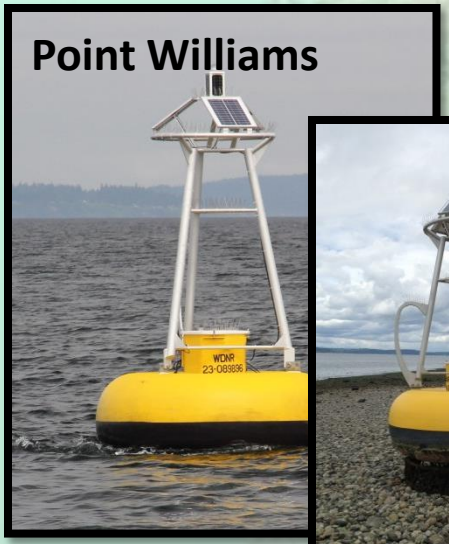
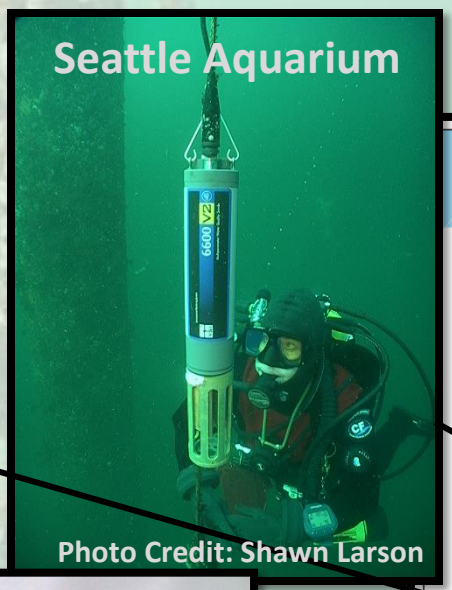
Marine moorings in Elliott Bay:
What you didn't know you were missing

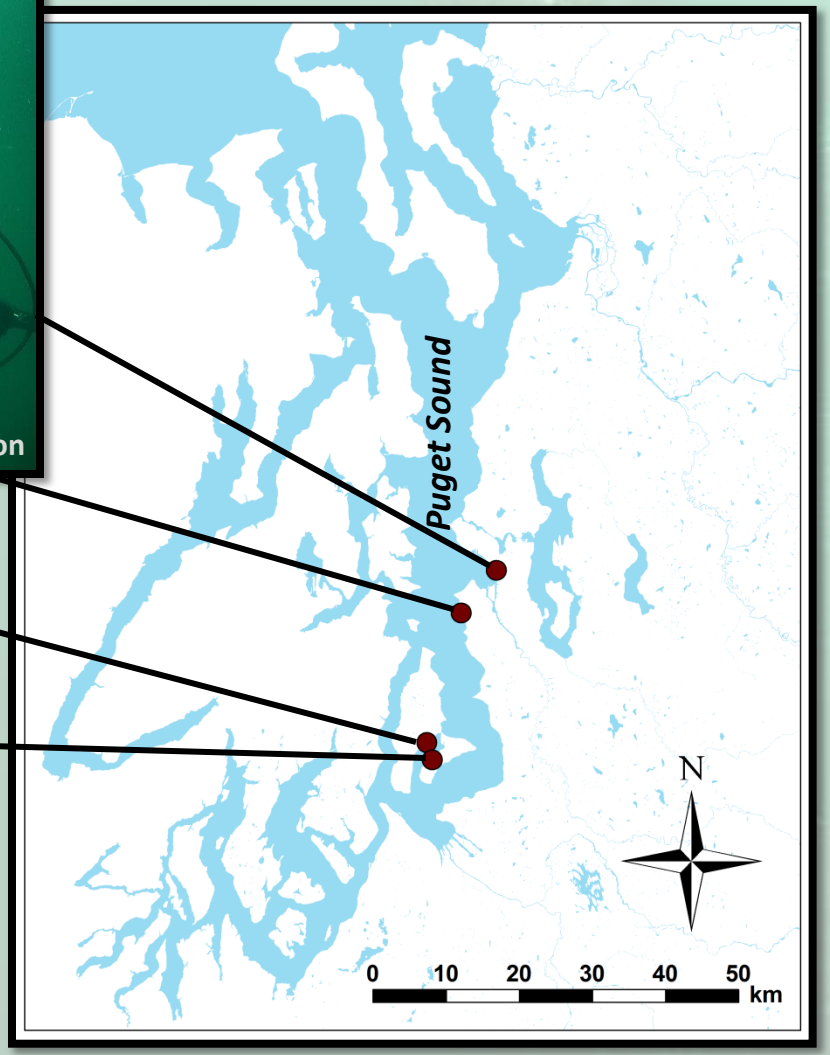
Wendy Eash-Loucks

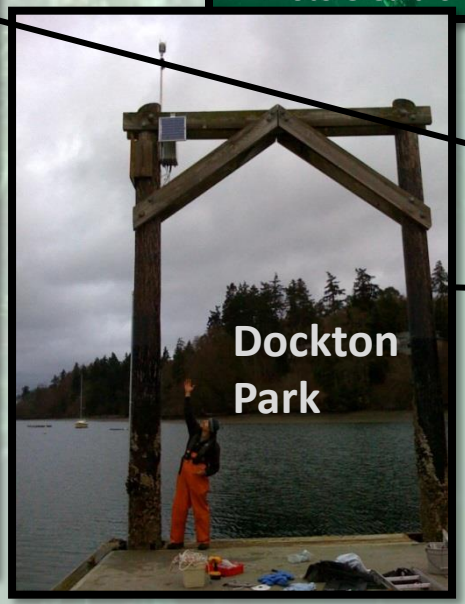
King County, Marine and Sediment Assessment Group

King County Moorings









Mooring System

YSI 6600EDS V2 datasondes

- Depth
- Water Temperature
- Conductivity
- Salinity
- Dissolved Oxygen
- pH
- Chlorophyll
- Turbidity

Valsala WXT510 meteorological station

- Air Temperature
- Wind Speed
- Wind Direction
- Relative Humidity
- Rainfall
- Pressure
- Radiation

Satlantic SUNA sensor

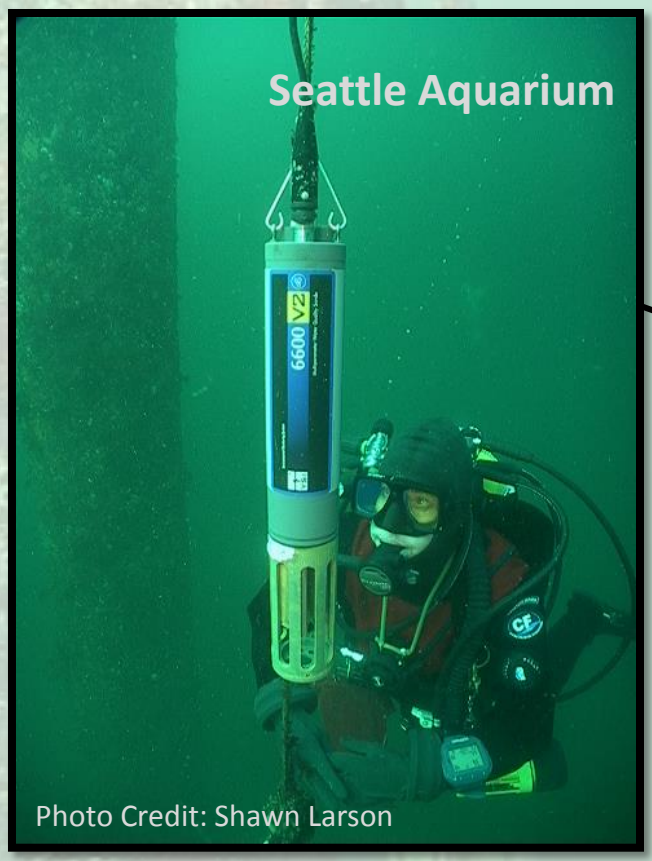
- Nitrate-N

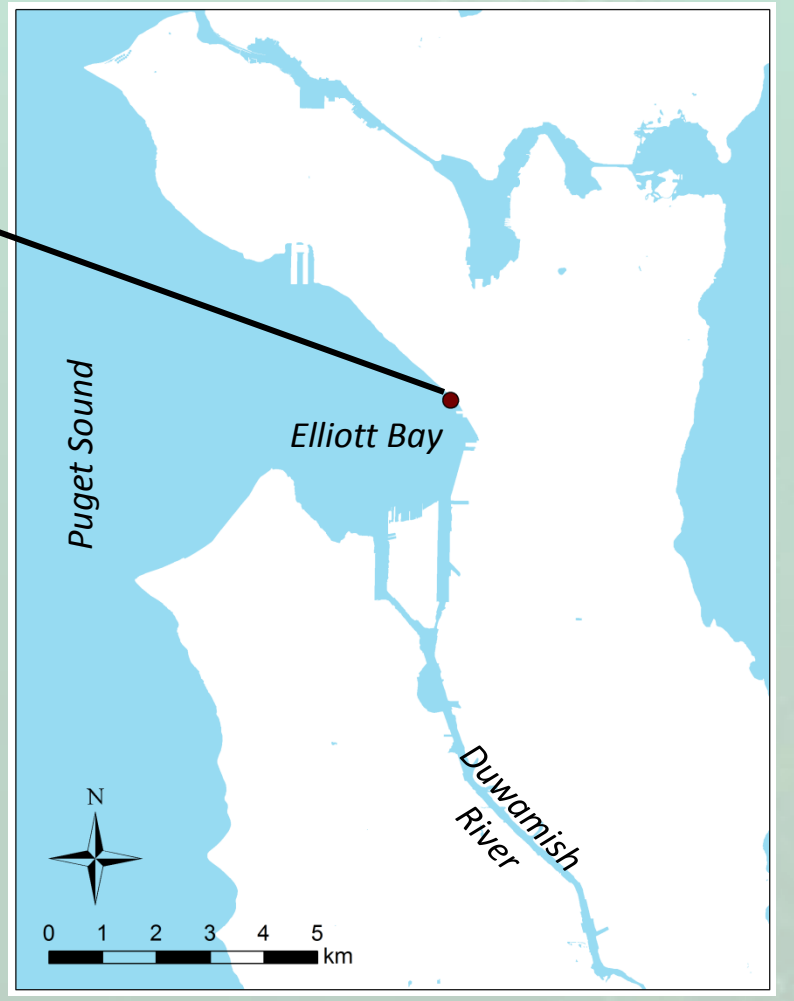
YSI EcoNet data acquisition system

Why Use Moorings?

- Supplements monthly/bimonthly monitoring data with near-continuous data
  - 15-minute intervals
- Records water conditions when we can't
- Cost-effective and efficient
  - Monthly calibration
- Provide public with near-real-time water quality data

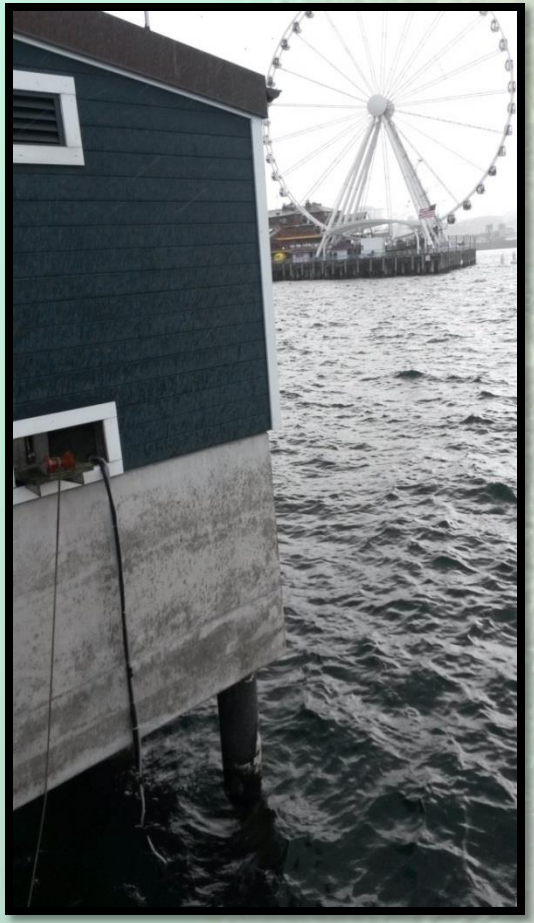
Elliott Bay Seattle Aquarium Mooring





Pilot Project – November 2005

Current System Online – January 2008



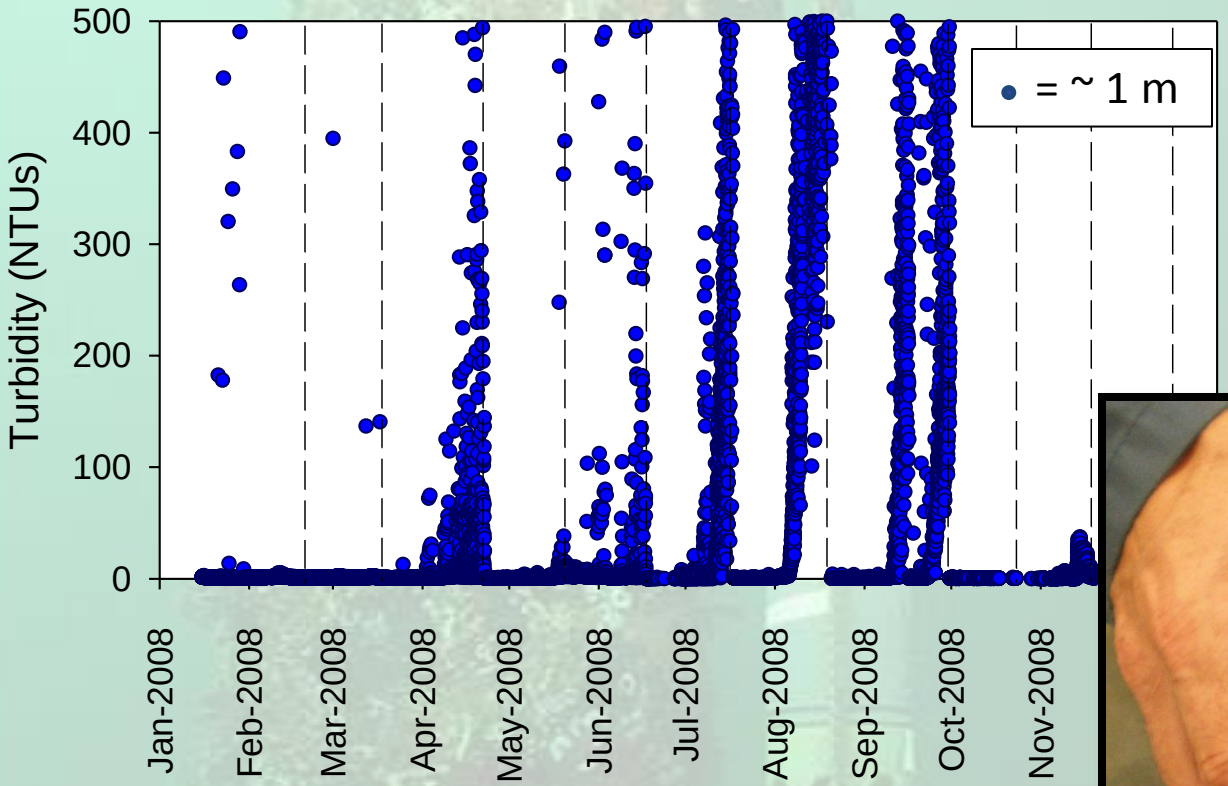
Goals:

- Real-time water quality data
  - Provide Seattle Aquarium with data from intake
  - Provide public with Elliott Bay water quality data
- Observe seasonal water quality trends
- Evaluate influence of Duwamish River

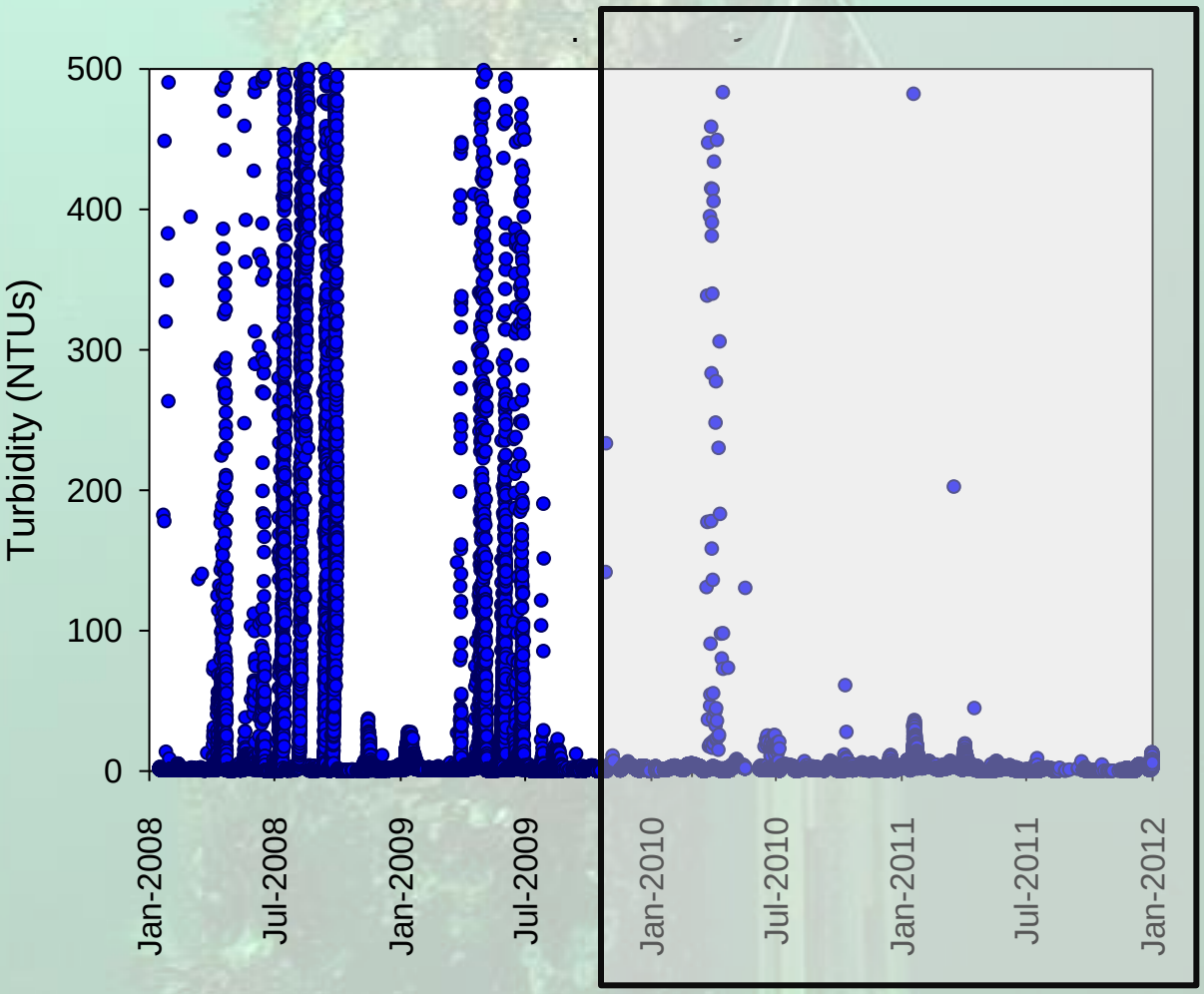
Issues: Bio-fouling

- Make data un-useable
  - Turbidity
  - Chlorophyll

Fouling vs Sensors

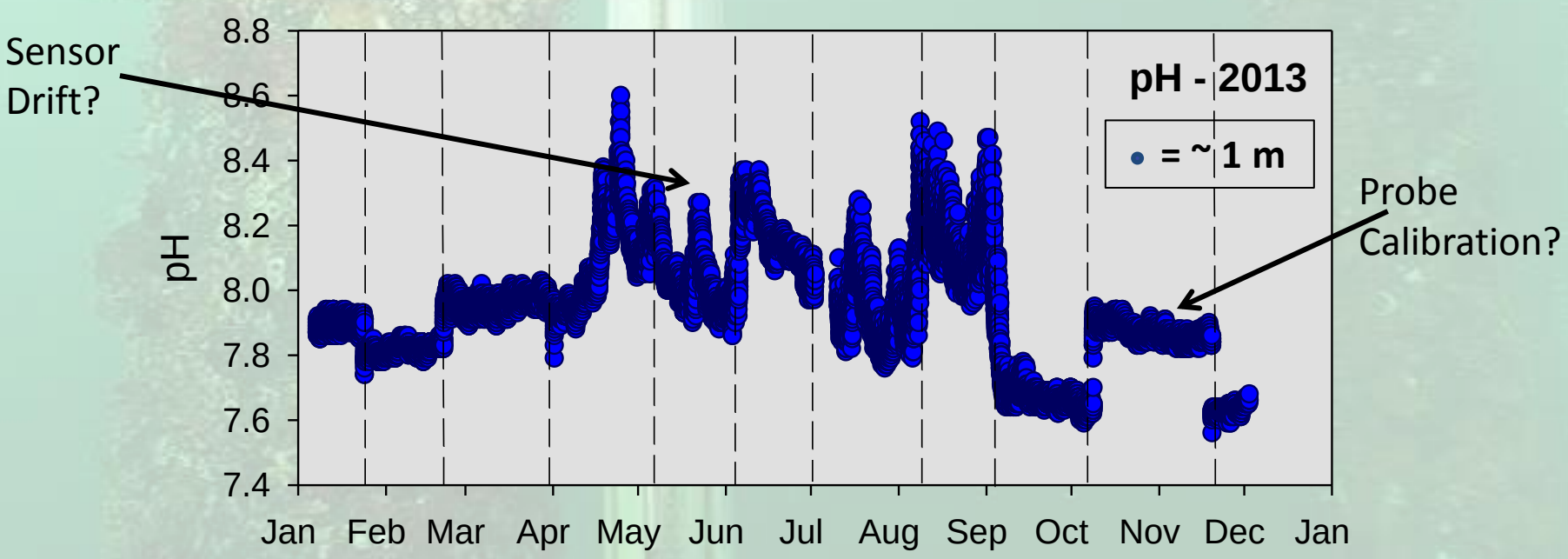


Combat Fouling with Copper!



Issues: pH Data

- Still having problems with drift in pH between deployment and sonde/probe specificity despite passing post-calibration QC checks

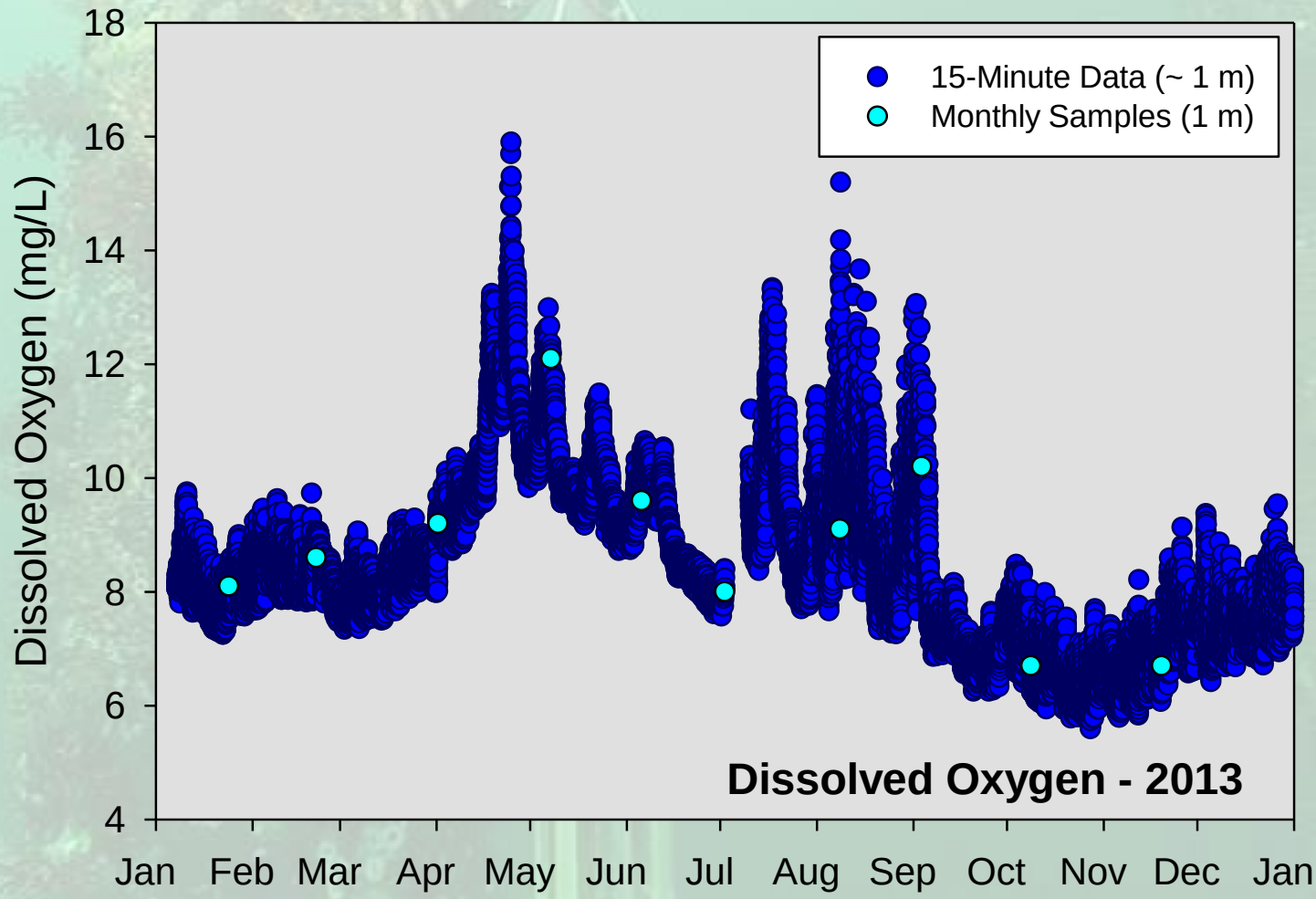


- We can't monitor for ocean acidification with current accuracy of probes

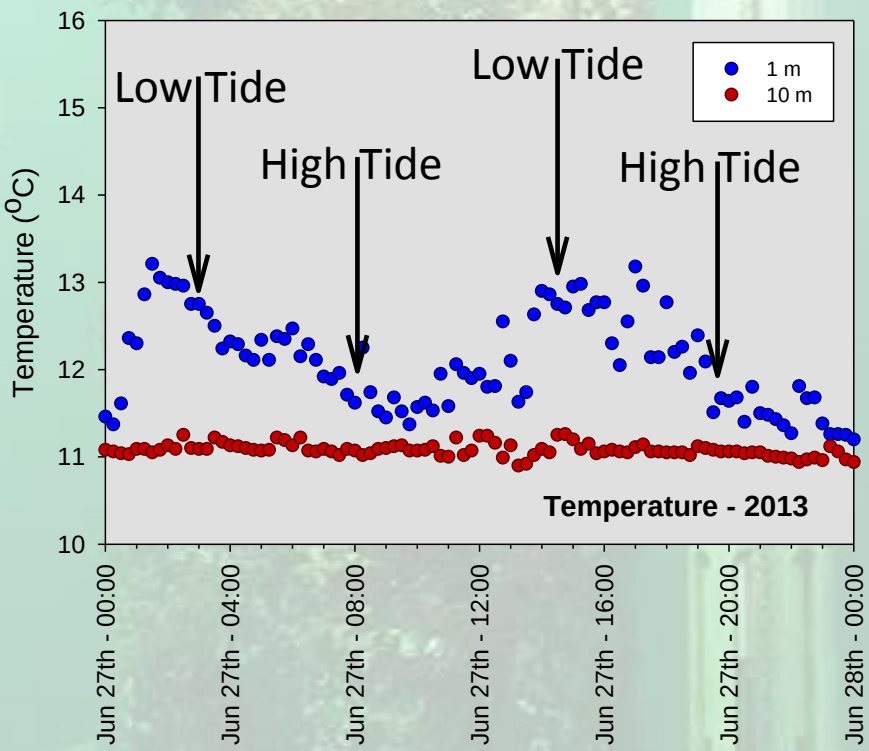
The Data

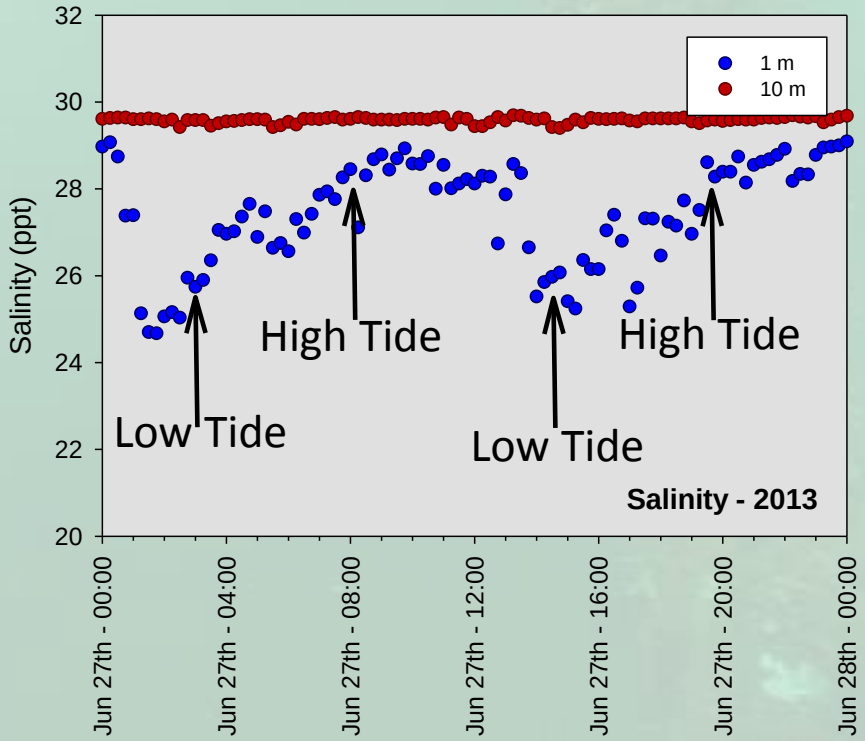
- Real-time water quality data
- Seasonal/inter-annual trends
- Evaluate influence of Duwamish River

Fine-Resolution Data = More Data!



Fine-Resolution Data: What's Going on During the Day (and Night)?

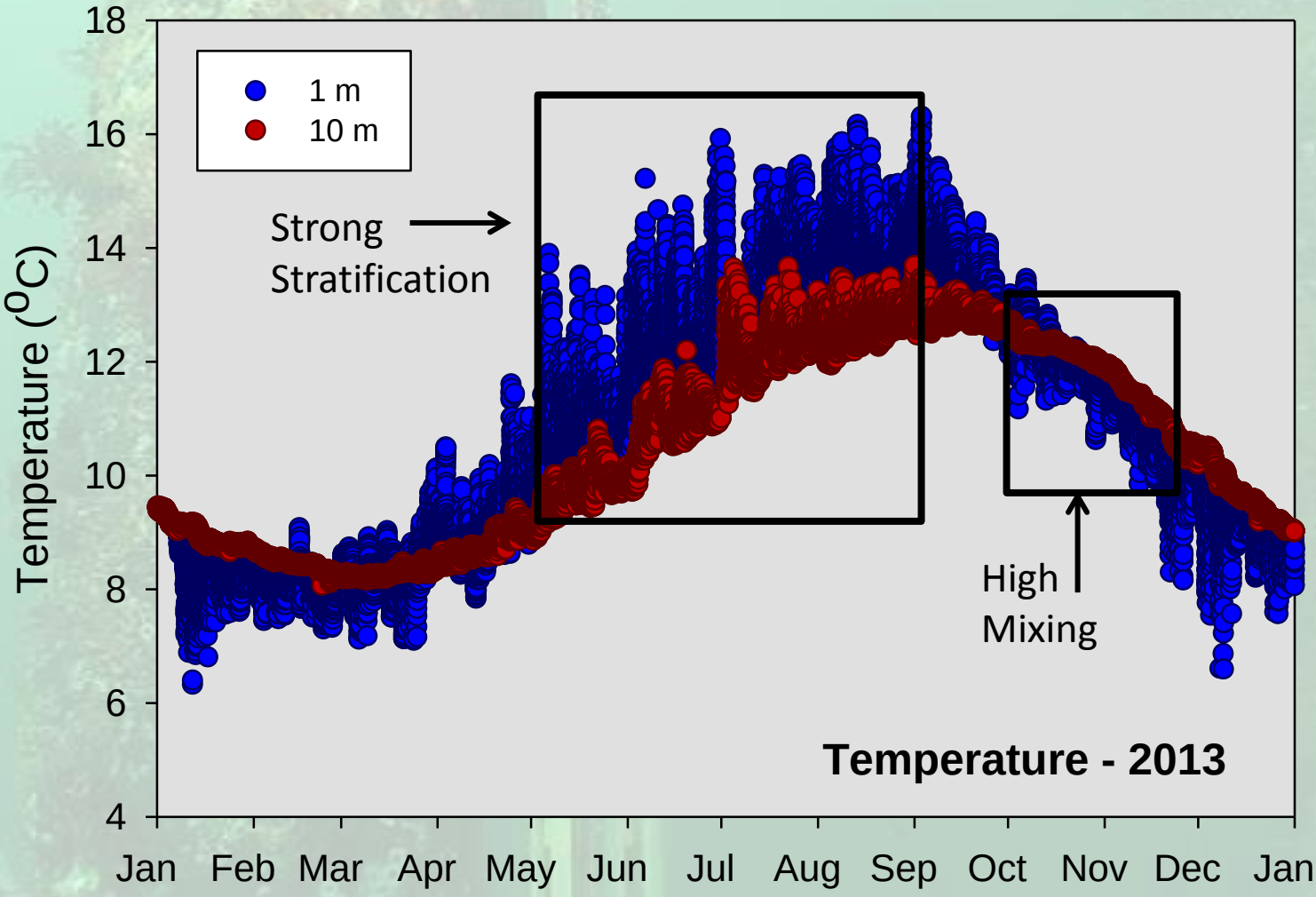




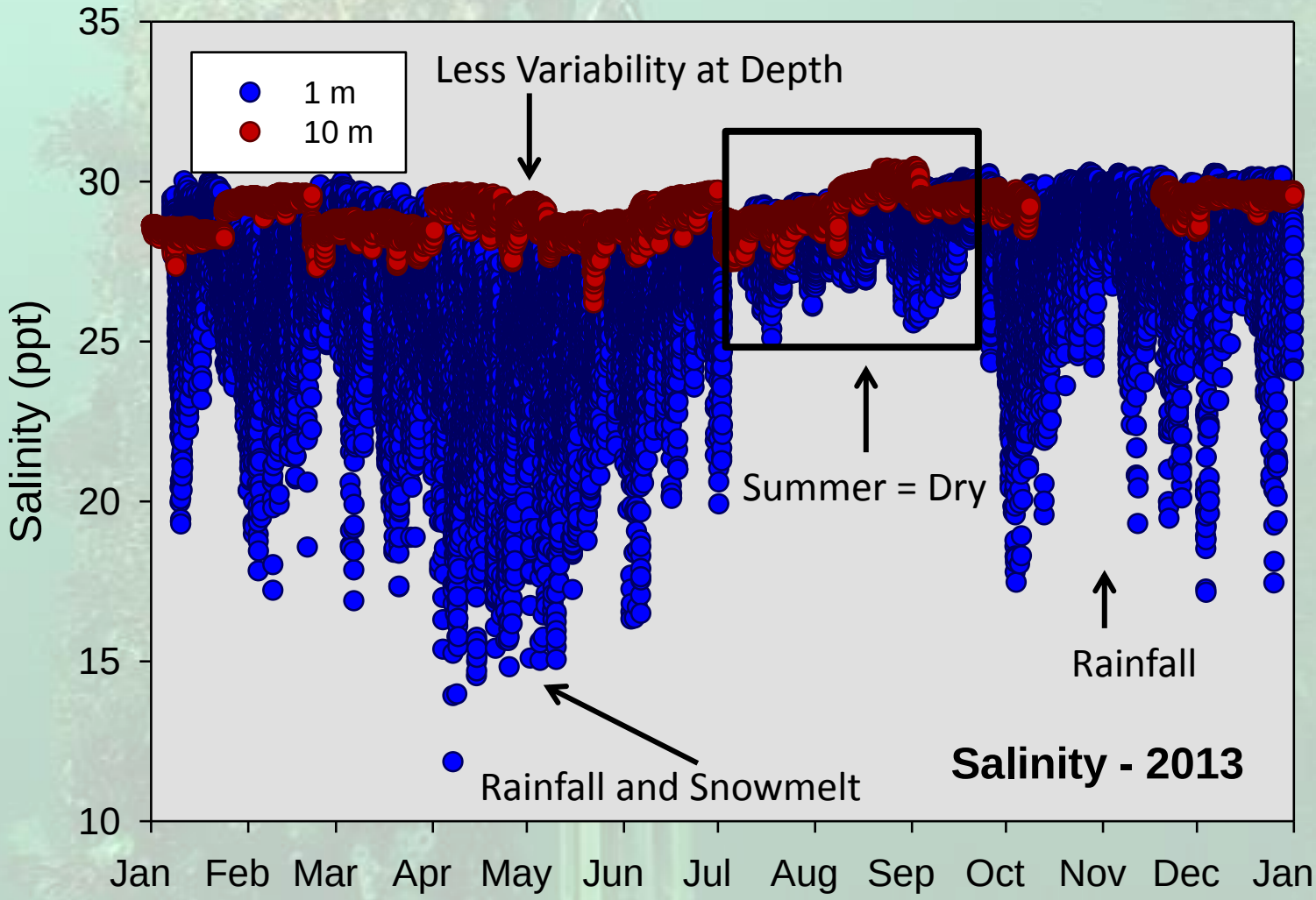
The Data

- Real-time water quality data
- Seasonal/inter-annual trends
- Evaluate influence of Duwamish River

Seasonal Trends



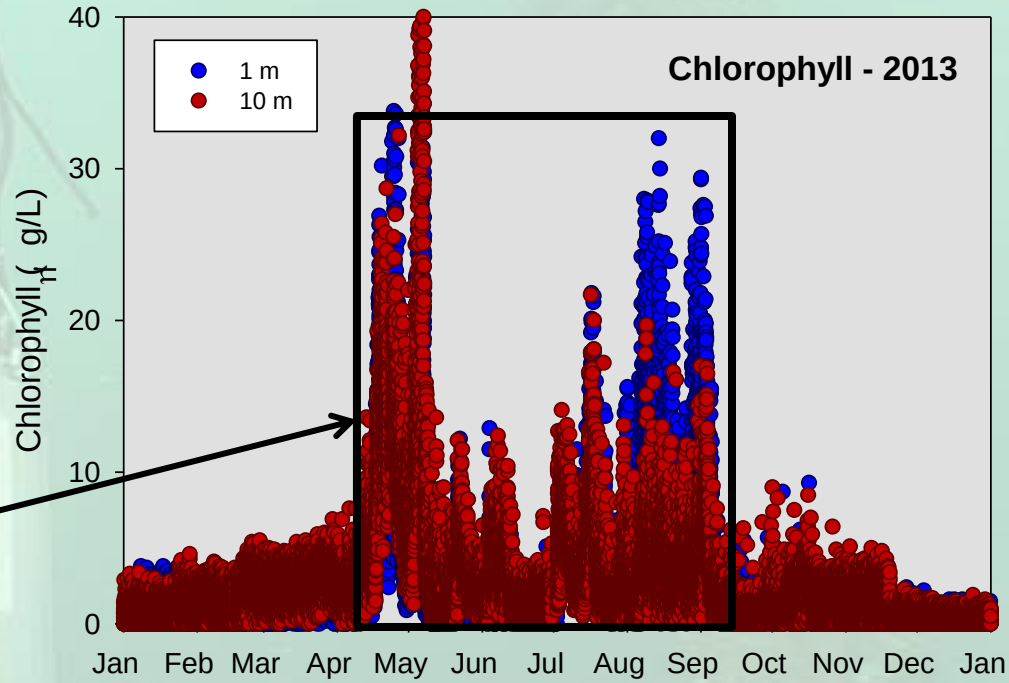
Seasonal Trends

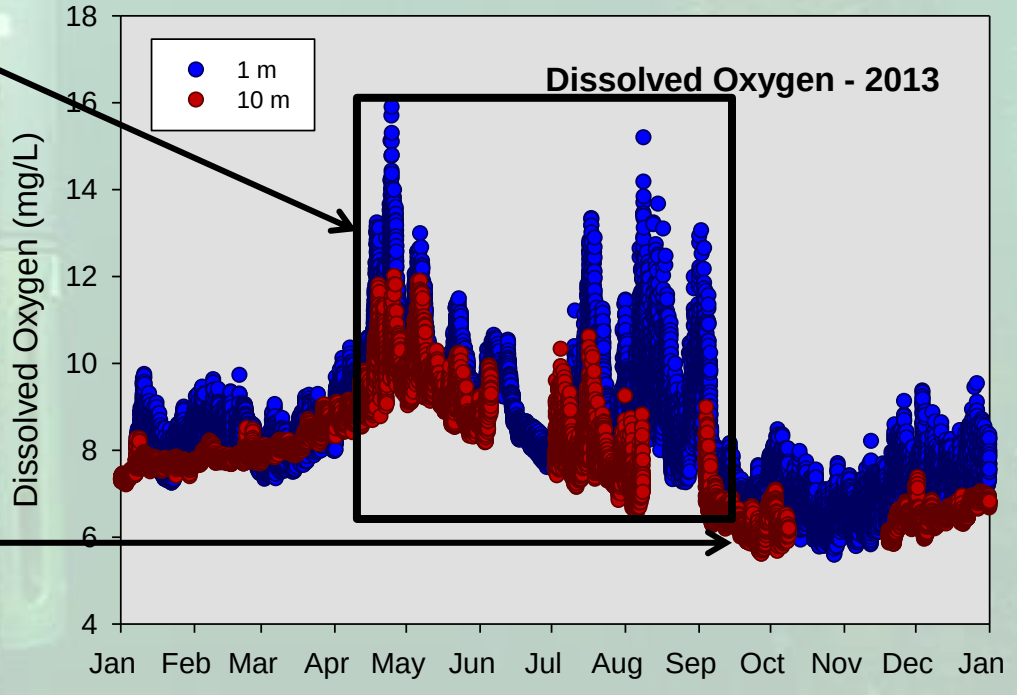


Seasonal Trends

Chlorophyll and DO are highest in early spring through late fall

Upwelling of deep water





The Data

- Real-time water quality data
- Seasonal/inter-annual trends
- Evaluate influence of Duwamish River

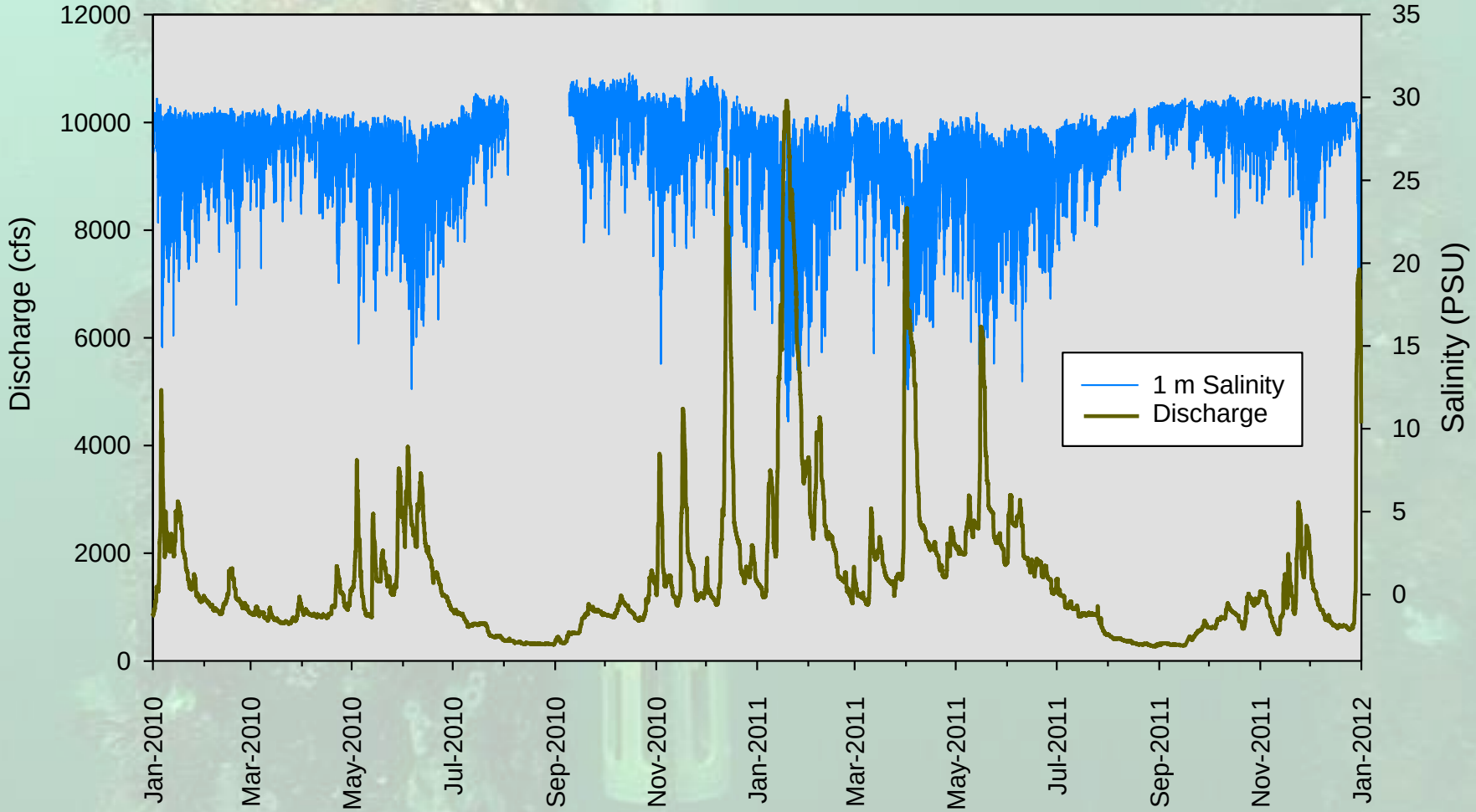
Influence of the Duwamish River

“Typical” Elliott Bay

Elliott Bay after heavy rains/ river discharge

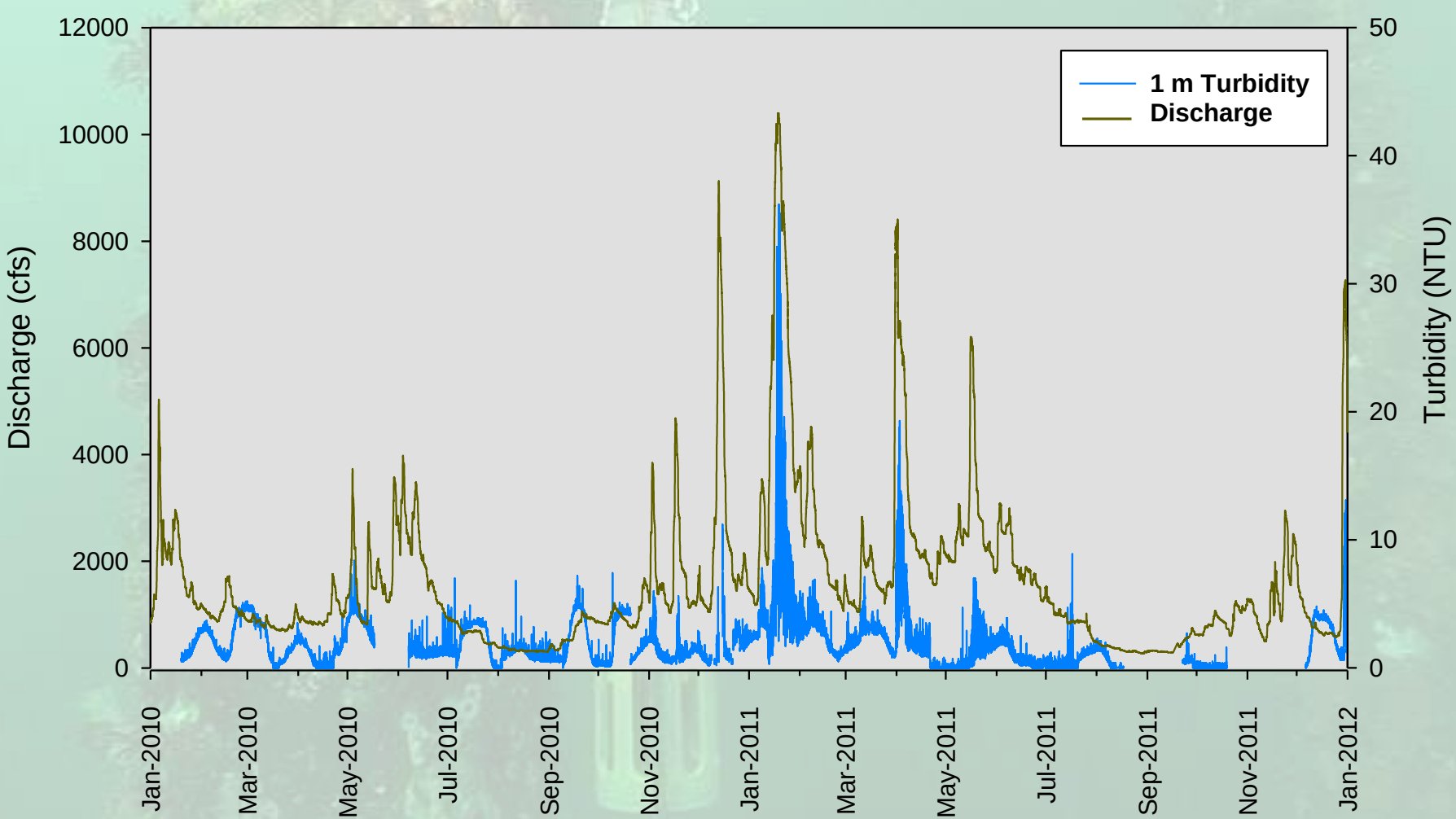
Influence of the Duwamish River

Salinity

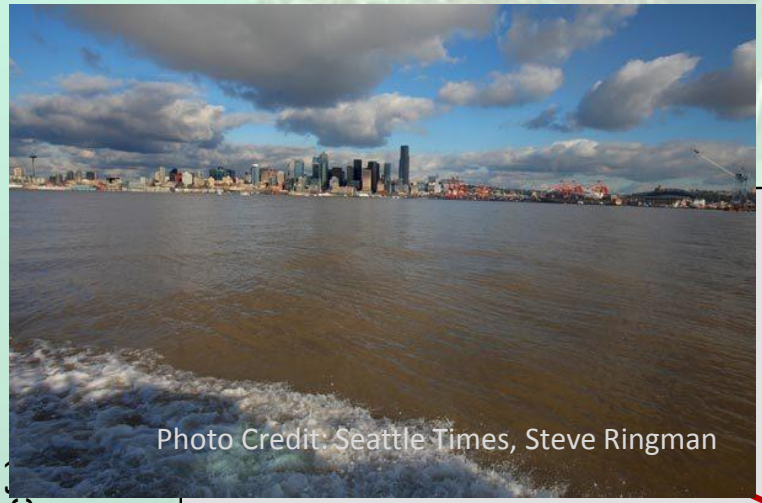


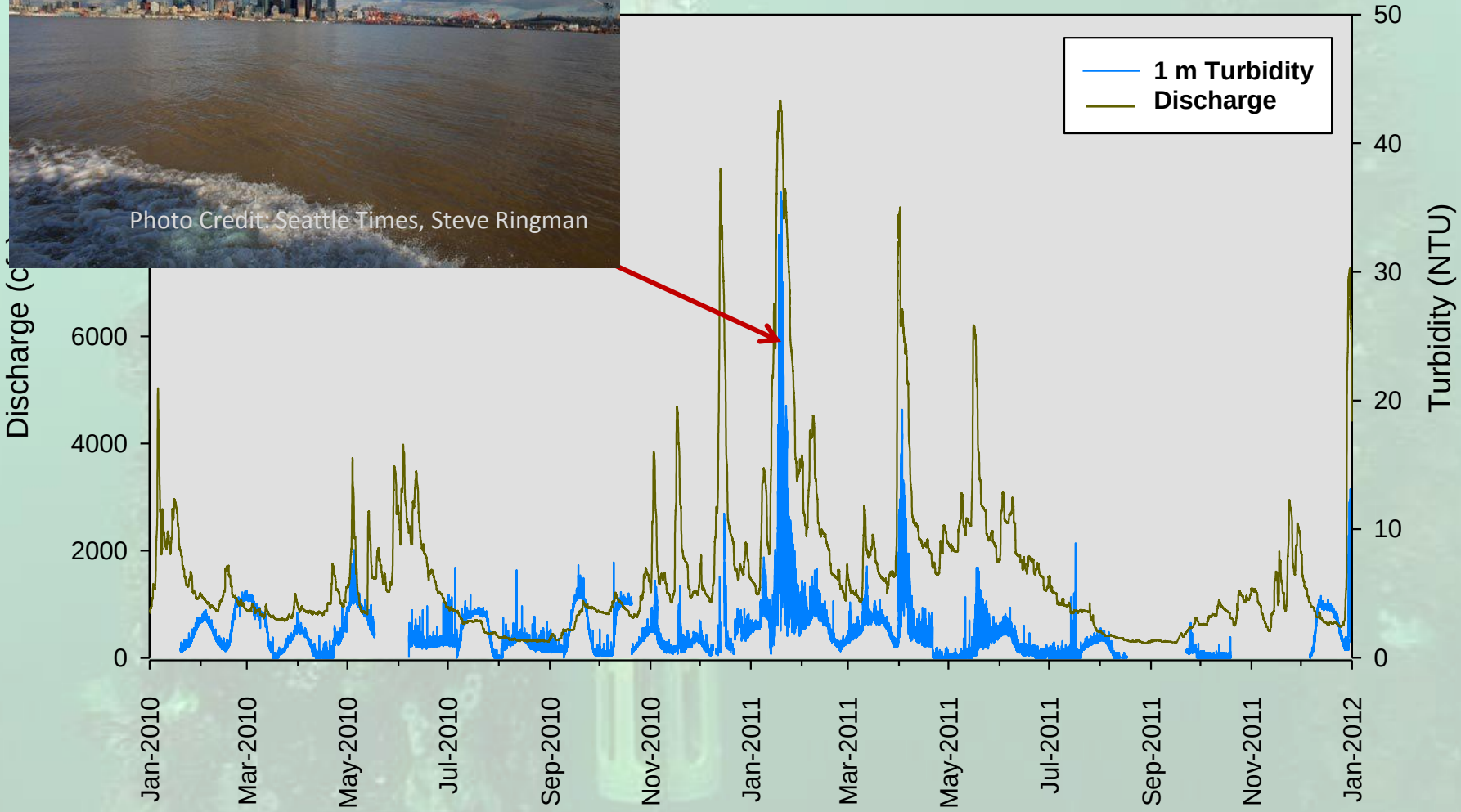
Influence of the Duwamish River

Turbidity



Influence of the Duwamish River





Future Uses of Data

- What conditions are ideal for phytoplankton blooms
- Conditions that biological communities are exposed to (fish, benthos, plankton…)
- Evaluate long-term trends
  - Changes in temperature
  - Changes in timing of upwelling/de-stratification
  - Changes in timing of first bloom
- Education programs

Where are the Data?

- King County

https://green2.kingcounty.gov/marine-buoy/default.aspx

- NANOOS

http://nvs.nanoos.org/Explorer?action=oiw:fixed_platform:KC_SEAQYSI:observations:H1_CO2:30d

Acknowledgements

- Seattle Aquarium
  - Shawn Larson
- King County Environmental Lab
  - Field Science Unit
    - Bob Kruger
    - Jim Devereaux
    - David Robinson
    - Stephanie Hess
    - Christopher Barnes
- NANOOS
- King County's Marine and Sediment Assessment Group
  - Kim Stark and Amelia Kolb

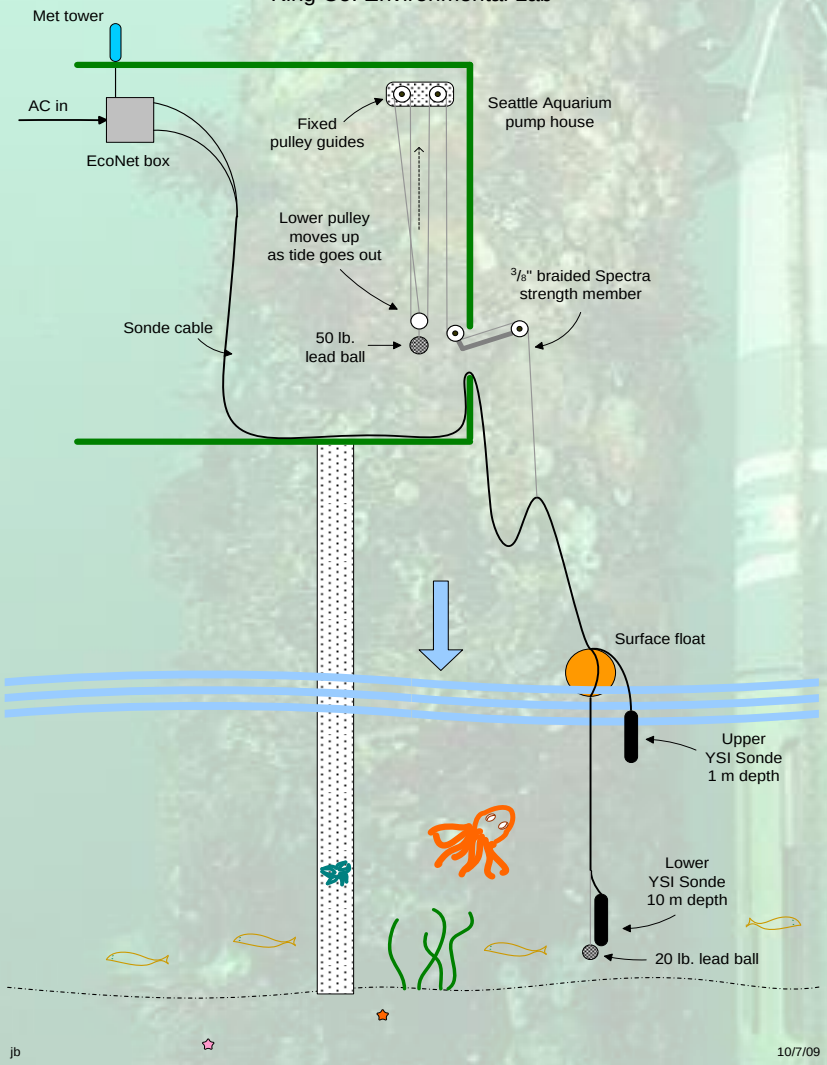
Questions?

Instrument Performance

Parameter	Range	Resolution	Accuracy
Temperature (°C)	-5 to 50	0.01	+/- 0.15
Conductivity (mS/cm)	0 to 100	0.001 to 0.1	+/- 0.5% of reading
Salinity (PSS)	0 to 70	0.01	0.1
Depth (m)	0 to 61	0.001	+/- 0.12
Dissolved Oxygen (mg/L)	0 to 50	0.01	+/- 0.1
Turbidity (NTU)	0 to 1,000	0.1	0.3
pH	0 to 14	0.01	+/- 0.2
Chlorophyll (µg/L)	0 to 400	0.1	Detection Limit – 0.1

Schematics

Seattle Aquarium YSI Buoy Design
at Low Tide
~King Co. Environmental Lab~



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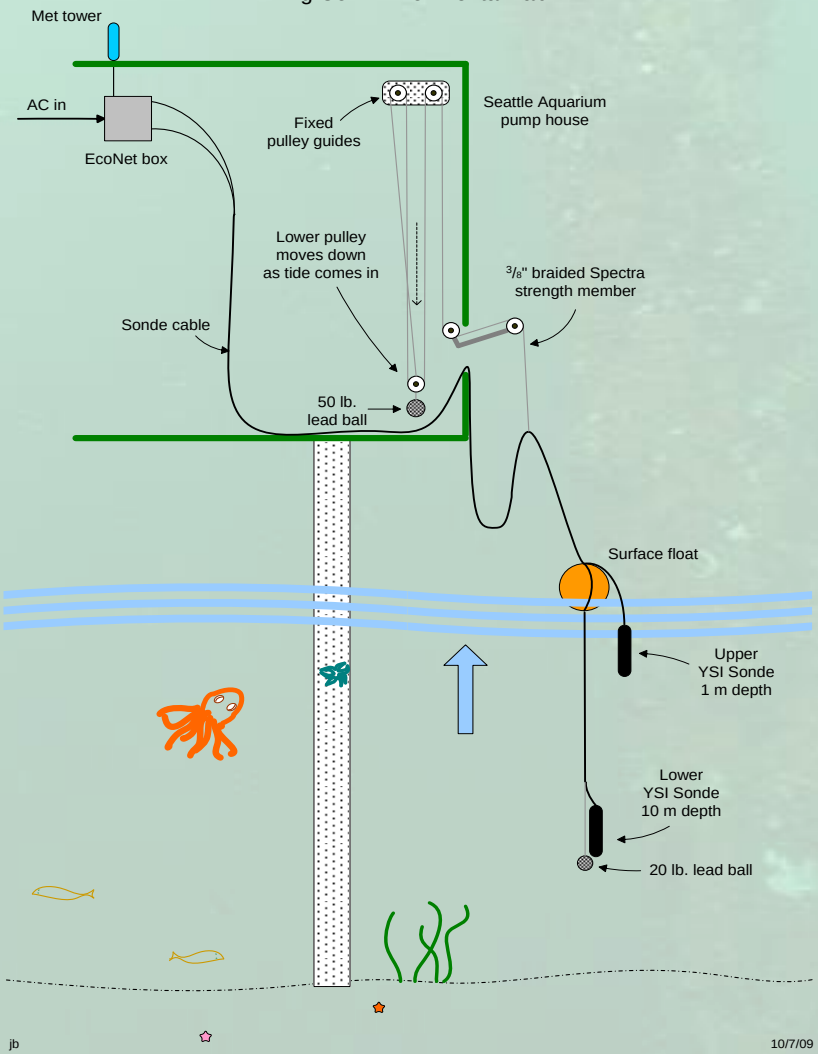
10/7/09

Seattle Aquarium YSI Buoy Design
at High Tide
~King Co. Environmental Lab~



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