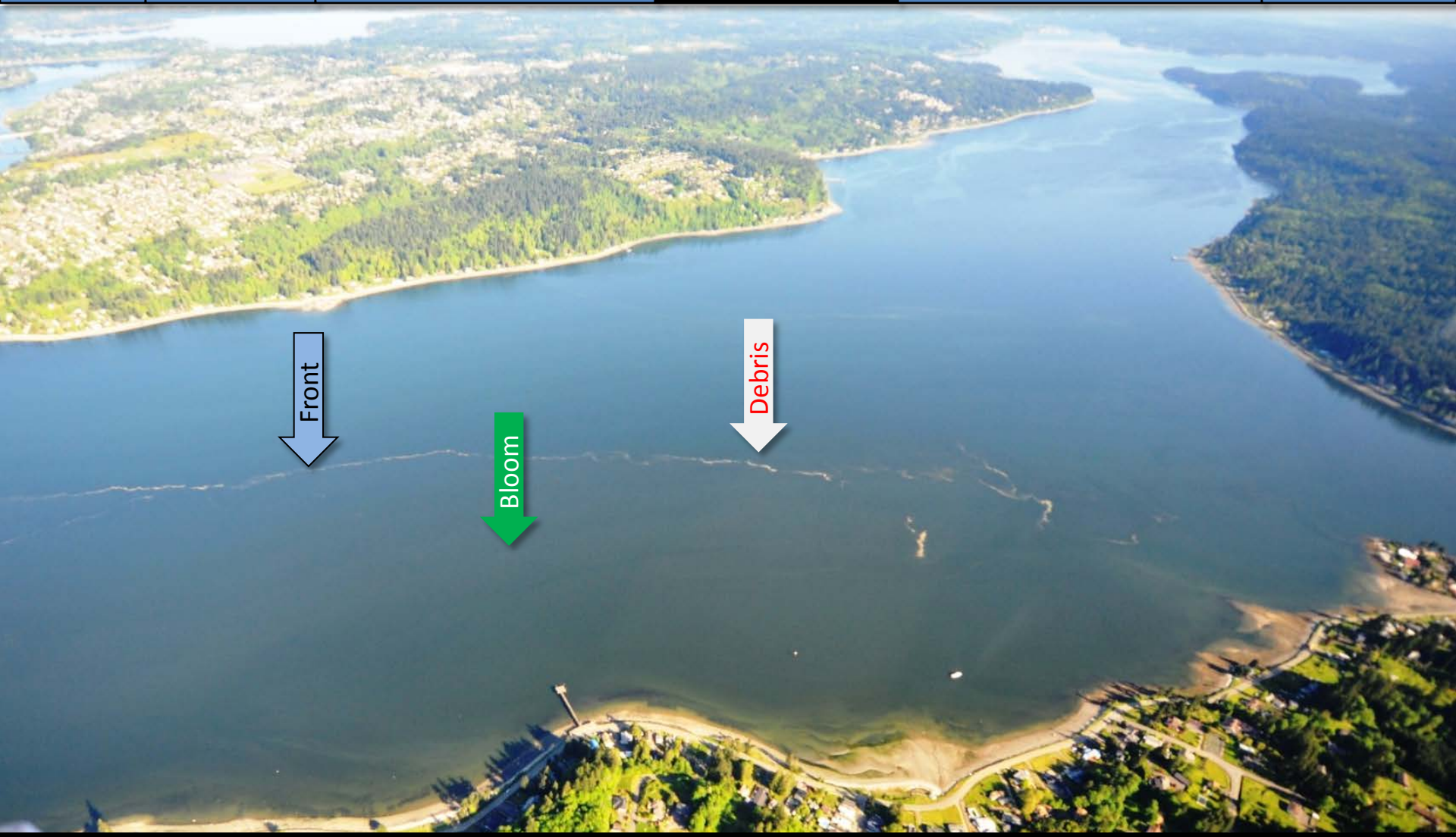
Aerial photography 5-14-2012



Red-brown algae bloom debris line and front in Sinclair Inlet. Location: Sinclair Inlet, 8:43 AM

Red-brown algae bloom debris lines and front in Sinclair Inlet. Location: Sinclair Inlet, 8:43 AM

Aerial photography 5-14-2012

Water leaving Dana Passage meets strong algae bloom. Location: Case Inlet, 8:59 AM

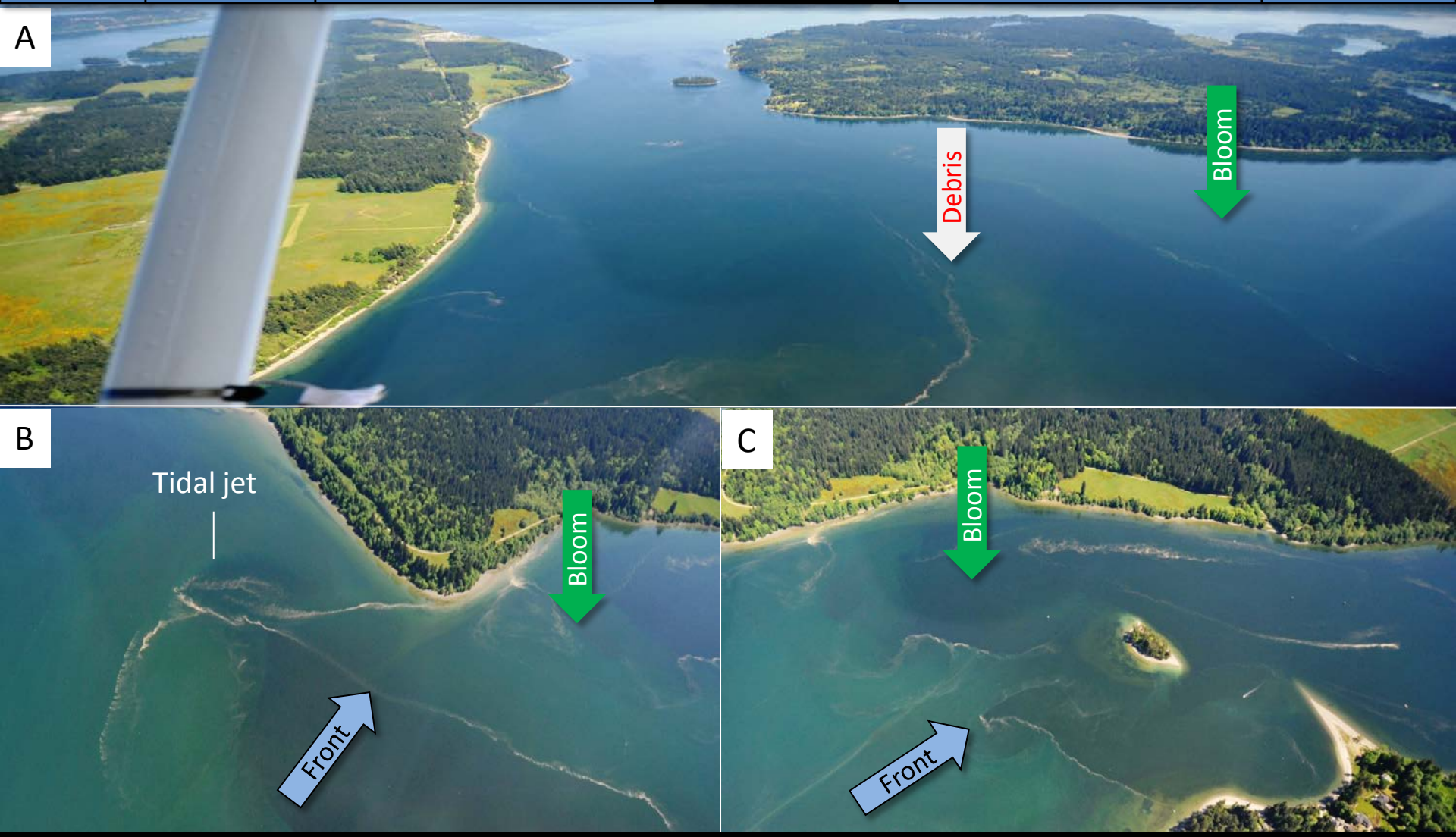
Water leaving Dana Passage with front and algae bloom. Location: Henderson Inlet (South Sound), 9:01 AM

Green and red algae bloom originating from water near Squaxin Island with debris lines.
Location: Dana Passage (South Sound), 9:02 AM

Aerial photography 5-14-2012

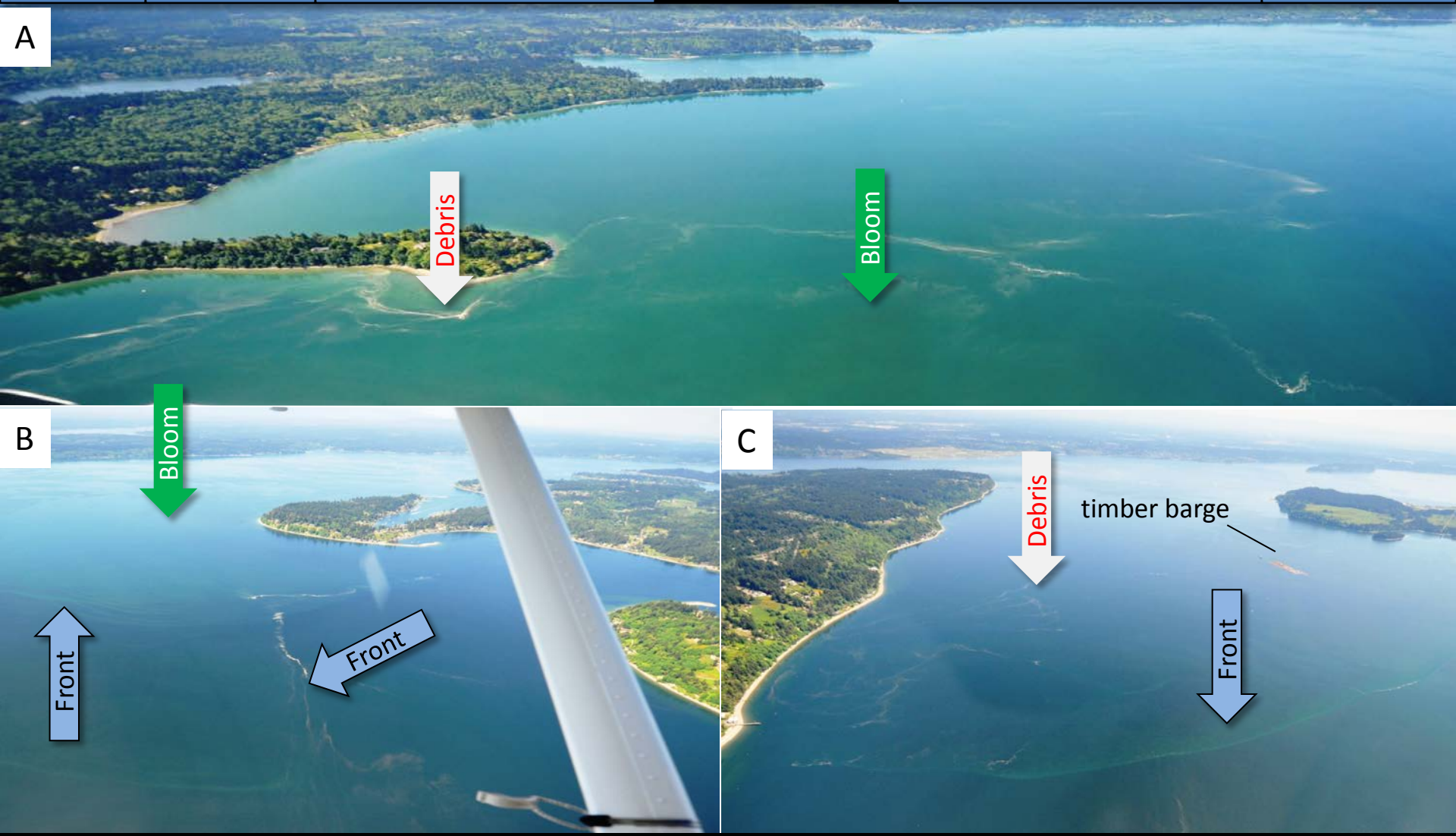
Green algae bloom originating from Budd Inlet meeting water from Case Inlet with debris lines.
Location: Dana Passage (South Sound), 2:35 PM

Different water masses with unique algae blooms converging, Anderson Island (South Sound), 2:39 PM



Water masses with different types of algae blooms meeting and mixing around McNeil Island (A), tidal jet (B), and tidal fronts (C), Location: South Sound, 2:51 PM

Aerial photography 5-14-2012



Turquoise/green algae blooms and debris lines near Fox Island.
Location: Carr Inlet (South Sound), 2:42 PM

Aerial photography 5-14-2012

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

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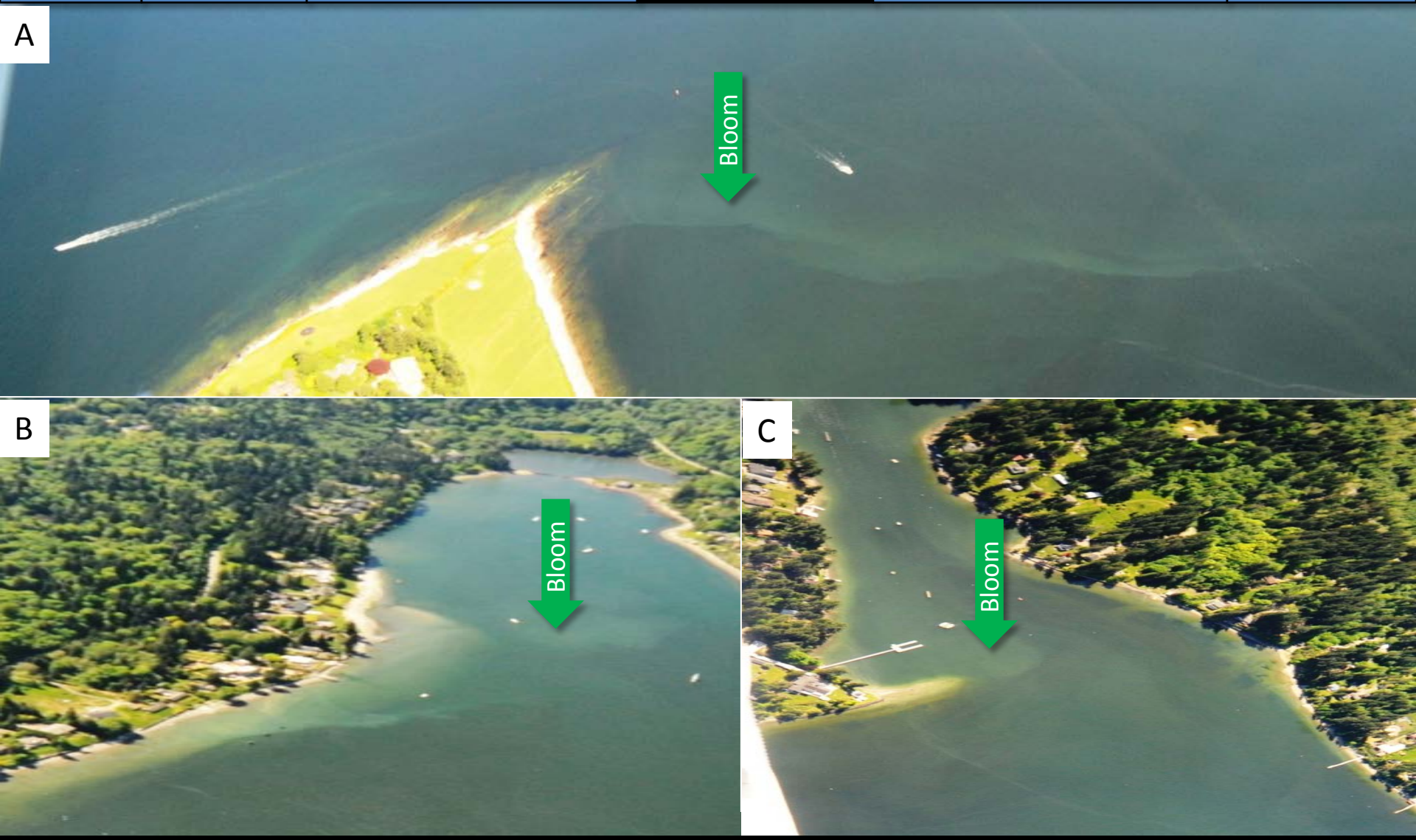
Aerial photography 5-14-2012

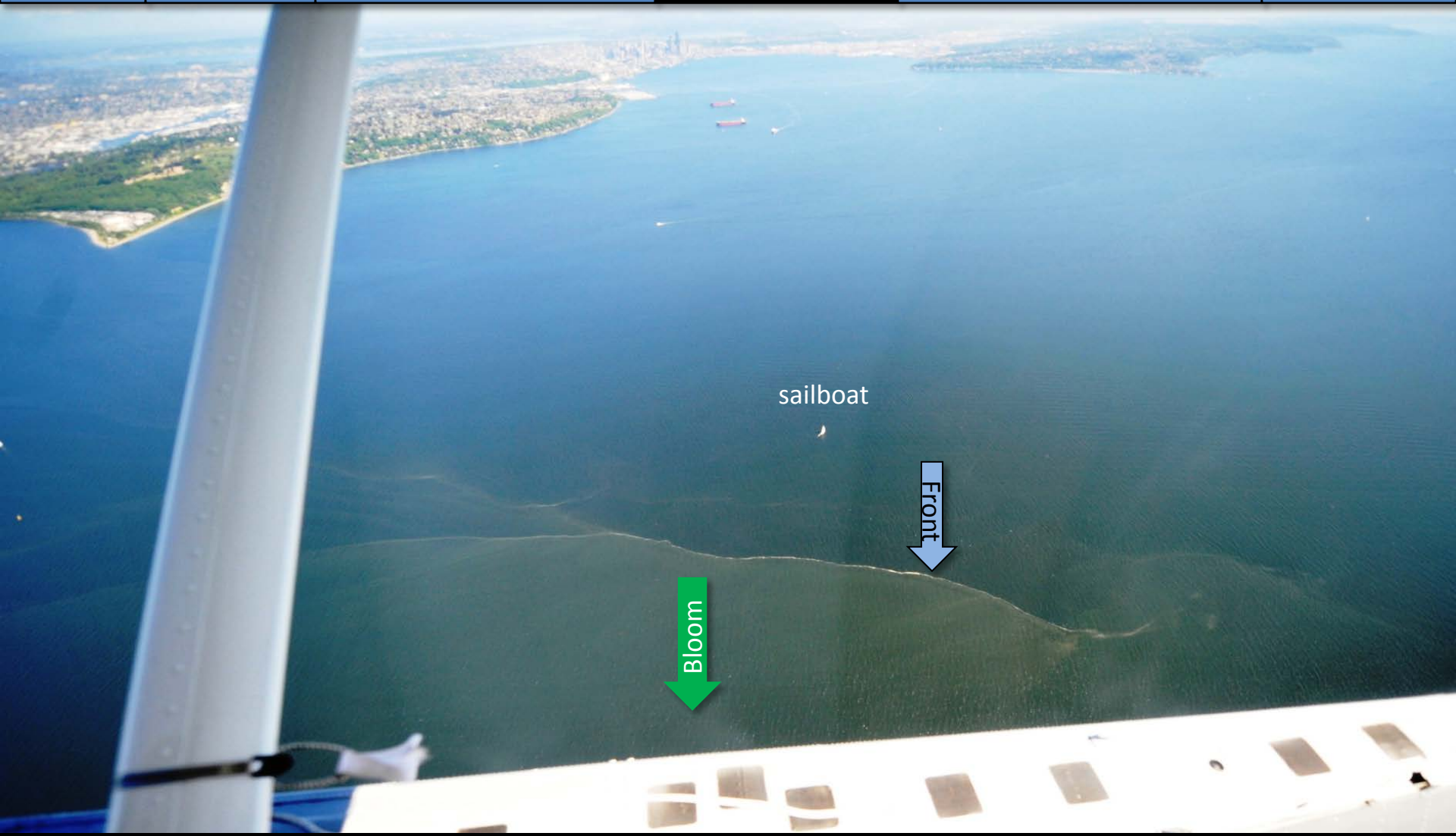
Green bloom in Quartermaster Harbor. Location: Vashon Island (Central Sound), 2:50 PM

Aerial photography 5-14-2012



Localized turquoise algae blooms? Location: Blakely Harbor, Bainbridge Island (A, B) and Filucy Bay (South Sound) (C), 3:53 PM

Aerial photography 5-14-2012

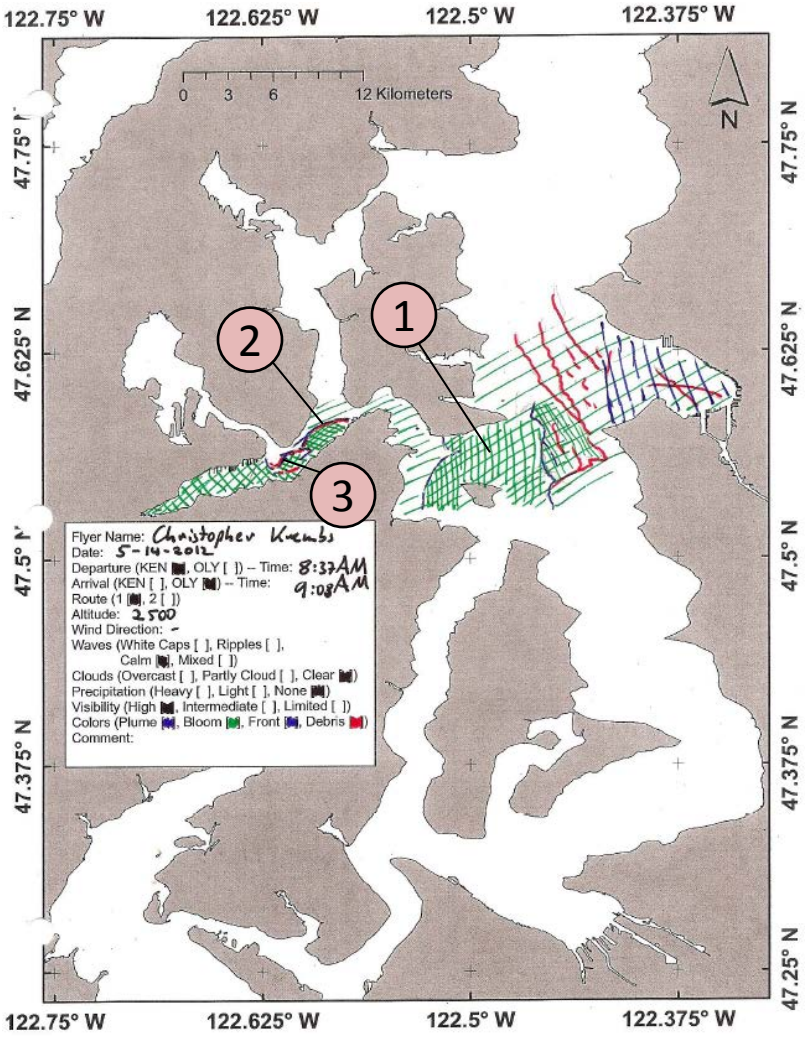


Strong algae bloom between Bainbridge Island and West Point (Seattle): Location: Central Sound , 3:01 PM

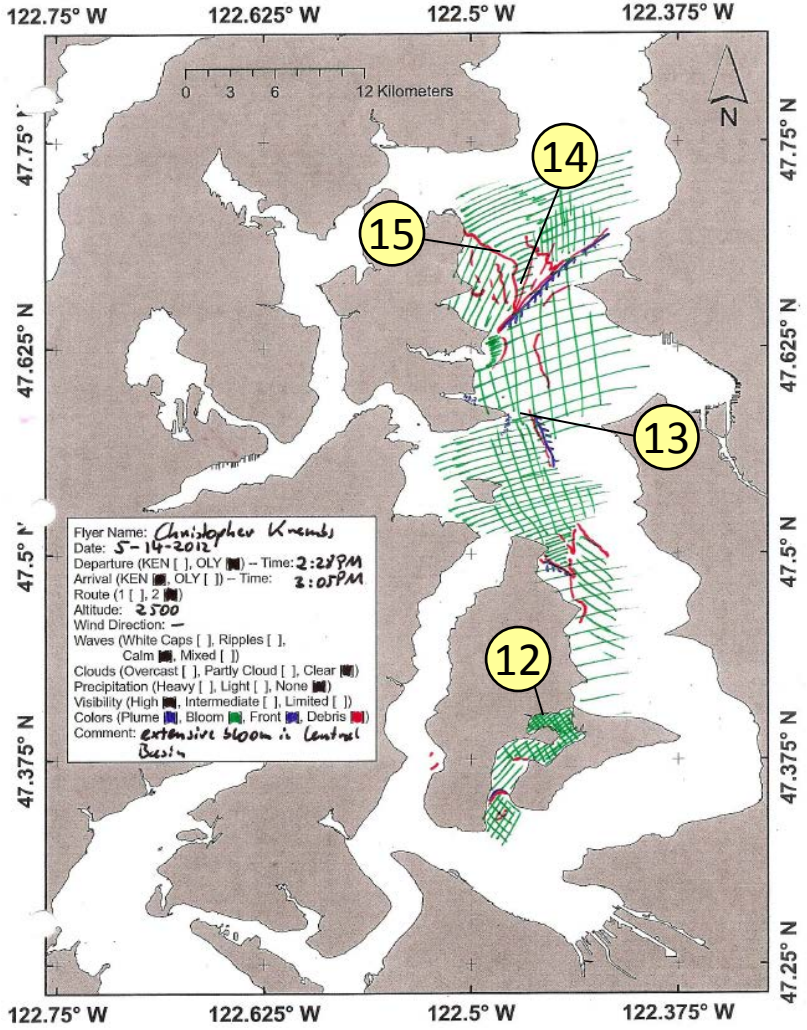
Strong algae bloom between Bainbridge Island and West Point (Seattle): Location: Central Sound , 3:01 PM

Aerial observations in Central Sound, 5-14-2012

Morning



Evening



Numbers on map refer to picture numbers for spatial reference

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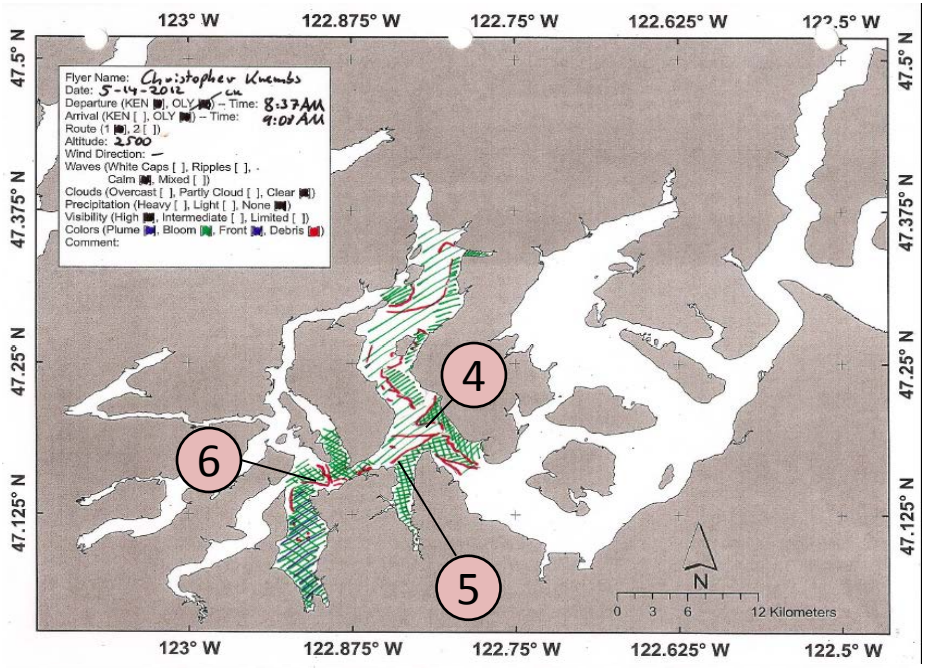
Aerial photography

Observations in South Sound: 5-14-2012

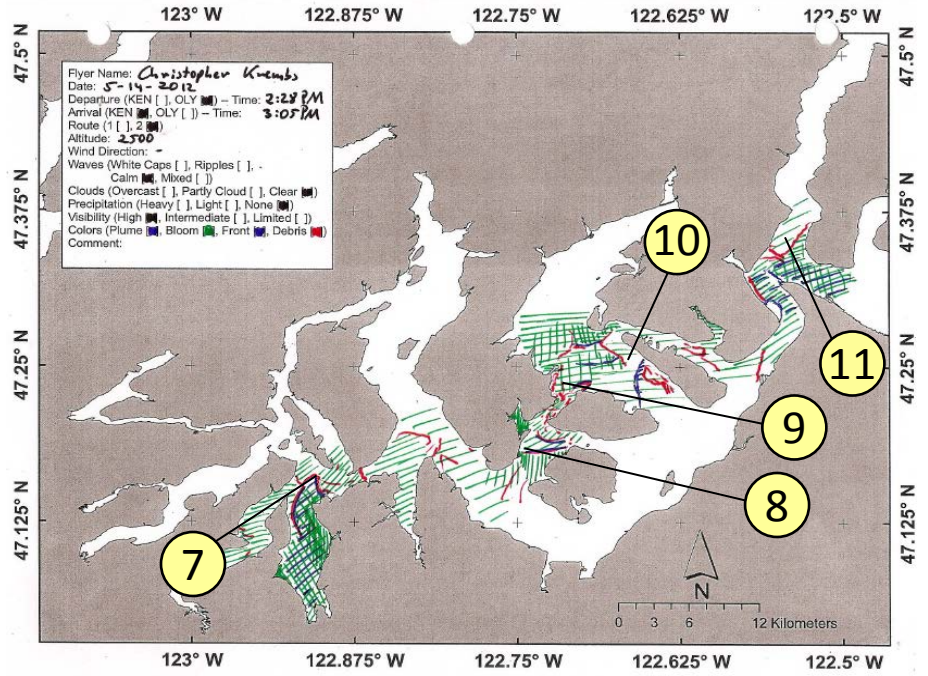
Navigate

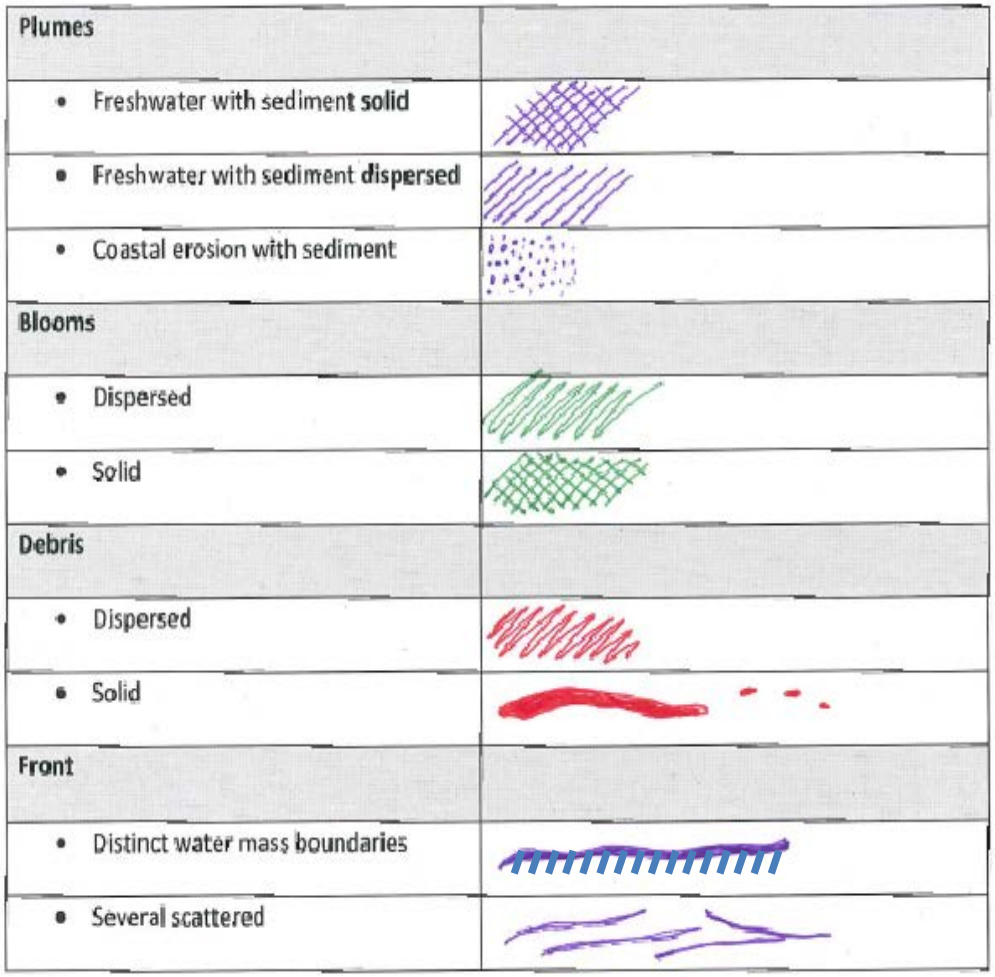
Numbers on map refer to picture numbers for spatial reference

Morning



Evening



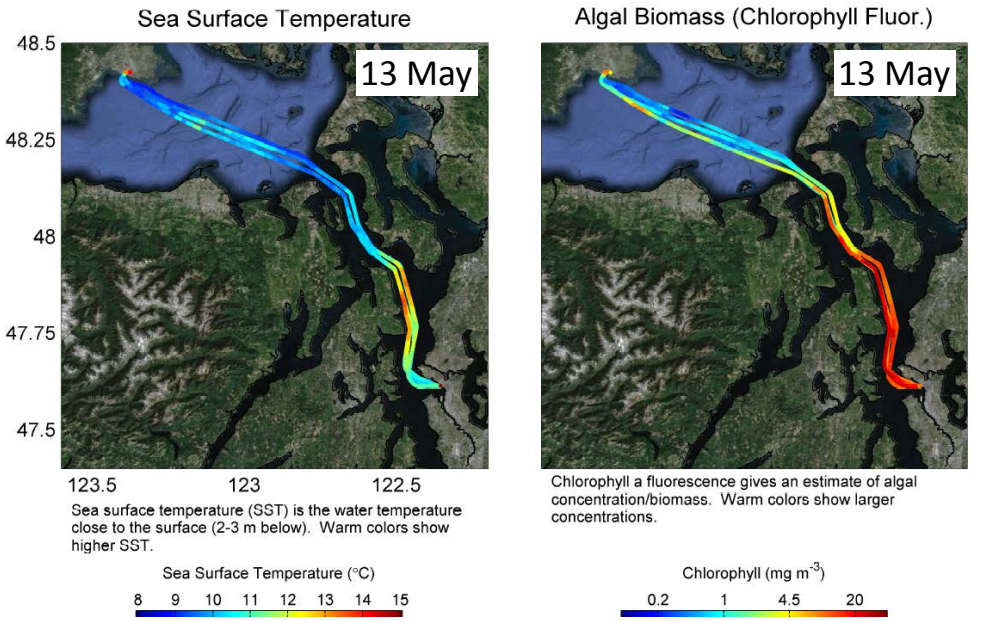


Comments:
Maps are produced by observers during and after flights. They are intended to give an approximate reconstruction of the surface conditions on scales that connect to and overlap with satellite images in the section that follows.

Daily ferry and satellite observations in Central Sound, 5-13-2012

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: Increasing fluorescence in Central Sound; lower levels in the Strait of Juan de Fuca. Temperatures near Triple Junction > 13 °C; associated with freshwater entering Central Sound from Whidbey Basin.

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

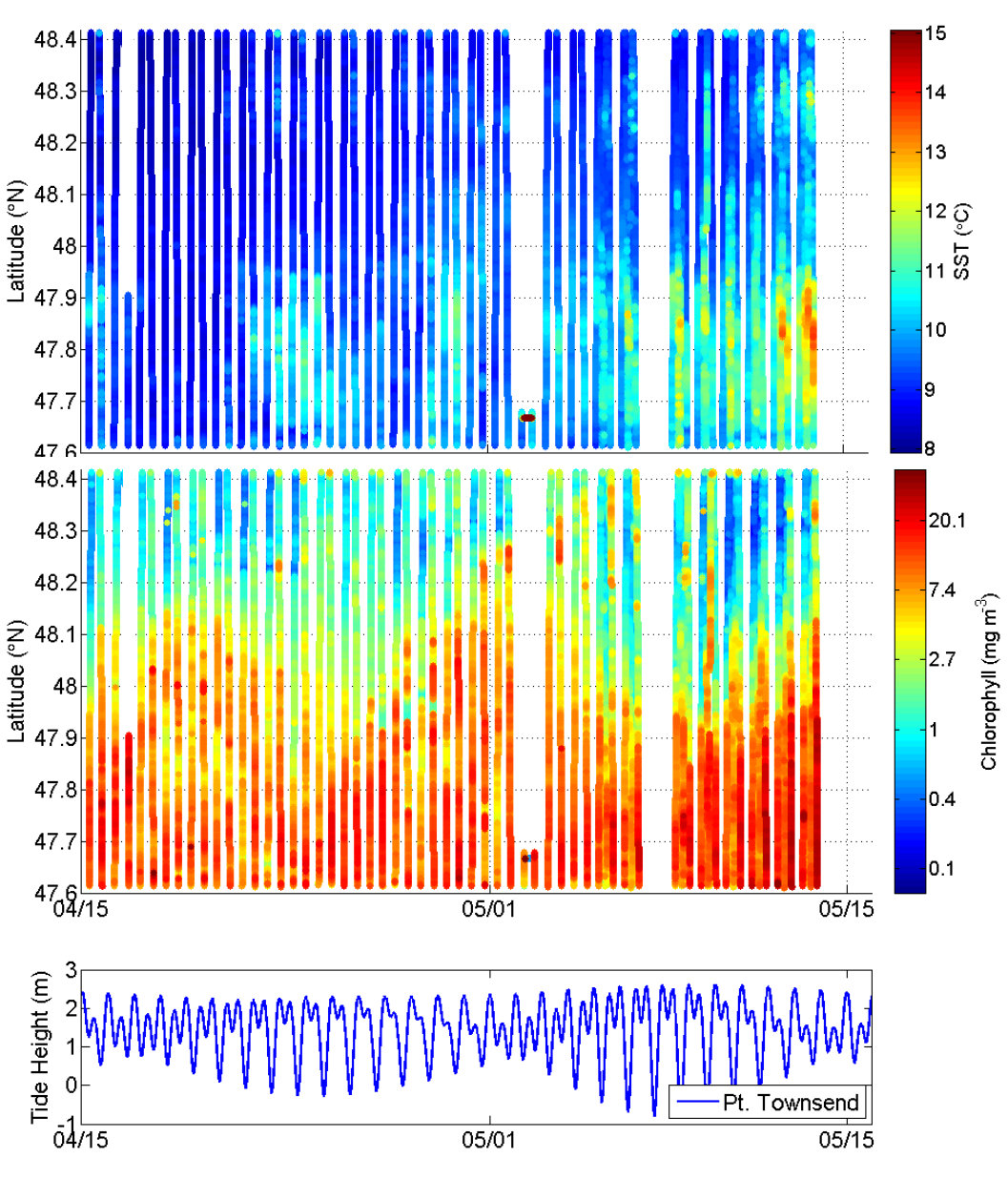
(http://www.ecy.wa.gov/programs/eap/mar_wat/eops/clipper.html)

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

Warmer sea surface temperatures seen in Central Sound over the last week; associated with higher flows from Whidbey Basin.

Phytoplankton continue to bloom in Central Sound.

Neap tides and reduced mixing allow blooms to extend through Admiralty Inlet (48.15 N).

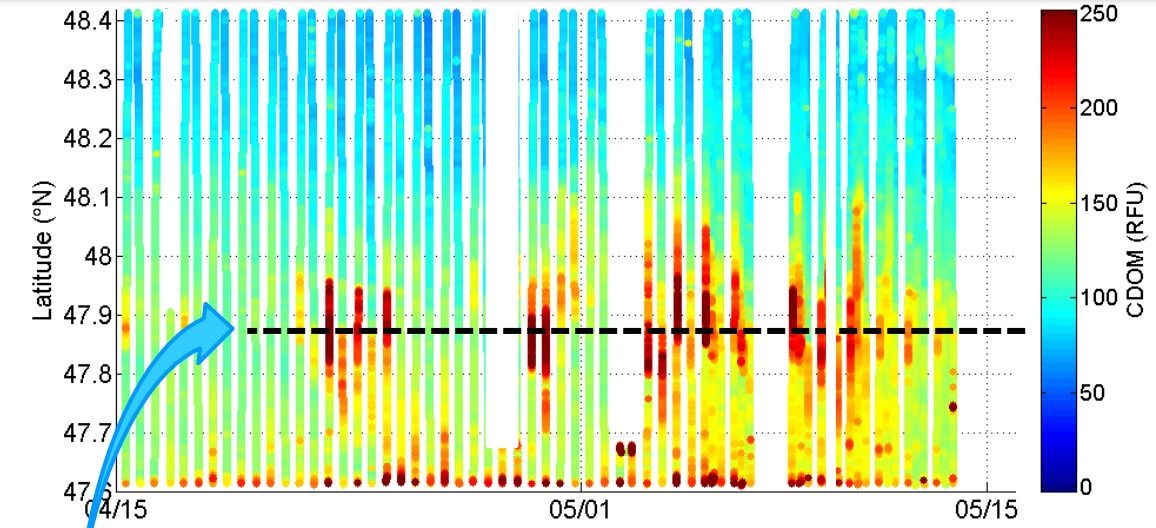


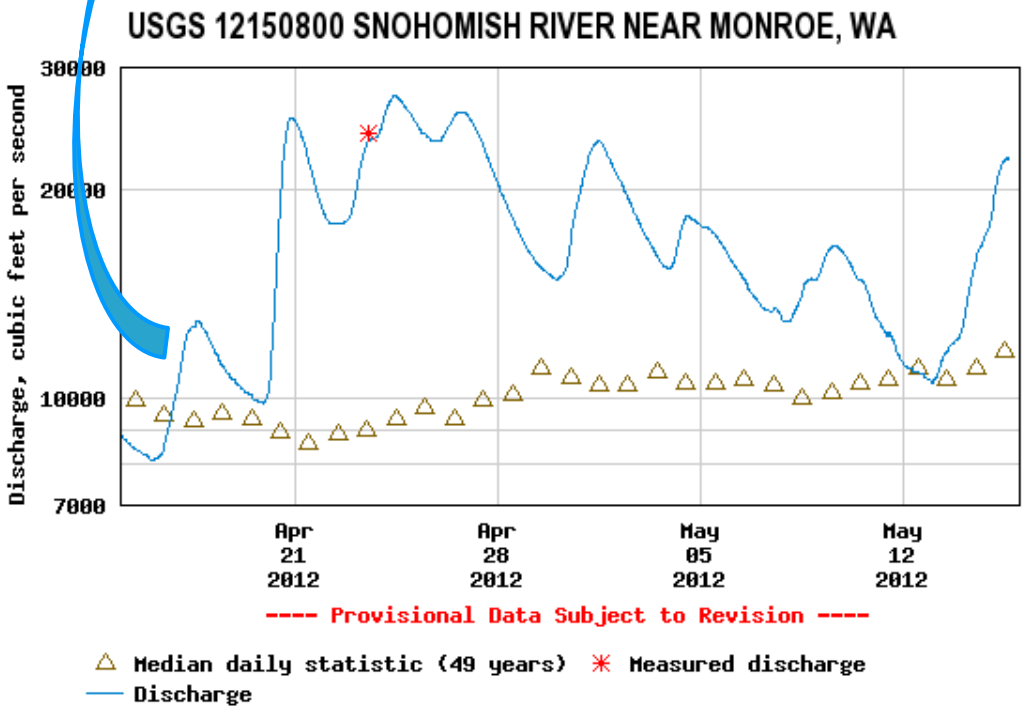
Ferry & satellite observations, 4-15-2012 to 5-13-2012

CDOM fluorescence as an indicator of freshwater influence in Central Sound

A primary source of Colored Dissolved Organic Matter (CDOM) to Puget Sound is from rivers.

Highly colored water is making its way into Puget Sound, associated with higher river flows into Whidbey Basin.





Ferry & satellite observations

News & Announcements

End of an Era

The European Space Agency (ESA) lost contact with the Envisat satellite on 8 April. On 15 May, following rigorous attempts to re-establish communication, ESA declared an end to the mission. Envisat had already operated twice as long as its planned lifetime, making it well overdue for retirement. This satellite carried the MERIS ocean color sensor that Ecology had been using to provide high resolution ocean color data for Puget Sound. Ecology will now focus on developing ocean color products using NASA's MODIS-Aqua and MODIS-Terra sensors.

Read more...

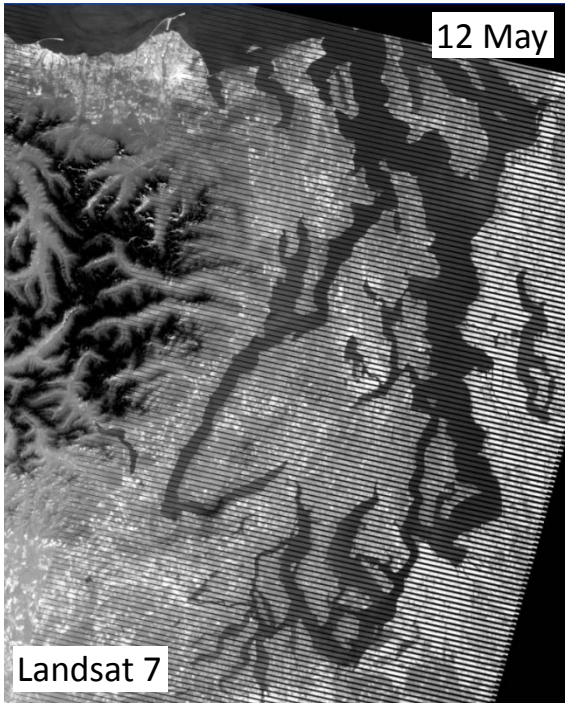
What to do about Landsat?

Since 2010, Ecology has been using Thematic Mapper (TM) data from Landsat 5 (launched 1 March 1984) and Landsat 7 (launched 15 April 1999) to provide high resolution true color and sea surface temperature data for Puget Sound. In late 2011 Landsat 5 developed problems and showed signs of impending failure. Imaging has been suspended while USGS investigates.

More Landsat Headlines...

Ecology will now rely on TM data from Landsat 7. Unfortunately, in May 2003 Landsat 7 suffered a failure of the Scan Line Corrector. This failure results in a marked image 'striping' that can be challenging to work with. However, Landsat 7 still provides a wealth of valuable information.

Thermal TM data from 12 May suggests warmer temperatures in Hood Canal and South Sound.



Ferry & satellite observations

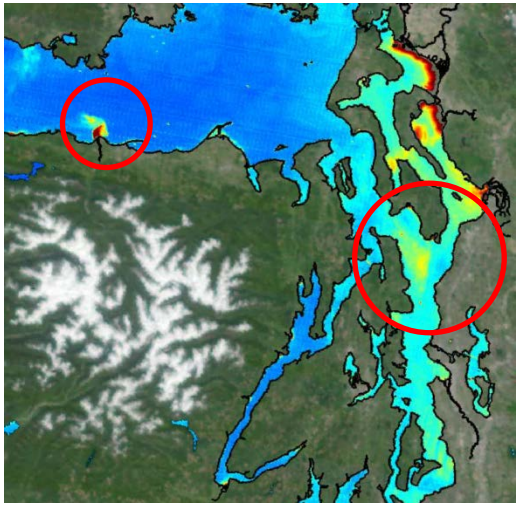
Elevated turbidity in Central Sound; associated with high chlorophyll *a* fluorescence, consistent with a moderately intense near-surface algae bloom.

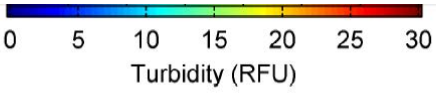
Water from the Elwha River can now freely enter the Strait of Juan de Fuca following removal of the Elwha Dam (completed March 2012)

MODIS-Terra
14 May 2012 @ 12:05 PDT

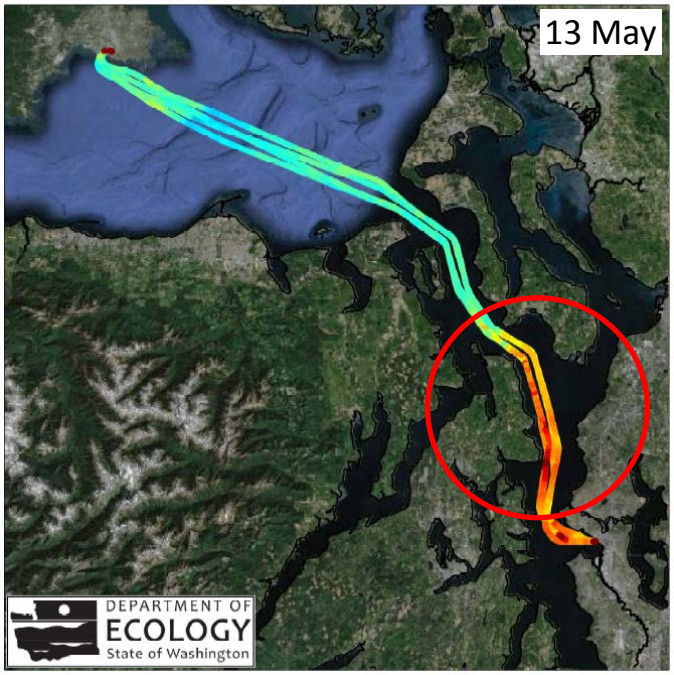
RGB True Color

Rrs(645 nm); Turbidity Proxy





Water Clarity (Turbidity)



Mooring observation and trends 4-30-2012 to 5-13-2012

Summary: Over the past 2 weeks, we observed trends toward lower DO levels in Whidbey Basin. In Central Sound, we observed lower DO levels, lower salinity, and warmer water.

Mukilteo, Whidbey Basin near Everett: At near-bottom (12-16 m), we observed peak DO levels on May 1 with an overall trend toward lower DO levels and warmer water. Lower DO levels correlated with higher salinity and colder water. Near-surface water temperature increased and salinity decreased.

Mean values & trend over past 2 weeks:

NB: DO: 9.53mg/L (↓ 1.2 mg/L)
Temp: 9.0°C (↑ 0.15°C)
Salinity: 28.2 PSU (↓ 0.1 PSU)

Surface: Temp: 10.2°C (↑ 0.9°C)
Salinity: 23.1 PSU (↓ 1.2 PSU)

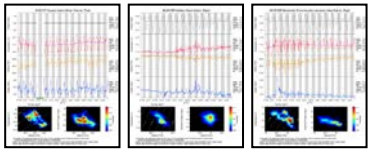
Manchester, Central Sound: At near-bottom (8.3-12.9 m), the overall trend was toward lower DO levels and warmer water. Lower DO levels correlated with higher salinity and colder water. Near-surface (1.1-5.7 m) salinity decreased and water temperature increased.

Mean values & trend over past 2 weeks:

NB: DO: 9.6 mg/L (↓ 0.6 mg/L)
Temp: 8.9°C (↑ 0.7°C)
Salinity: 28.7 PSU (↓ 0.6 PSU)

Surface: Temp: 9.3°C (↑ 1.5°C)
Salinity: 28.1 PSU (↓ 0.6 PSU)

Squaxin Passage (South Sound) near Olympia: Station decommissioned



Real-time data online (click)

Mooring observation and trends 4-30-2012 to 5-13-2012

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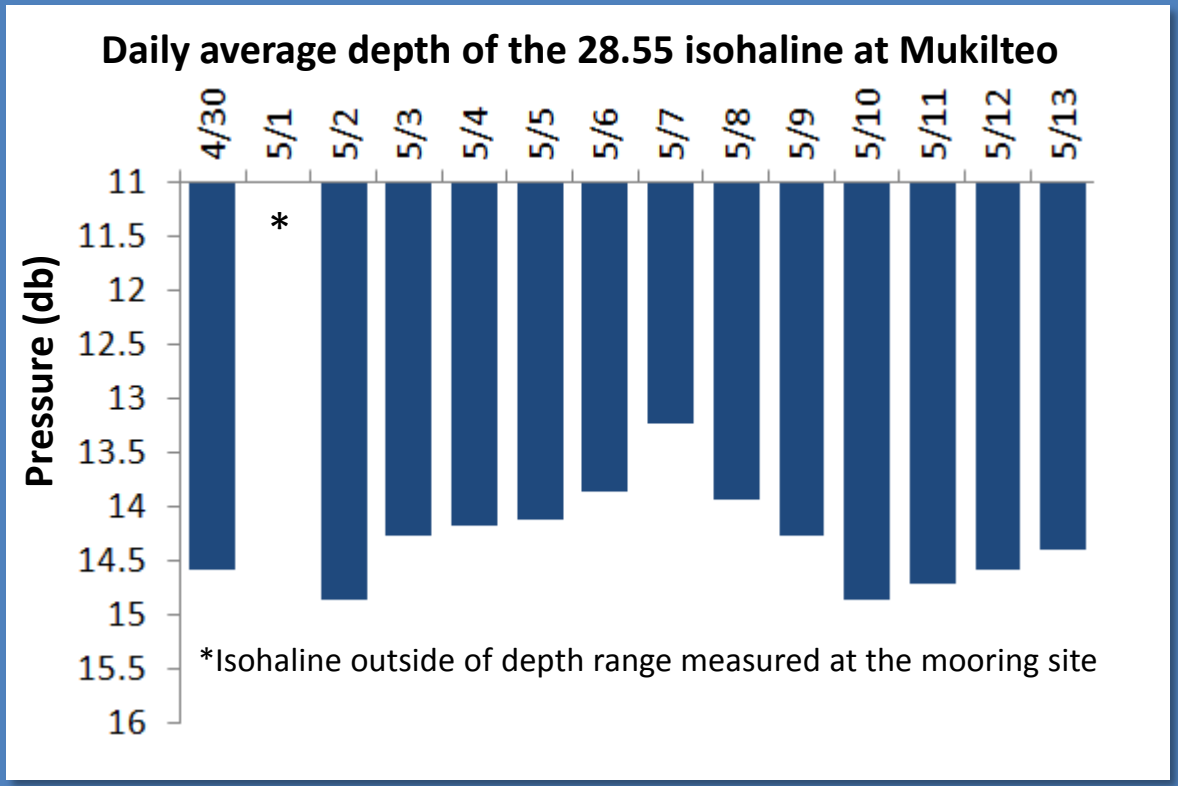
NANOOS

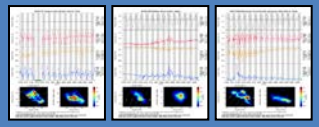
Go to our mooring site at: http://www.ecy.wa.gov/programs/eap/mar_wat/moorings.html

Summary: : The thickness of the 28.55 isohaline fluctuated; however, on average it was 0.2 meters less than previous month, meaning that the freshwater layer is getting thinner.

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 4-30-2012 to 5-13-2012

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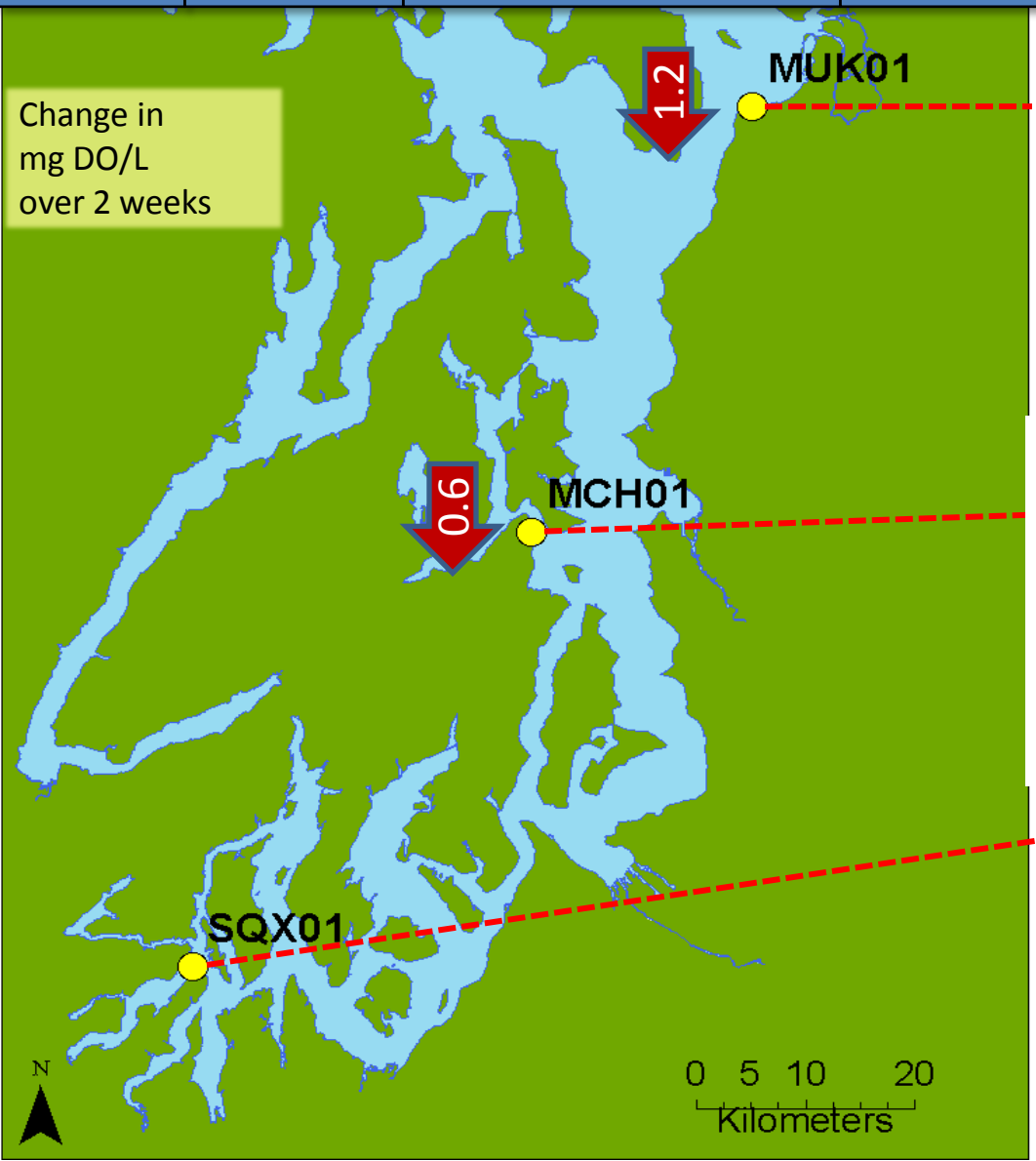
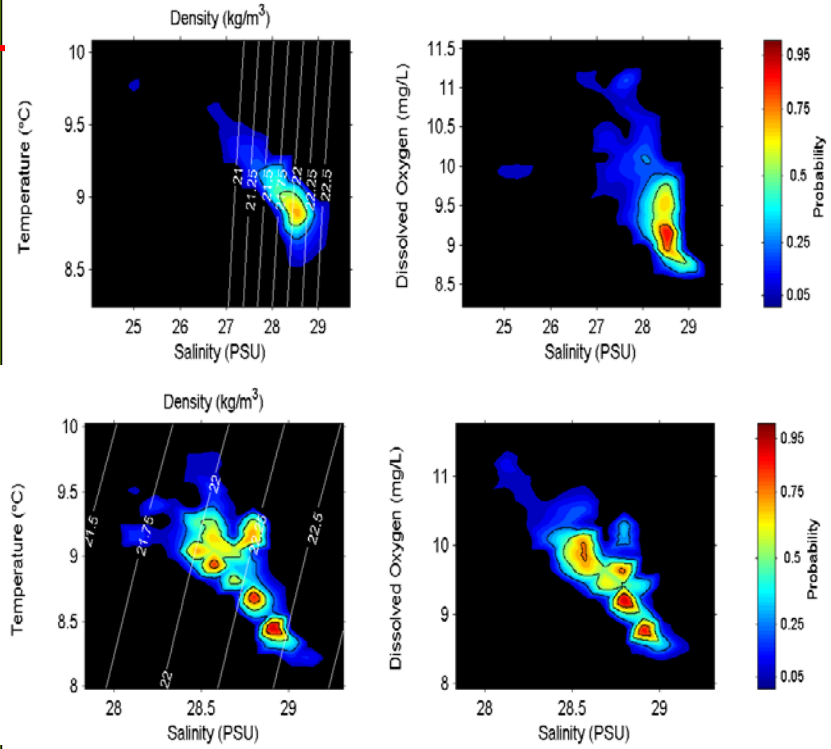
NANOOS





Station SQX01 decommissioned

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

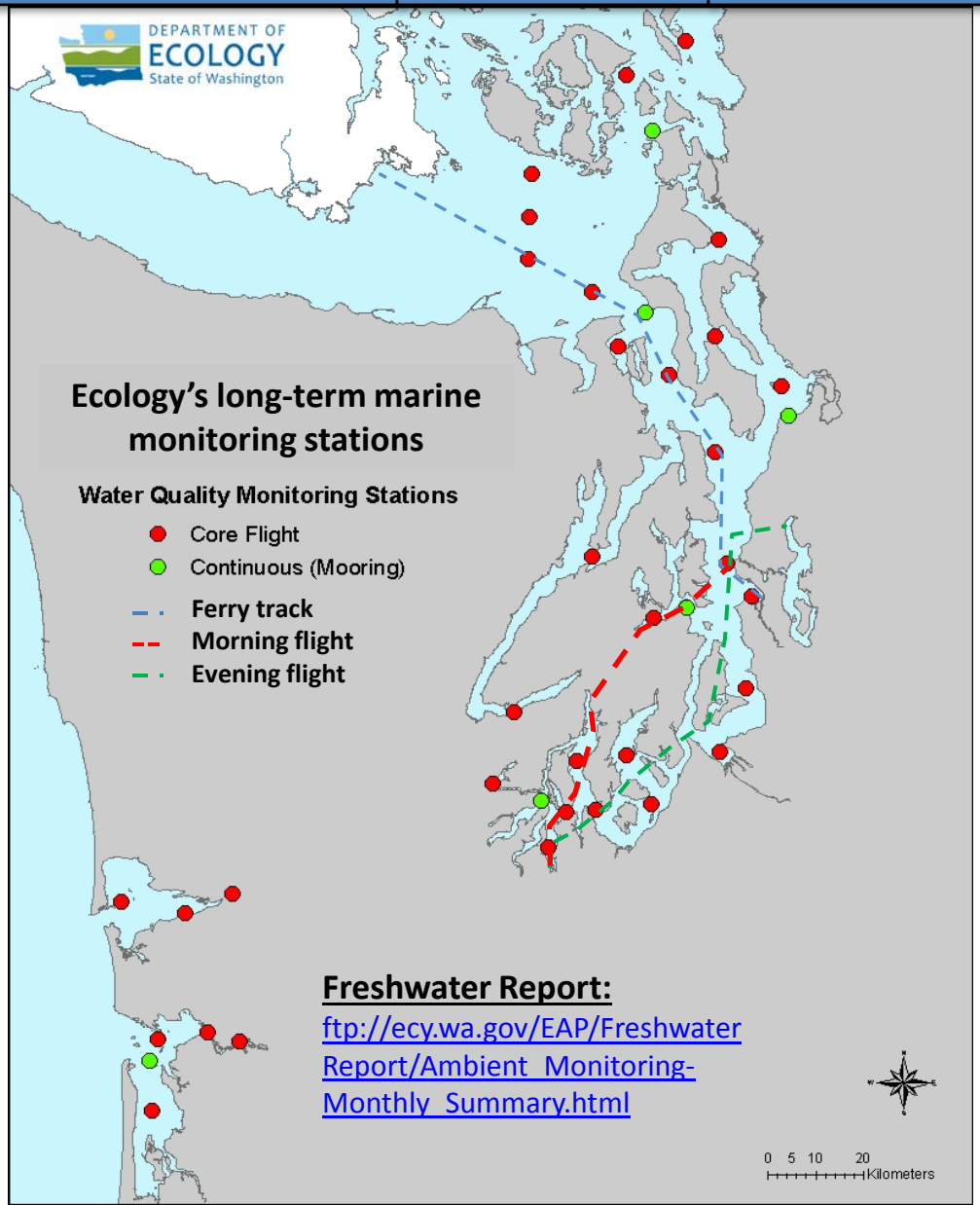
Field log	Weather	Water column	Aerial photos	Ferry and Satellite	Moorings

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.