

Use of real-time data to monitor the biogeochemistry and plankton ecology of the lower Columbia River

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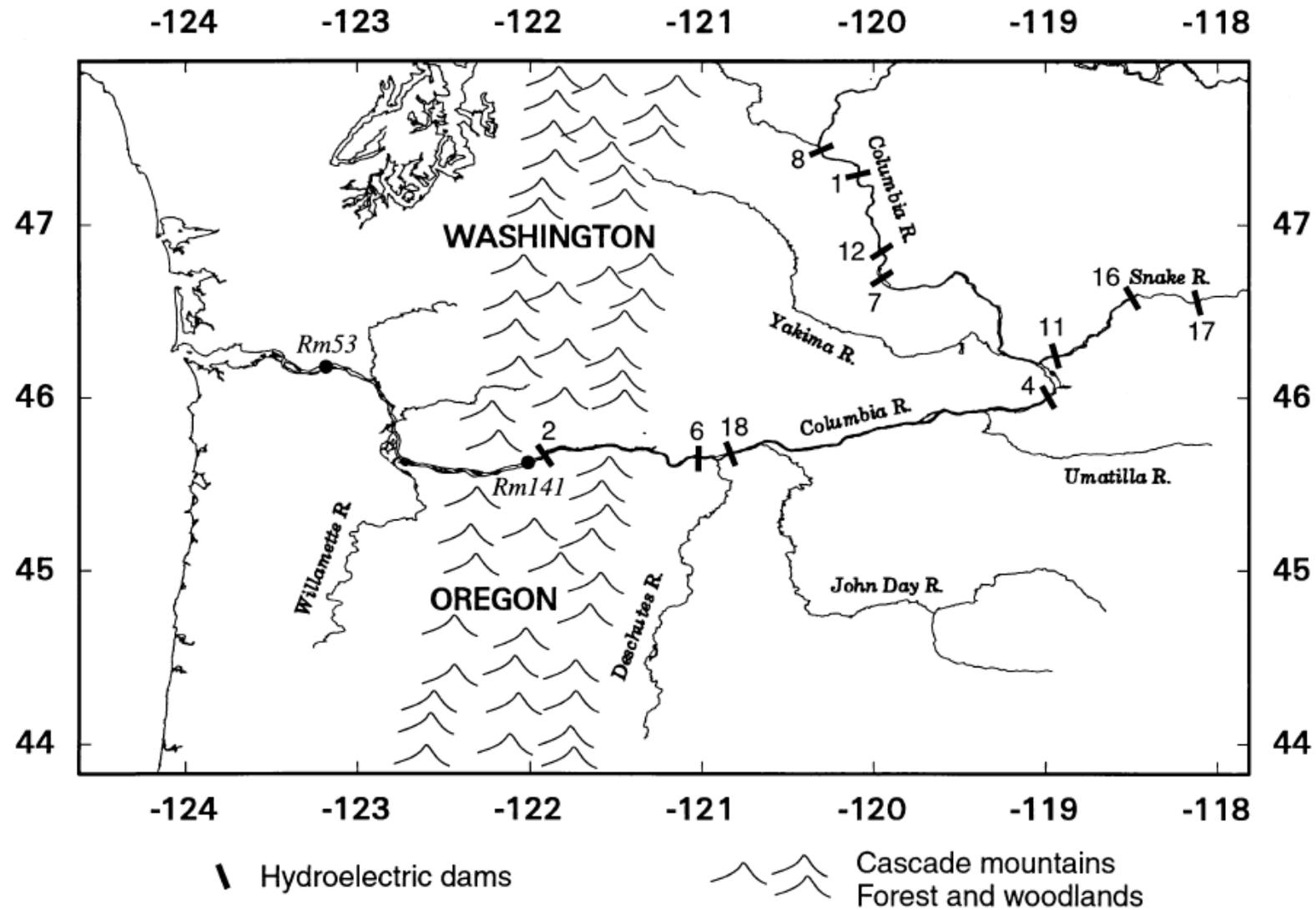


- 2 years (2009-2011) of high resolution biogeochemical data from the lower Columbia River
- What we've learned from the real-time data
- How we use the real-time data to target sampling efforts to study plankton ecology

Background: Columbia River Basin

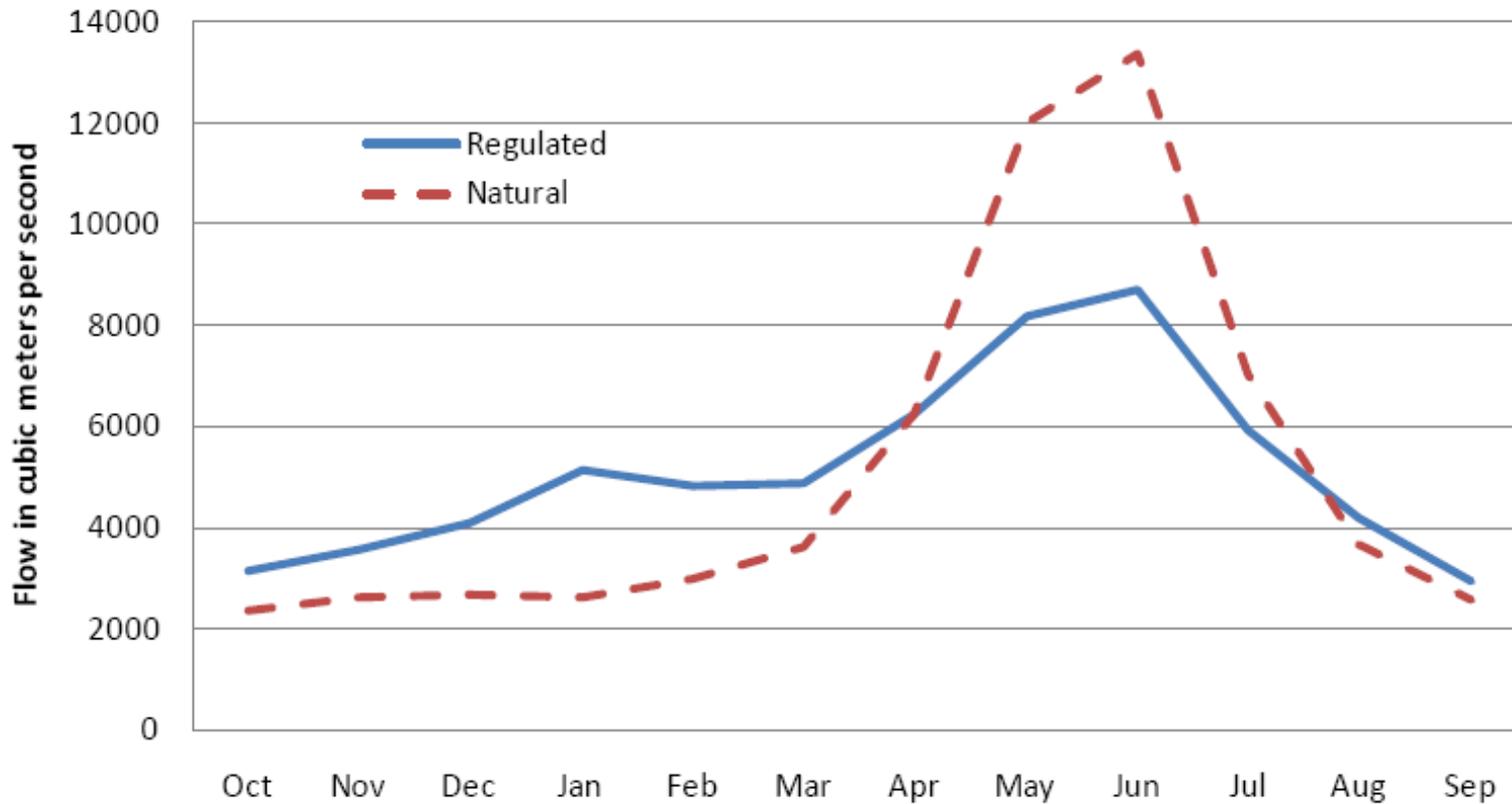


Historical Changes to the Columbia River



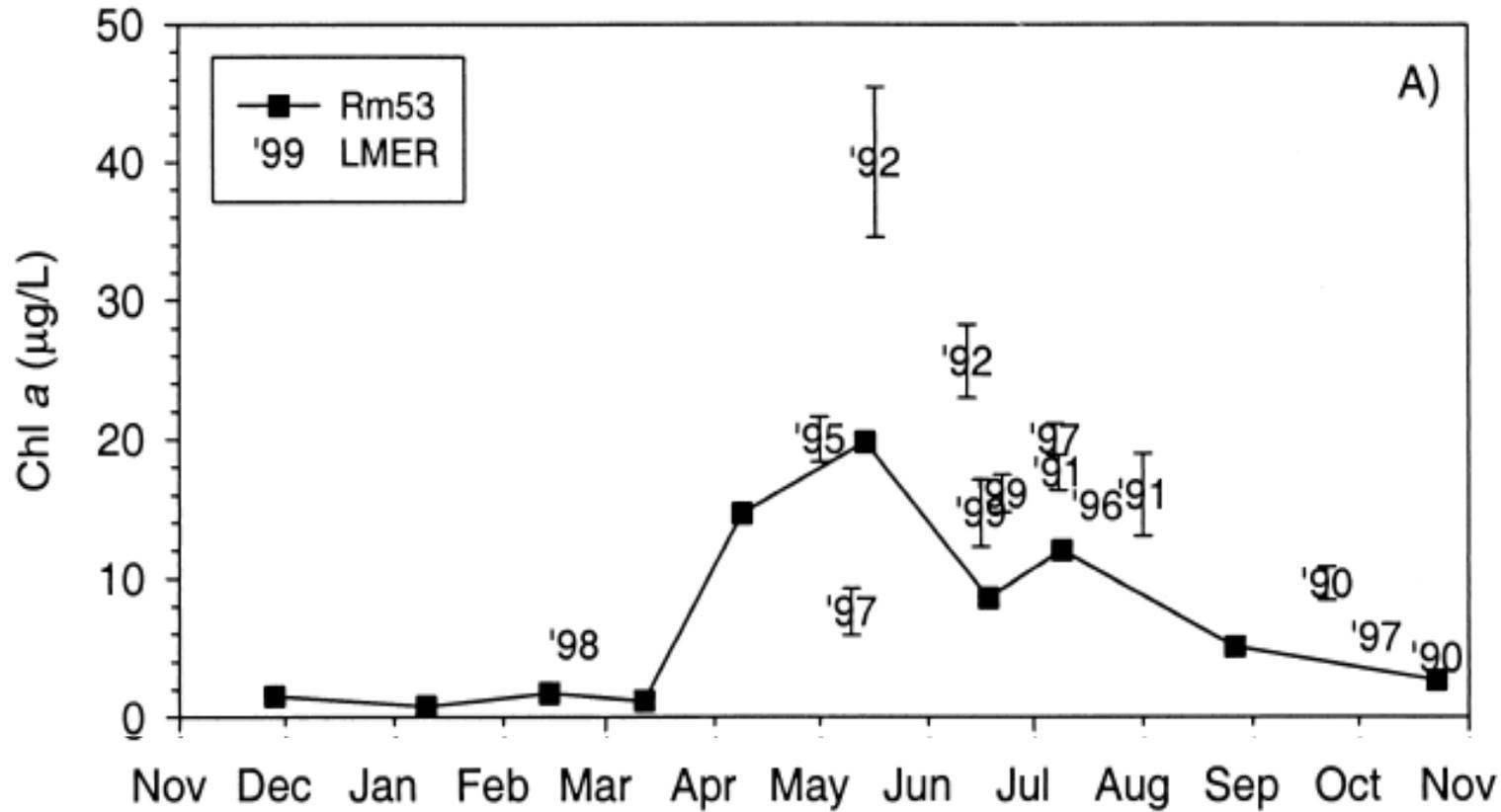
Historical River Flow

Regulated and Natural Flows at The Dalles Dam



*Independent Scientific Advisory
Board for the Northwest Power
and Conservation Council,
Columbia River Basin Indian Tribes,
and NOAA Fisheries 2011*

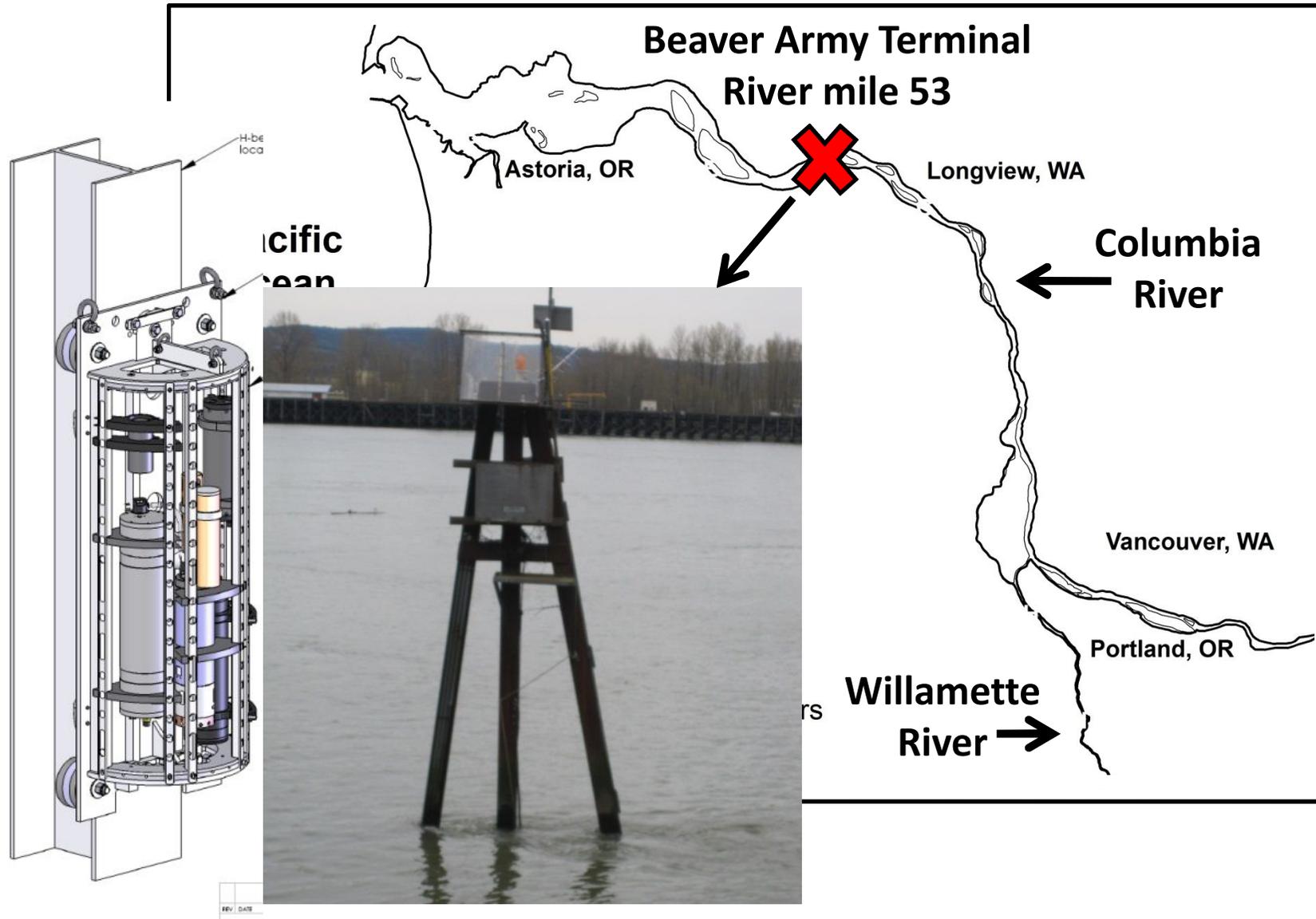
“Greening” of the River



Motivation for high resolution data

- Historical change in dominant primary producers from vascular plants to fluvial phytoplankton ('greening' effect)
- Track drivers of chlorophyll production and plankton assemblages
- Monitor water quality and influence of Willamette River discharge

Columbia River Biogeochemical Sensors



Land/Ocean Biogeochemical Observatory (LOBO) Sensor Platform

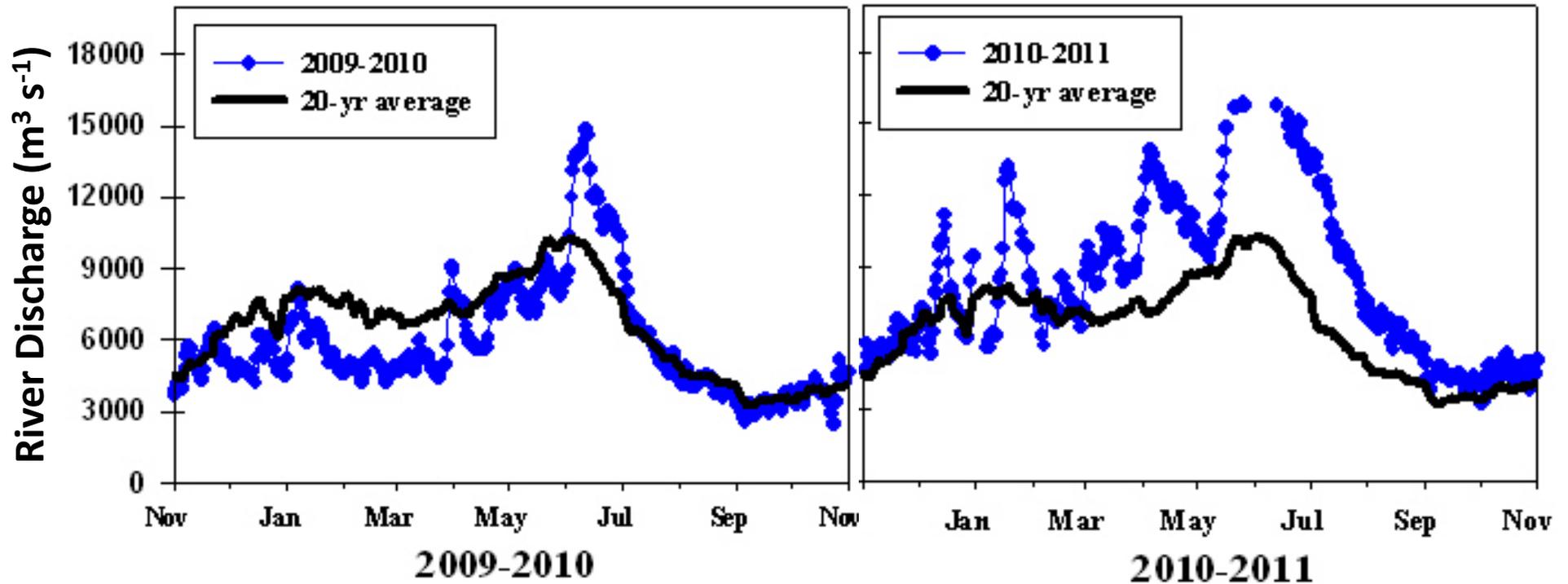
Sensors deployed June 23, 2009

<http://columbia.loboviz.com>

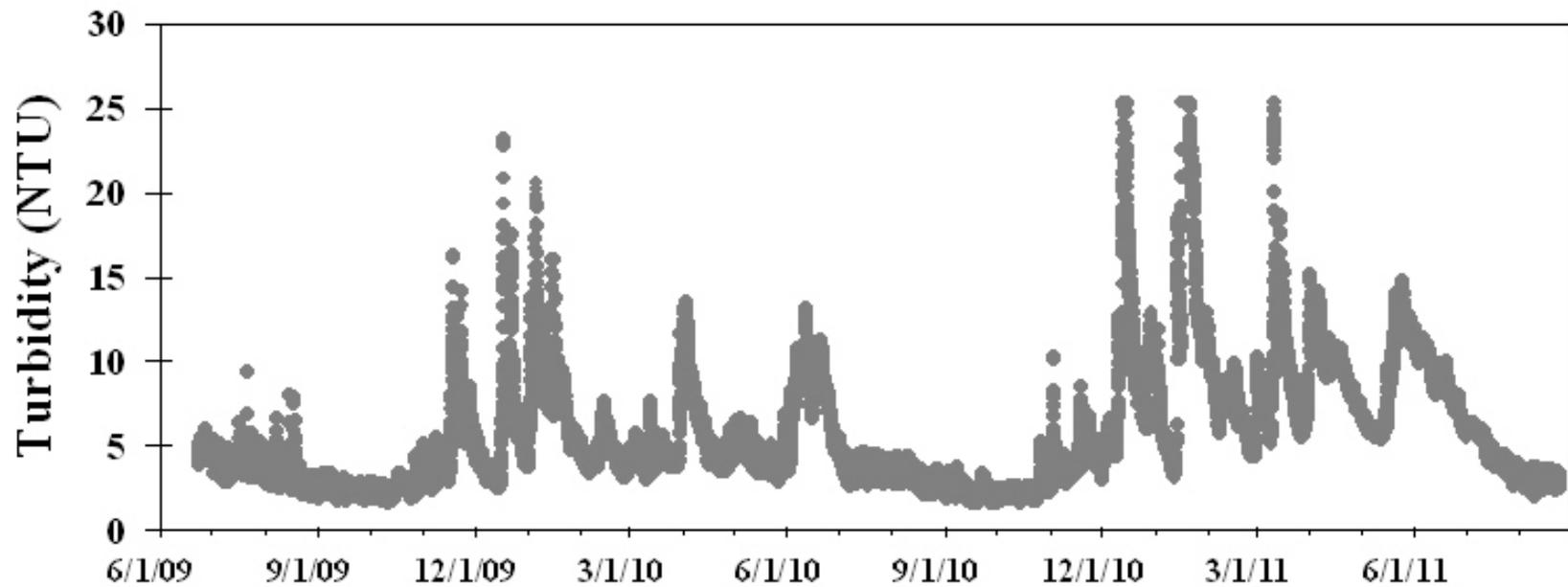
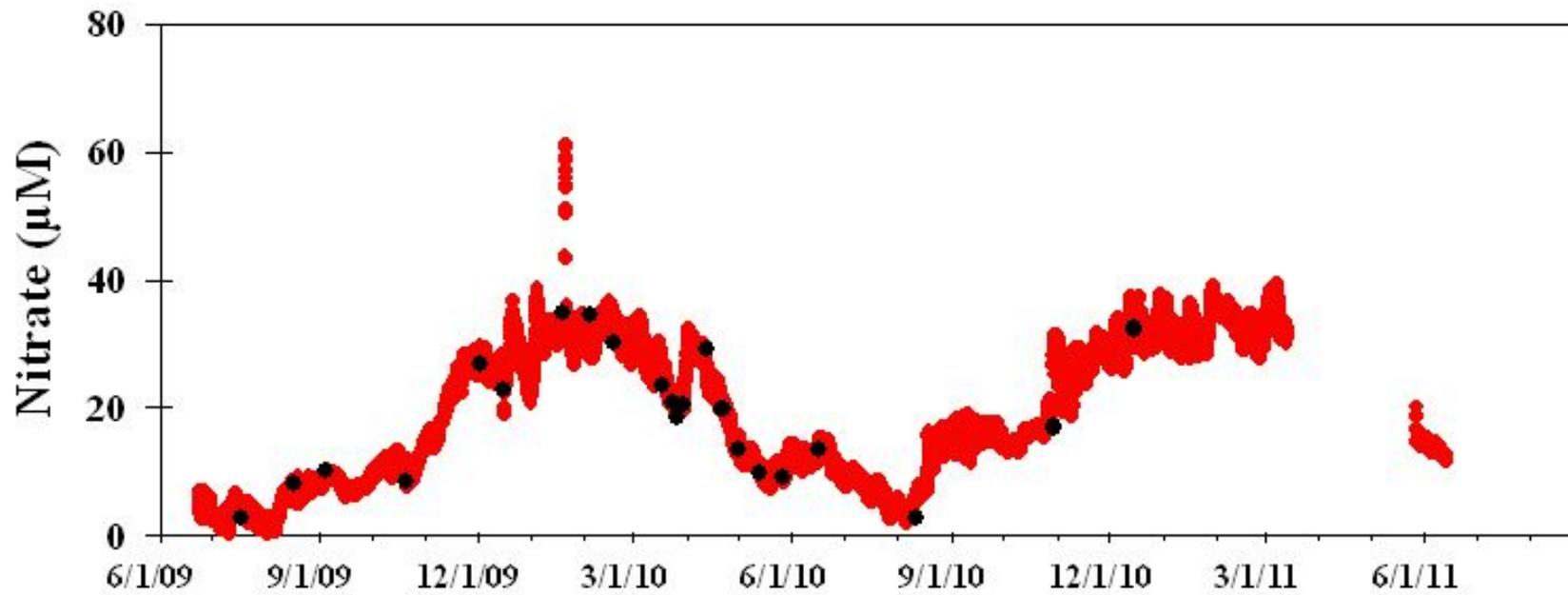
- Water Quality Monitor (WETlabs, Inc.)
 - Chlorophyll
 - Turbidity
 - Dissolved oxygen
 - Temperature
- SUNA nitrate sensor (Satlantic)
 - UV-Nitrate sensor
- CDOM Fluorometer (WETlabs, Inc.)
 - Colored Dissolved Organic Matter

Latest		
Lower Columbia River		
2012-04-06 12:00:00 PST		
CDOM	24.66	QSDE
Chlorophyll	2.61	µg/L
Conductivity	0.0084	S/m
Depth	4.317	m
Dissolved O ₂	9.23	ml/l
Nitrate	29.6	µM
O ₂ Saturation	8.39	ml/l
O ₂ % Saturation	110.0	%
Salinity	0.06	PSU
Temperature	7.44	°C
Turbidity	10.57	NTU
Battery Voltage	14.2	V

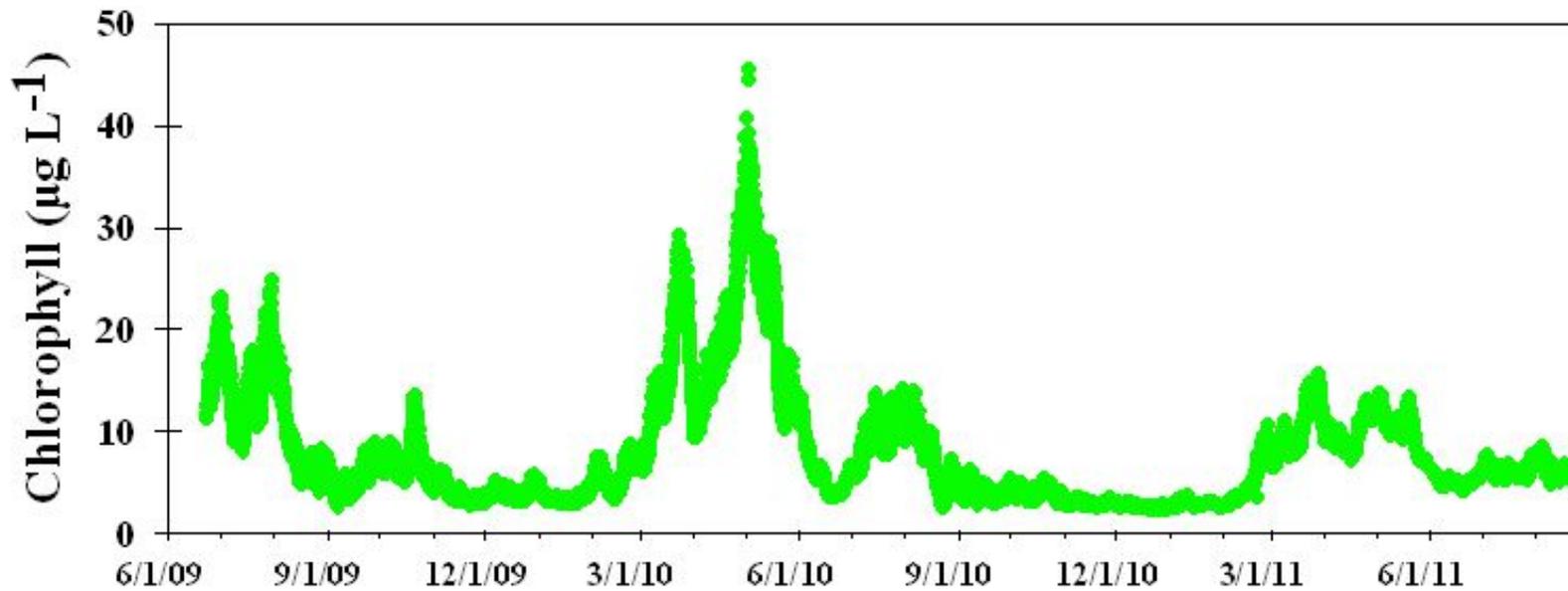
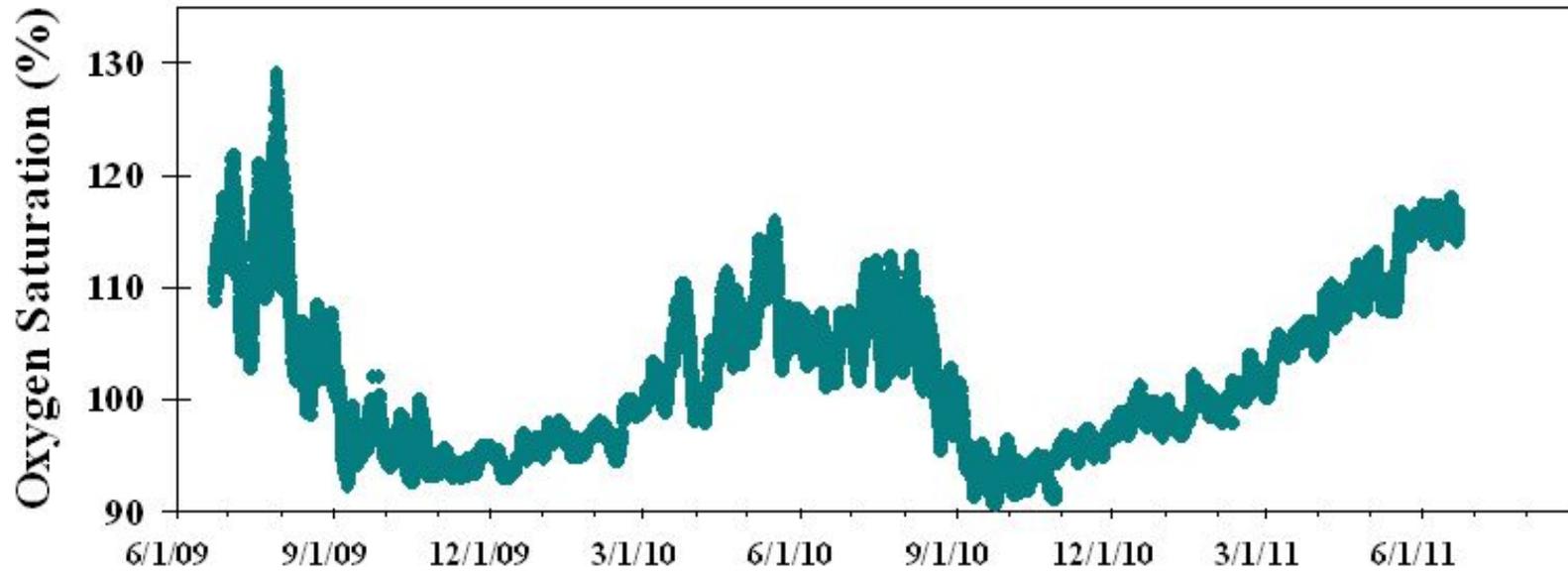
River Discharge at Beaver Army Terminal



Hourly Data: Nitrate & Turbidity

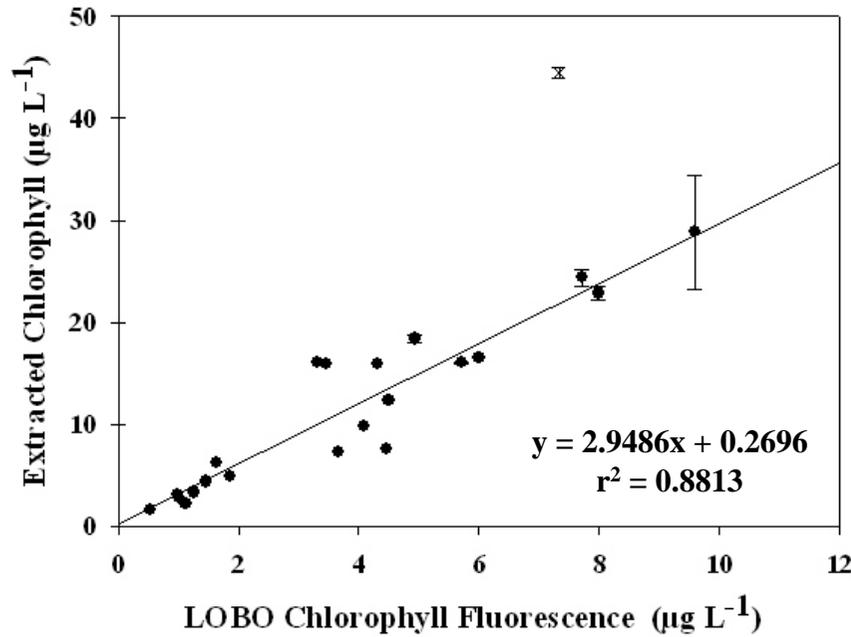


Hourly Data: Oxygen Saturation (%) & Chlorophyll

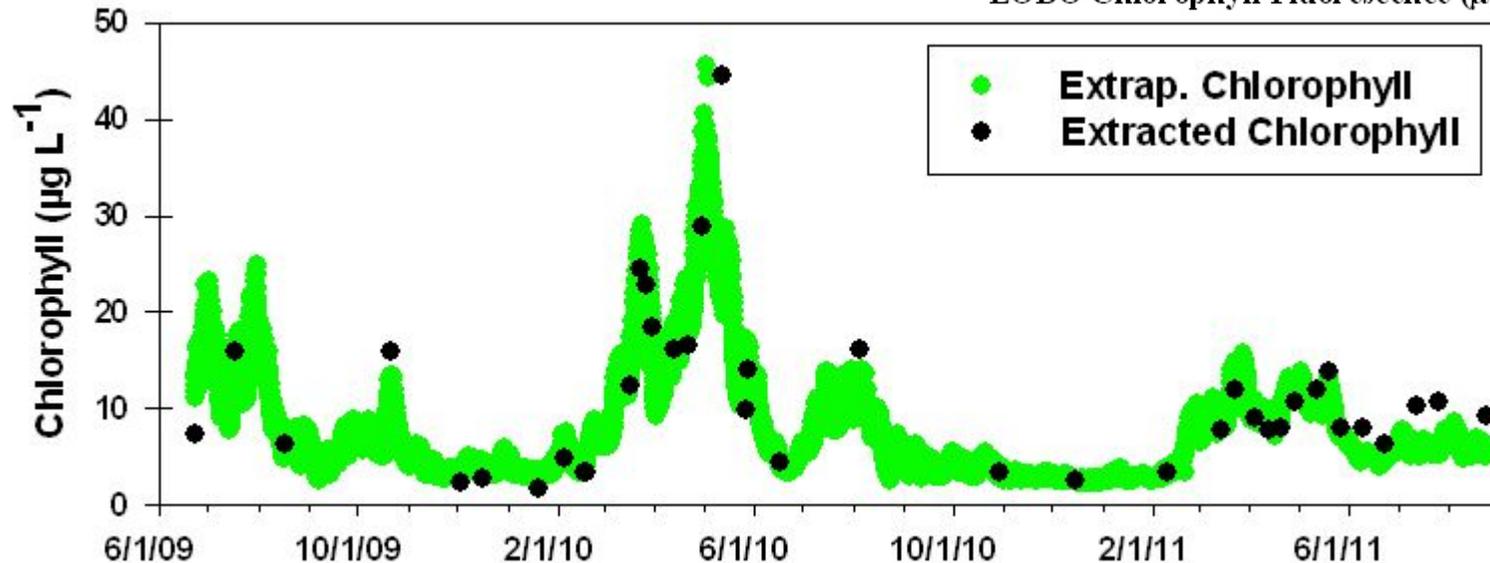
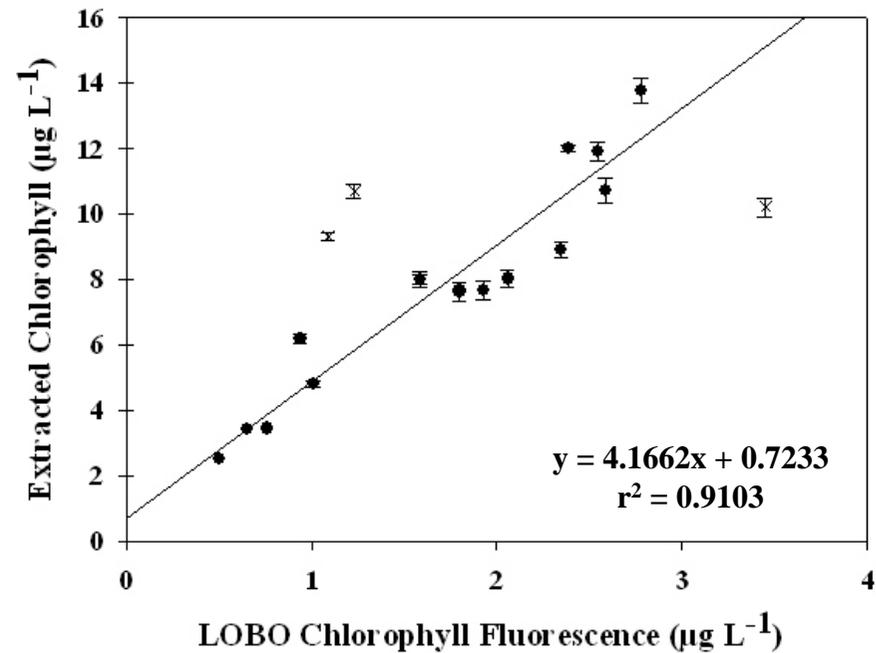


Chlorophyll Fluorometer Quality Control

Fluorometer #1: 2009-2010

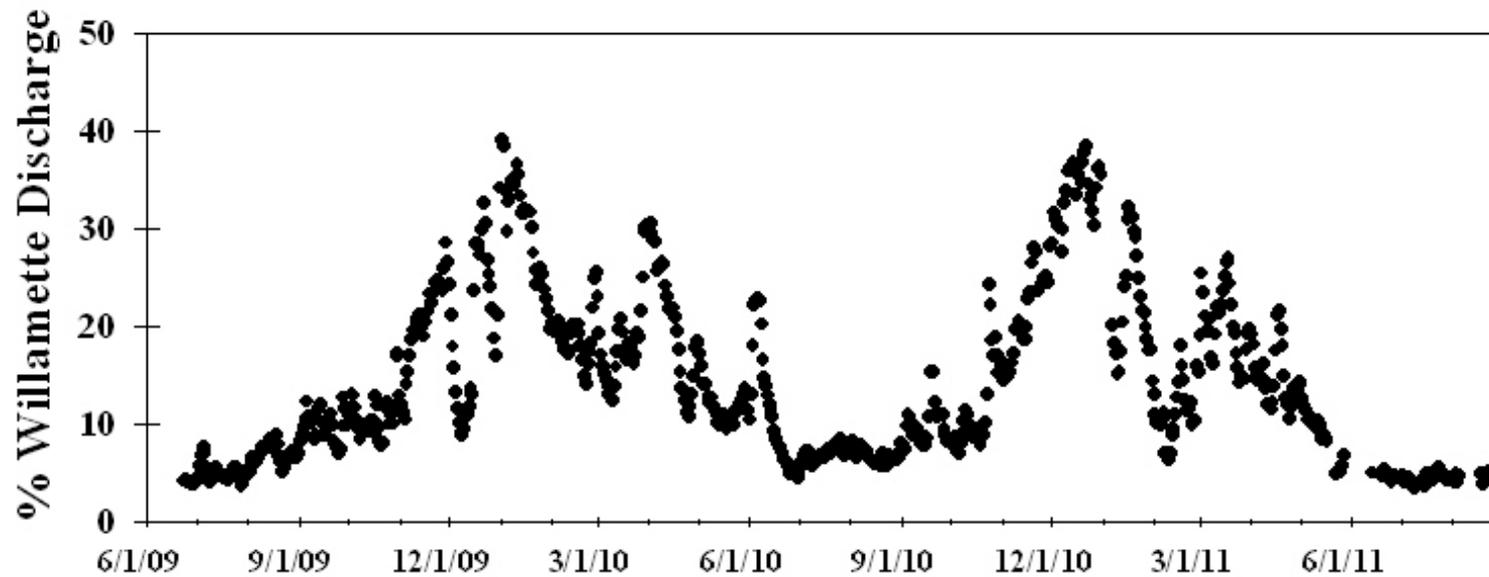
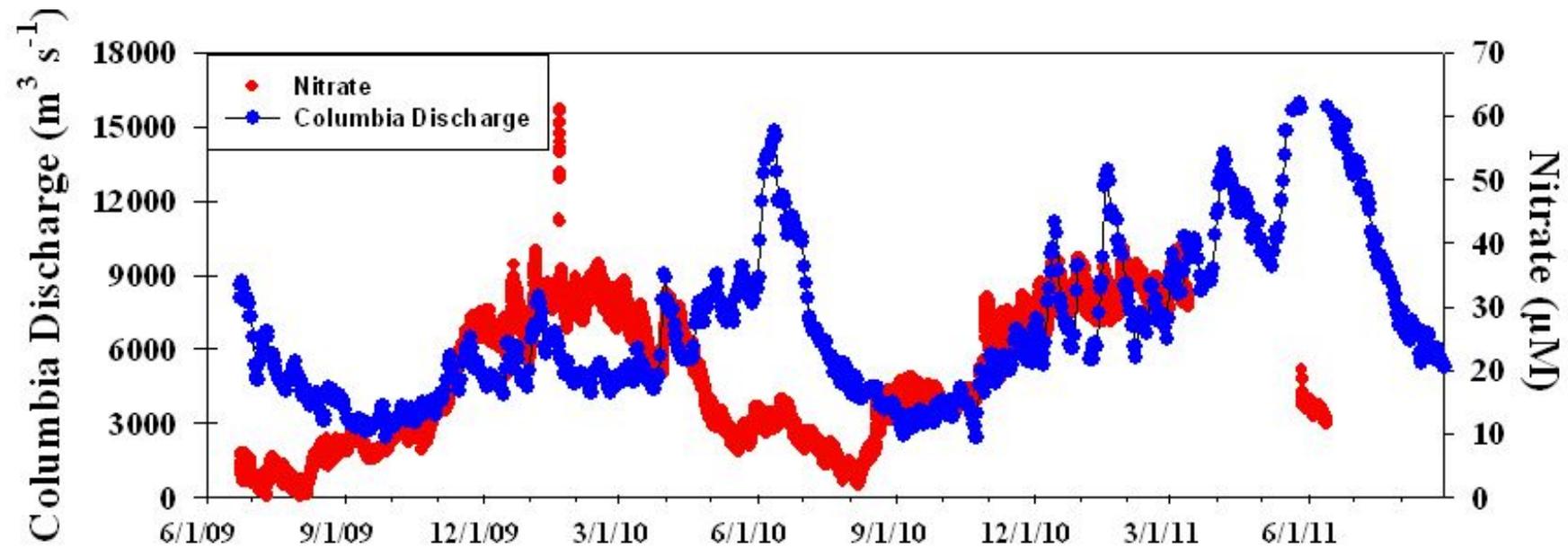


Fluorometer #2: 2011

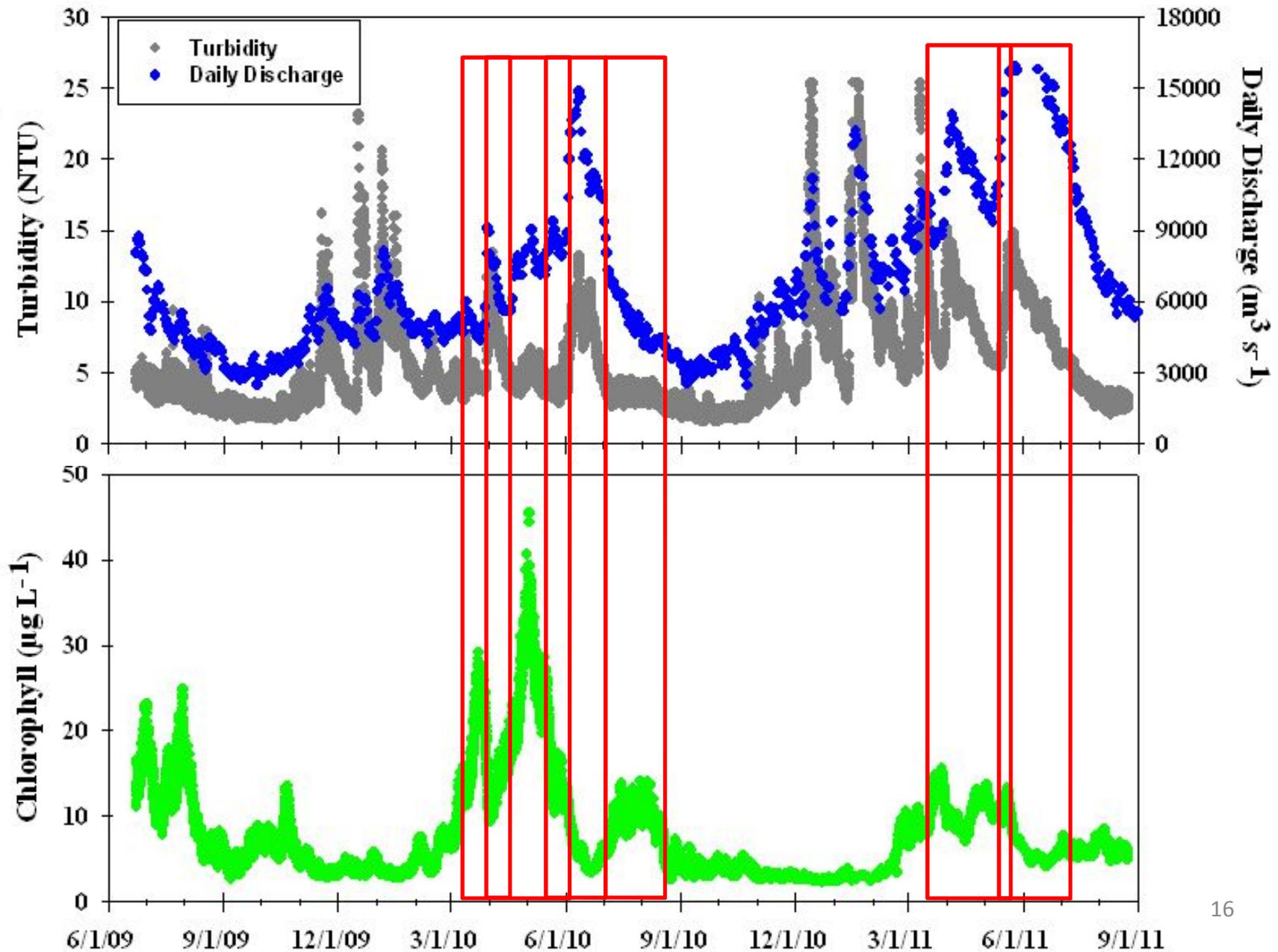


What we've learned from high resolution data in the Columbia River

Results #1: Increased nitrate in winter storm run-off

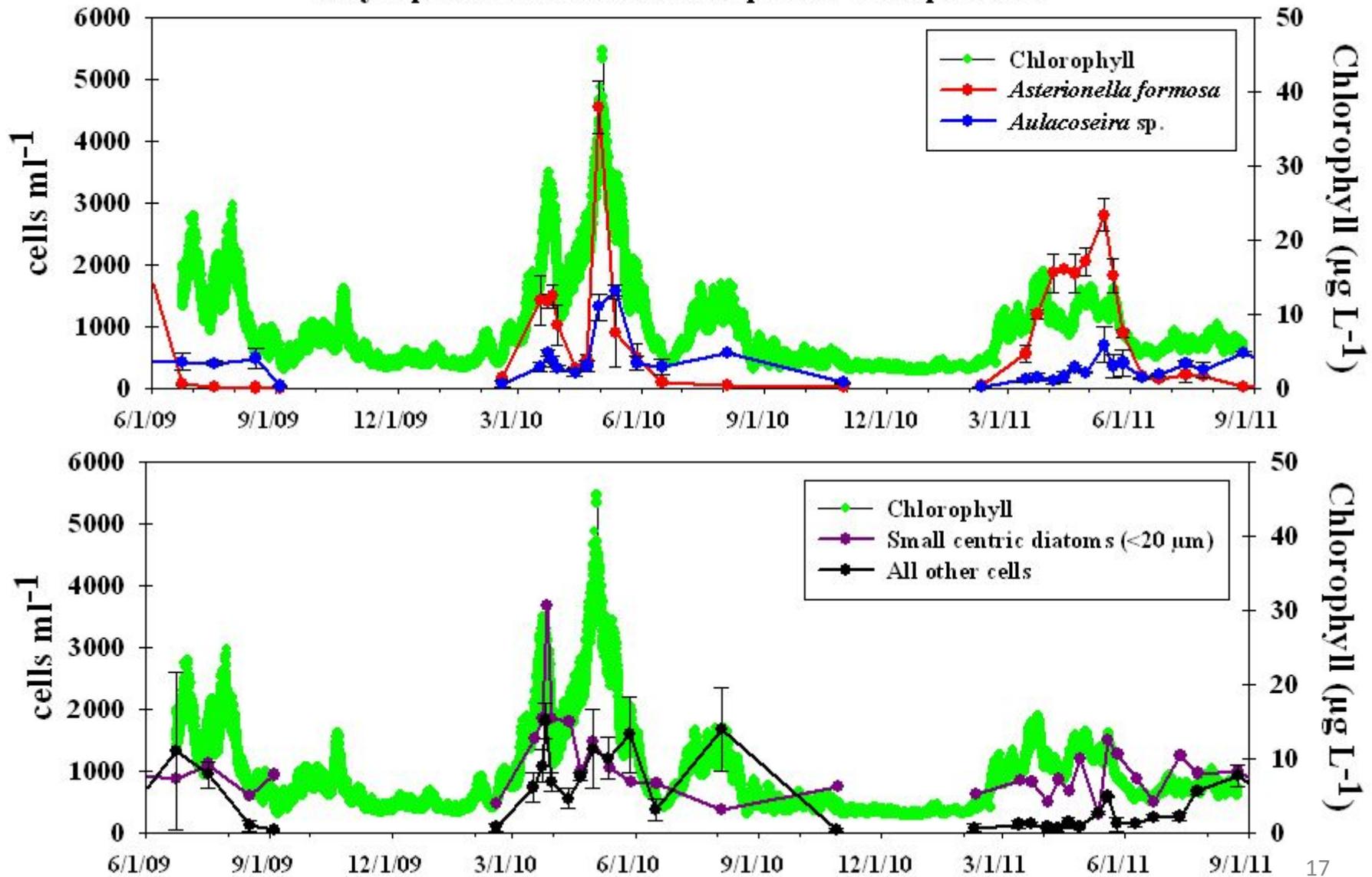


Results #2: Relationship of river discharge & chlorophyll

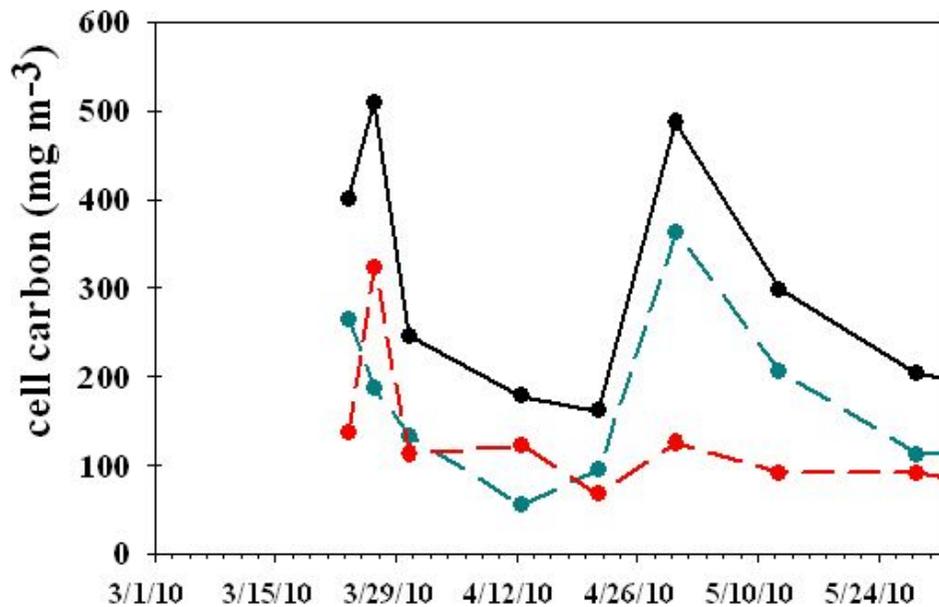
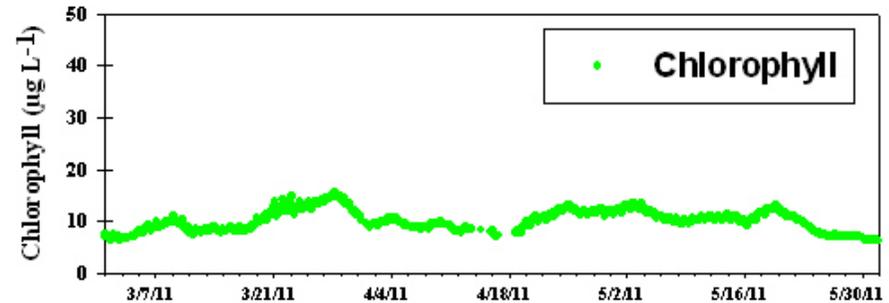
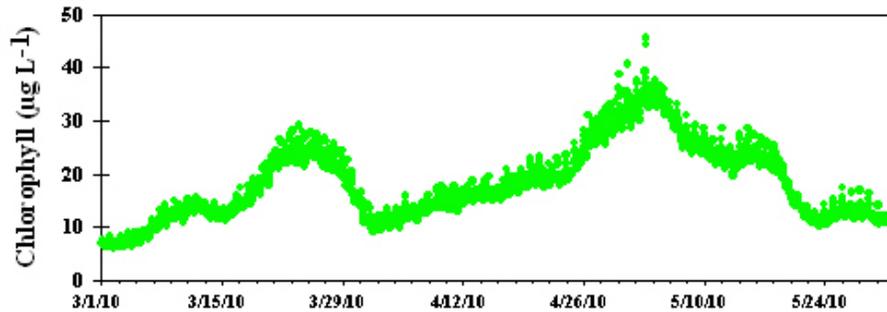


Results #3: Track seasonal phytoplankton composition

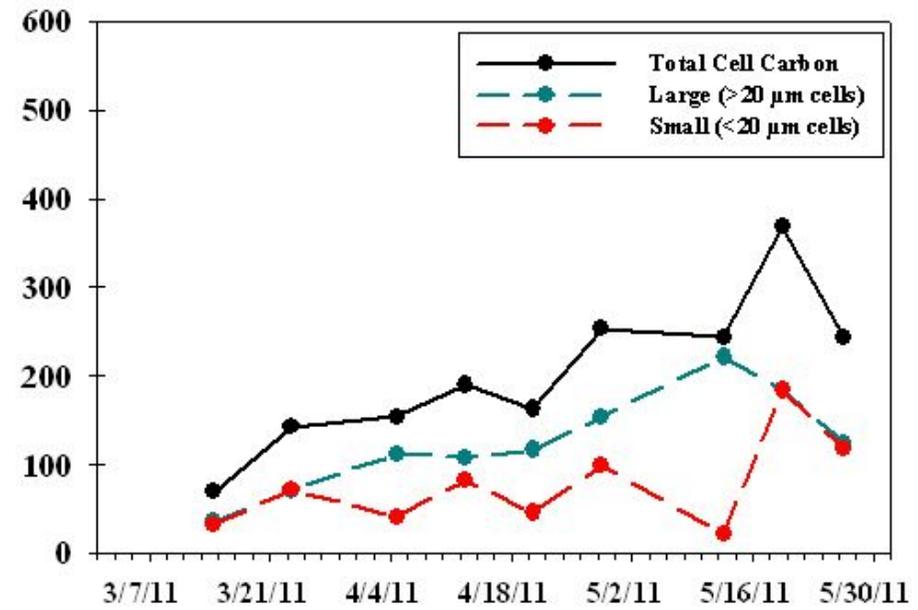
Phytoplankton Dominant Species Composition



Results #4 Calculate phytoplankton POC from discrete sampling



Phytoplankton particulate carbon
Spring-Summer 2010

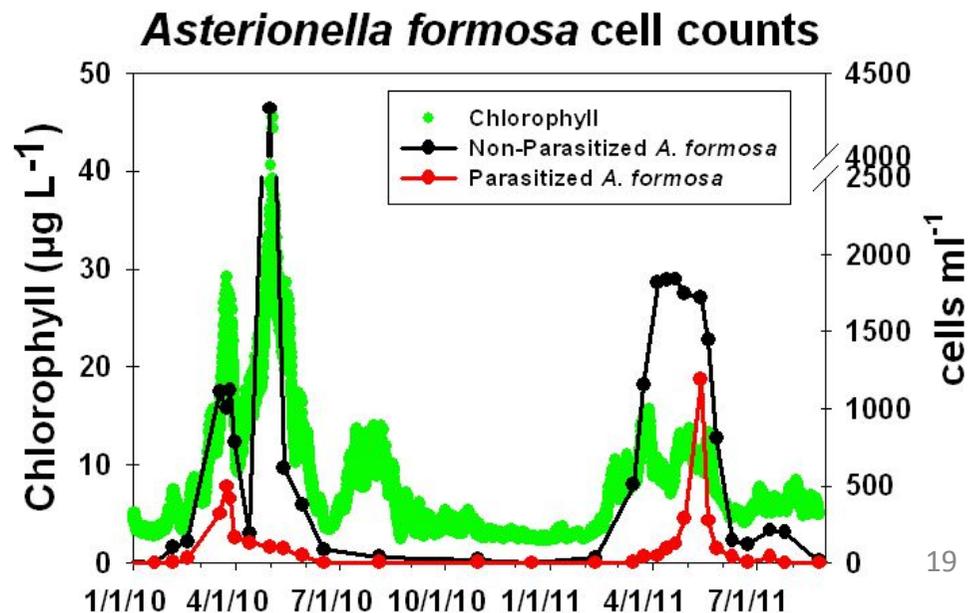


Phytoplankton particulate carbon
Spring-Summer 2011

Cell Particulate Carbon: $\text{pg carbon/cell} = .288 * \text{biovolume}^{0.811}$

Case Study: Using the real time data to target studies of plankton ecology

- Identification of phytoplankton parasites ('chytrid' fungi) during spring blooms
- Most prevalent on dominant species (40% infected)
 - i.e. *Asterionella formosa*
- Dynamics of infections controlled by river discharge



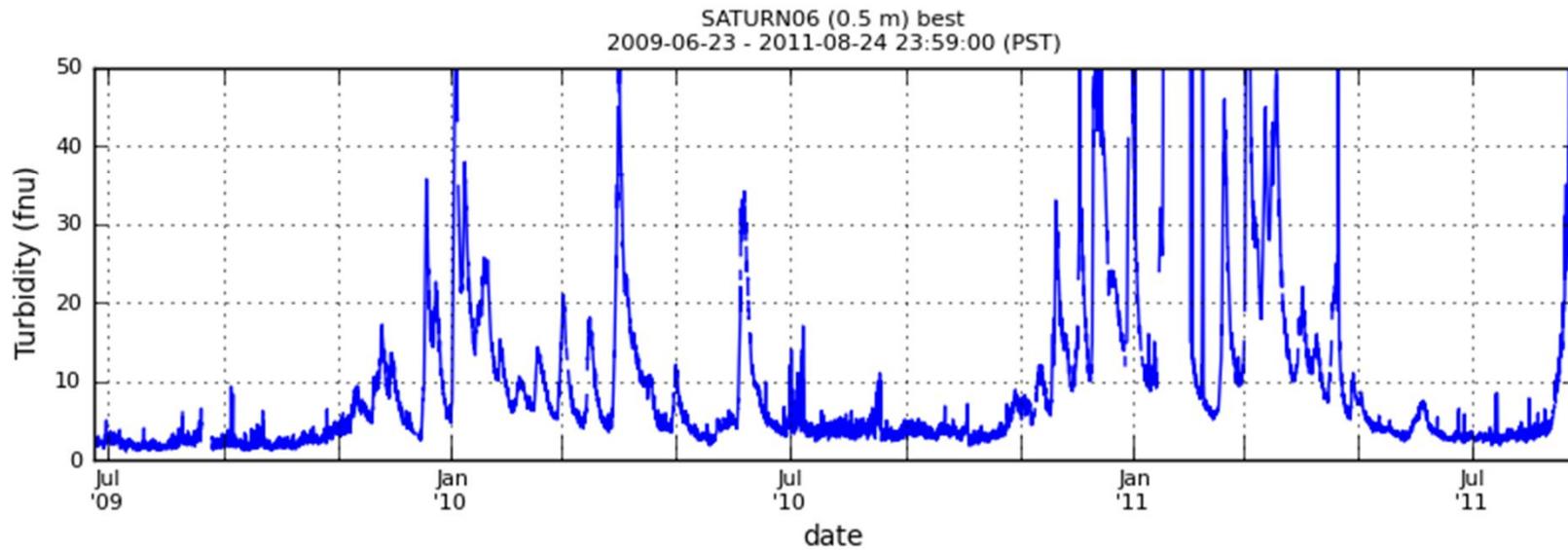
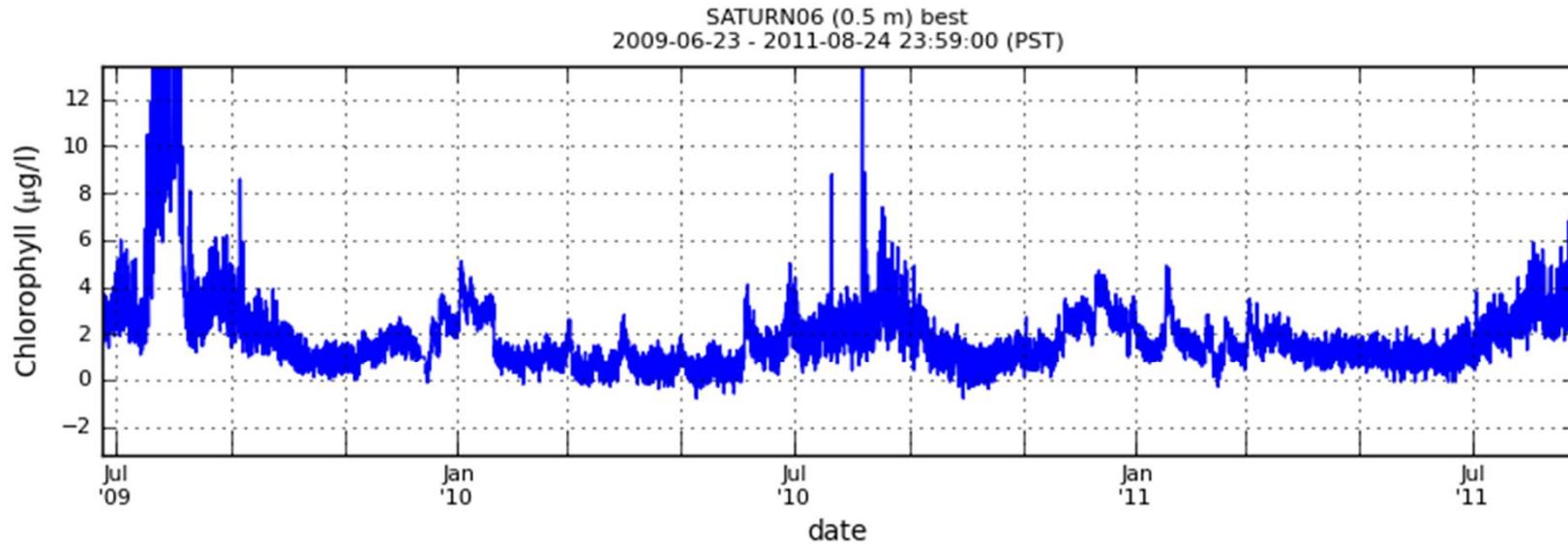
Conclusions & Future Work

- What we know now from sensors that we didn't know before
 - High resolution seasonal trends in biogeochemical parameters
 - Control of river discharge on timing, magnitude, & number of spring bloom events
- How we use sensors to advance science
 - Adaptive sampling from real-time data to analyze phytoplankton seasonal dynamics and plankton ecology
- Future work
 - LOBO installment before influence of Willamette River (planned for spring 2012)

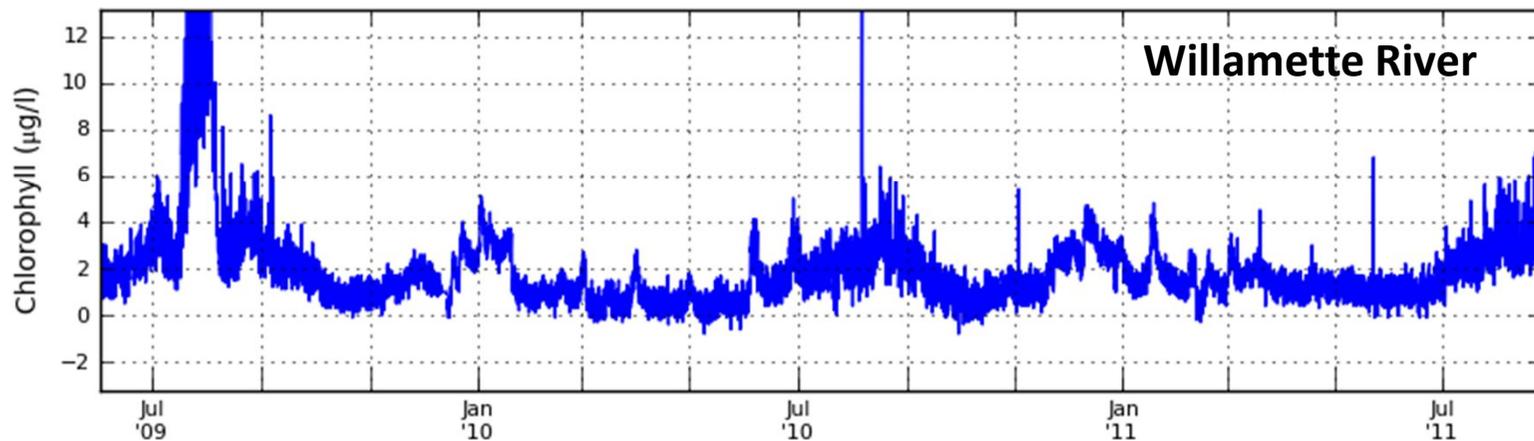
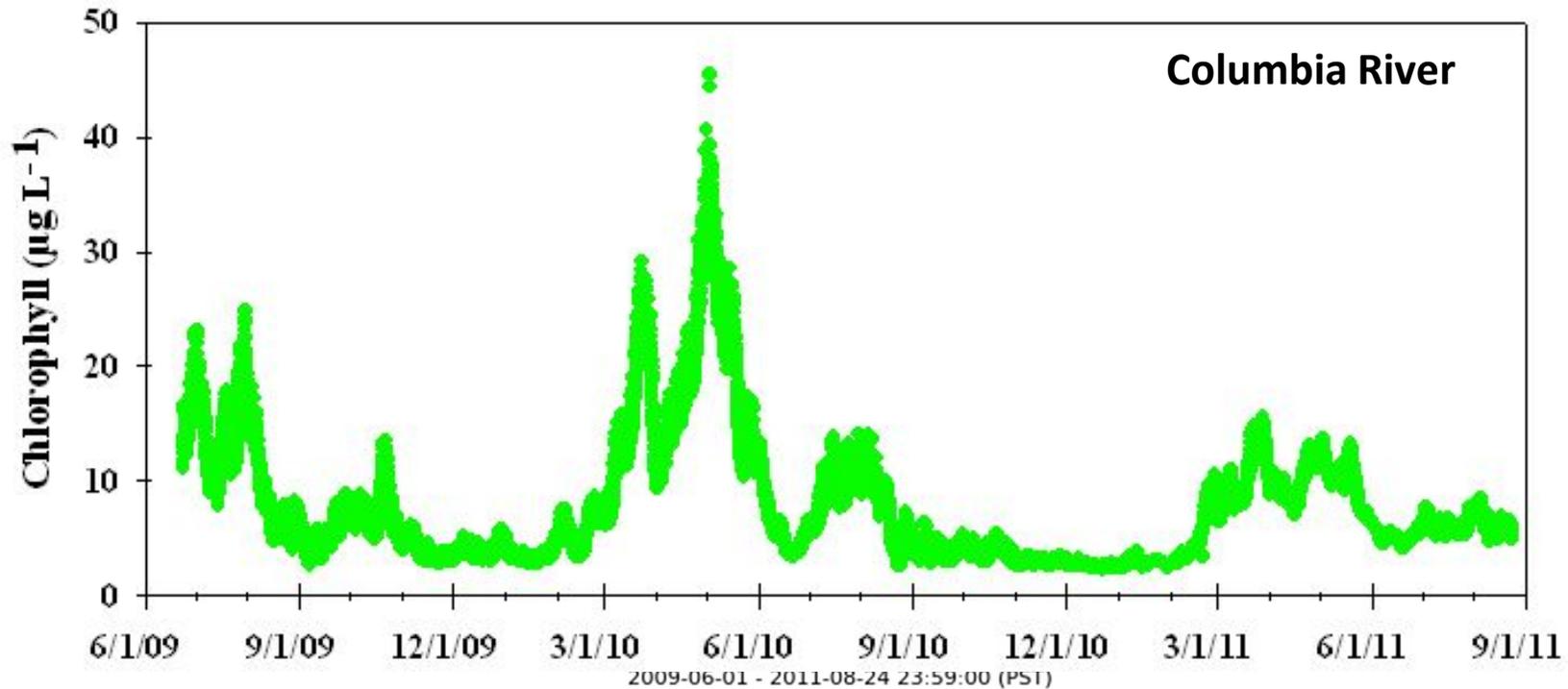
Acknowledgments

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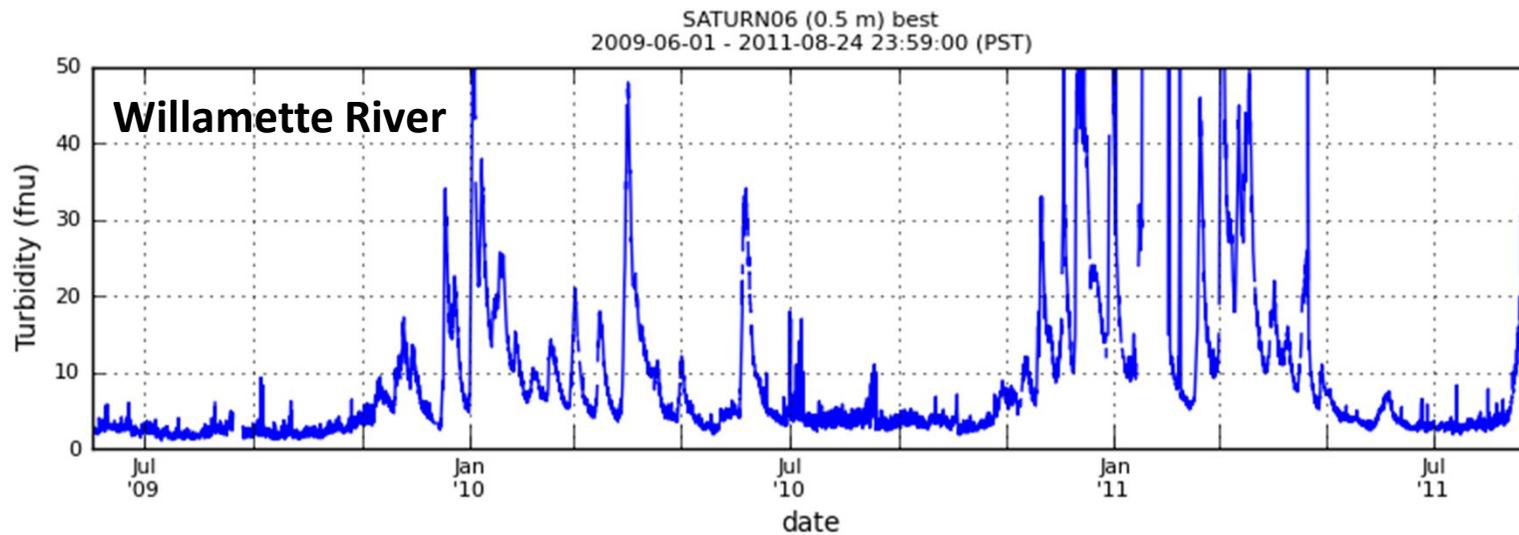
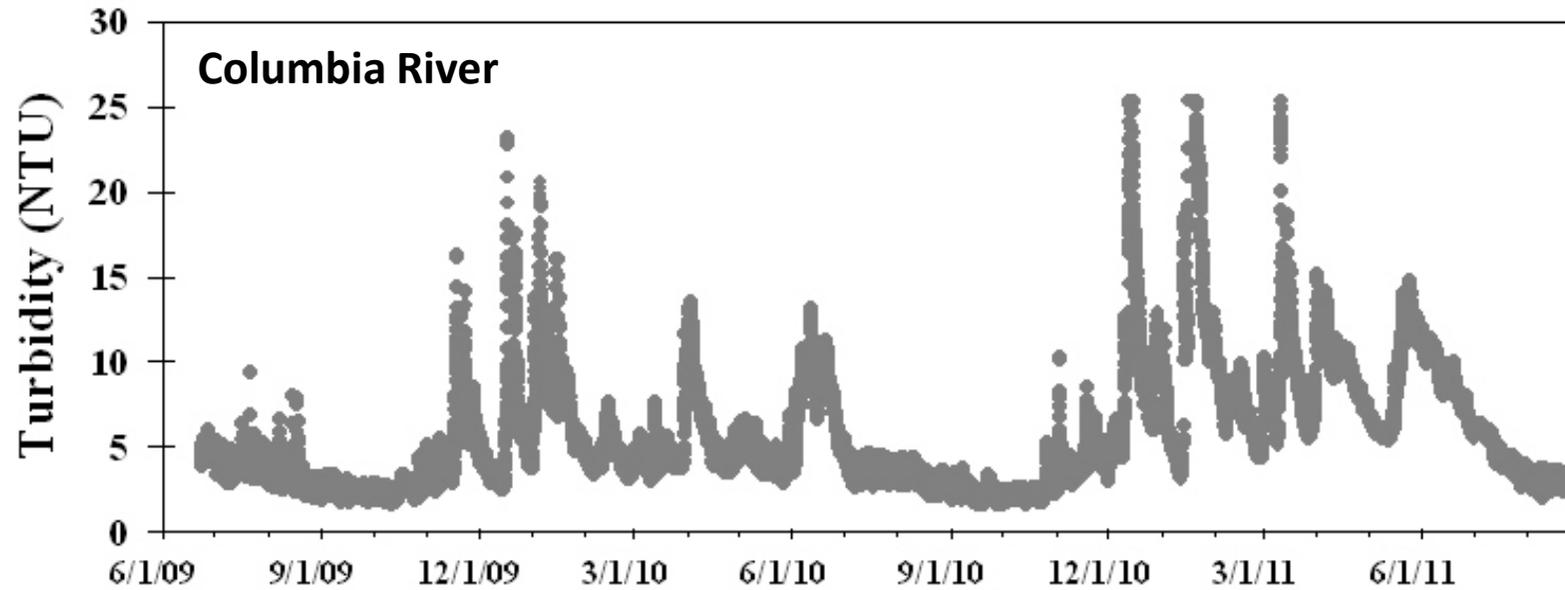
Willamette River Chlorophyll & Turbidity

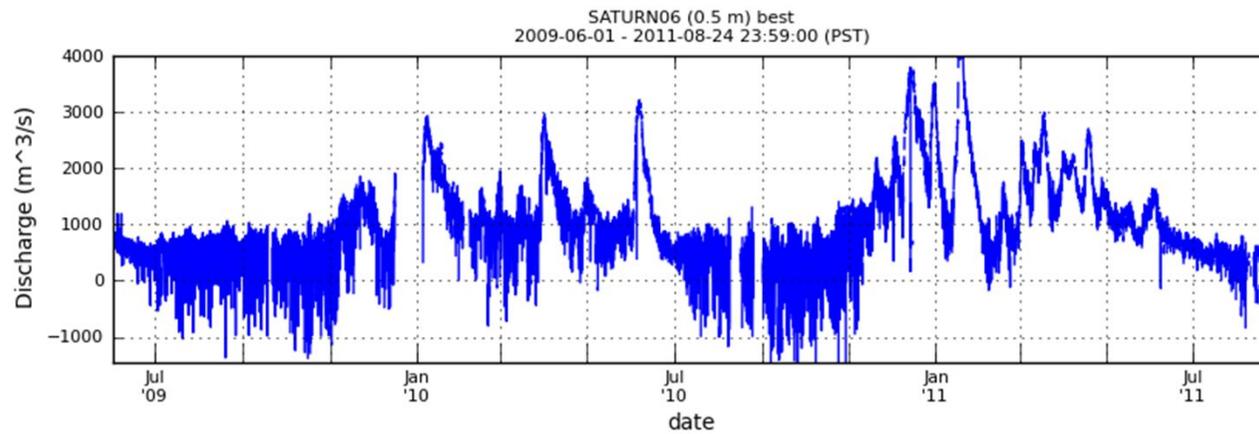
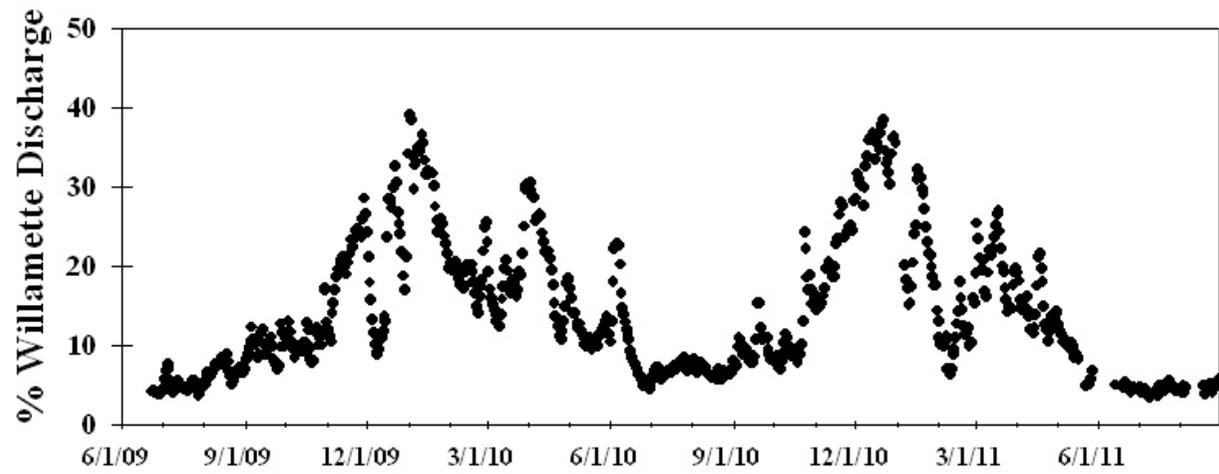
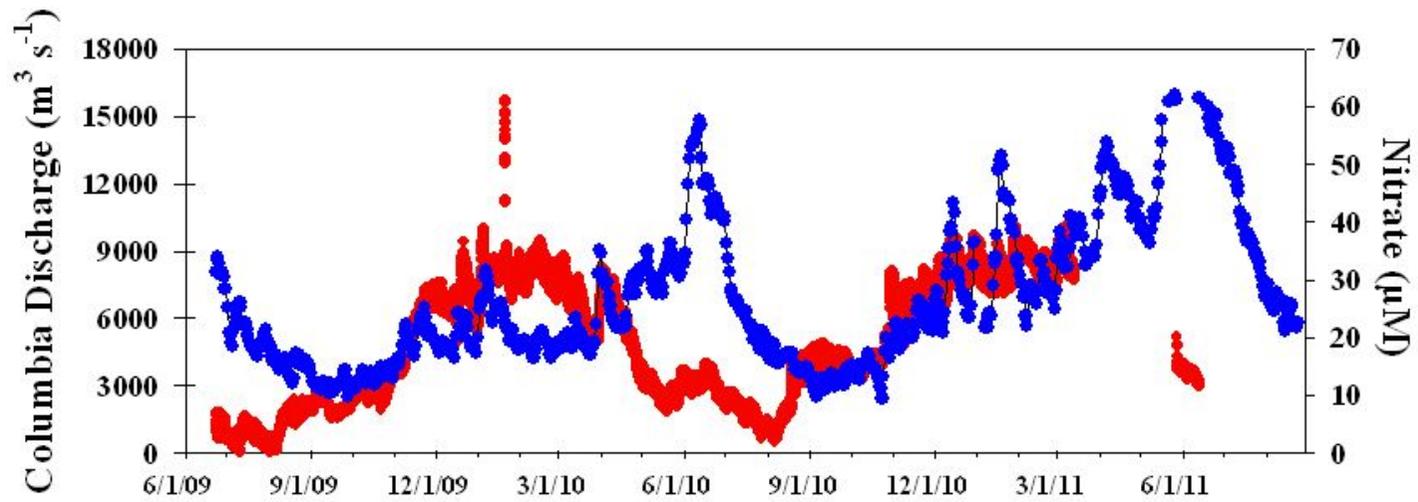


Willamette River Chlorophyll Contribution

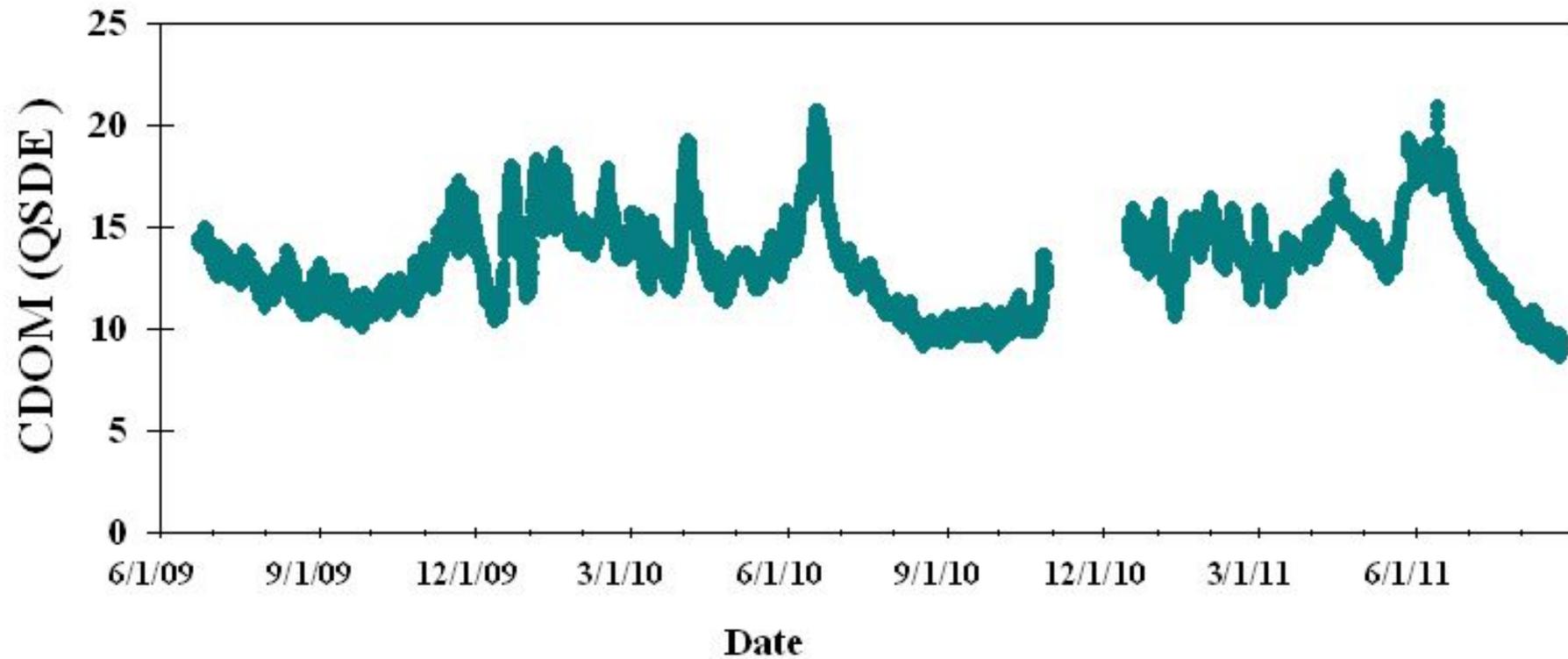


Willamette River Turbidity Contribution

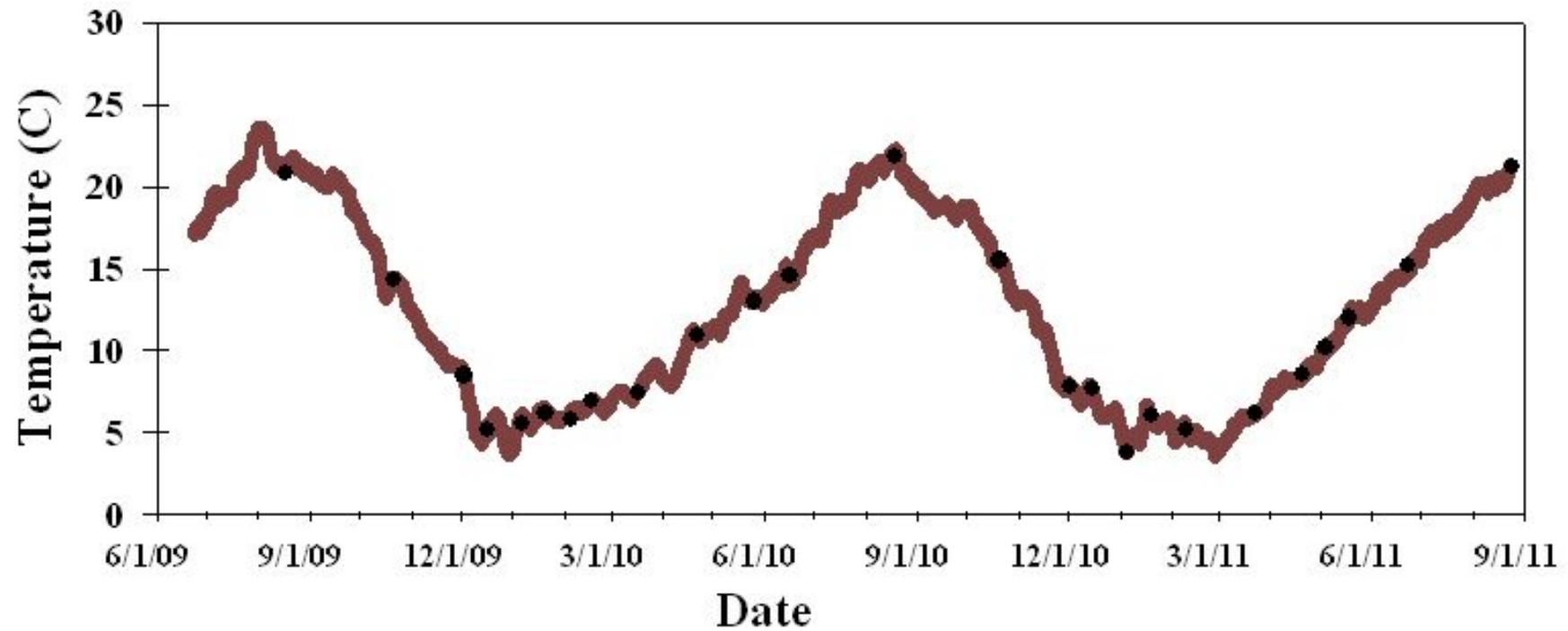




Colored Dissolved Organic Matter



Temperature



Oxygen Saturation (%)

