

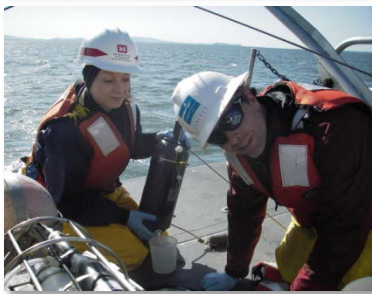
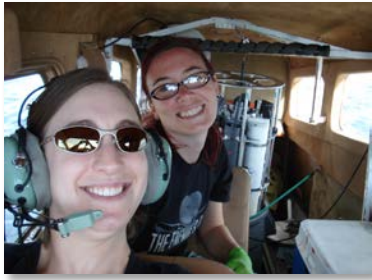
Eyes Over Puget Sound

An aerial photograph taken from the perspective of someone looking out of an airplane window. The wing of the plane is visible in the upper left corner. Below, the Puget Sound is visible, with a large, forested island in the foreground. The water is a deep blue, and the surrounding land is green with trees. In the distance, the Strait of Juan de Fuca and the Olympic Mountains are visible under a clear blue sky.

Surface Conditions Report July 6, 2011

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

Meet us in the field:



Content:

- Personal flight impression p. 4-5
Find out what it's like to be in the field.
- Aerial photography p. 6-29
Find out what you see at the surface.
- Ferry and satellite p. 30-38.
Find out what we measure at the surface every day
- *In-situ* mooring data p. 39-41
Find out what we measure below the surface every day

Get your data from Ecology's Environmental Assessment Program

Long – Term Monitoring Network

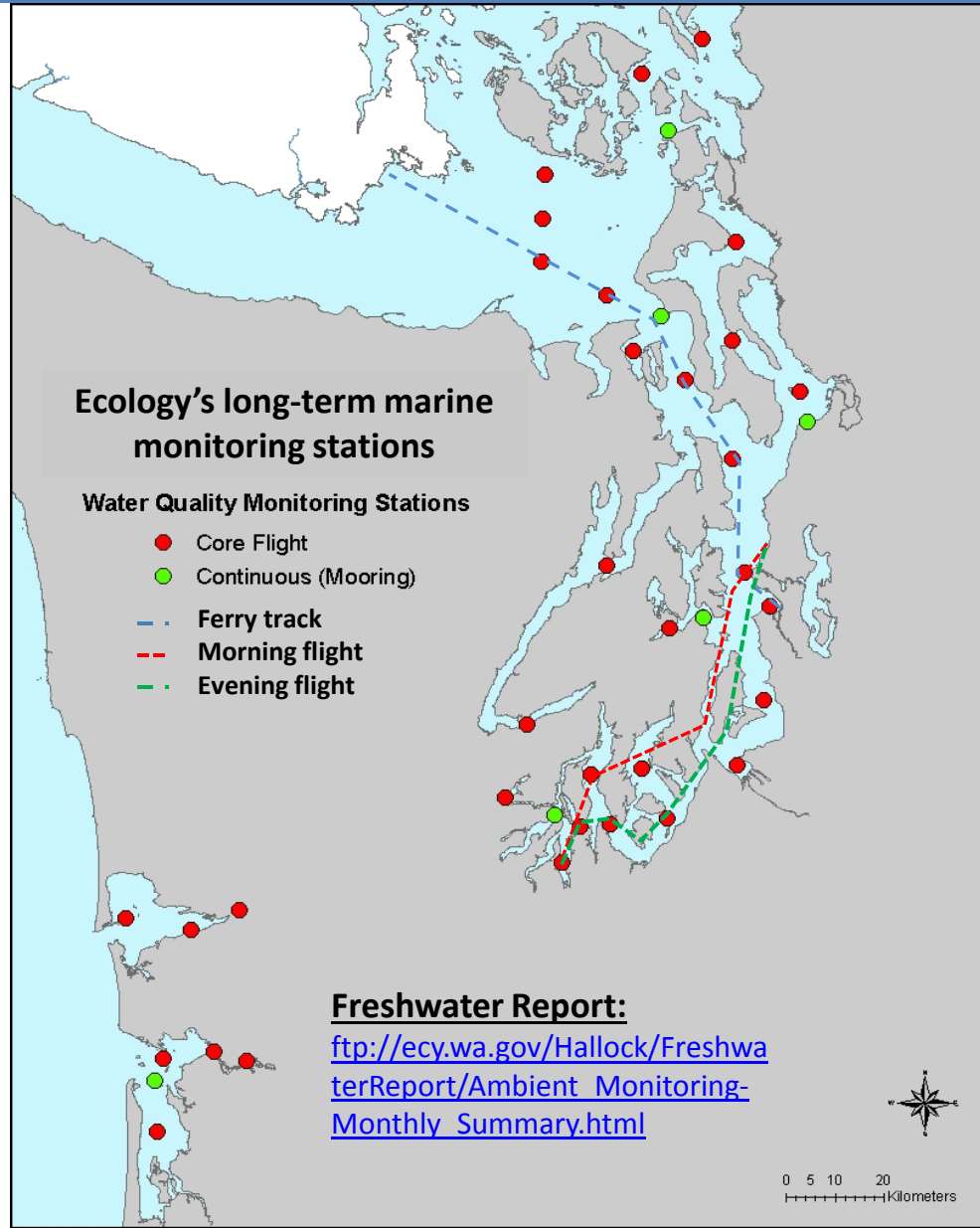


ftp://www.ecy.wa.gov/eap/Flight_Blog/



Access core monitoring data:

<http://www.ecy.wa.gov/apps/eap/marnewq/mwdataset.asp>



Real – Time Sensor Network



brandon.sackmann@ecy.wa.gov



Access mooring data:

http://www.ecy.wa.gov/programs/eap/mar_wat/mooring.html

Flight Impressions from 7-6-2011

Northwesterners have many different gauges to assess when summer *really* starts. As a flyer I gauge it based on how many recreational boaters I see out and about. So using that logic during the July 6th South Sound flight, I am happy to report summer is here! It was a beautiful day, with lots of folks out enjoying it. One interesting highlight was the Puyallup River discharge into Commencement Bay. I thought it was interesting to see the perspective from above and then from on the water. On the water, you really can't tell there is anything going on, except for the brown water color. We noticed debris islands throughout South Sound, possibly a result of the recent high neap tides. (see next page)



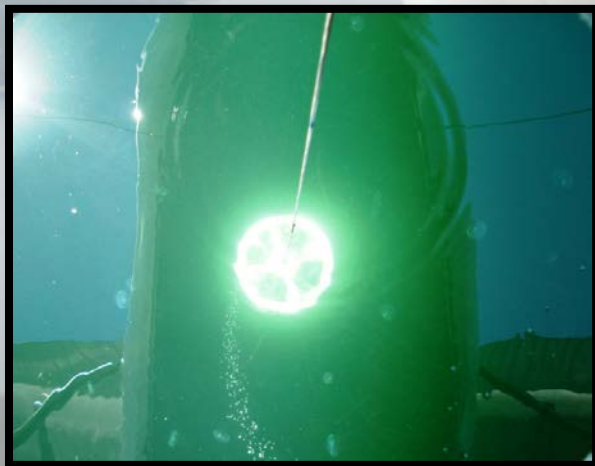
Looking north in Commencement Bay



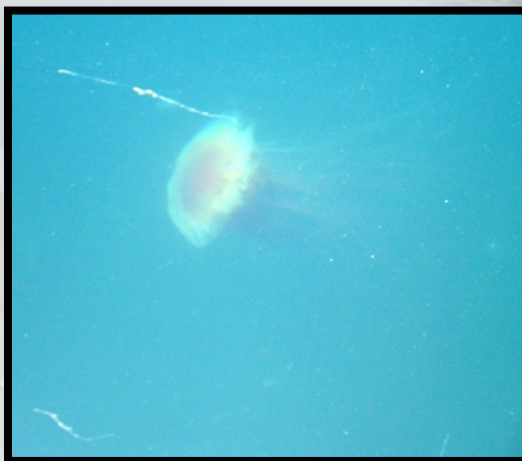
At Commencement Bay station - sampling on tide line.



East shoreline of Commencement Bay



Totten Inlet - CTD in middle of jellyfish swarm & the reflection of floatplane's belly.



Lion's mane jellyfish

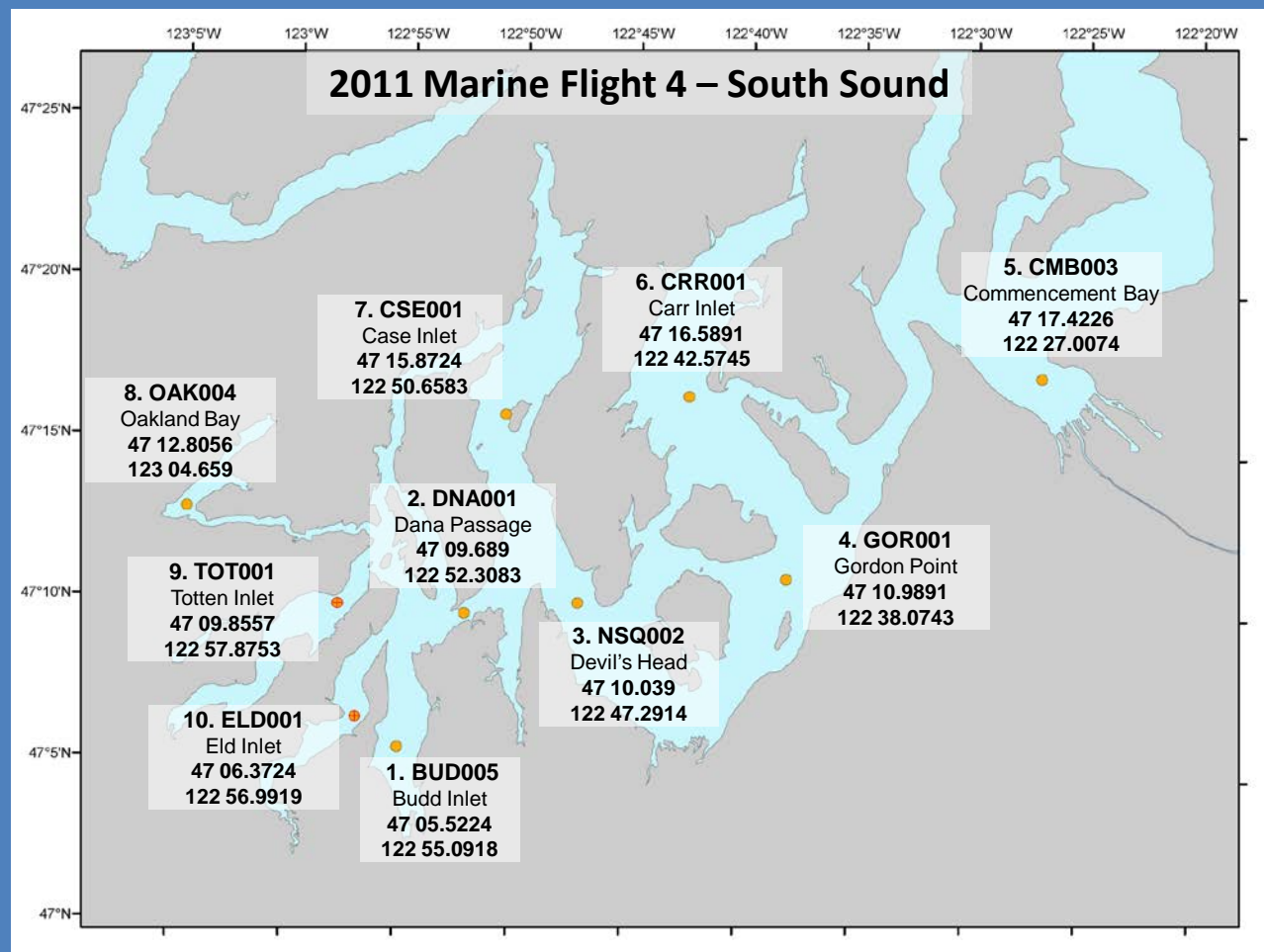


A debris island in Carr Inlet



Marine Flight 4 (South)

We saw jellyfish, distinct water masses converging, and debris islands. It was a successful flight with 100% station attainment. We saw very green water, with prominent phytoplankton growth.





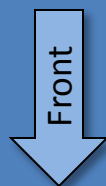
Summary of flight observation: 7-06-2011

Comment: Extensive and diverse phytoplankton blooms in Central and South Sound, large patches and strands of macroalgae in South Sound/southern Central Sound.

Floating algal mats in South Sound



Foaming water and bloom in Central Basin



Mixing and Fronts:

Dana Passage, Nisqually Reach, Commencement Bay, Dalco Passage, Quartermaster Harbor, east & north of Blake Island, Shilshole Bay .



Suspended sediment:

Nisqually Reach, Commencement Bay, Quartermaster Harbor, along various shores of Central Sound.



Visible blooms:

Brown-red: Budd Inlet, Oro Bay (Anderson Island).

Green: Budd, Case & Carr Inlets, Quartermaster Harbor, Horsehead Bay (Carr Inlet).

Turquoise : Budd & Case Inlet.



Debris (mainly macroalgae):

Extensive filaments and multiple patches in South Sound - Budd , Case & Carr Inlets, Nisqually Reach, Colvos Passage, around Vashon Island.



Flight conditions between Olympia and Seattle on 7-06-2011

Find and download all aerial images at ftp://www.ecy.wa.gov/eap/Flight_Blog/

Flight Details:

Flier - Christopher Krembs

Morning 7:30 AM:

Seattle via Main Basin, Colvos Passage, Carr Inlet, Case Inlet, Dana Passage, Budd Inlet into Olympia

Evening 3:05 PM:





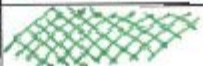




Olympia via Dana Passage, Anderson Island, Nisqually, Gordon Point, Commencement Bay, Quartermaster Harbor, Central Basin, Westpoint/Seattle

Conditions:

AM: Low clouds from Bellingham to Vashon Island

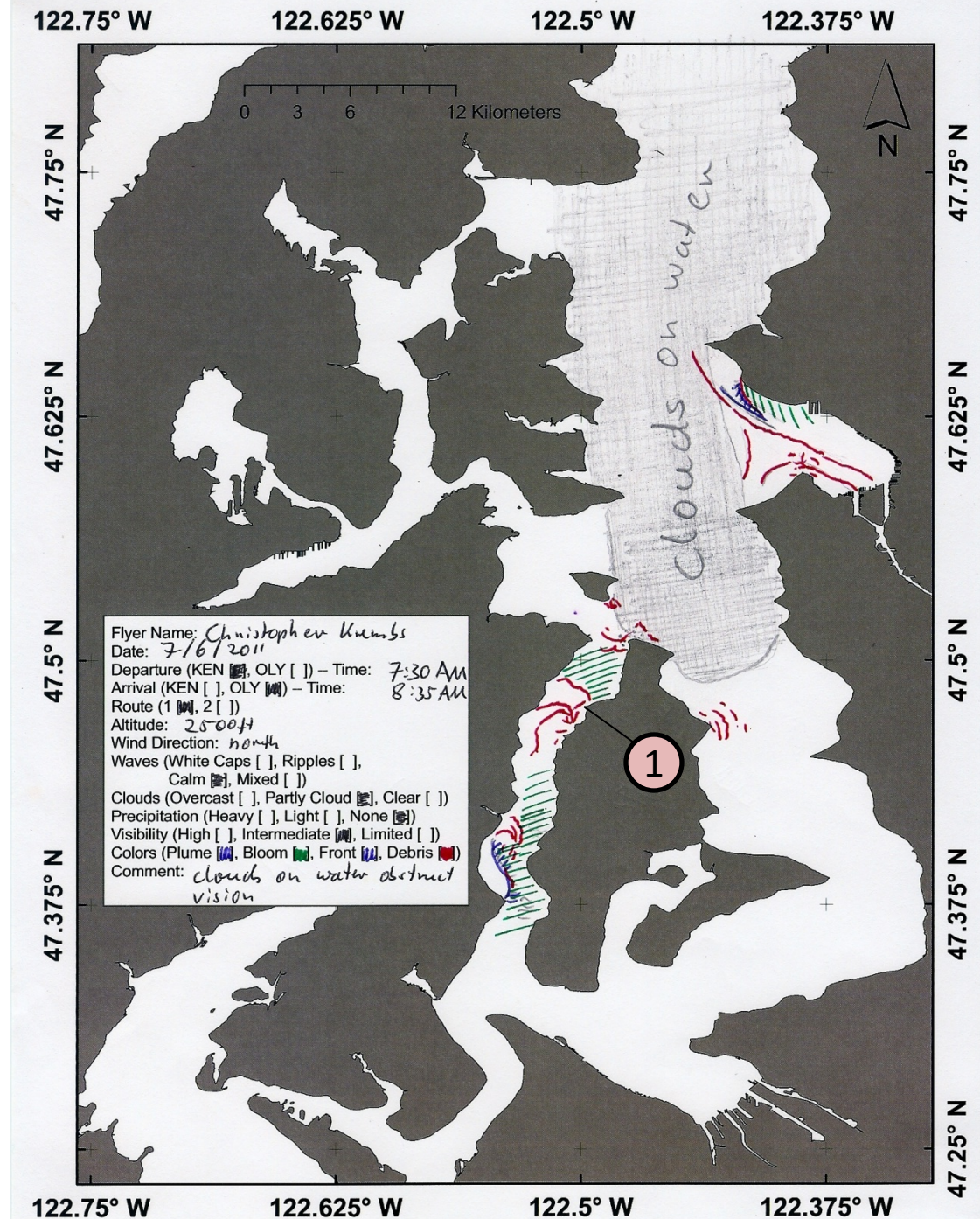
PM: Good visibility, altitude 2500 ft, sunny, no clouds.

Legend to map annotations

Plumes	
• Freshwater with sediment solid	
• Freshwater with sediment dispersed	
• Coastal erosion with sediment	
Blooms	
• Dispersed	
• Solid	
Debris	
• Dispersed	
• Solid	
Front	
• Distinct water mass boundaries	
• Several scattered	

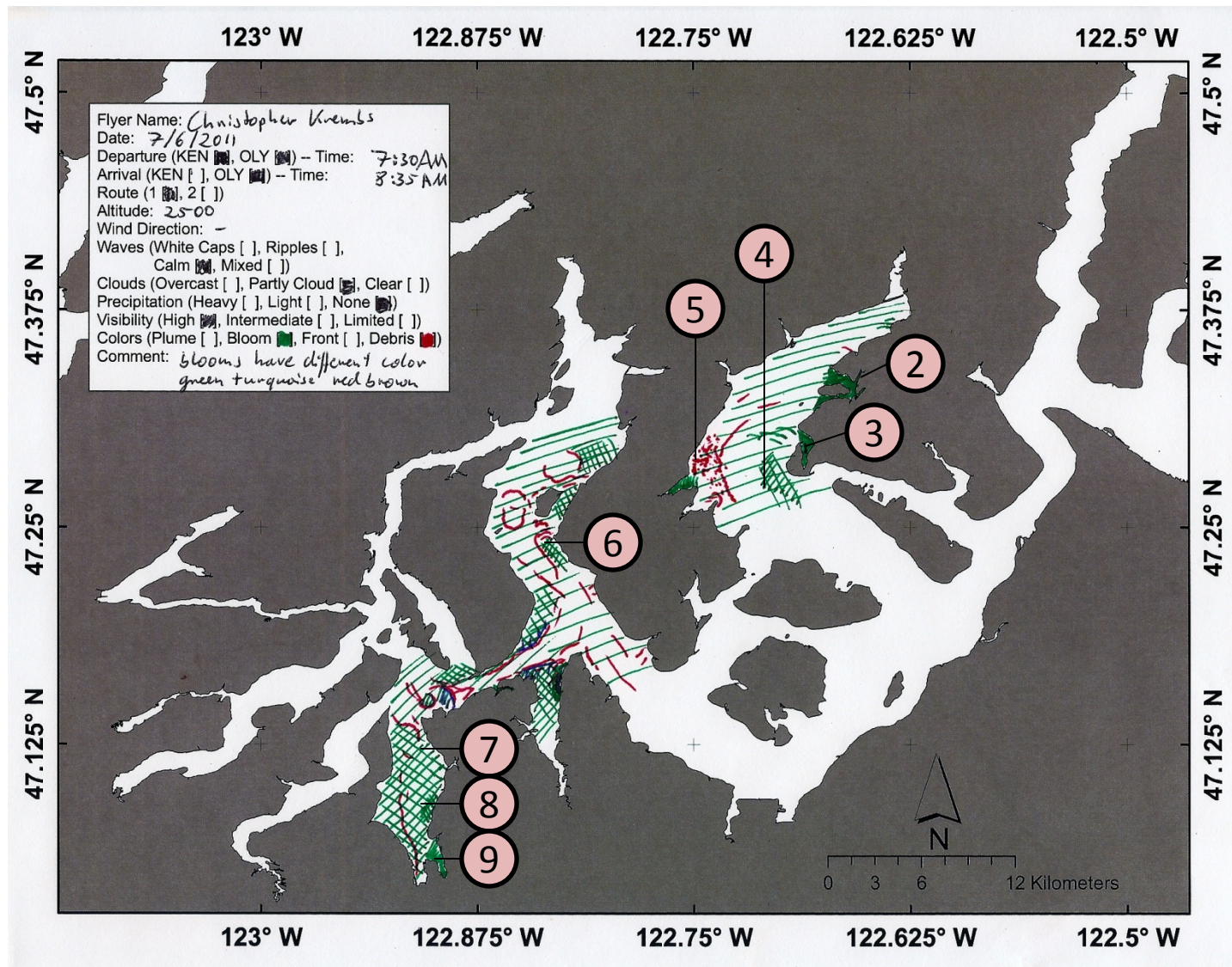
Central Sound 7:30-8:35 AM

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



South Sound: 7:30-8:35 AM

Numbers on map refer to picture numbers for spatial reference



1

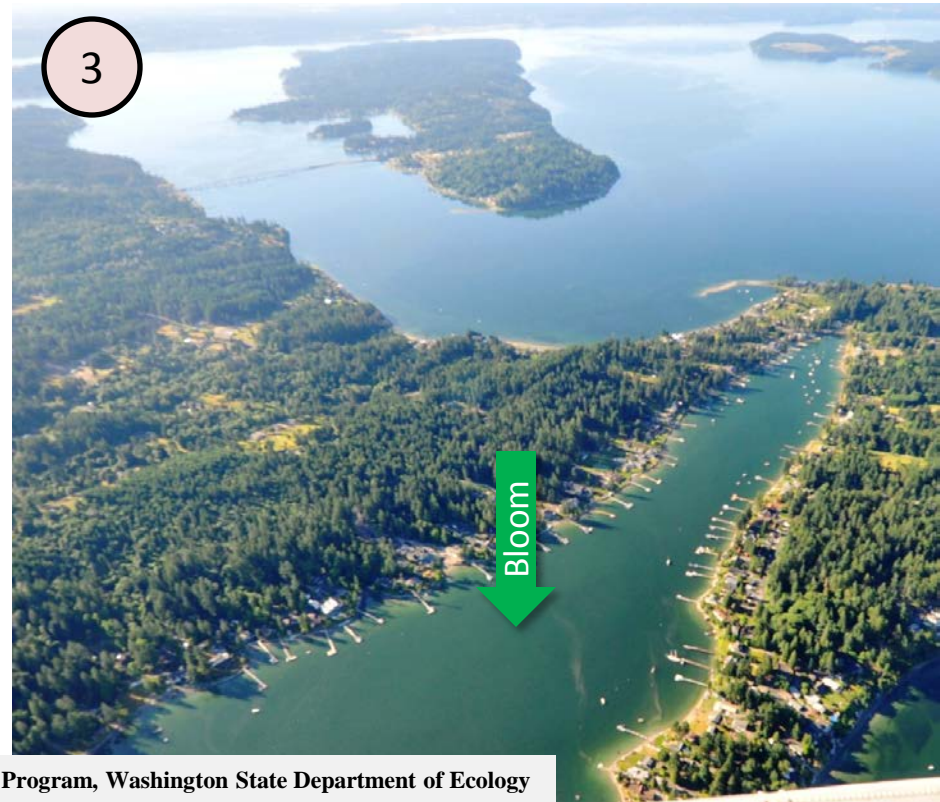
Morning flight from Seattle to Olympia at <2500 ft altitude

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Northern Colvos Passage (near Vashon Island) with drifting macro algae patches, 7: 45 AM

Morning flight from Seattle to Olympia at <2500 ft altitude



Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology

Lay Inlet and Horse Head Inlet in Carr Inlet with strong green blooms, 7: 50 AM

Morning flight from Seattle to Olympia at <2500 ft altitude

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Turquoise bands (algae blooms ?) and floating macro algae in Carr Inlet, 7:55 AM

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Debris Macro algae

Carr Inlet with large patches of macroalgae, 8:00 AM

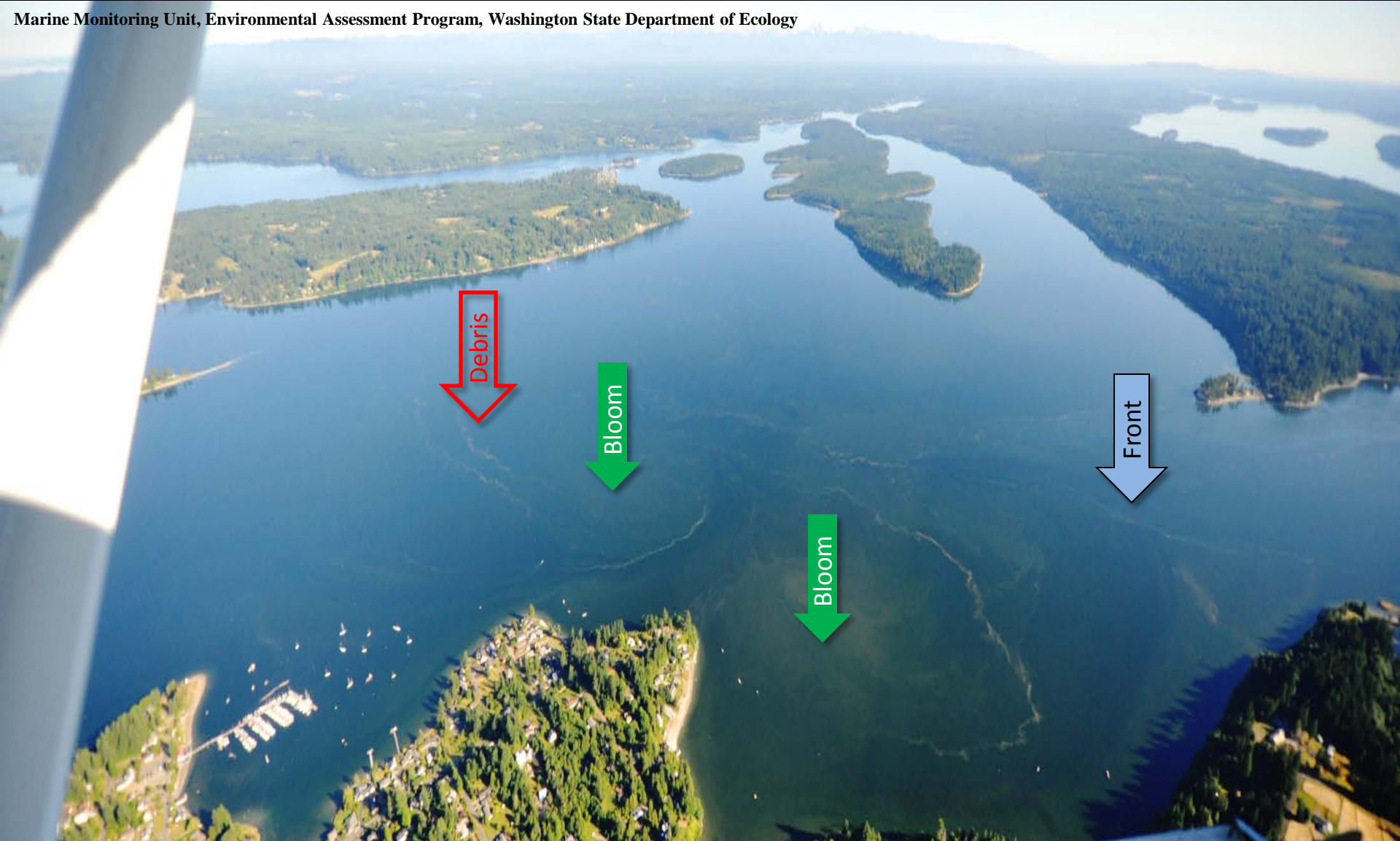
Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Case Inlet near Herron Island with macro algae and phytoplankton bloom, 8:10 AM

Morning flight from Seattle to Olympia at <1000 ft altitude

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Complex surface currents and algae blooms mixing near Boston Harbor, South Sound , 8:20 AM

Morning flight from Seattle to Olympia at <1000 ft altitude

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



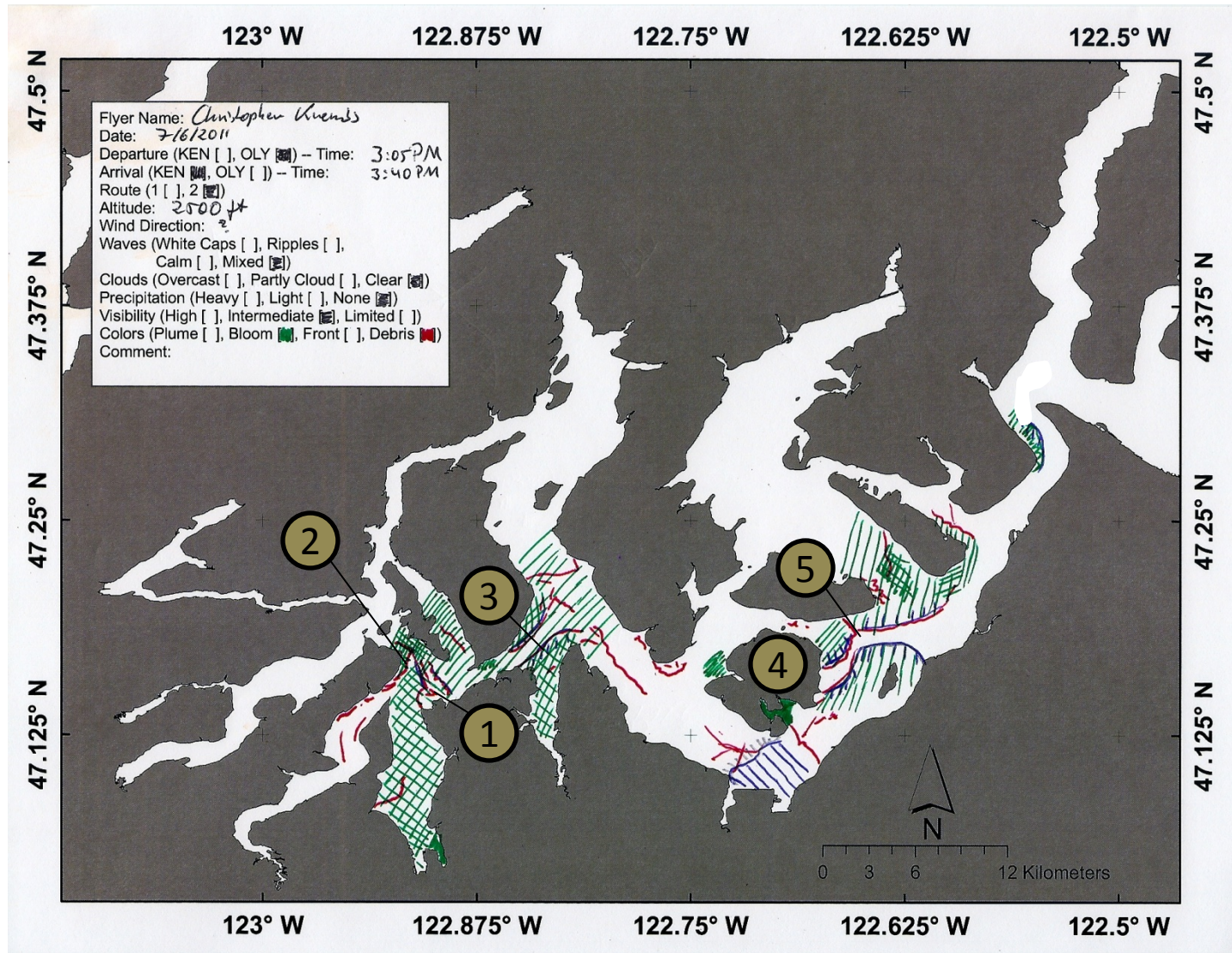
Red-brown bloom (not apparent in photo) and turquoise bloom in Budd Inlet, 8: 23 AM



Abundant debris and algae bloom near Swantown Marina in southern Budd Inlet, 8: 25 AM

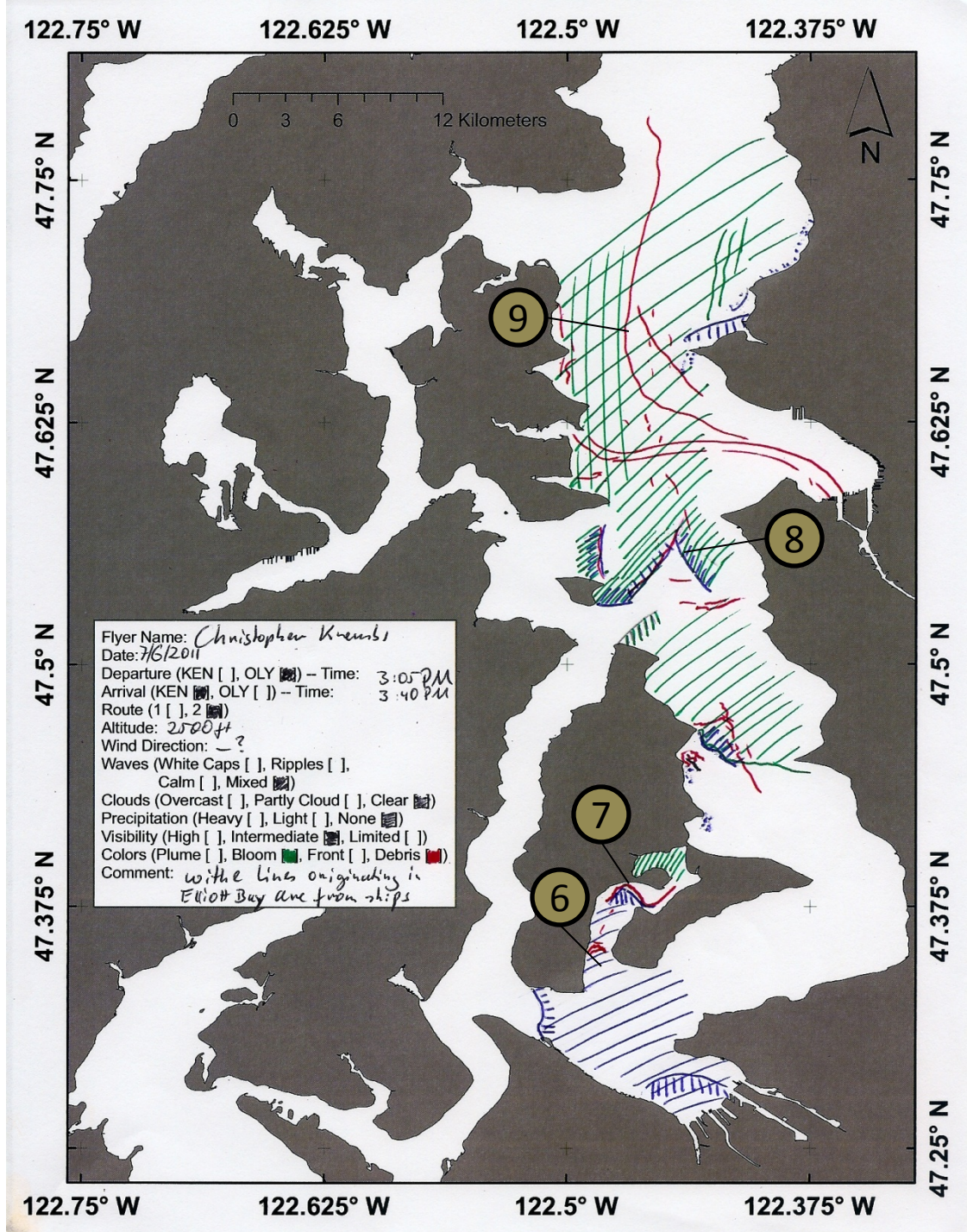
Evening, South Sound 3:05-3:40 PM

Numbers on map refer to picture numbers for spatial reference

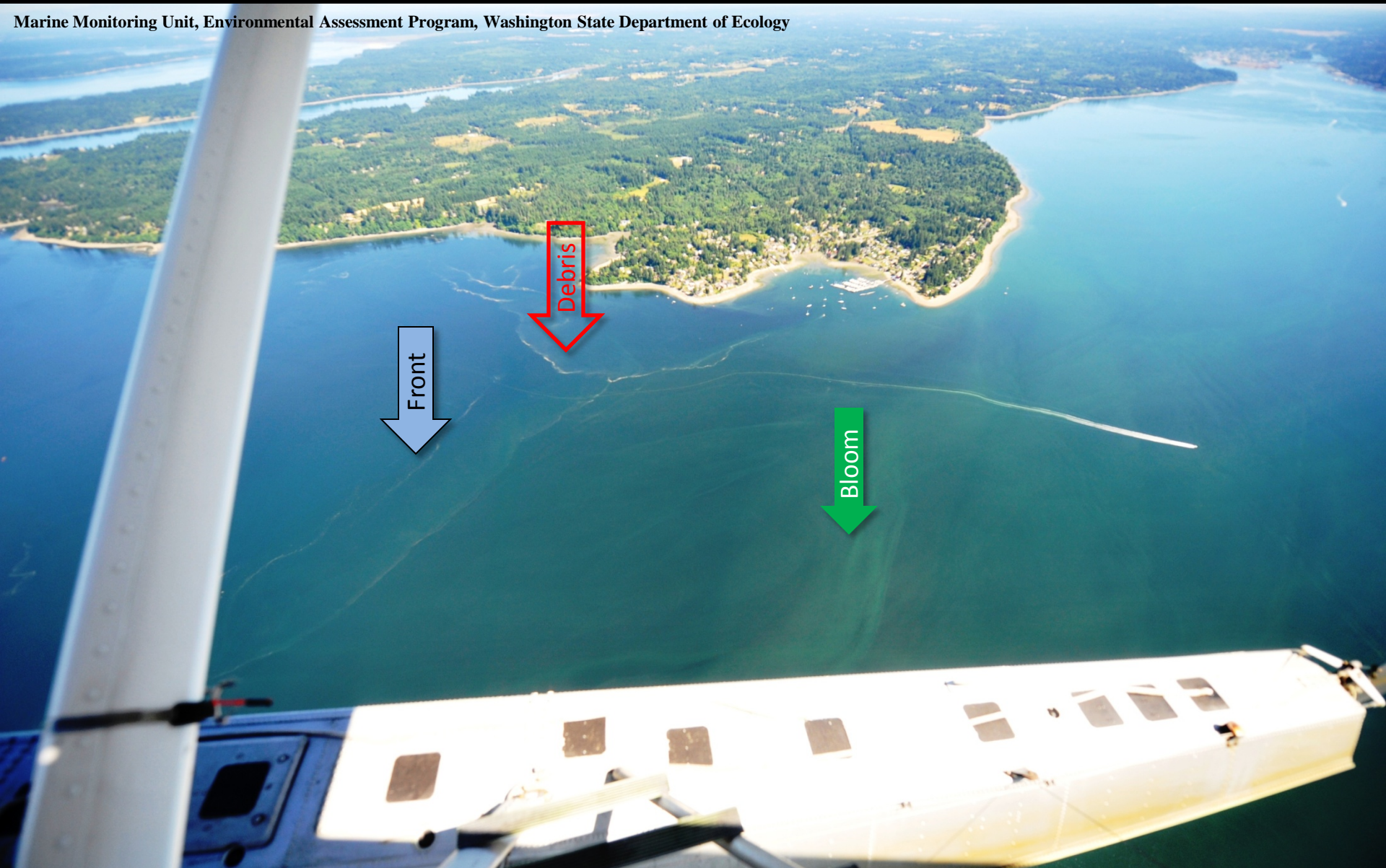


Evening Central Sound 3:05-3:40 PM

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



Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



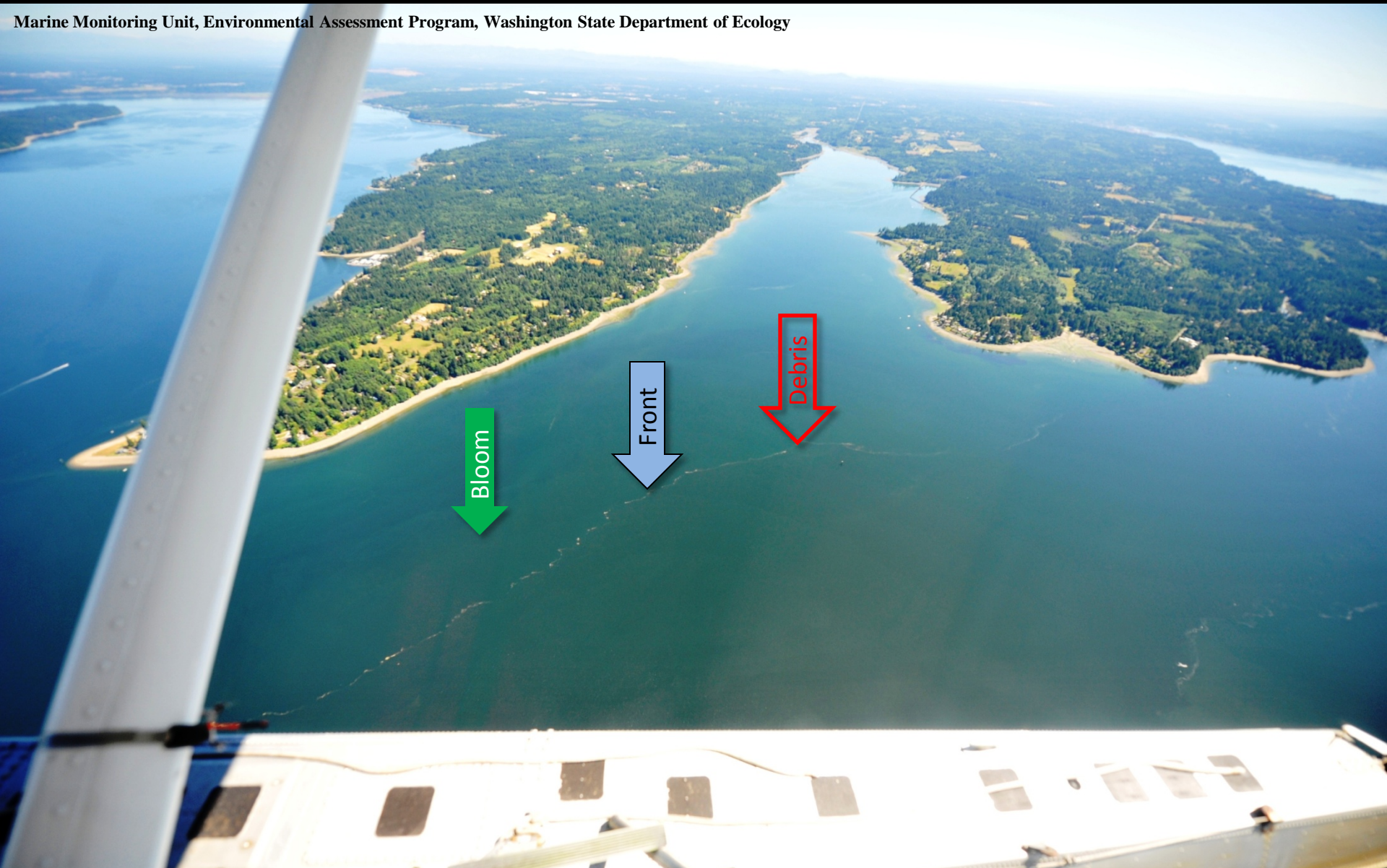
Turquoise algae bloom in water mass advecting out of Budd Inlet & debris near Boston Harbor, 3:10 PM

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Red-brown algae bloom in Squaxin Passage mixing near Boston Harbor, 3:10 PM

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Dana Passage with front and debris, 3:12 PM

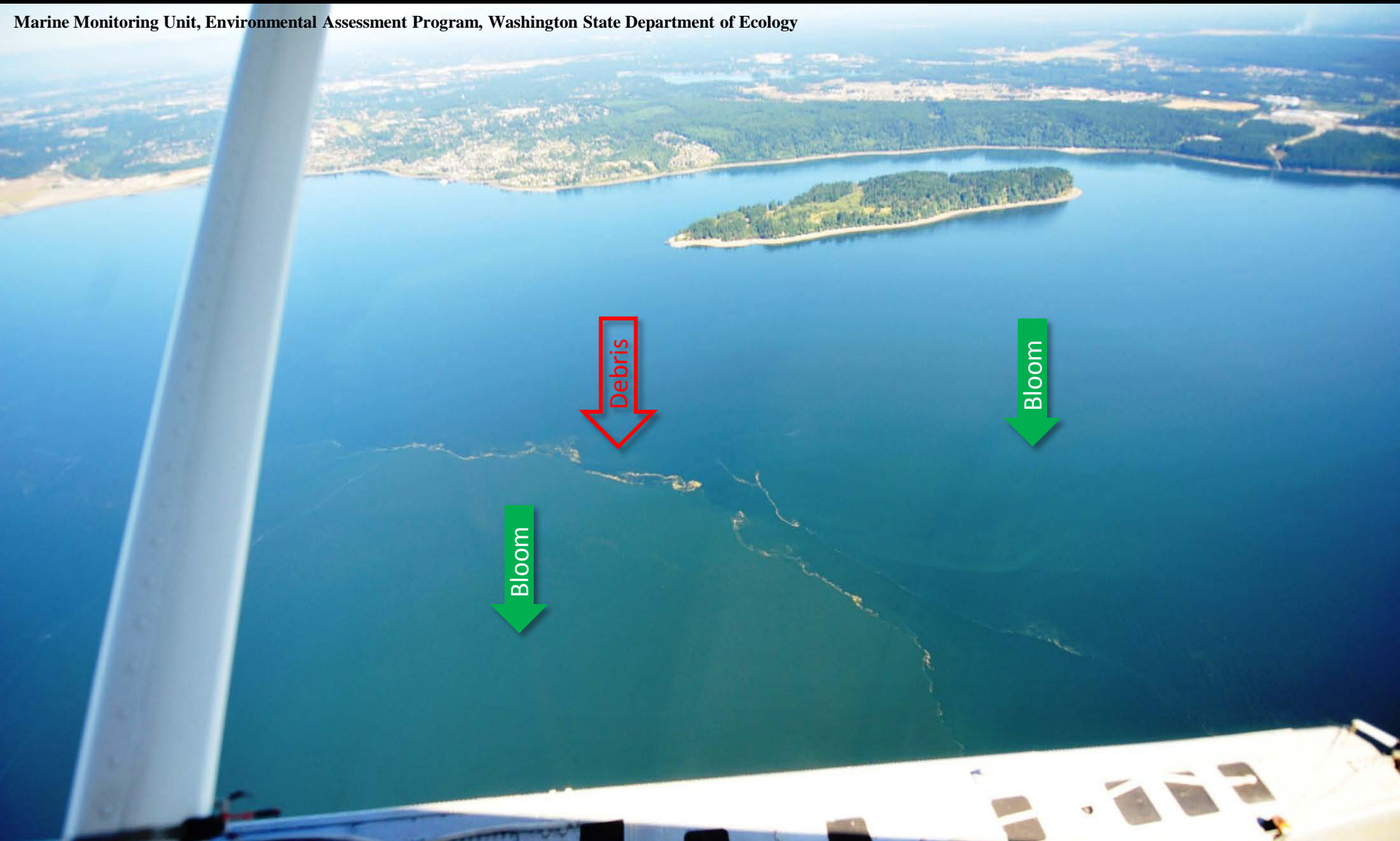


Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology

Strong red-brown bloom in Oro Bay (Anderson Island) South Sound, 3:18 PM

Morning flight from Seattle to Olympia at <1000 ft altitude

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Complex surface water masses meet near Anderson Island (South Sound) , 3: 20 PM

Evening flight from Olympia to Seattle at 2500 ft altitude

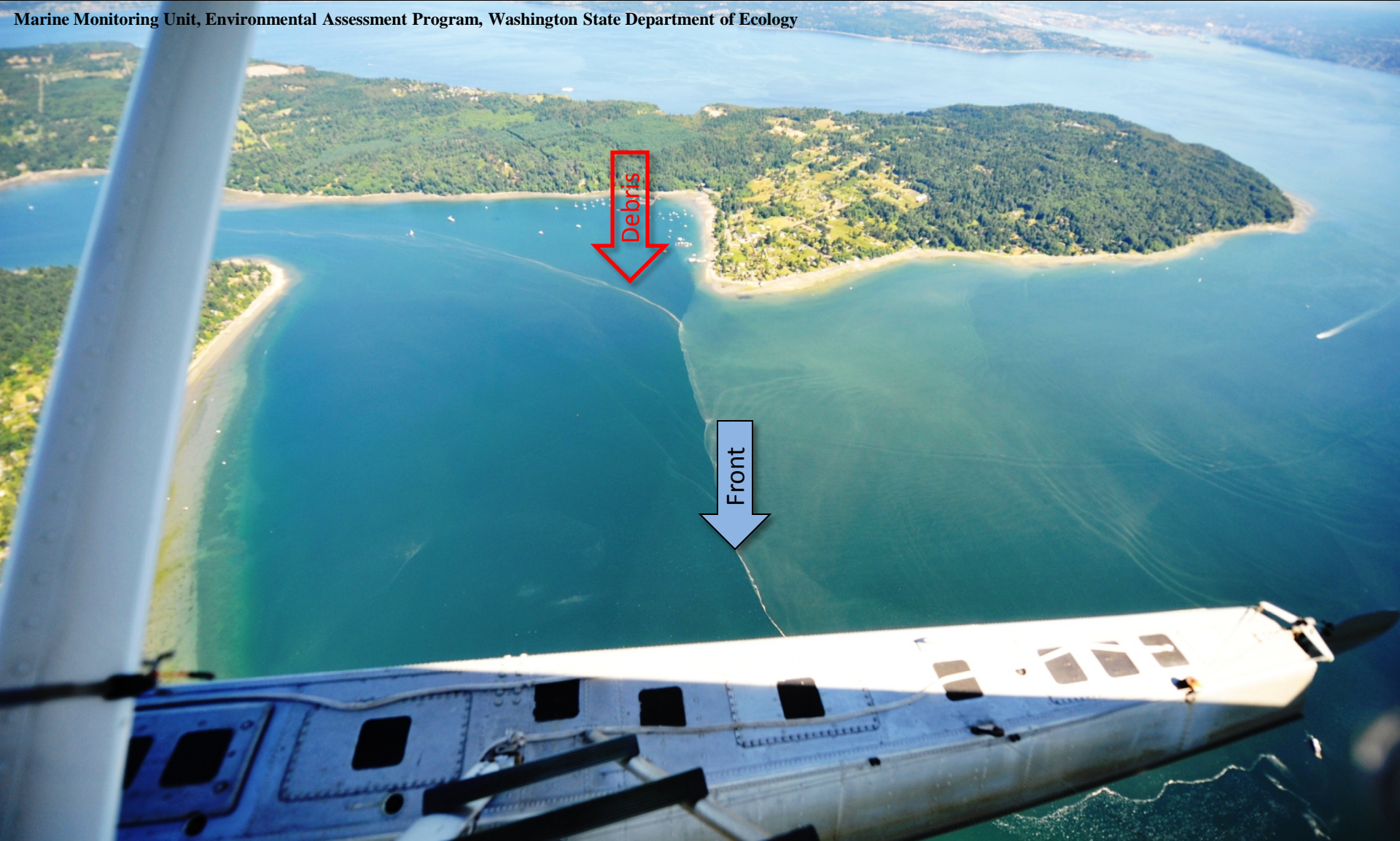
Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Quartermaster Harbor with floating debris and river water (Puyallup River, Tacoma) , 3: 28 PM

Evening flight from Olympia to Seattle at 2500 ft altitude

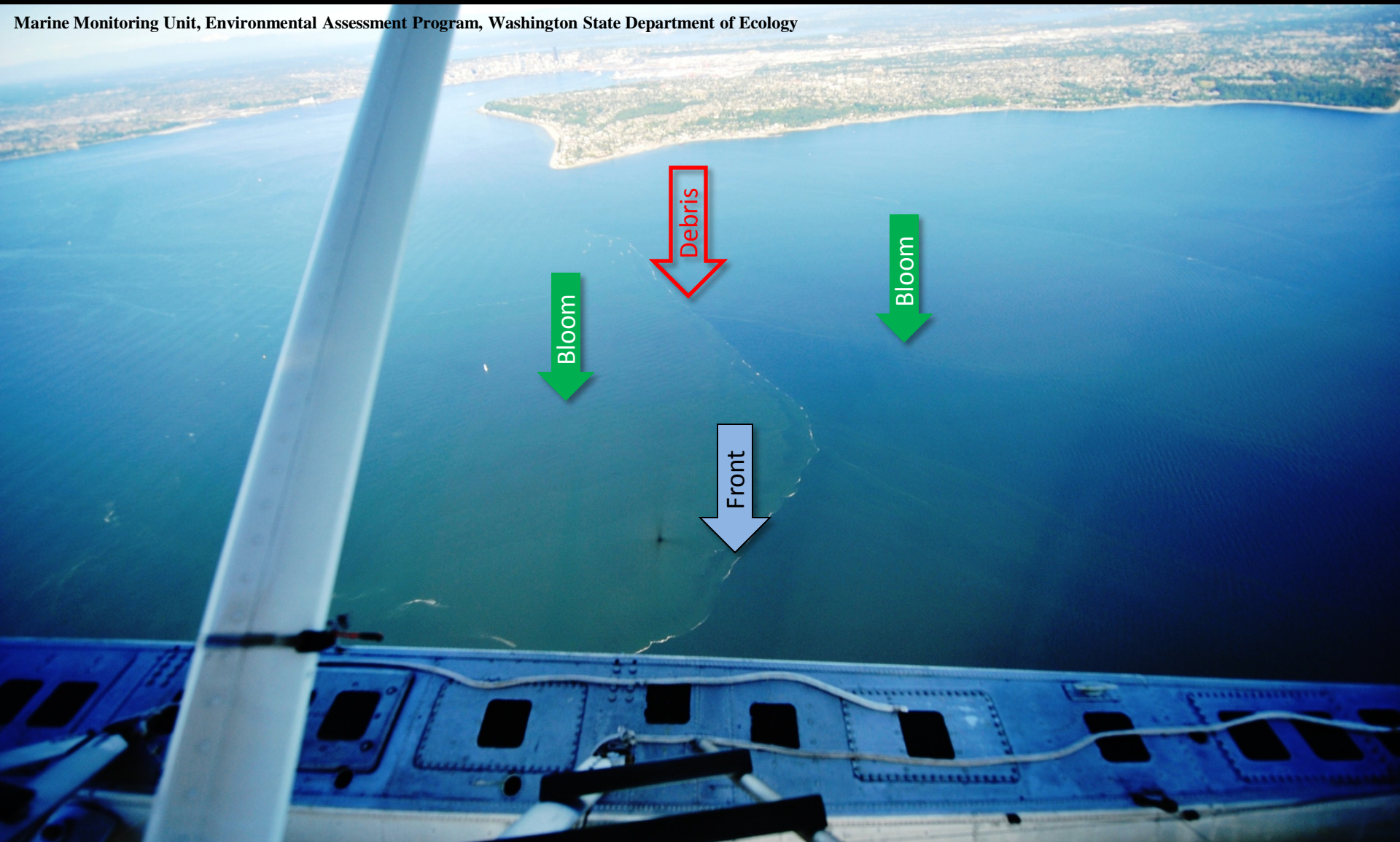
Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Quartermaster Harbor with floating debris and front (Puyallup River) , 3:30 PM

Evening flight from Olympia to Seattle at 2500 ft altitude

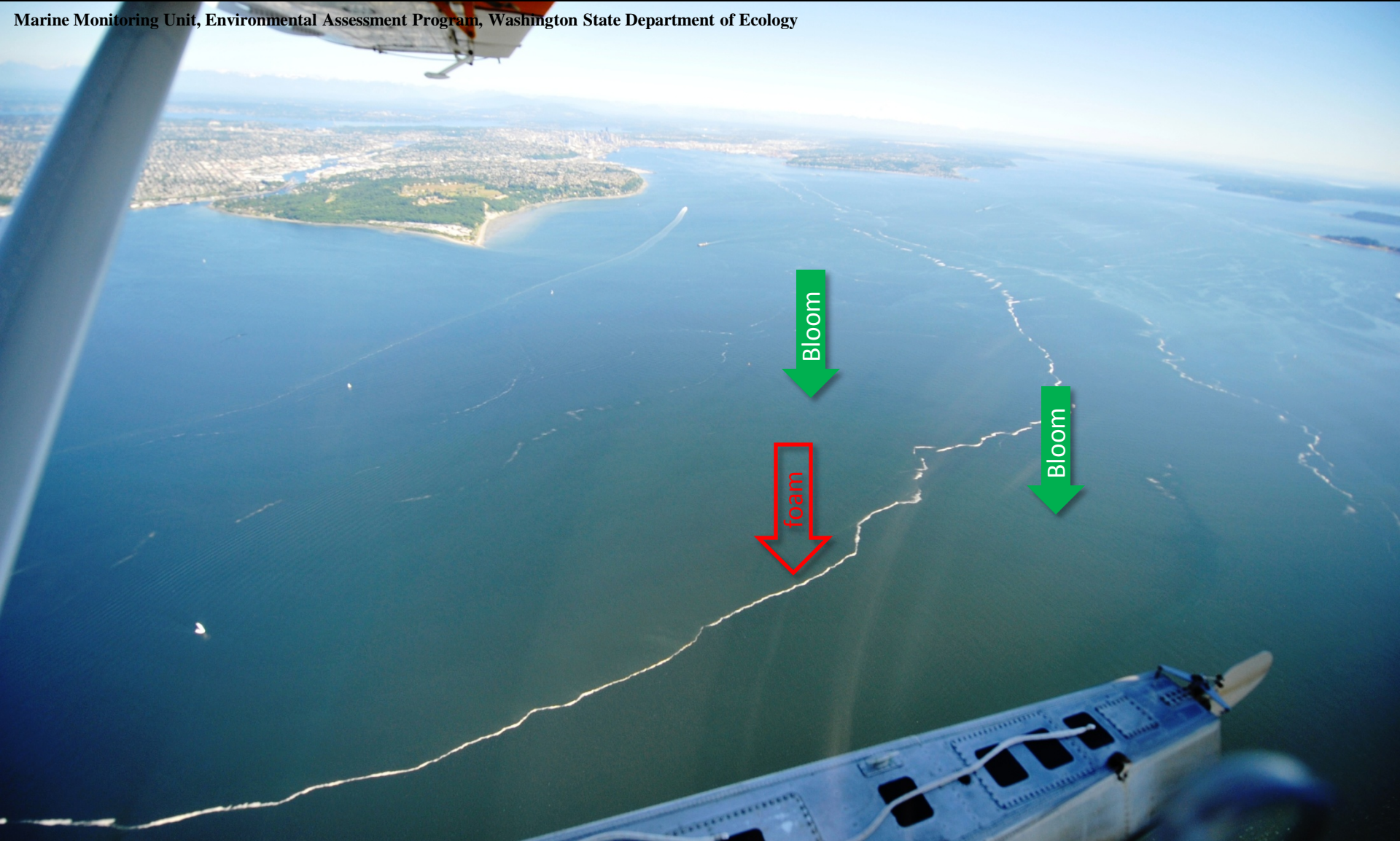
Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



Three surface water masses converge in Central Basin (West Seattle in back), 3:35 PM

Evening flight from Olympia to Seattle at 2500 ft altitude

Marine Monitoring Unit, Environmental Assessment Program, Washington State Department of Ecology



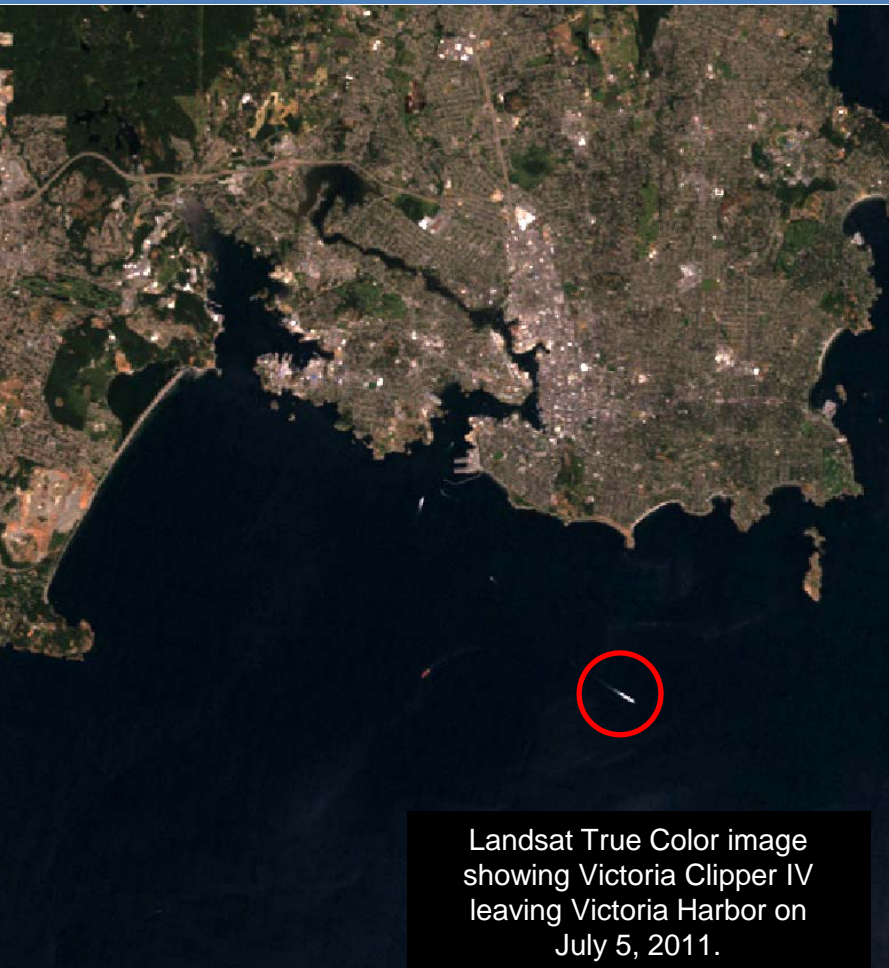
Long foam lines persist after ships have passed - Elliott Bay to Admiralty Reach , 3:38 PM



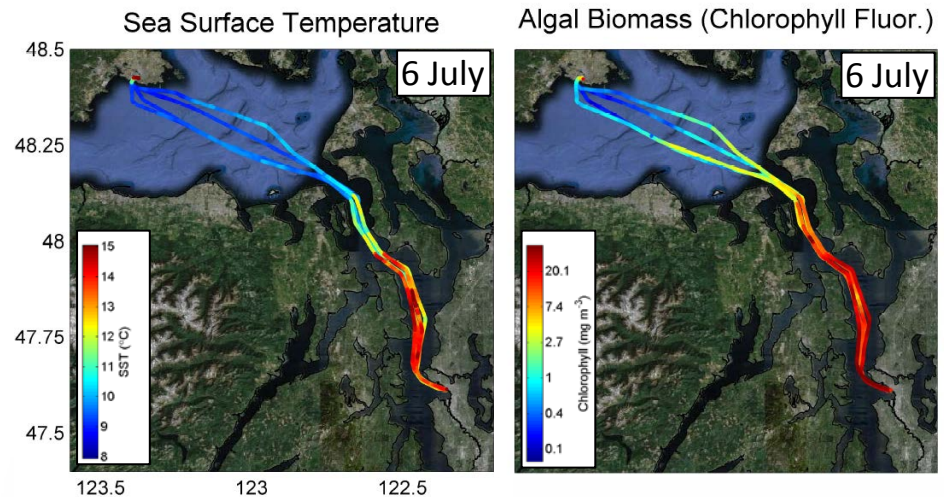
Daily Ferry and Satellite observations in Main Basin, July 6, 2011



Contact: brandon.sackmann@ecy.wa.gov



Landsat True Color image showing Victoria Clipper IV leaving Victoria Harbor on July 5, 2011.



Current Conditions: Widespread algae bloom in Main Basin continues; surface water temperatures have warmed to ~14-15 °C.

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



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

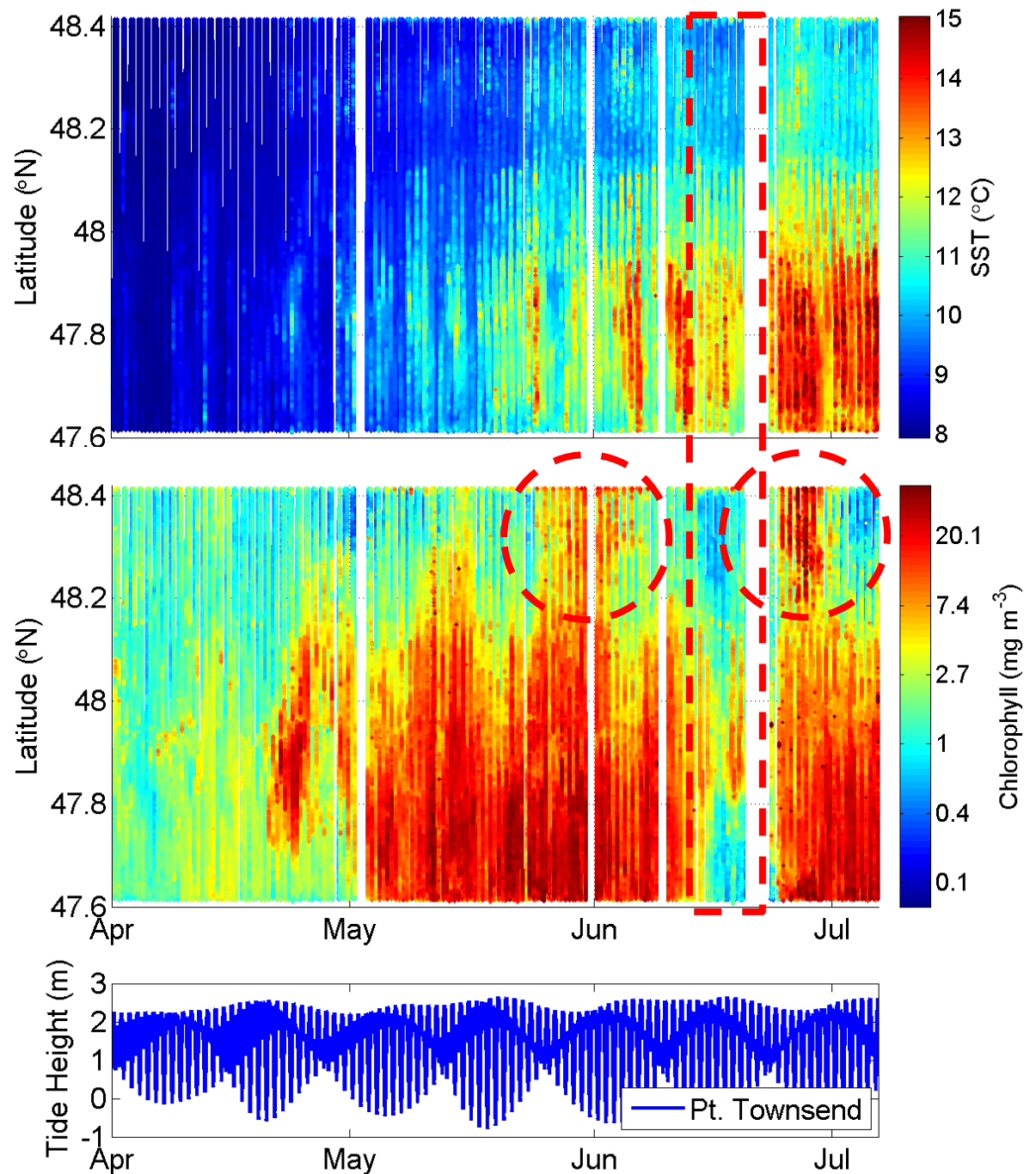
Victoria Clipper

Widespread algae
bloom in Main Basin
continues...

Temperatures have warmed to
~14-15 °C.

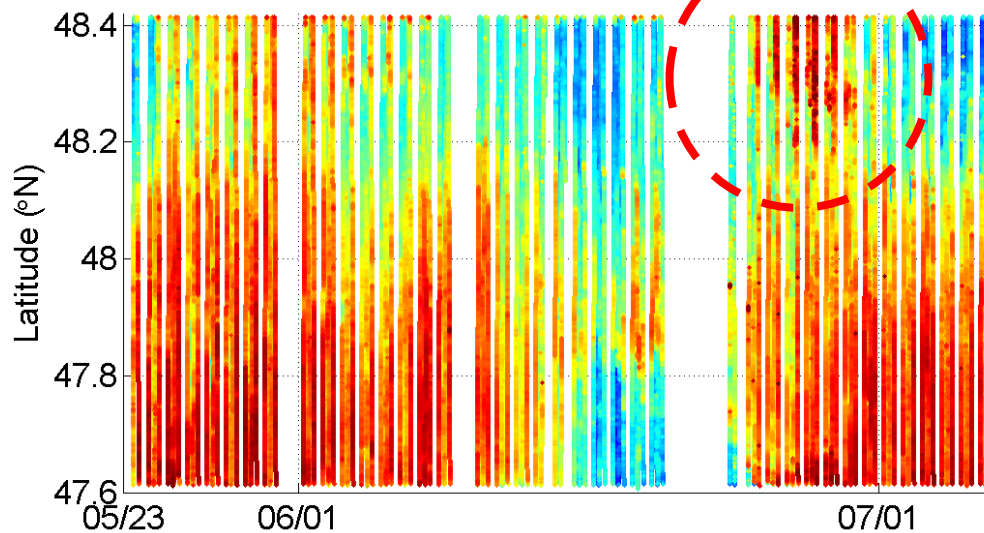
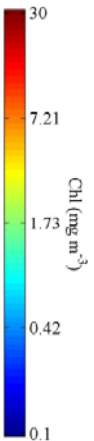
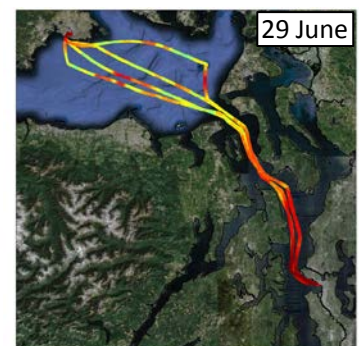
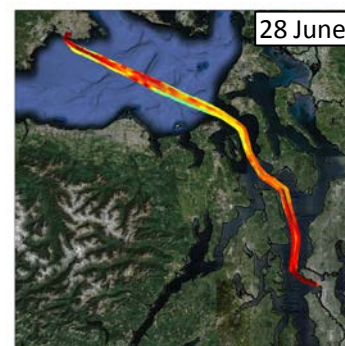
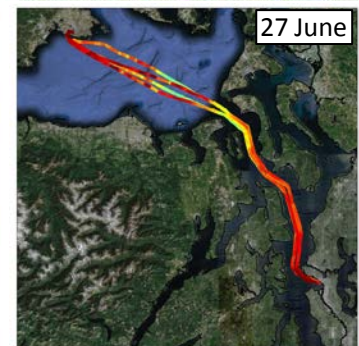
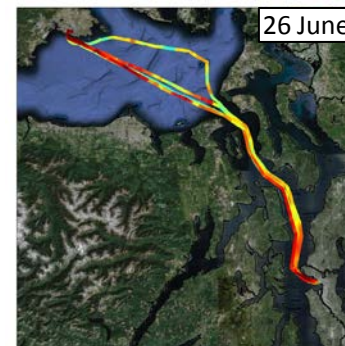
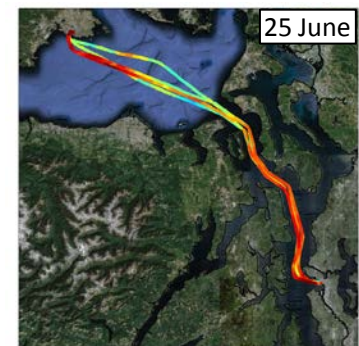
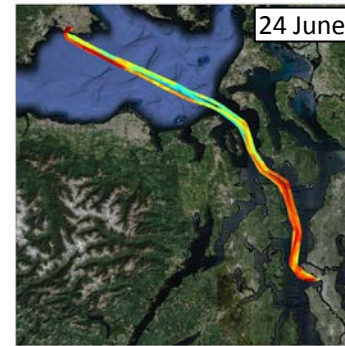
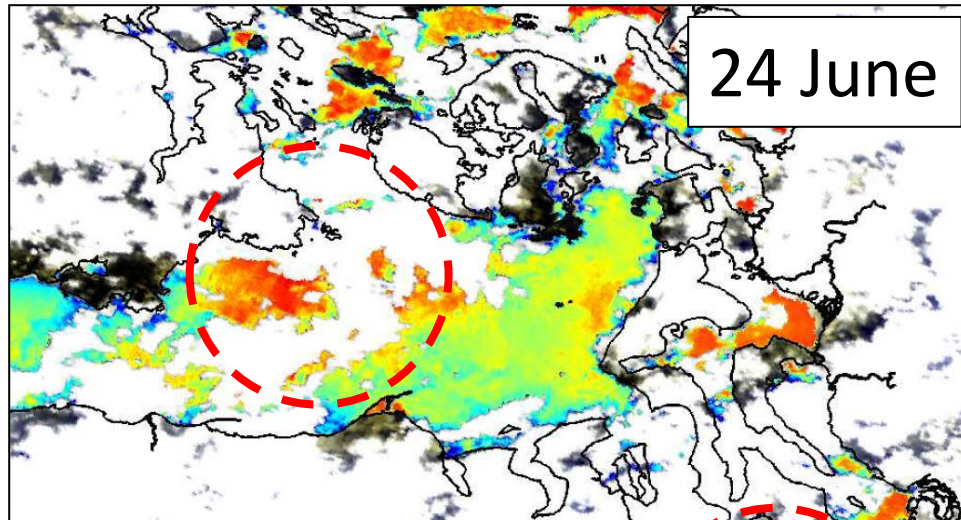
Brief *clearing* (red box) of
Main Basin waters in mid-June
(i.e., reduced fluorescence and
turbidity); associated with
cooler surface temperatures and
higher winds generating more
mixing in the near-
surface waters.

Two intense blooms observed
across Strait of Juan de Fuca
(red circles).



Victoria Clipper + MERIS Satellite Ocean Color

Bloom observed in Strait of Juan de Fuca
(24 – 29 June 2011)



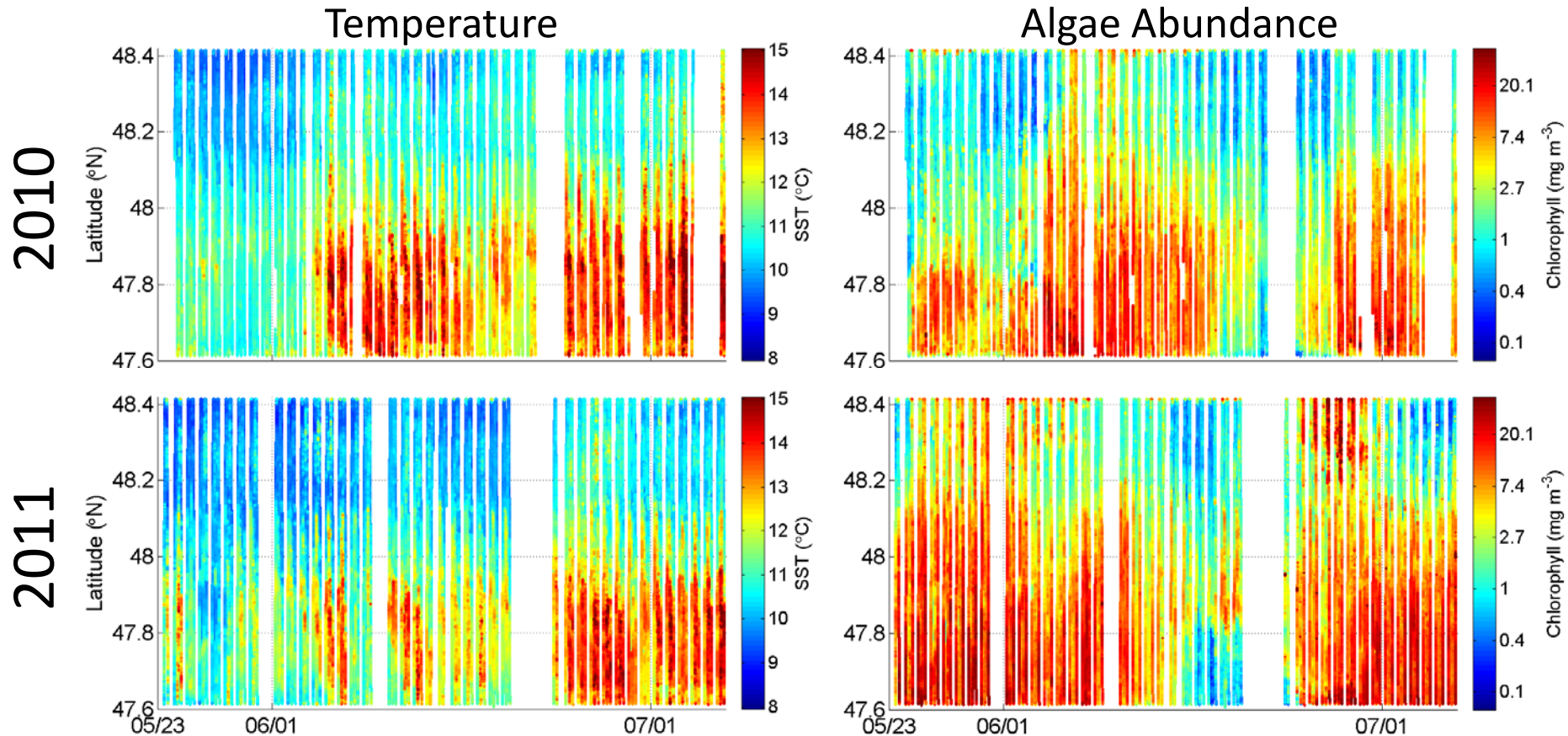
What a Difference a Year Makes!

Puget Sound water quality in 2011 compared to 2010
(23 May – 6 July)

This year:

- temperatures were 1-2 °C colder throughout MB and the SJdF in May and June.
- fluorescence levels were higher in MB in May and early June.
- stronger blooms observed in SJdF.

MB: Main Basin (47.6 – 48 °N) , **SJdF:** Strait of Juan de Fuca (48 – 48.4 °N)



What a Difference a Year Makes!

Puget Sound water quality in 2011 compared to 2010

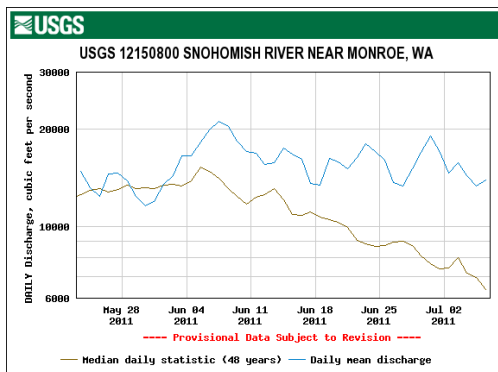
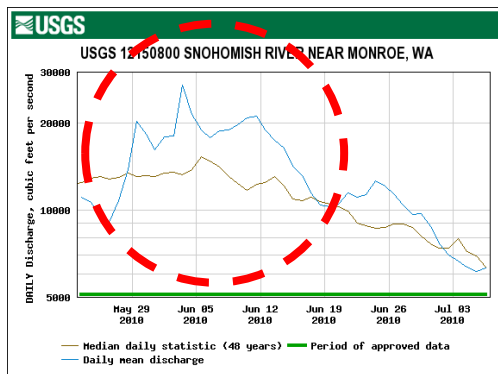
(23 May – 6 July)

This year:

- Snohomish river discharge rates were higher in June and July.
- no pulse of high CDOM water in MB (associated with rise in river discharge in 2010).

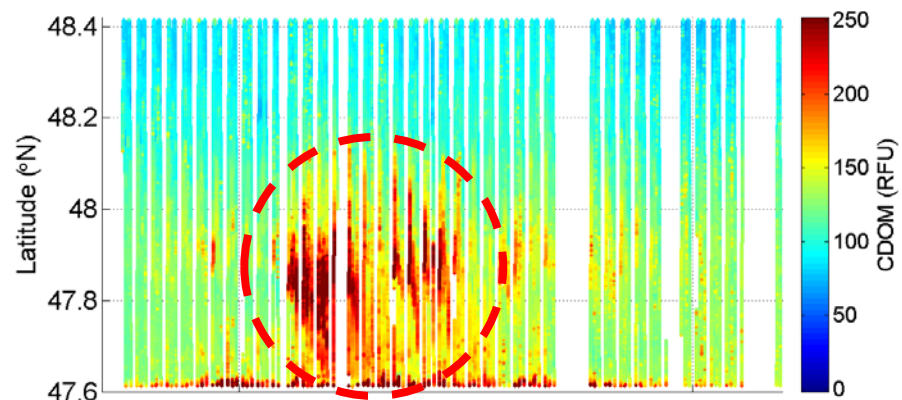
CDOM: Colored Dissolved Organic Matter

River Discharge

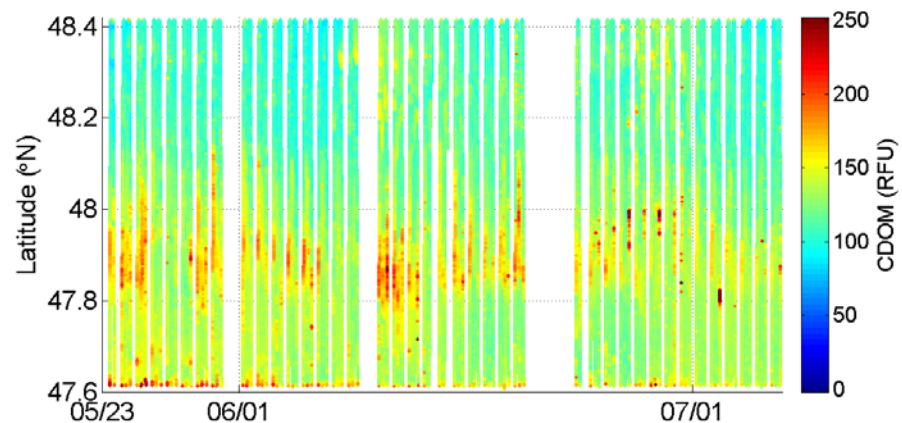


CDOM Fluorescence

2010



2011



5 July

20 miles

Landsat

(30m True Color)

Fraser River plume
entering Strait of
Georgia north of San
Juan Islands.



Landsat

(30m True Color)

Columbia River turbid plume moving onto the continental shelf (18.5 miles).



Landsat

(120m Thermal Band)

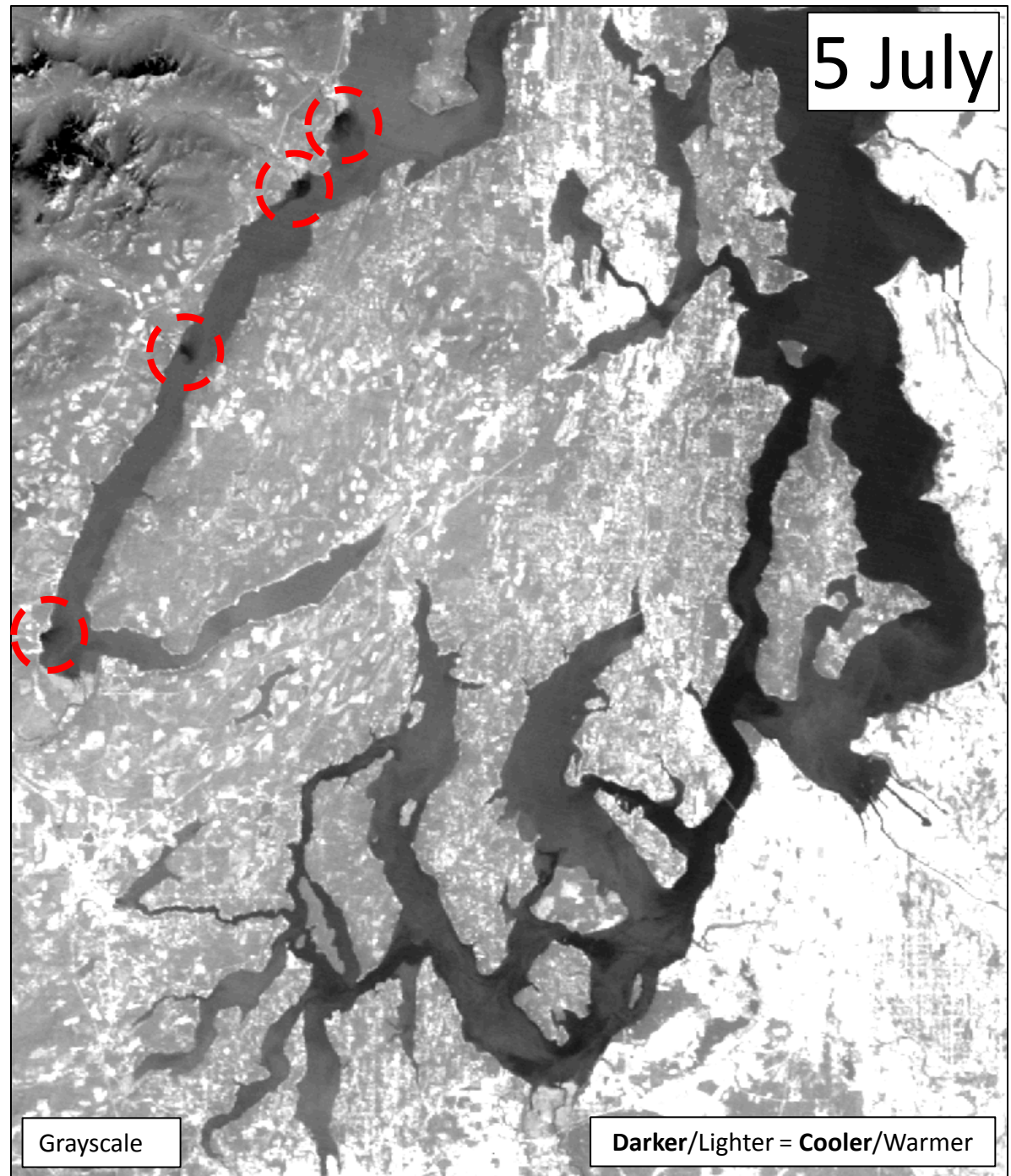
Temperatures:

Main Basin ~14 °C

South Sound ~17-18 °C

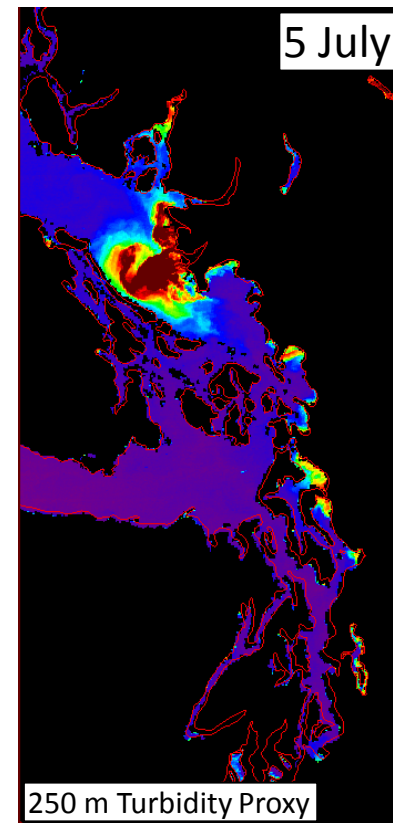
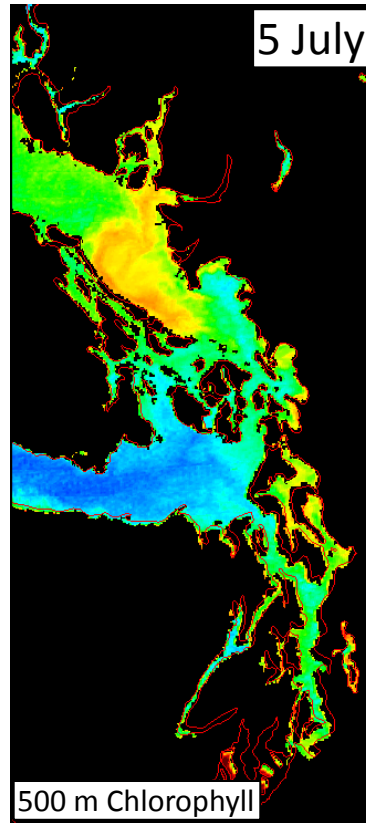
Hood Canal ~18-20 °C

Many of the
freshwater discharges
into Hood Canal are
associated with
cooler temperatures



MODIS Satellite Ocean Color – True Color & Turbidity

Refining high resolution products for Puget Sound



Two MODIS Ocean Color satellites provide daily imagery of Puget Sound:

- High resolution bands (250 and 500 m) can be used to develop true color, chlorophyll and turbidity products.
- MODIS + MERIS imagery = 3+ scenes per day, weather permitting!



Mooring observation from June 23- July 6, 2011



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

Summary: Localized dissolved oxygen trends, with high variability at two of three stations.

Mukilteo, Whidbey Basin near Everett

MUK01BR (14 m): DO values dropped 0.5 mg/L from previous two weeks - 9.0 mg/L to 8.5 mg/L. DO values highly variable last week with values ranging from 7.6 mg/L to 10.0 mg/L (observed on 7/5). Salinity mean value was 28.7 PSU. Temperature increased by 0.1 °C with mean daily values rising from 10.3 °C to 10.4 °C.

MUK01SR (0 m): Mean daily salinity values were approximately 25.0 PSU (3.7 PSU less than MUK01BR). The temperature mean value was 12.0 °C, an increase of 0.1 °C from previous month.

Manchester, Main Basin

MCH01BR (11m): DO values increased 1.6 mg/L with mean daily values increasing from 8.3 mg/L to 9.2 mg/L; mean value was 8.8 mg/L. Salinity mean value was 28.6 PSU. Temperature increased by 0.8 °C with mean daily values rising from 10.8 °C to 11.5 °C.

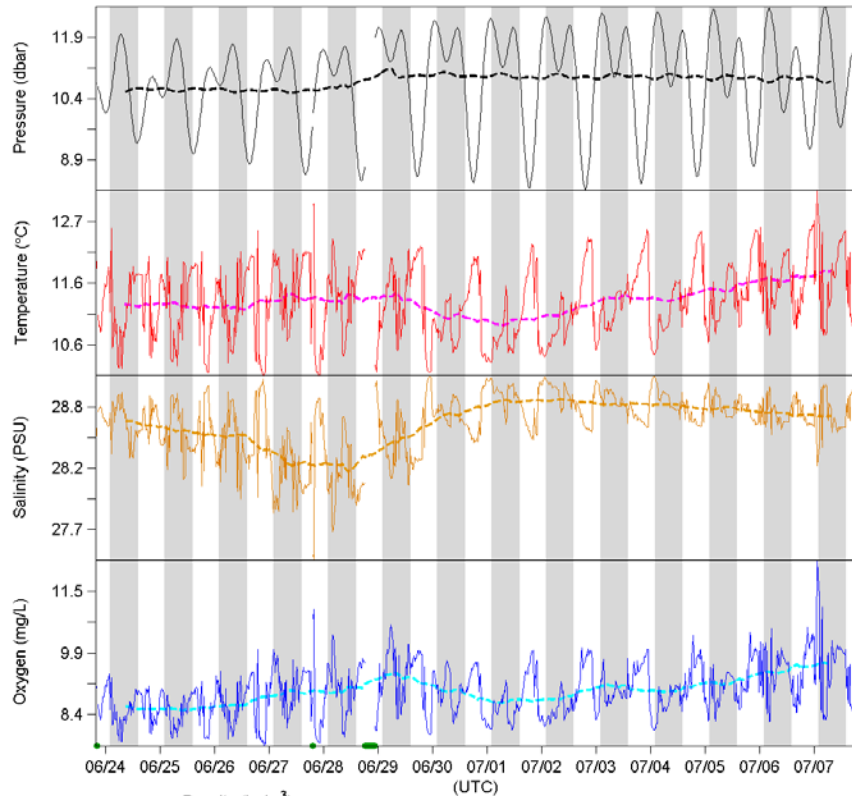
MCH01SR: Salinity mean value was 28.6 PSU. Temperature mean value was 11.8 °C

Squaxin Passage (South Sound) near Olympia

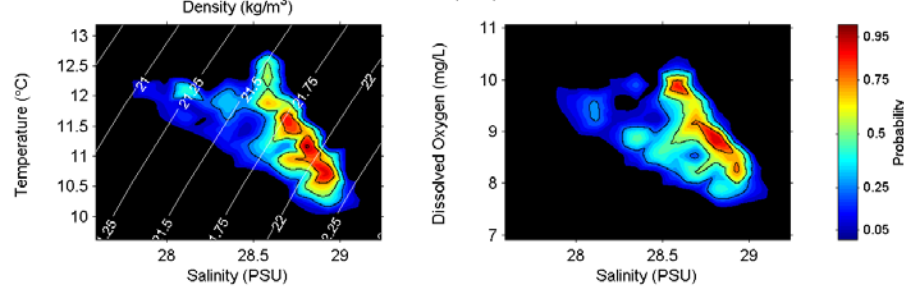
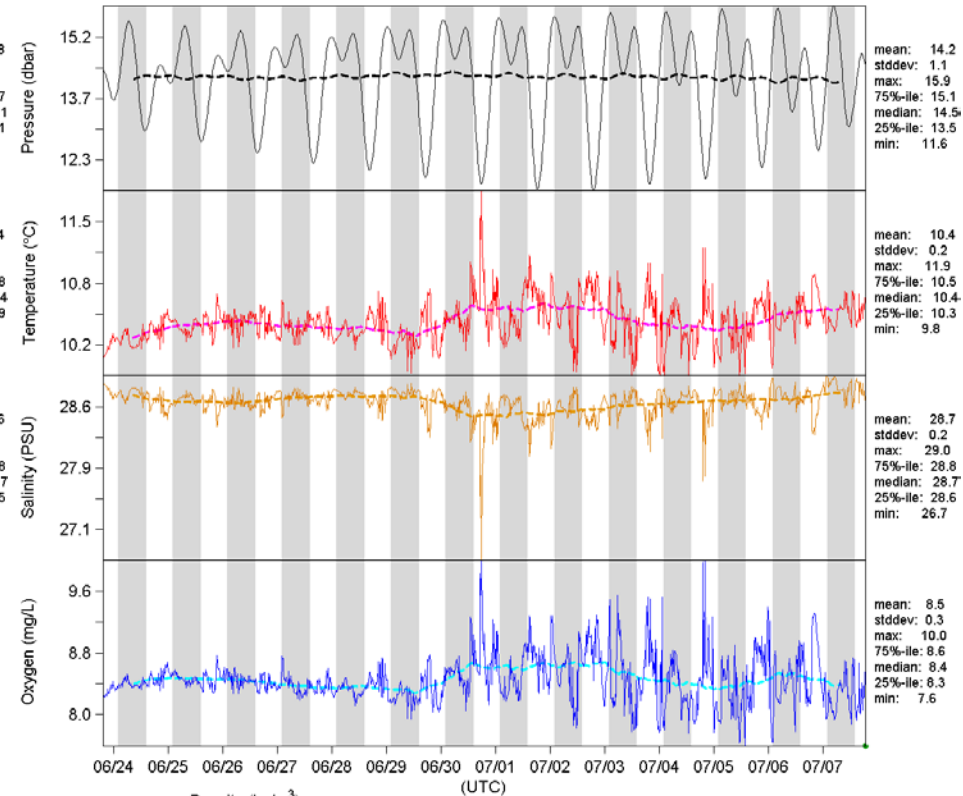
SQX01CR: Dissolved oxygen mean value observed was 10 mg/L. Mean daily DO values peaked at 10.5 mg/L on 6/26 and decreased to 9.8 mg/L by 7/6. Salinity increased by 0.3 PSU with mean daily values rising from 27.8 to 28.1 PSU. Temperature increased by 0.4 °C with mean daily values rising from 13.4 °C to 13.9 °C.

Mooring data, Mukilteo (Whidbey Basin) and Manchester Park (Main Basin) from 6-23-2011 to 7-6-2011

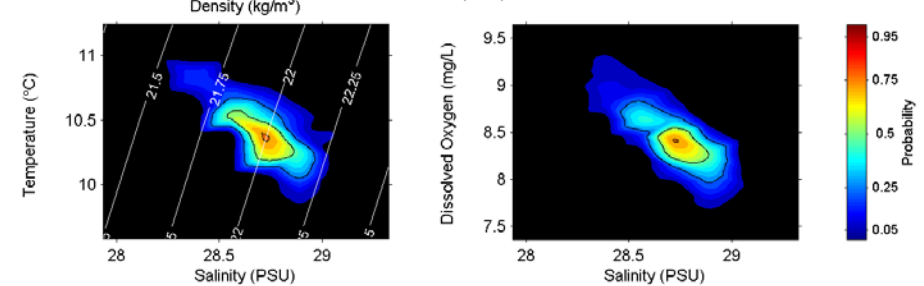
MCH01BR Manchester Environmental Laboratory (Near Bottom, Rigid)



MUK01BR Mukilteo (Near Bottom, Rigid)

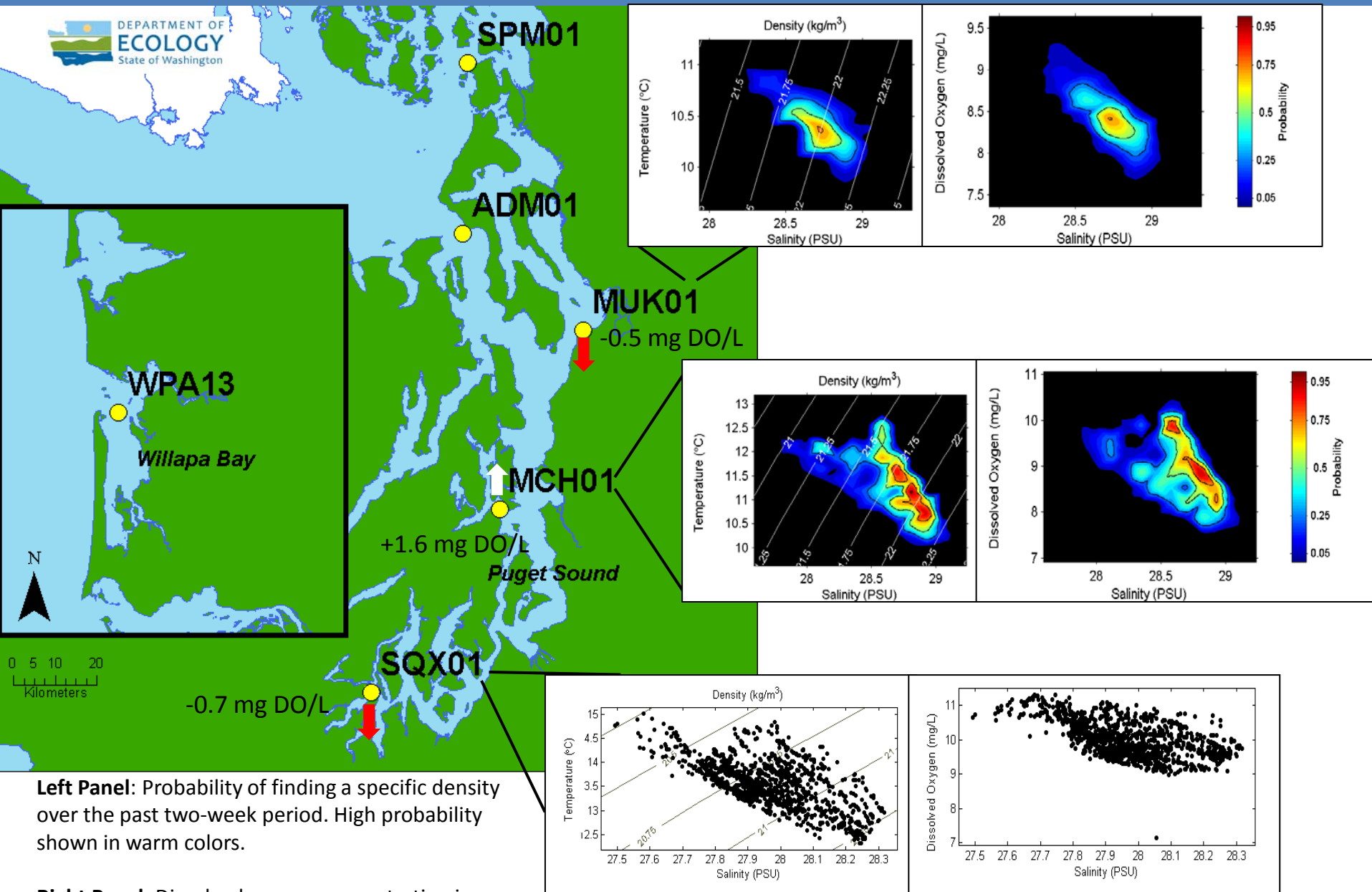


Top panels: Two-week time series and 24 h avg. (12/12 h day/night cycle in local time shown by gray bands).
Green dots superimposed onto x-axis are periods of missing data.
Bottom left: Probability of finding a specific density over the past two-week period. High probability shown in warm colors.
Bottom right: Dissolved oxygen concentration in relation to salinity. High probability shown in warm colors



Top panels: Two-week time series and 24 h avg. (12/12 h day/night cycle in local time shown by gray bands).
Green dots superimposed onto x-axis are periods of missing data.
Bottom left: Probability of finding a specific density over the past two-week period. High probability shown in warm colors.
Bottom right: Dissolved oxygen concentration in relation to salinity. High probability shown in warm colors

Water Masses and DO from our Moorings: 6/23/11-7/6/11



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.

Comment: Mooring temporary shifted to 1.5m depth

You may subscribe or unsubscribe to the Eyes Over Puget Sound email listserv by going to this link:

<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
Department of Ecology**

