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<td><strong>Long-term Marine Monitoring Unit</strong></td>
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</tbody>
</table>
| Mya Keyzers | | | | | p. 3-4
| Laura Friedenberg | | | | | |
| Skip Albertson | | | | | p. 7
| Dr. Christopher Krembs | | | | | |
| Dr. Brandon Sackmann | | | | | p. 9-28
| David Mora | | | | | |
| Suzan Pool | | | | | |
| **Previous Eyes Over Puget Sound reports:** | | | | | |
| www.ecy.wa.gov/programs/eap/mar_wat/eops/ | | | | | |

**Personal flight impression**
A bonanza of red-orange streaks in Central Basin. *Noctiluca*, a small dinoflagellate with a story to tell.

**Weather conditions**
Cool weather with recent sun breaks, river flows above normal but trending lower.

**Aerial photography**
Large *Noctiluca* bloom in Central Sound
Strong red-brown bloom and turquoise in Case Inlet. Oil sheen in Sinclair Inlet.

**Ferry and satellite**
Reduced fluorescence south of Edmonds; likely related to intense *Noctiluca* bloom.

**In-situ mooring data**
In the Whidbey Basin, higher DO levels coincide with lower salinity and warmer water.
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.
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!
**Species corner: Noctiluca and the spring bloom**

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.

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.*

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

*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.*

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

**Phytoplankton ID contribution:** Gabriela Hannach, King County Environmental 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.

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

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

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

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

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.
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](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.

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.

**Mixing and Fronts:**
Fronts between Bainbridge Island and West Seattle, and in Squaxin Passage

**Suspended sediment:**
Budd Inlet – sediment mixing with algae bloom

**Visible blooms:**

**Debris**
Abundant in Central Sound and usual locations in South Sound (Squaxin Passage, Case and Carr Inlet)
Aerial photography navigation guide 6-12-2012

Flight Information:

- **Morning flight:** Limited to poor visibility, calm

- **Evening flight:** Limited visibility, calm

Observation Maps:

- Central Sound
- South Sound
Large *Noctiluca* bloom in Central Sound. Location: West Seattle (Central Sound), 8:06 AM.
Large *Noctiluca* bloom in Central Sound. Location: West Seattle (Central Sound), 8:06 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), 8:07 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
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
Red-brown and turquoise blooms near Herron Island, Location: Case Inlet (South Sound), 4:01 PM

Aerial photography 6-12-2012
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
Noctiluca bloom drifting towards shore  
Location: (A) Quartermaster Harbor - Vashon Island, (B) East Passage, (Central Sound), 4:15 PM
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
Aerial observations in Central Sound, 6-12-2012

Numbers on map refer to picture numbers for spatial reference

Morning

Evening

Numbers on map refer to picture numbers for spatial reference
Aerial photography

Observations in South Sound: 6-12-2012

Numbers on map refer to picture numbers for spatial reference
**Legend to map annotations**

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.

<table>
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<th>Plumes</th>
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<td>• Freshwater with sediment solid</td>
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</tr>
<tr>
<td>• Freshwater with sediment dispersed</td>
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<td>• Coastal erosion with sediment</td>
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<th>Blooms</th>
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<tr>
<td>• Distinct water mass boundaries</td>
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<tr>
<td>• Several scattered</td>
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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.
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.

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

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

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 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).
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.

Change in mg DO/L over 2 weeks

MCH01BR, no real-time reporting for this period.

SQX01 decommissioned

Field log  | Weather  | Water column  | Aerial photos  | Ferry and Satellite  | Moorings
Get data from Ecology’s Monitoring Programs

Long–Term Monitoring Network


christopher.krembs@ecy.wa.gov

Freshwater Report:

Real–Time Sensor Network

Access mooring data:

Ferry and Satellite:
brandon.sackmann@ecy.wa.gov

Field log | Weather | Water column | Aerial photos | Ferry and Satellite | Moorings
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

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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.