Publication No. 18-03-072

DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound

Surface Conditions Report, *June 28, 2018*

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

Start here

LONG-TERM MARINE MONITORING UNIT

Stephen Gonski

Skip Albertson

Tyler Burks
Jim Shedd

Dr. Christopher Krembs (Editor)

Personal stories

p. 3

Meet Stephen Gonski, our ocean acidification expert.

Climate & Streams

p. 6

River flows have rapidly declined from May, but snow-fed river flows in particular have been highly variable toward the end of June. Precipitation levels are below normal with abundant sunshine. With projected drier and warmer conditions, will the remaining snowpack translate to low stream flows in September?

Testing an infrared camera

p. 10

Juvenile fish are migrating out of the estuaries and meeting a complex thermal habitat. Will they hit optimal temperatures to grow? See the new infrared images.

Aerial photography

p. 14

A large *Noctiluca* bloom extends across South Central Basin and coccolithophores bloom in Hood Canal. macroalgae present on many beaches in South Sound, Central Sound, and Whidbey Basin and adrift in Port Madison, South Central Basin, and South Sound.

Editorial assistance provided by: Suzan Pool, Dany Burgess, and Carol Maloy

Meet our new Ocean Acidification Scientist

Stephen Gonski joined our marine team to develop and implement the ocean acidification (OA) component of our monitoring program. He has worked extensively with biogeochemical sensors and studied OA in both estuarine and coastal ocean systems.

Stephen graduated from the University of Delaware with a BS in Environmental Chemistry and an MS in Oceanography.

Sensor vs. Scientist!

This sensor in Murderkill Estuary near Delaware Bay has run afoul. It takes a scientist with a clear mind and fresh ideas (contrary to this sensor's appearance) to tackle estuarine sensor deployments.

SeapHOx Sensor

Fieldwork has taken him to the Hawai'ian Islands, Norway, Svalbard, and the Canadian Arctic, and now Puget Sound.

What was the visibility in the water for divers?

June

Best and Worst horizontal visibility and corresponding depth (ft)

#	Best		Worst	
1	19	98	16	10
2	13	23	2	7
3	17	98	14	23
4	37	98	5	23
5	16	98	8	7
6	36	98	5	23
7	26	59	2	2
8	13	26	4	3
9	22	89	6	7
10	28	57	4	34
11	27	98	3	5
12	6	7	6	34
13	24	98	14	3
14	21	80	9	8
15	15	94	11	3
16	20	30	5	13

Find depths with high/low visibility

- **Best visibility** was 37 feet, deep in Saratoga Passage (stations 4 and 6), in about same location as last month.
- **Poor visibility** occurred in Oakland Bay (near Shelton) , but also in Bellingham Bay.
- We use transmissometer readings from our CTD package and convert them into horizontal visibility. The poster, Underwater Visibility Maps – a Tool for Scuba Divers, is available at: Click here

This is a new feature and we are soliciting feedback (skip.albertson@ecy.wa.gov).

Critter of the Month – The "Unicorn Shrimp"

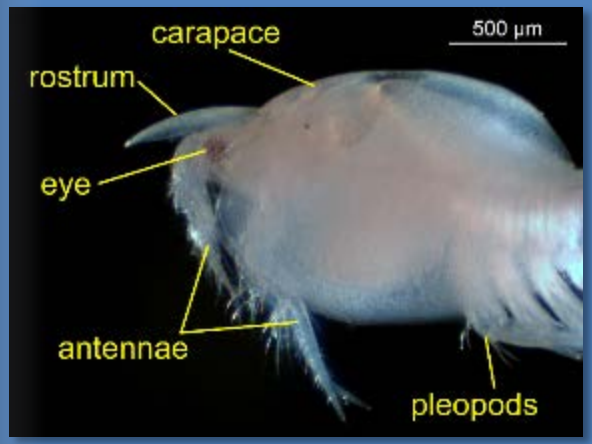
Dany Burgess & Angela Eagleston
Marine Sediment Monitoring Team

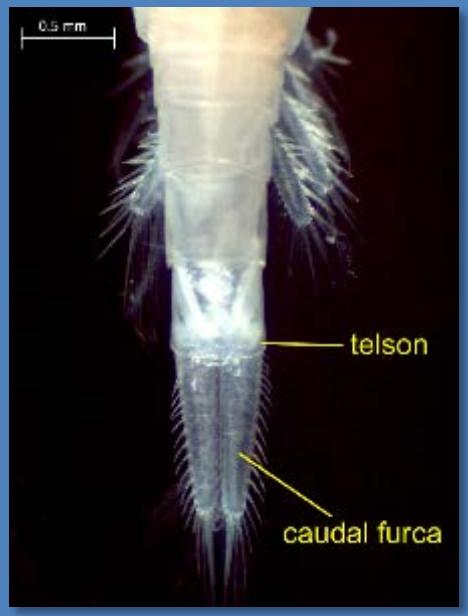
Nebalia pugettensis

This critter has no official common name, but with the projection on its head, we think "Unicorn Shrimp" is fitting! The leptostracans aren't actually shrimp, but a primitive group of crustaceans with a unique set of qualities all their own.

Fun Leptostracan Facts

- Some species can live in extreme environments, like deep-sea hydrothermal vents.
- Breathe through their legs.
- *N. pugettensis* spend their days buried in the mud of Puget Sound, emerging for a swim at night to feed on particles of organic matter and detritus.





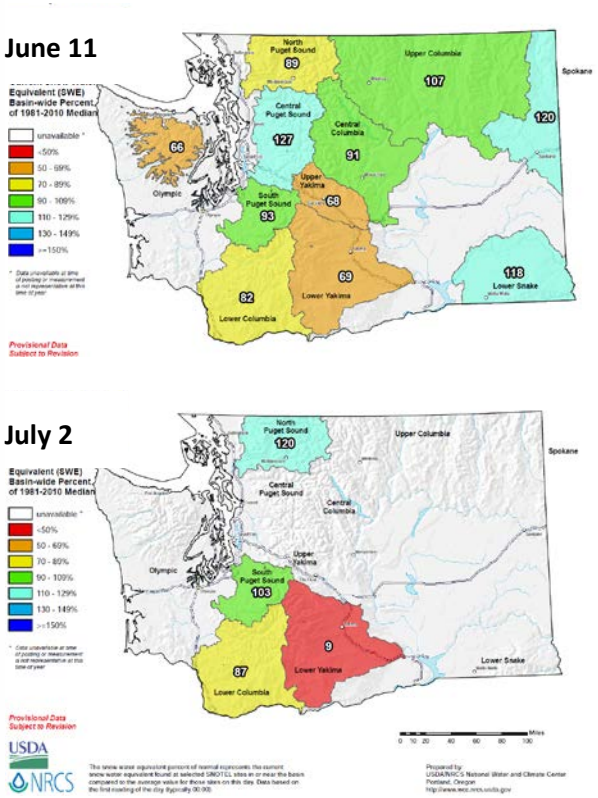
Learn more about leptostracans and other critters on Ecology's EcoConnect blog here

How much water flows into coastal marine waters?

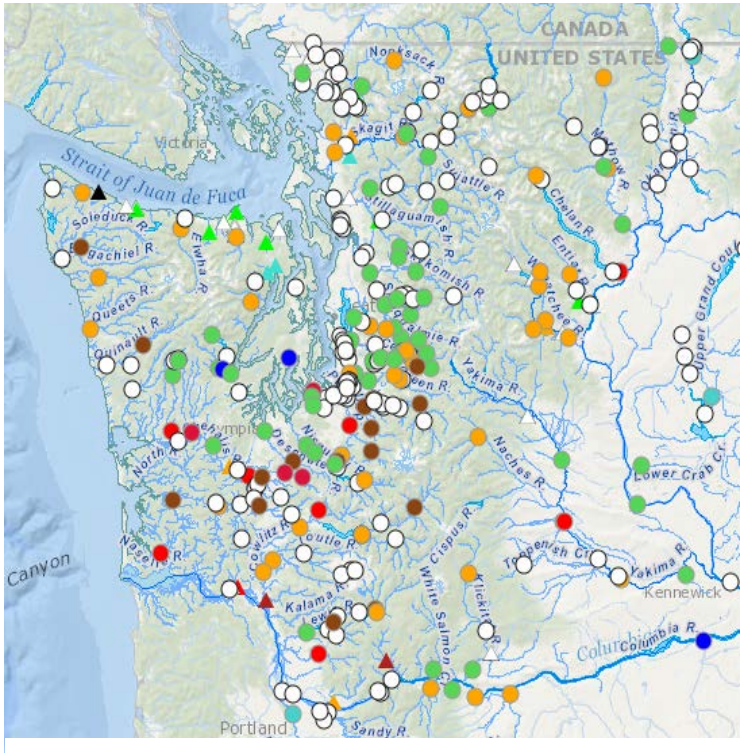
Tyler Burks, Jim Shedd

Near normal air temperatures and continued low precipitation during June have resulted in highly variable freshwater inputs to Puget Sound (map, center). Runoff from snow-dominated rivers varied from below to near normal, dependent on remaining snowpack and melt conditions in June (map panel, left). Rain-dominated rivers are much below normal in many cases, with regional exceptions from recent precipitation.

Snowpack Conditions



Current Streamflow Conditions as of 7/2/2018



Current conditions: CLICK HERE!

USGS Real Time Streamflow Values

- Much above normal (>90%)
- Above normal (76-90%)
- Normal (25-75%)
- Below normal (10-24%)
- Much below normal (5-10%)
- Far below normal (>5%)
- Lowest recorded
- Not Ranked

Ecology Daily Streamflow

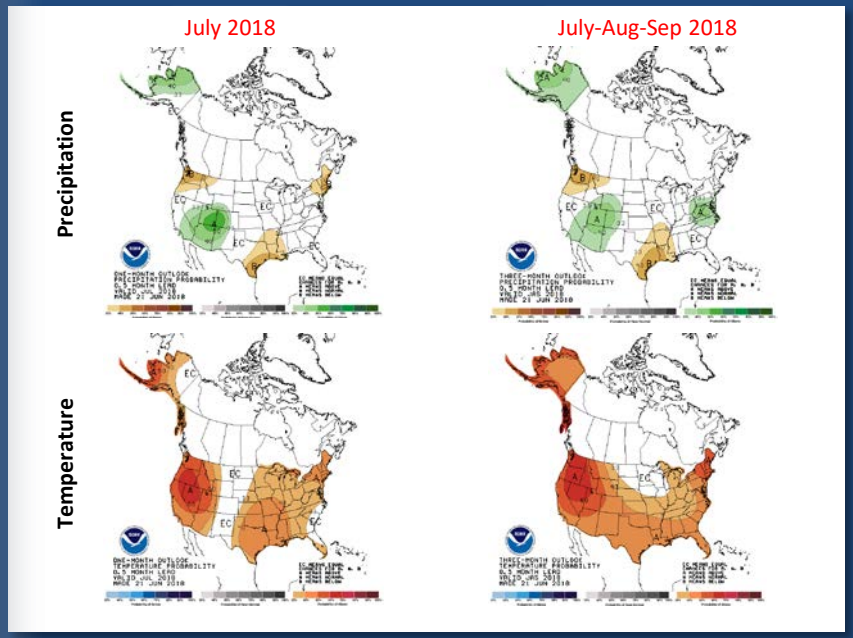
Daily Streamflow

- Highest recorded
- Much above normal (>90%)
- Above normal (76-90%)
- Normal (25-75%)
- Below normal (10-24%)
- Much below normal (<10%)
- Lowest recorded
- Not ranked

How much water flows into coastal marine waters?

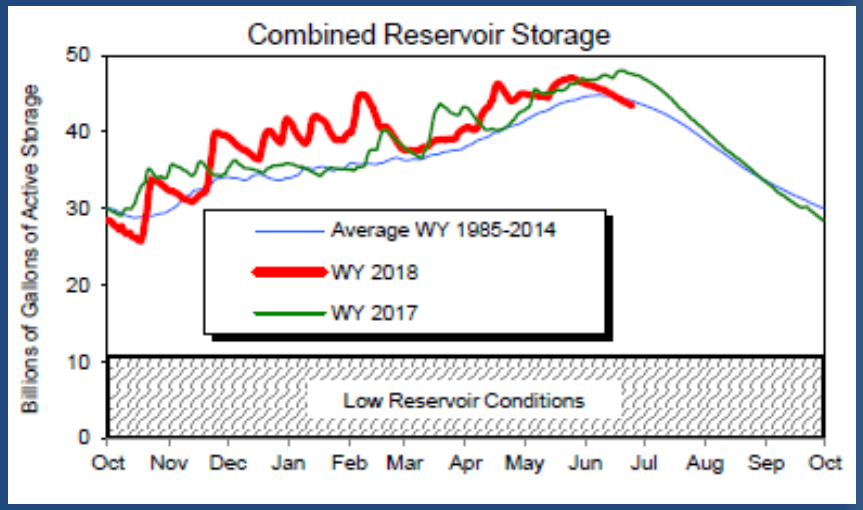
Climatologists predict drier and warmer conditions this summer. The current available snowpack is declining but about average for this time of year. Will these conditions translate to low stream flows in September? The reservoirs serving Seattle are near average, and that is good.

Climate Prediction Center, NOAA



The maps on the top show higher probability of below normal precipitation in the NW. The maps on the bottom show a higher probability of higher temperatures in the west. Click here

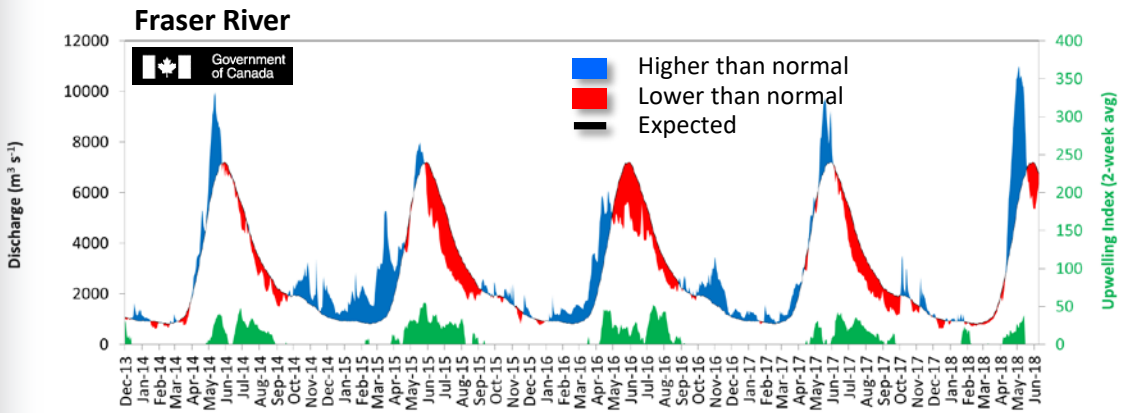
Seattle Public Utilities Water System Synopsis



The combined reservoir storage of Chester Morse Lake, Masonry Pool, Masonry Pool, Lake Youngs, and South Fork Tolt Reservoir is near the long term average for this time of the year. WY = water year. Click here

Climate influences: How well is Puget Sound exchanging its water?

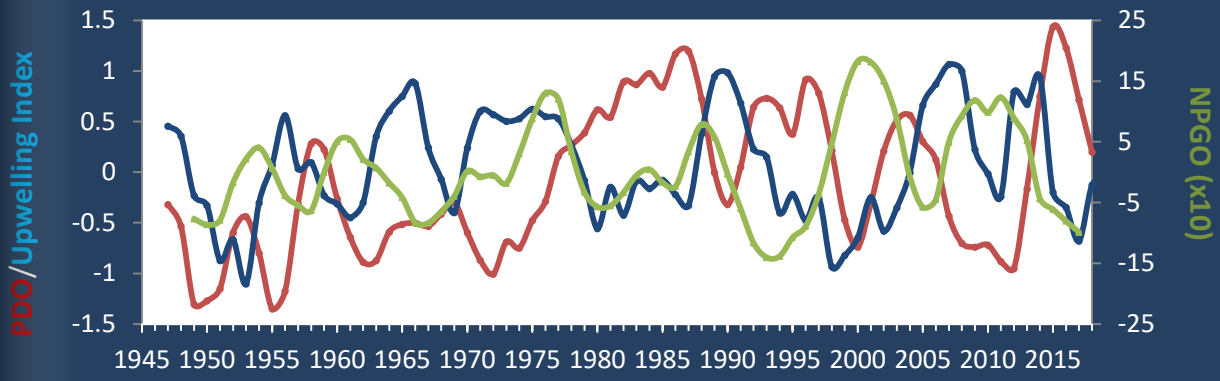
Historically, peaks of coastal upwelling and the freshet are in sync. Will they be this year?



The Fraser River is the major driver of estuarine circulation and water exchange with the ocean.

Fraser River flows have rapidly fallen and the snowpack in BC is below normal (Basin Snow Water Index)

Three-year running average of PDO, Upwelling, and NPGO indices



How do ocean boundary conditions affect the quality of water we exchange with the ocean?

Past years' warm water is gone (PDO), upwelling is neutral (Upwelling Index anomaly), and surface productivity along the coast is lower (NPGO).

*Pacific Decadal Oscillation Index (**PDO, temperature**, explanation). Upwelling Index (anomalies) (**Upwelling, low oxygen**, explanation). North Pacific Gyre Oscillation Index (**NPGO, productivity**, explanation).*

What's the story of influences affecting water quality?

Climate and natural influences include weather, river flows, and the adjacent ocean conditions that affect our marine waters. This graphic provides context for interpreting Puget Sound marine conditions. All data are from public sources: weather from UW GRAYSKIES; river flows from USGS and Environment Canada; indices from NOAA, UW (PDO), and E. Di Lorenzo (NPGO).

Summary:

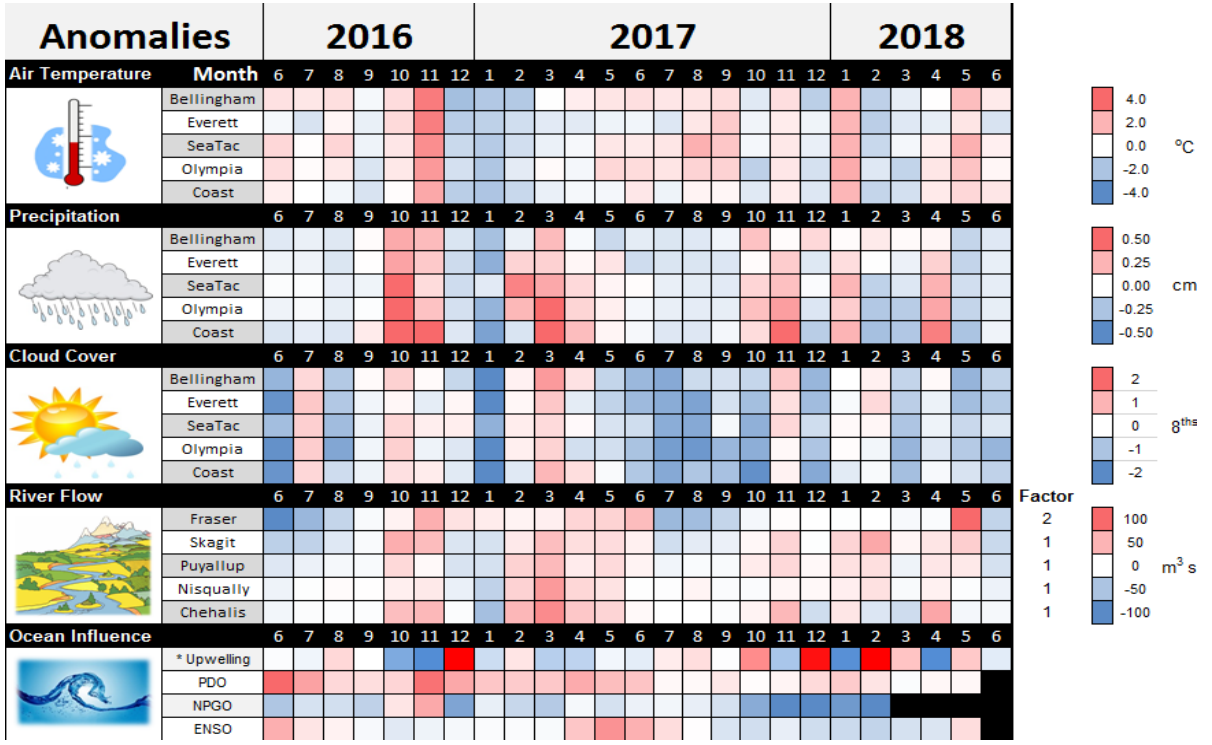
Air temperatures were above normal for May, but closer to normal in June.

Precipitation levels have been below normal in May and June.

Sunshine levels have been above normal (low cloud cover).

River flows are much lower in June than May, but highly variable during the past week.

Upwelling is normal, but lower than in May. ENSO is slightly positive, indicating the end of La Niña.



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

higher — expected — lower

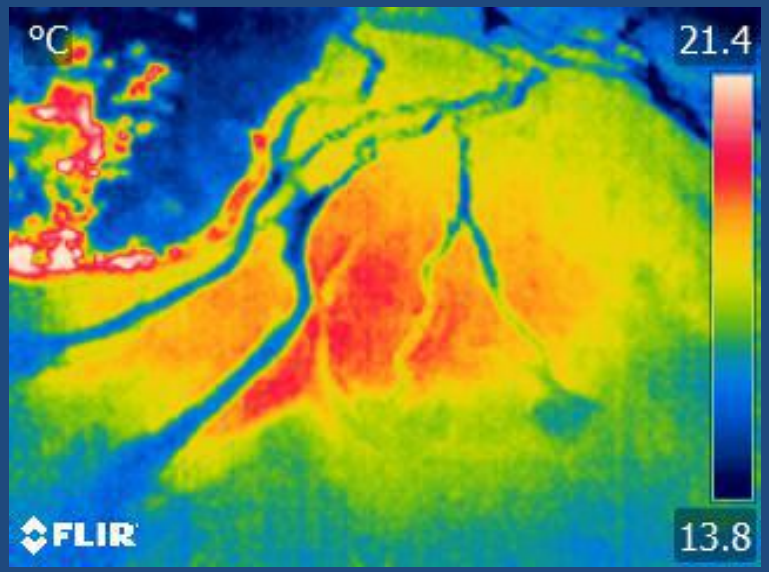
No data

Did you know: River deltas can have complex temperatures

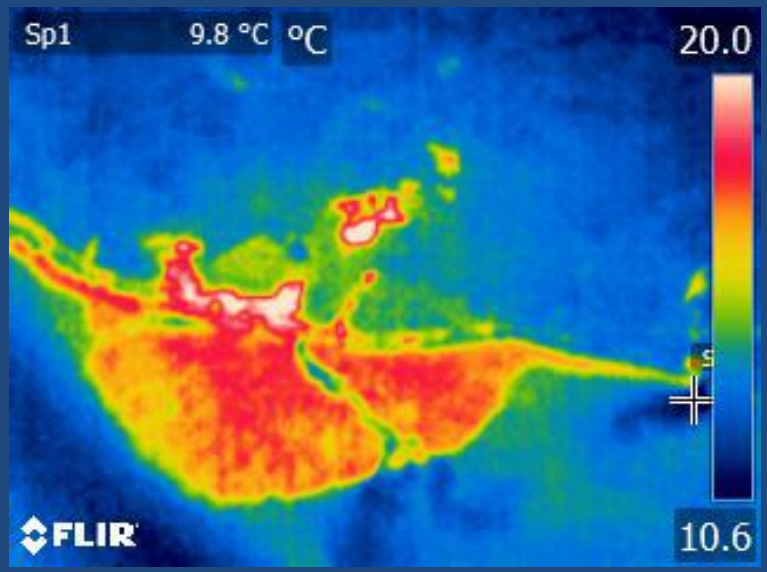
Migrating juvenile salmon face a complex thermally structured habitat in estuaries that can make or break a successful recruiting year. See what it looks like using an infrared camera from 2500 feet.

The same picture with a regular camera in comparison does not reveal much of the thermal complexity and flows of cooler river water.

A. Skokomish River delta (Hood Canal)



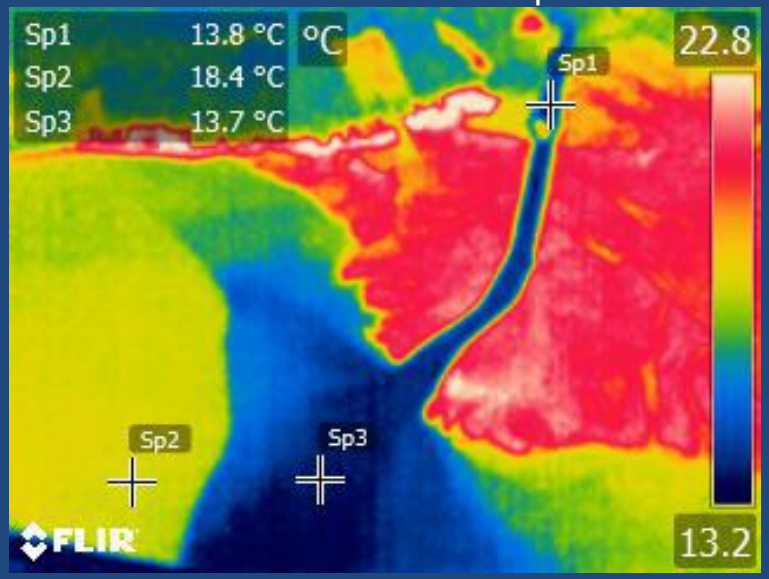
B. Eagle Creek delta (Hood Canal)



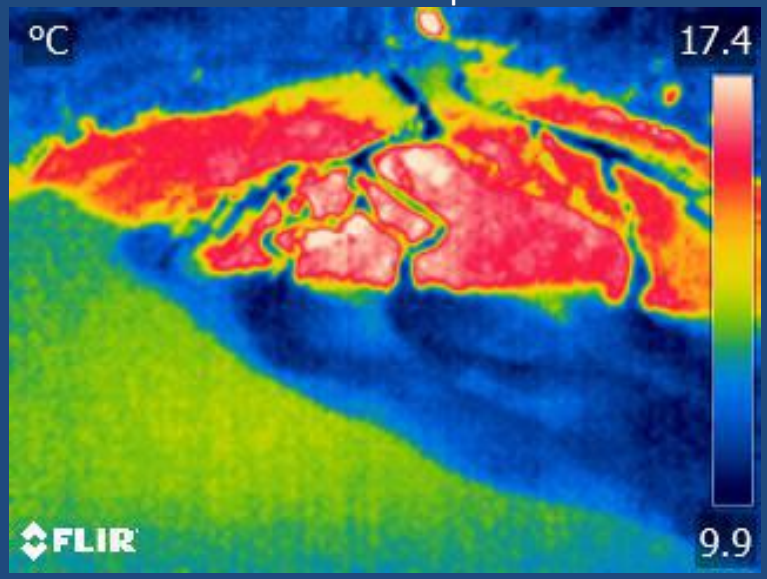
Did you know: The infrared camera shows what the eye can't see

Once the cooler rivers enter Hood Canal surface water, the extent of the river plume can be seen on infrared images.

A. Colder Hamma Hamma River plume



B. Colder Duckabush River plume

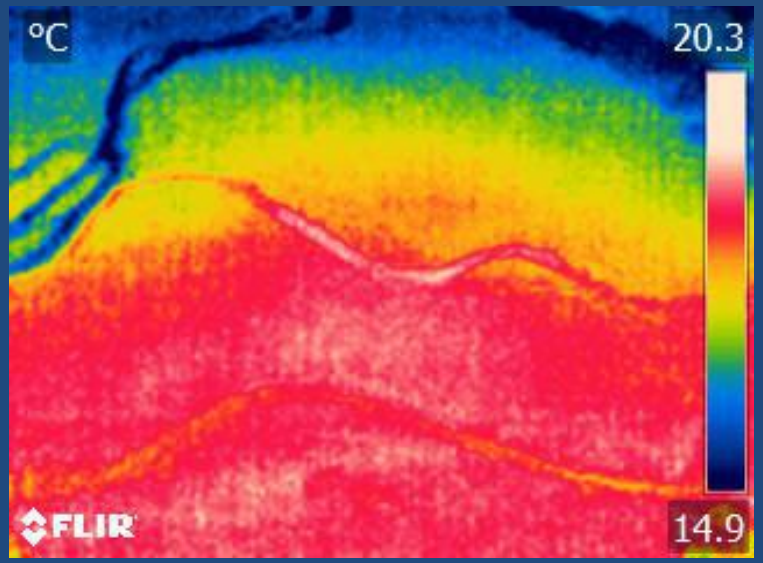


On images using a regular camera this structure is not visible. For salmon, a temperature difference of 5 °C means a lot.

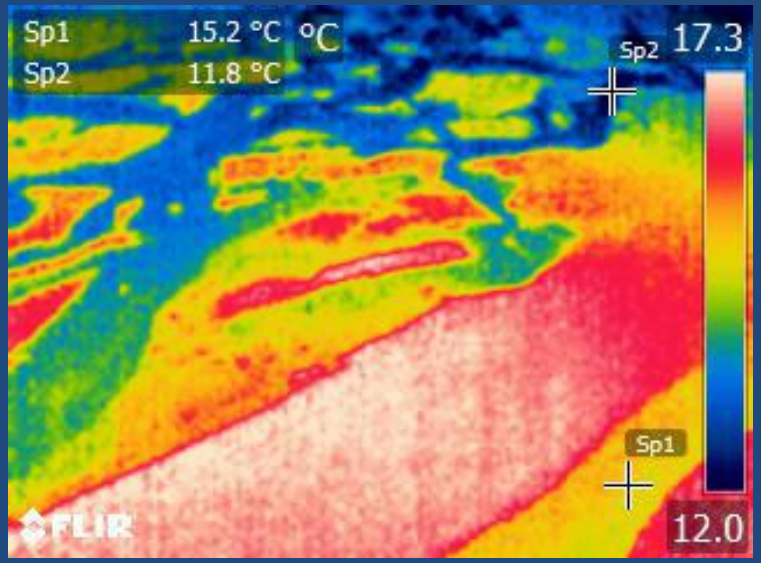
Did you know: Water on mudflats can have different temperatures

During low tides mudflats bake in the sun. A. Some water can reach up to 20 °C, B. while cooler river water provides a cool refuge.

A. South Fork of Skagit River delta, mudflats



B. Stillaguamish River delta, mudflats

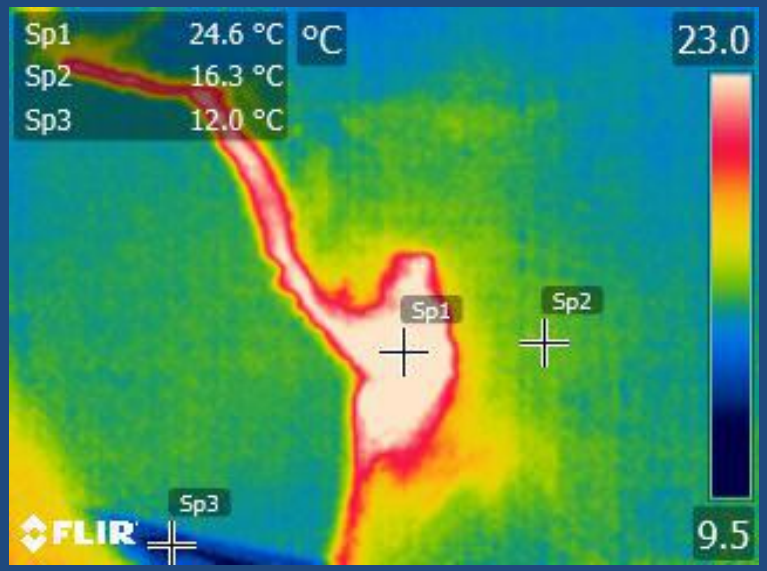


Differences in water temperature between B. the Skagit South Fork (11.8 °C, Sp2) and the Stillaguamish North Fork (15.2 °C, Sp1) can be seen on one infrared image.

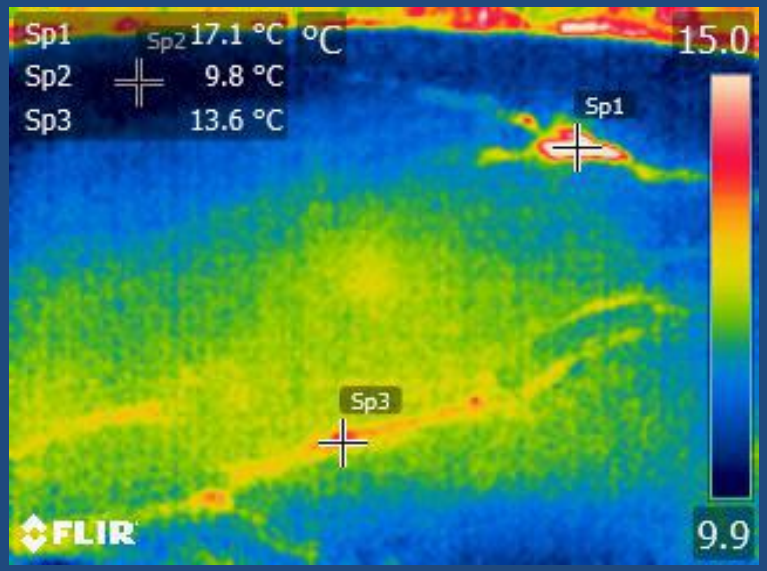
Did you know: Patches of drifting organic material are warmer

Surface water is warmed by the sun. Organic material floating on the surface traps the heat and shows up to 8 °C temperature differences.

A. *Noctiluca* accumulating at front



B. macroalgae patch and *Noctiluca*



Crustaceans and other larvae might benefit from these warm and sheltered little floating heated microcosms.

What are conditions at the surface?

Large *Noctiluca* bloom in South Central Basin and a coccolithophore bloom in Hood Canal. Macroalgae present on many beaches of South Sound, Central Sound, and Whidbey Basin. Macroalgae drifting at the surface of Port Madison, Southern Central Basin, and South Sound.

Start here

Macroalgae growing in Quilcene Bay

Dabob Bay with strong coccolithophore bloom

Front

Mixing and Fronts:
Tidal fronts visible in Dana Passage.

Jellyfish:
Occasional jellyfish patches in Hood Canal near Hamma Hamma River. No jellyfish patches seen in South Sound.

Plume

Suspended sediment:
Suspended sediments nearshore due to very low tides.

Bloom

Visible blooms:
Orange *Noctiluca* bloom in South Central Basin.
Turquoise coccolithophore bloom in Hood Canal.
Red-brown blooms in finger inlets of South Sound and Port Townsend Bay.

Debris

Debris:
Noctiluca bloom surfacing along Normandy Park, numerous macroalgae adrift in Central and South Sound.

Aerial photography and navigation guide

Date: 6-28-2018

Tide data from June 28, 2018 (Seattle):

	Height (ft)	High/Low
12:13 AM	7.03	L
04:47 AM	10.02	H
11:48 AM	-1.61	L
7:27 PM	11.42	H

Flight Information:

Low ceiling low visibility.

Flight routes

Skokomish River delta at very low tide exposing macroalgae.

Location: Union (Hood Canal), 12:06 PM

Hamma Hamma River delta at low tide exposing macroalgae. Stephen taking infrared images of estuaries.

Location: Eldon (Hood Canal), 12:13 PM

Duckabush River delta at very low tide exposing macroalgae. Turquoise coccolithophore bloom

Location: Duckabush River (Hood Canal), 12:18 PM

Dosewallips River delta at very low tide exposing macroalgae and green water.

Location: Dosewallips River (Hood Canal), 12:20 PM

Red-brown and warmer water (13.8 °C) with turquoise color meeting in Port Townsend Bay.

Location: Off Indian Island (North Sound), 12:34 PM

Kelp beds north of coast, off Fort Worden State Park.

Location: Fort Worden State Park (Admiralty Reach), 12:37 PM

Aerial photography 6-28-2018

Macroalgae growing in large mats on beaches north of Langley.

Location: Saratoga Passage (Whidbey Basin), 12:56 PM

Macroalgae mats on beaches and drifting in Port Madison.

Location: Port Madison (Central Sound), 1:11 PM

Large ribbons of Noctiluca accumulating at the surface and beaches.

Location: Three Tree Point (Central Sound), 1:29 PM

Noctiluca accumulating at the surface and beaches.
Location: Normandy Park (Central Sound), 1:46 PM

Ribbons of Noctiluca accumulating at beaches from Normandy Park to Des Moines.

Location: Normandy Park and Des Moines (Central Sound), 1:29 PM

Large ribbons of Noctiluca accumulating at the surface.

Location: Off Chautauqua, Vashon Island (Central Sound), 1:30 PM

Large ribbons of Noctiluca and macroalgae accumulating at the surface.

Location: Poverty Bay (Central Sound), 1:34 PM

Aerial photography 6-28-2018

Front off Piner Point and sediment-rich water from the Puyallup River plume.

Location: Maury Island (Central Sound), 1:36 PM

Macroalgae growing in large mats on northern beaches of McNeil Island.
Location: McNeil Island (South Sound), 1:46 PM

Macroalgae drifting in mats south of McNeil Island.
Location: McNeil Island (South Sound), 1:16 PM

Red-brown bloom next to tidal front. Floating macroalgae mats.

Location: Dana Passage (South Sound), 1:53 PM

Red-brown bloom. No jellyfish. Macroalgae on beaches.

Location: Eld Inlet (South Sound), 1:57 PM

Red-brown bloom. Location: Eld Inlet (South Sound), 2:00 PM

Aerial photography 6-28-2018

Red-brown bloom. Location: Budd Inlet (South Sound), 2:00 PM

Find past editions of EOPS with images on last pages

We have published 74 editions!

Find all previous Eyes Over Puget Sound editions at the end of this document.

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Environmental Assessment Program
WA Department of Ecology

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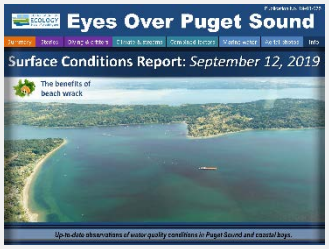

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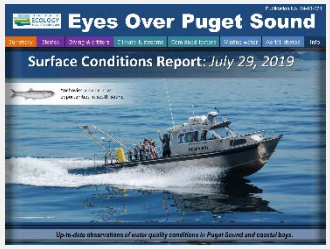

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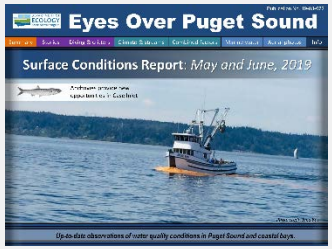

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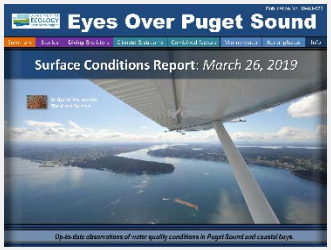

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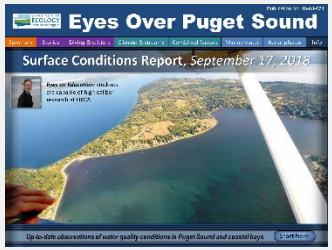

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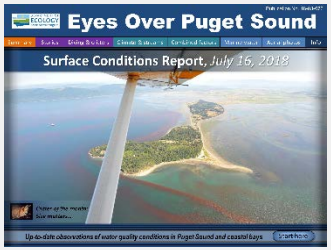

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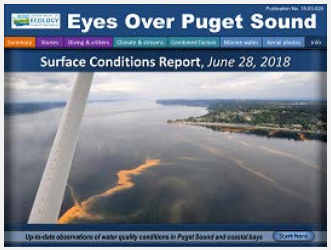

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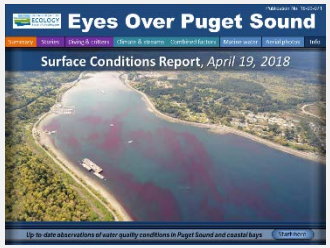

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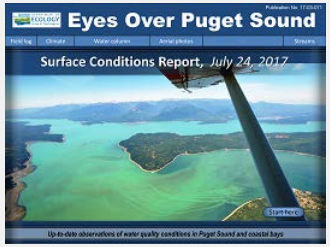

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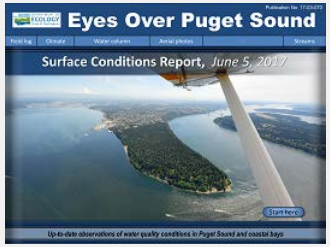

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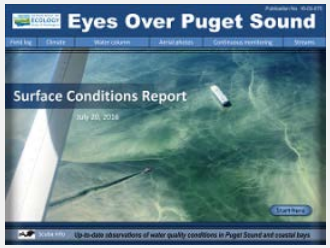

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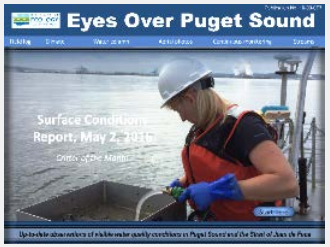

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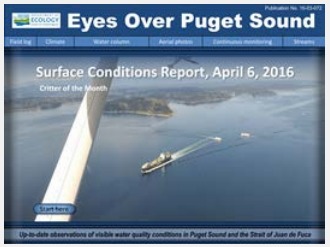

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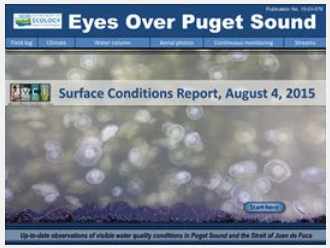

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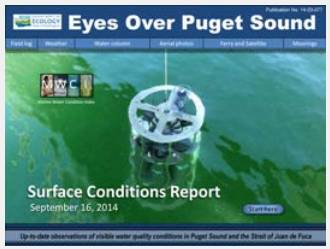

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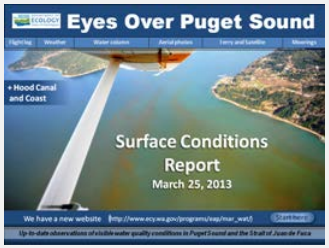

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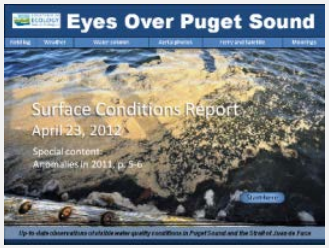

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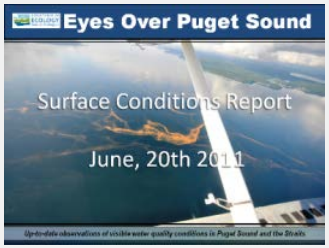

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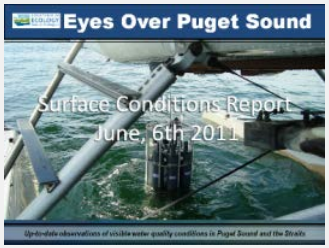

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