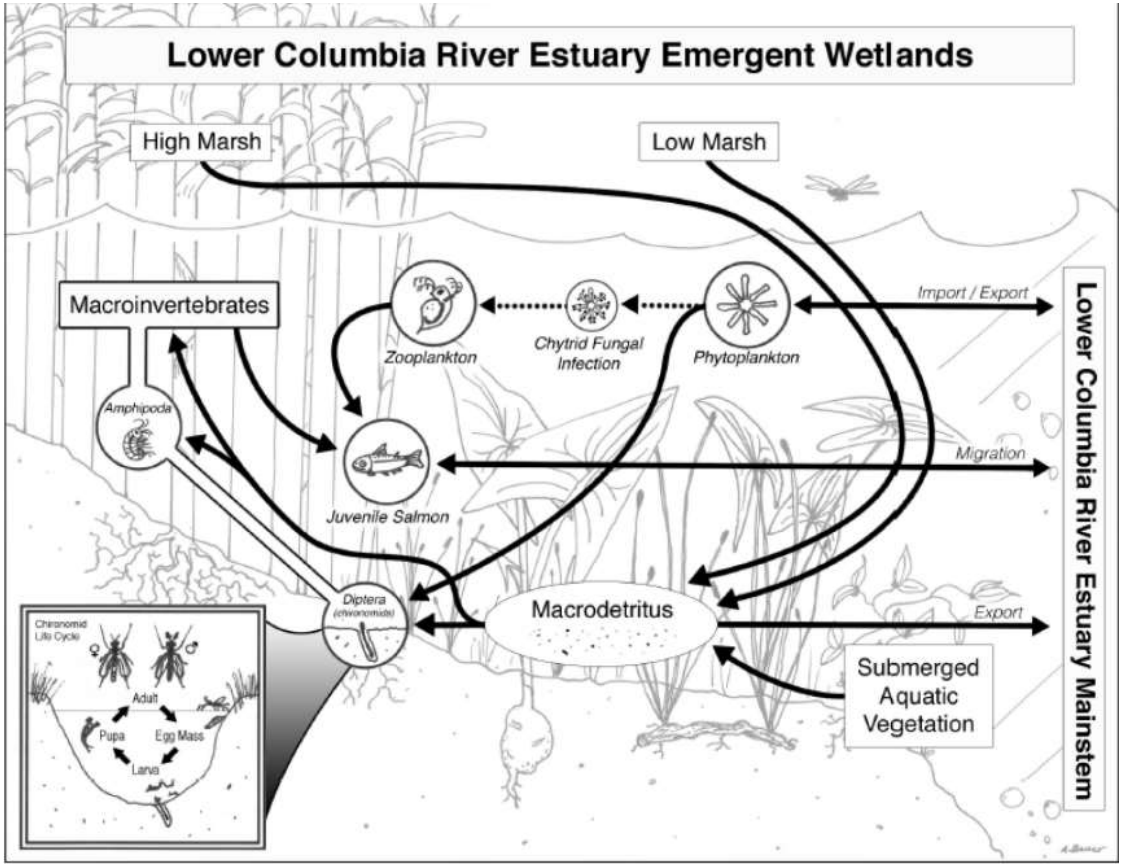
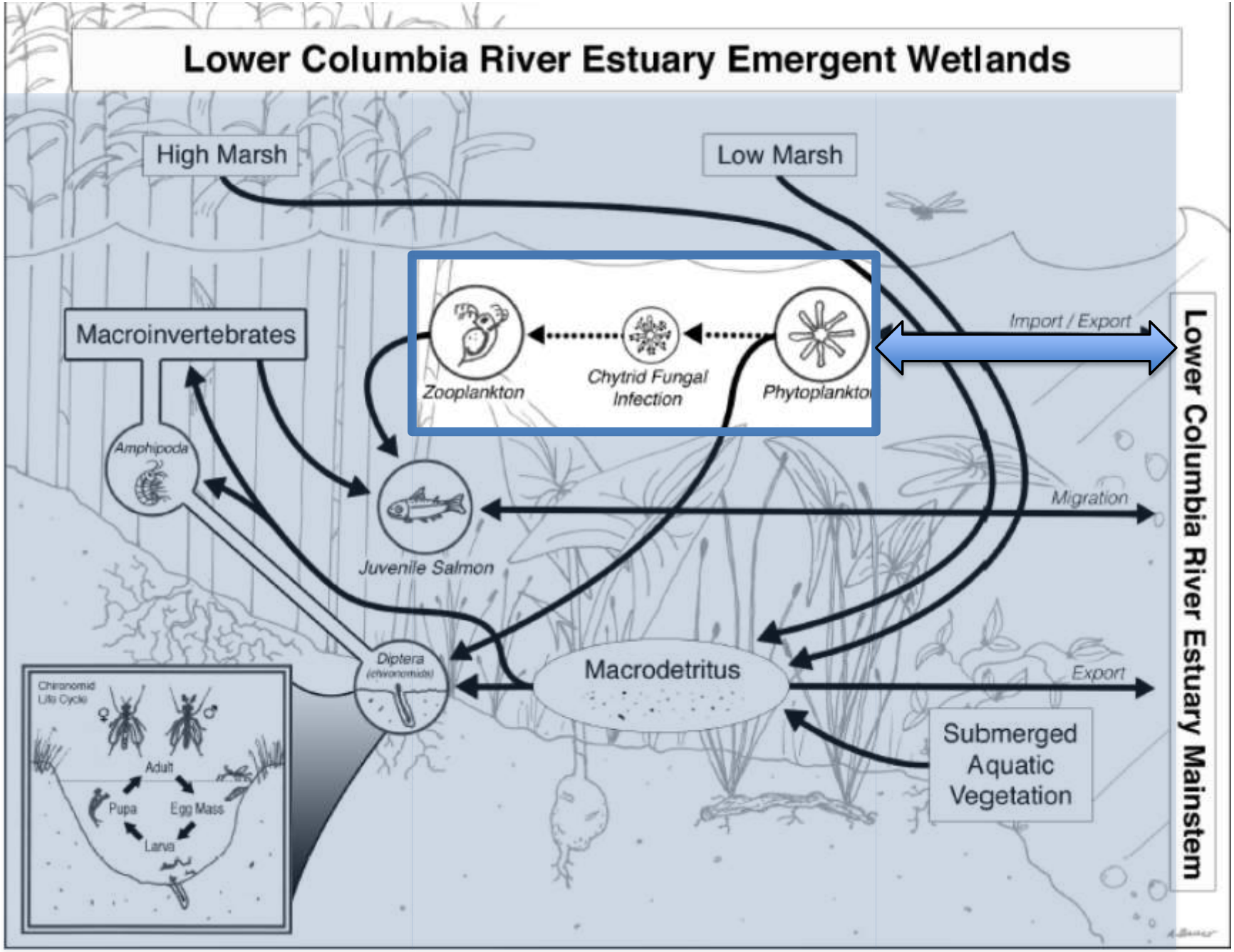
Ecosystem Monitoring Program: *Food web*



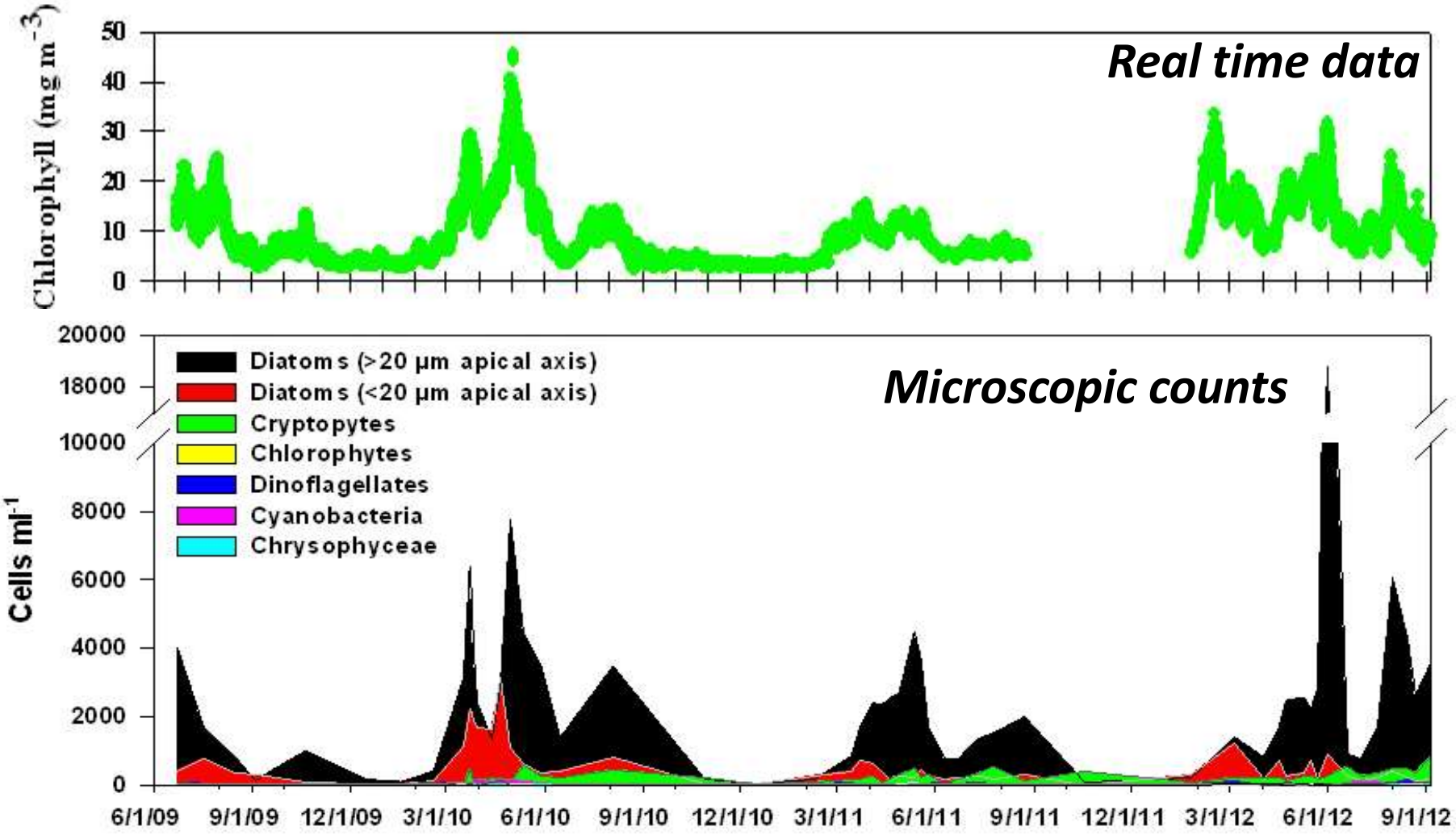
Tawnya D. Peterson, Claudia E. Tausz, Stuart W. Dyer, Joseph A. Needoba, Amanda Hansen & Estuary Partnership


Lower Columbia River Estuary Emergent Wetlands
High Marsh
Low Marsh
Macroinvertebrates
Zooplankton
Chytrid Fungal Infection
Phytoplankton
Import / Export
Lower Columbia River Estuary Mainstem
Amphipoda
Juvenile Salmon
Migration
Diptera
Macrodetritus
Export
Submerged Aquatic Vegetation
Chironomid Life Cycle
Adult
Pupa
Egg Mass
Larva

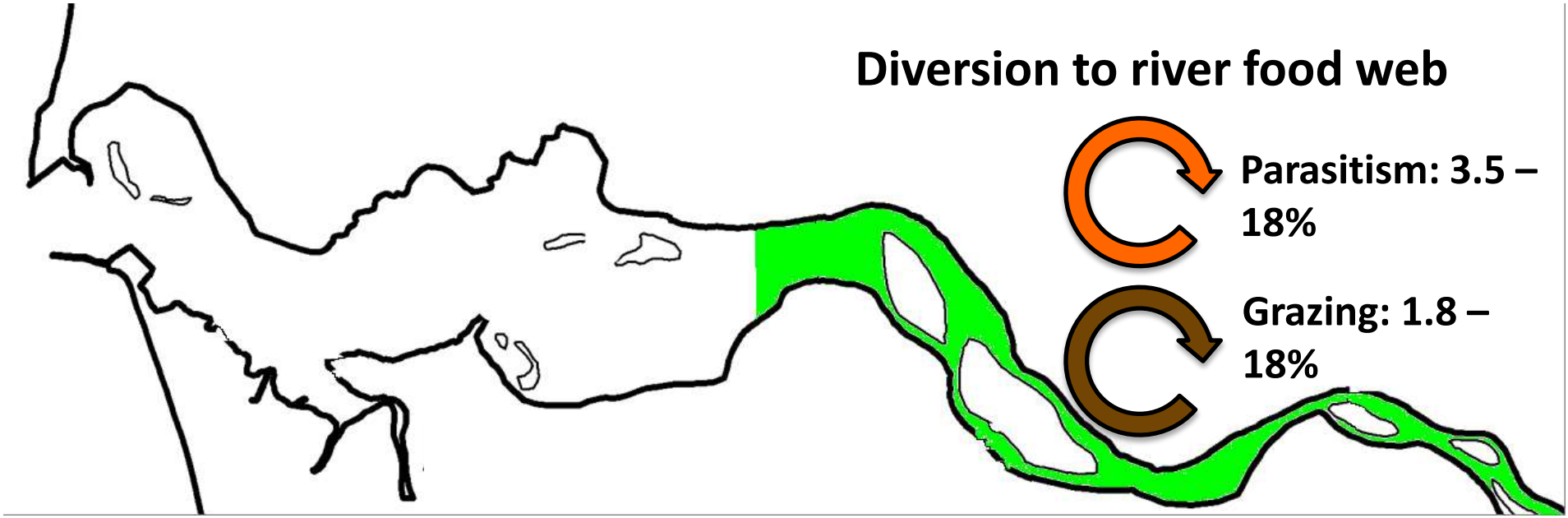
Questions
What are the primary sources of organic matter fueling salmonid food webs?
Do these primary organic matter sources vary in space and time?
Do these primary organic matter sources differ among sites or times in ways that predict abundance, condition, and diversity of salmonids?
Can river flows be managed to influence organic matter sources for juvenile salmonids? How will climate impact primary/secondary production and river flow?

What do we know
Phytoplankton community is dominated by diatoms in the spring and in the mainstem
Zooplankton community is dominated numerically by rotifers and according to biomass by copepods or cladocerans, depending on the site and month
Cyanobacteria blooms have occurred the last few summers at Campbell Slough and Franz Lake Slough
Connectivity between mainstem and off-channel sites determines how similar or different plankton communities within the latter are to the mainstem (dictates succession)

Multiple chlorophyll peaks are dominated by diatoms

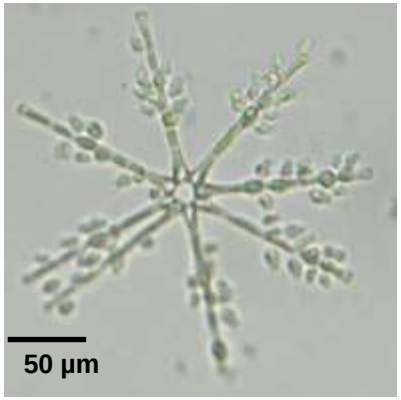


Diatom carbon produced during spring blooms can be exported, consumed, or recycled



Export to estuary

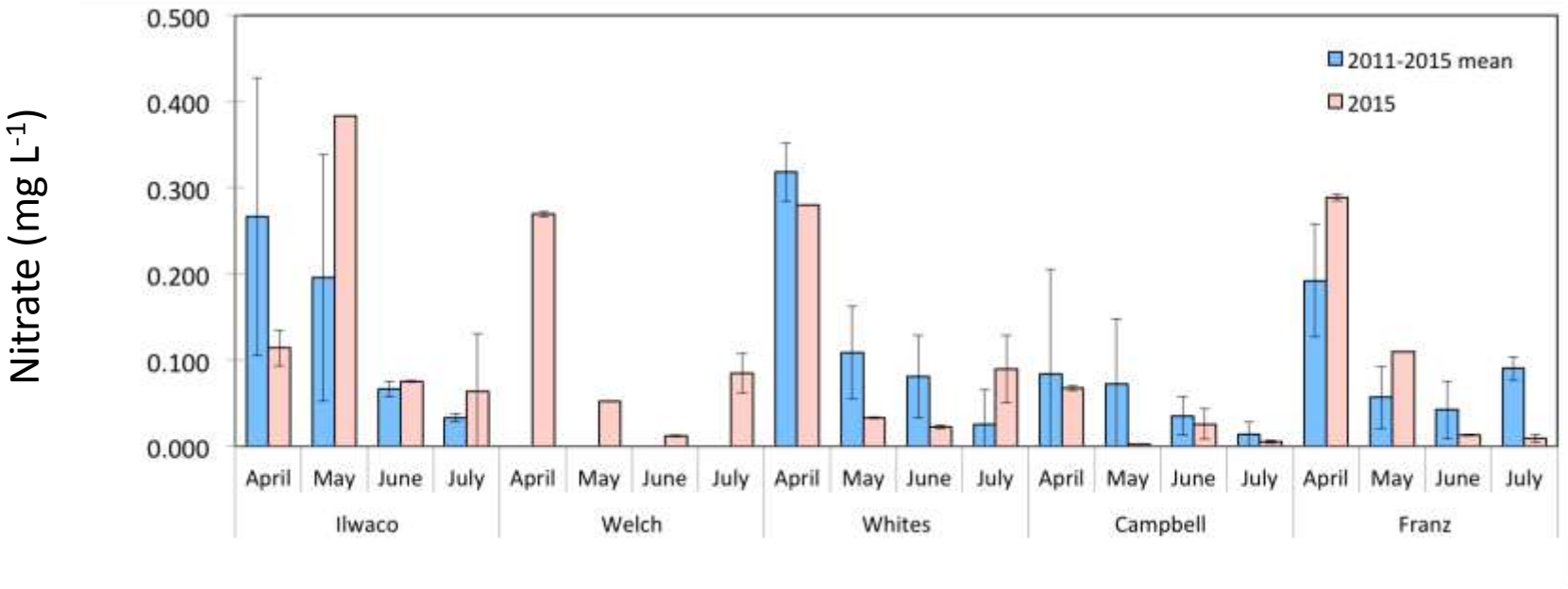
5-36% of in situ production (POC) is diverted into food webs and away from export

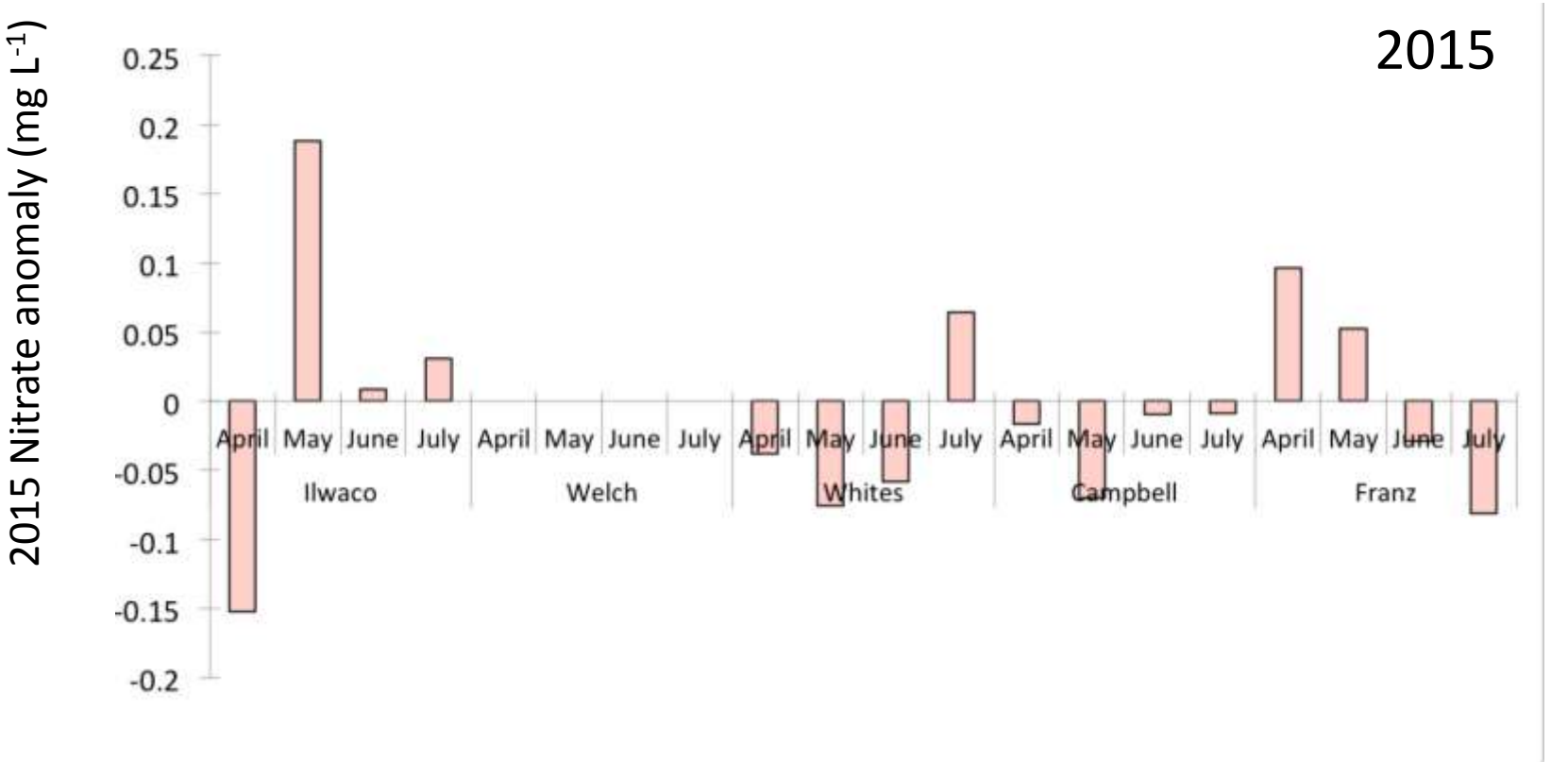


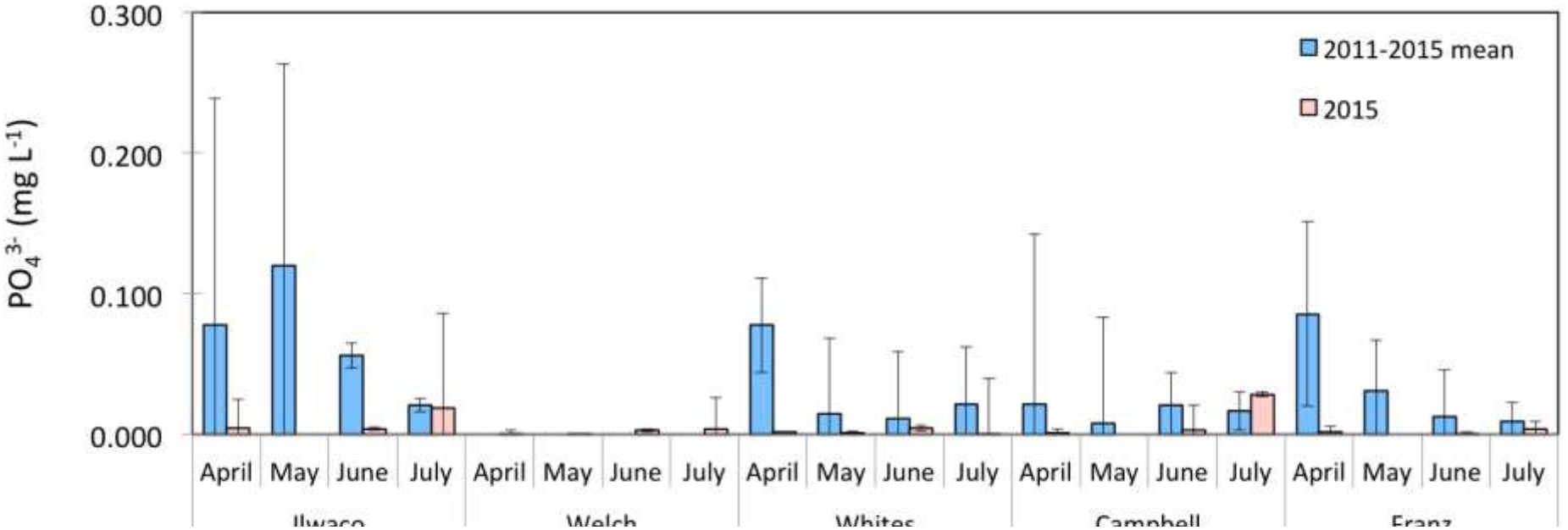
Samples from 2016

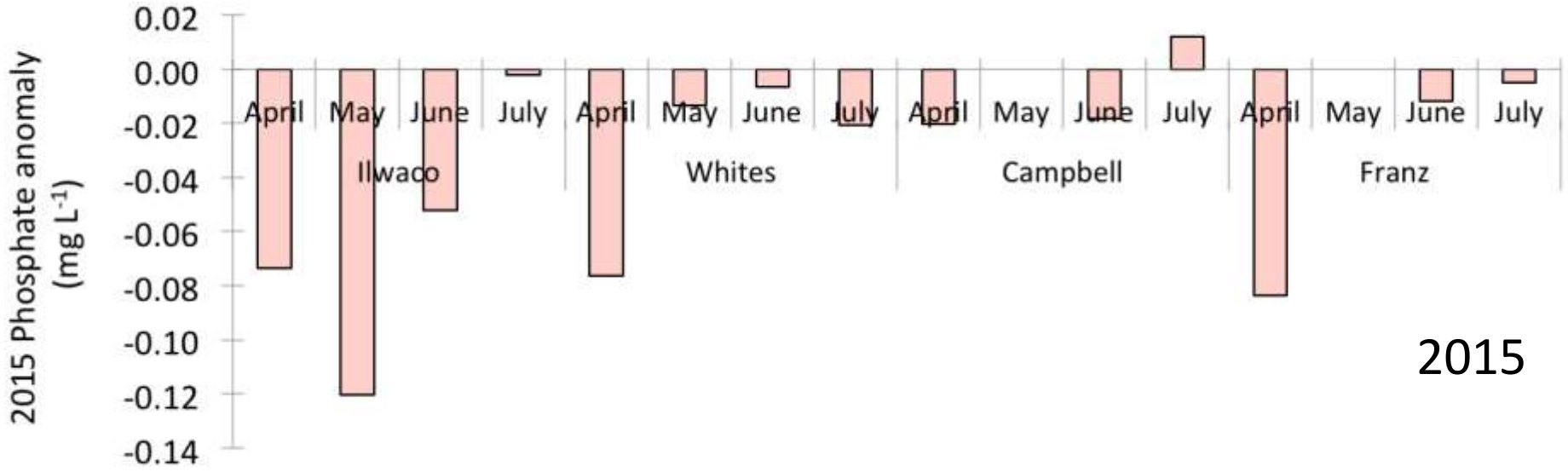
Site	Date	Chl	DIN/ DIP	TDN/ TDP	Total Nuts	Phyto	Zoop	POM	Inverts	Live Plants	Dead Plants	Periphyton
Ilwaco	3/29/16	X	X	X	X	X	X	X	X	X	X	X
Campbell	3/31/16	X	X	X	X	X	X	X	X	X	X	X
Franz LS	3/31/16	X	X	X	X	X	X	X	X	X	X	X
Whites Island	4/7/16	X	X	X	X	X	X	X	X	X	X	X
Welch Island	4/7/16	X	X	X	X	X	X	X	X	X	X	X
Ilwaco	4/28/16	X	X	X	X	X	X	X	X	X	X	X
Campbell	5/3/16	X	X	X	X	X	X	X	X	X	X	X
Franz LS	5/3/16	X	X	X	X	X	X	X	X	X	X	X
Campbell	5/8/16	X	X	X	X	X	X					
Whites Island	5/9/16	X	X	X	X	X	X	X	X	X	X	X
Welch Island	5/11/16									X	X	
Welch Island	5/18/16	X	X	X	X	X	X	X	X			X
Campbell	6/2/16	X	X	X	X	X	X	X	X	X	X	X
Franz LS	6/2/16	X	X	X	X	X	X	X	X	X	X	X
Campbell	6/6/16	X	X	X	X	X	X					
Whites Island	6/7/16	X	X	X	X	X	X	X	X	X	X	X
Welch Island	6/9/16	X	X	X	X	X	X	X	X	X	X	X
Ilwaco	6/13/16	X	X	X	X	X	X	X	X	X	X	X
Campbell	6/30/16	X	X	X	X	X	X	X	X	X	X	X
Franz LS	6/30/16	X	X	X	X	X	X	X	X	X	X	X
Whites Island	7/6/16	X	X	X	X	X	X	X	X	X	X	X
Welch Island	7/6/16	X	X	X	X	X	X	X	X	X	X	X
Ilwaco	7/8/16	X	X	X	X	X	X	X	X	X	X	X

Gray = samples for stable isotope analysis


Nitrate (mg L-1)
0.500
0.400
0.300
0.200
0.100
0.000
2011-2015 mean
2015
April
May
June
July
Ilwaco
Welch
Whites
Campbell
Franz

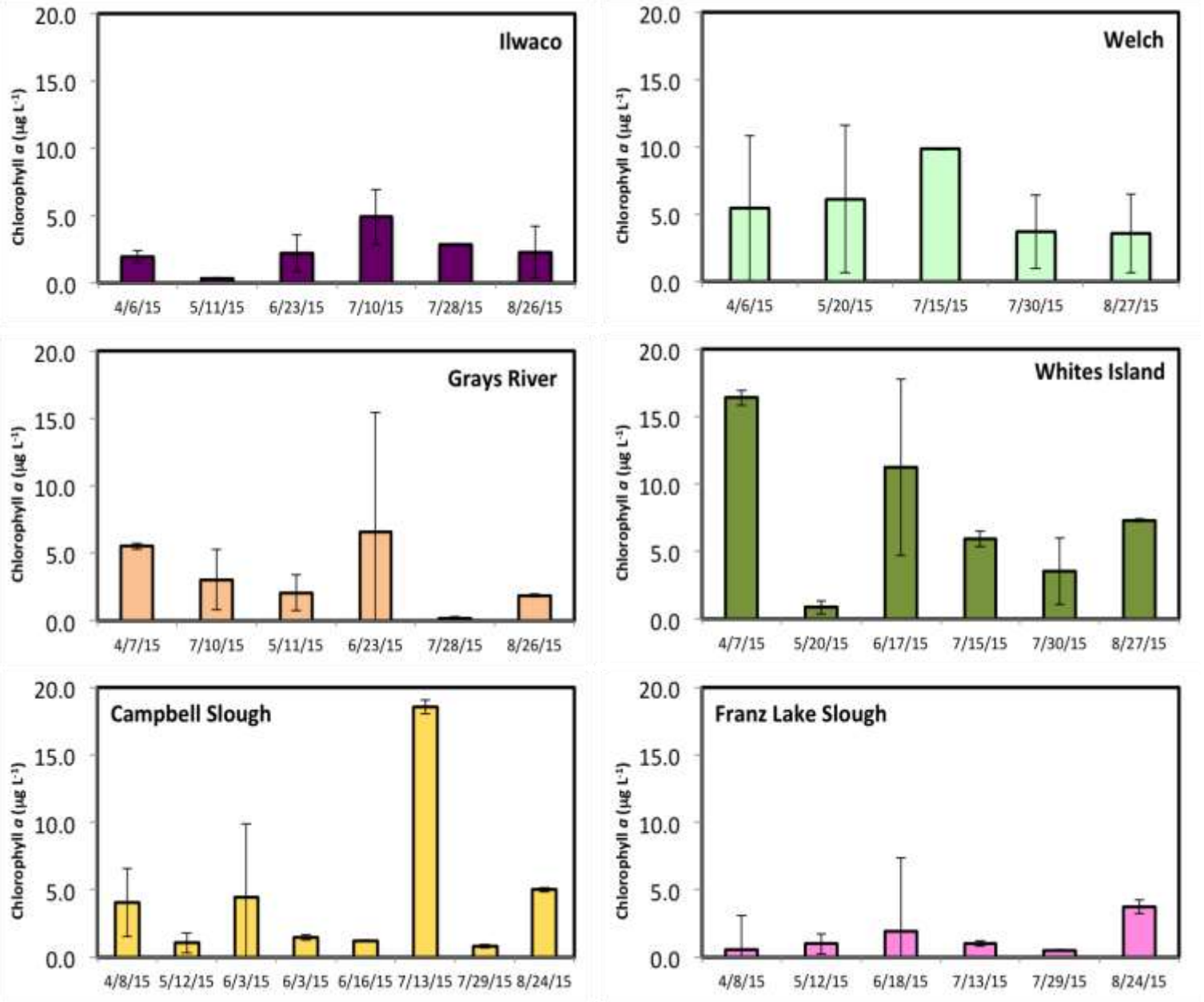

2015 Nitrate anomaly (mg L-1)
2015
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
April
May
June
July
Ilwaco
Welch
Whites
Campbell
Franz


0.300
0.200
0.100
0.000
PO_4^{3-} (mg L^{-1})
2011-2015 mean
2015
April
May
June
July
Ilwaco
Welch
Whites
Campbell
Franz

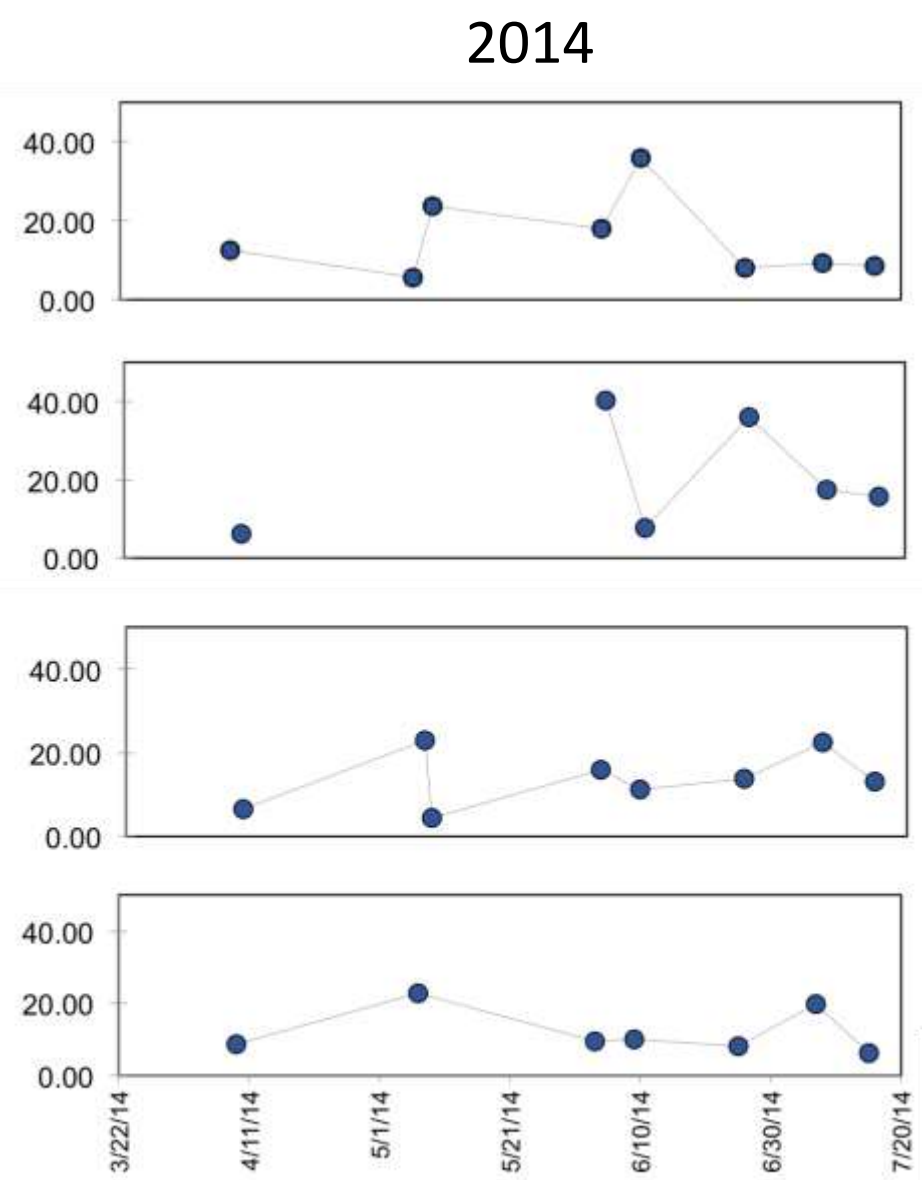

0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
2015 Phosphate anomaly (mg L^{-1})
April
May
June
July
Ilwaco
Whites
Campbell
Franz

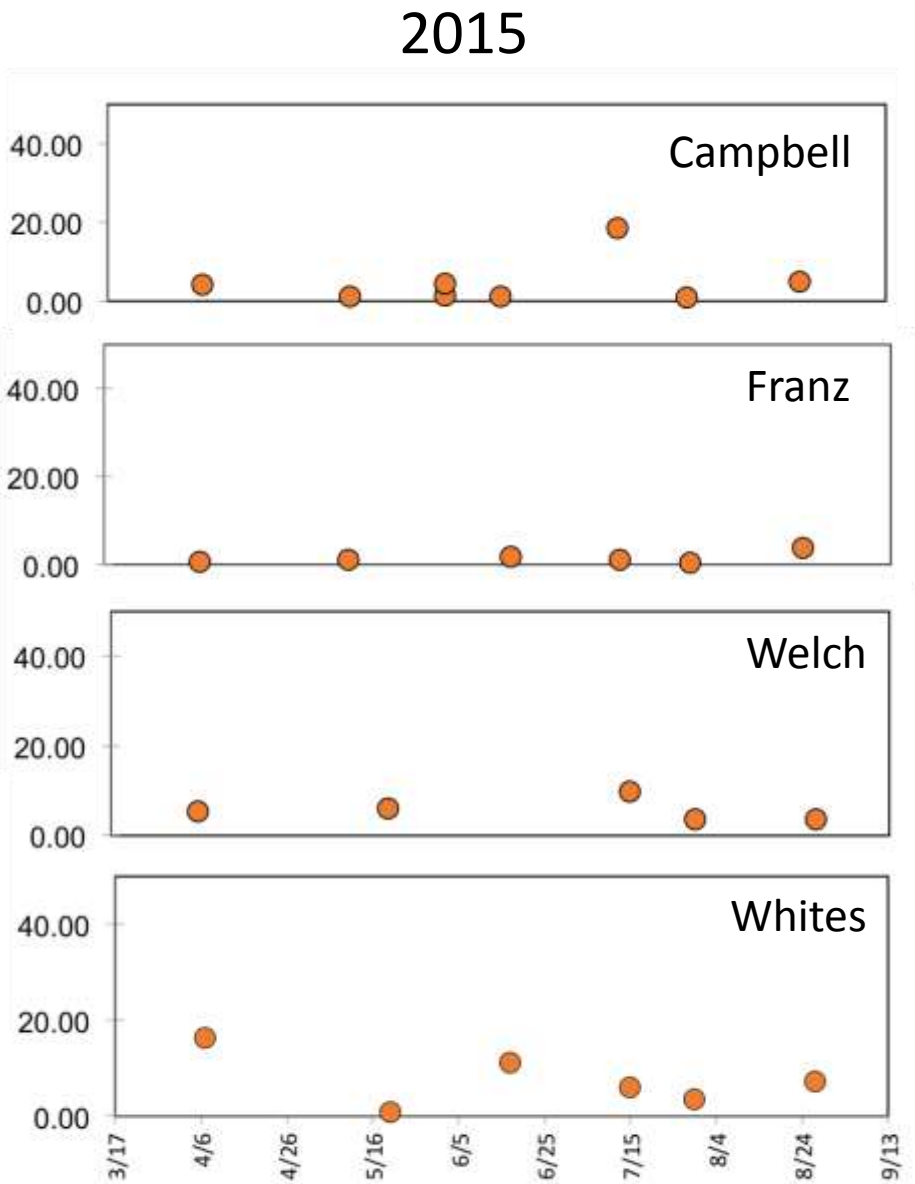
2015

Chlorophyll in 2015



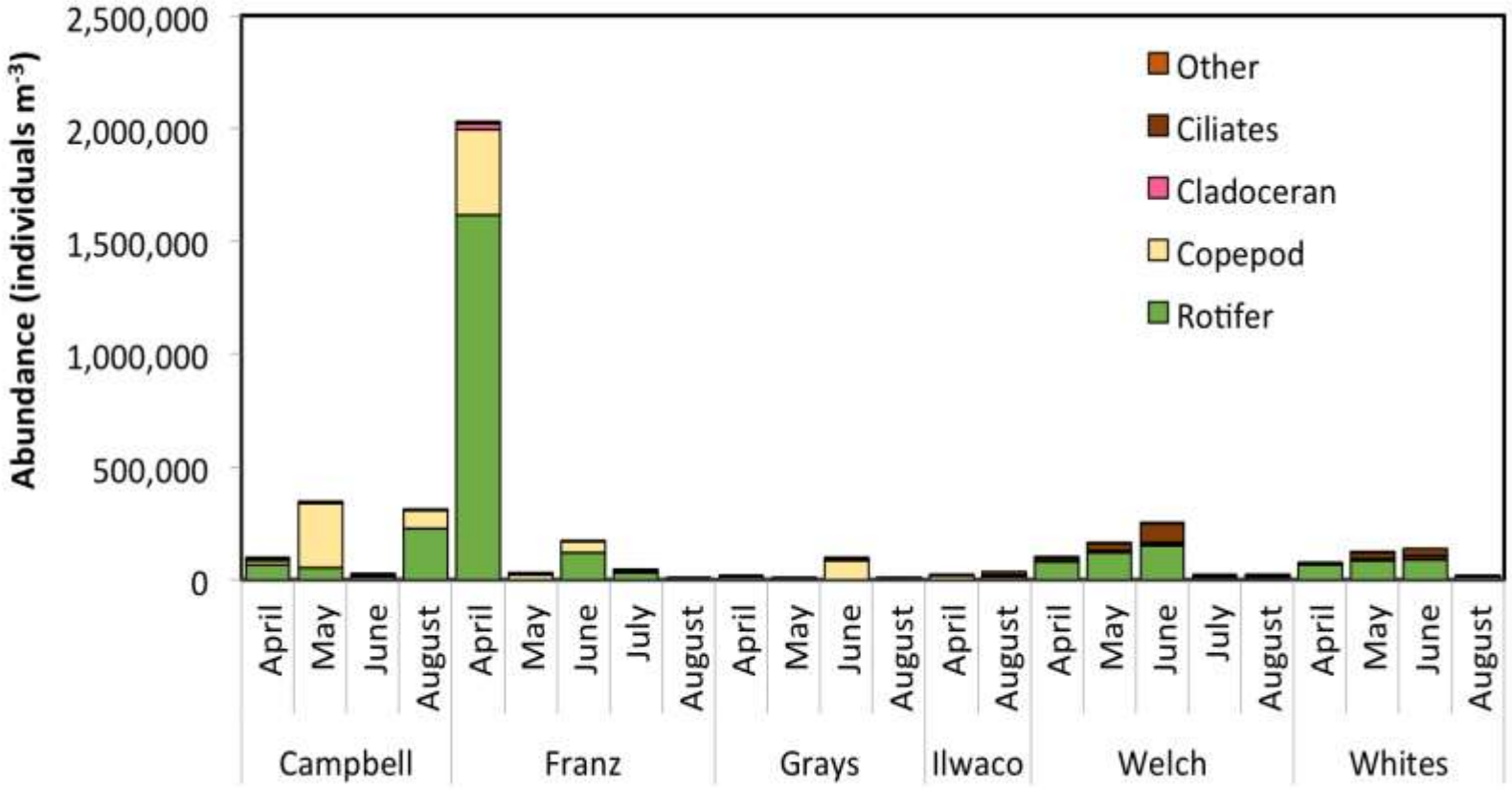
Chlorophyll



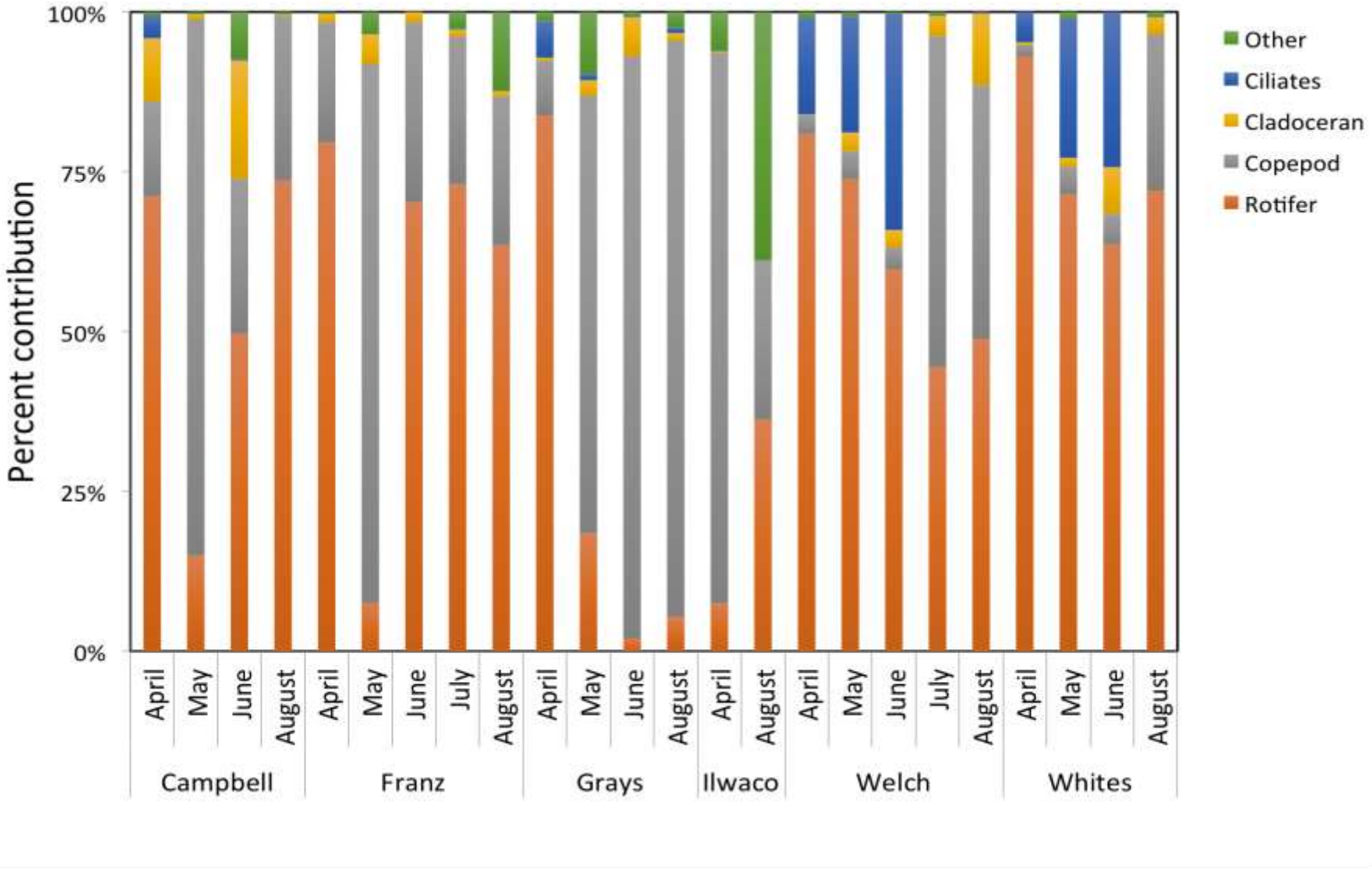


Phytoplankton: 2015

Zooplankton: 2015

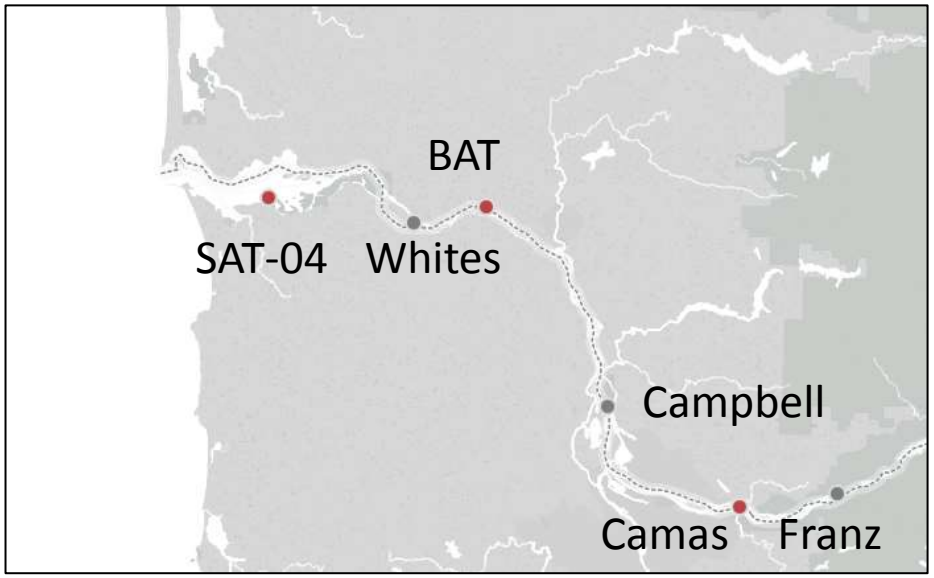


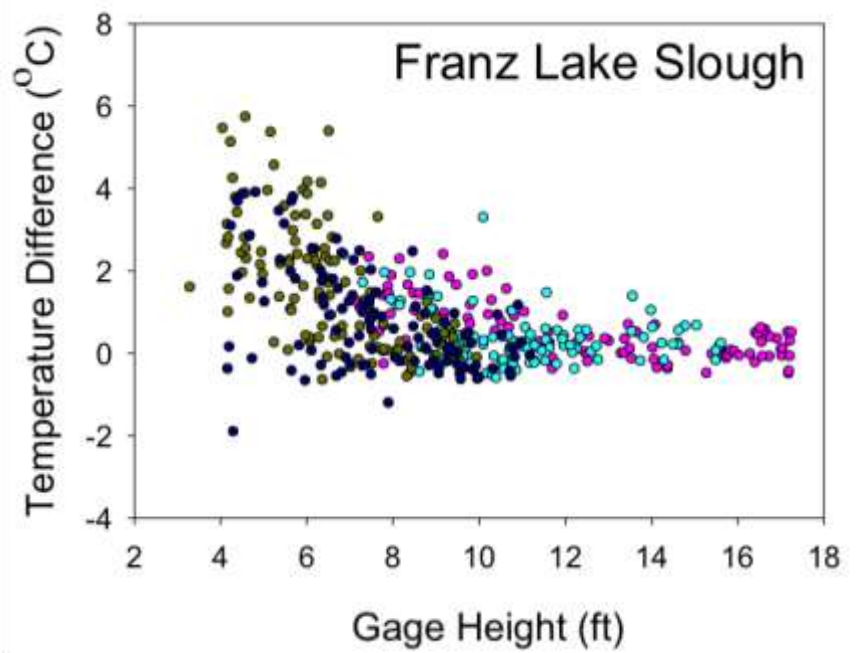
Zooplankton relative abundances

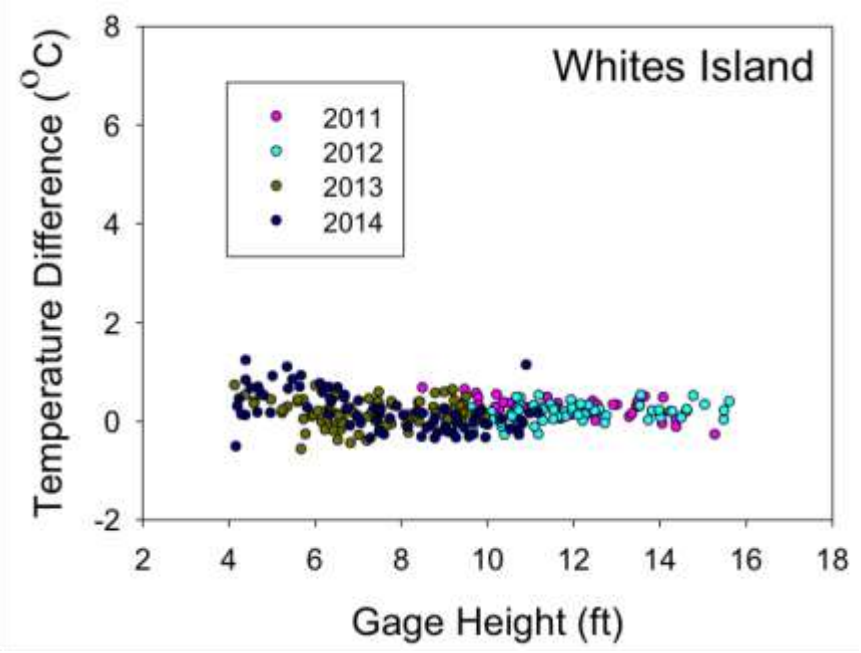


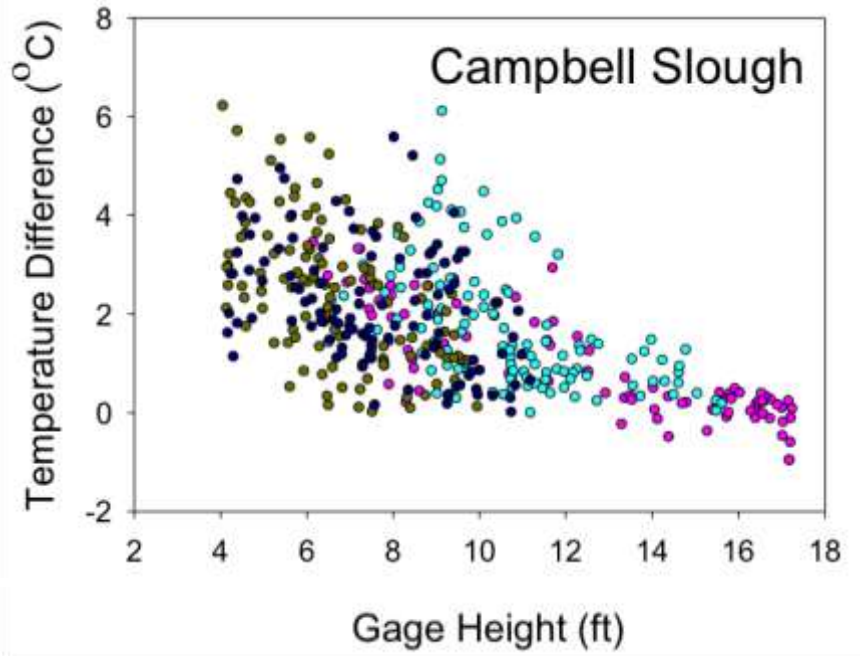
Assess connectivity by comparing off-channel sites with mainstem

- Compare Franz Lake Slough (Reach H), Campbell Slough (Reach F), Whites Island (Reach C) to data from mainstem
- Calculate difference between mainstem and fixed sites









- Temperatures at Whites Island do not differ very much from the mainstem
- In contrast, temperatures at Franz Lake and Campbell Slough differ from the mainstem when river levels are low

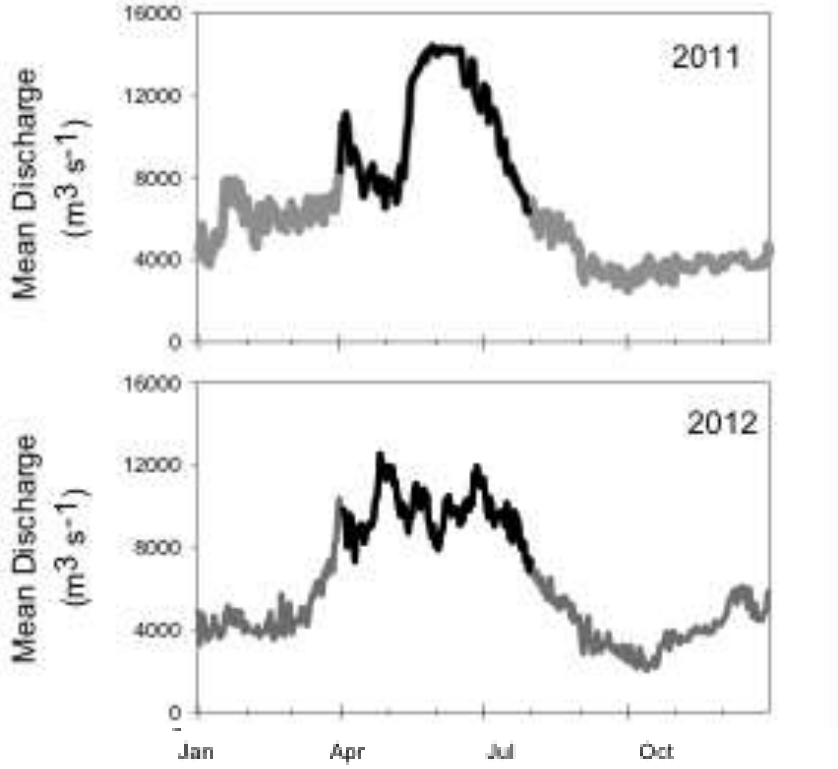
Ongoing work

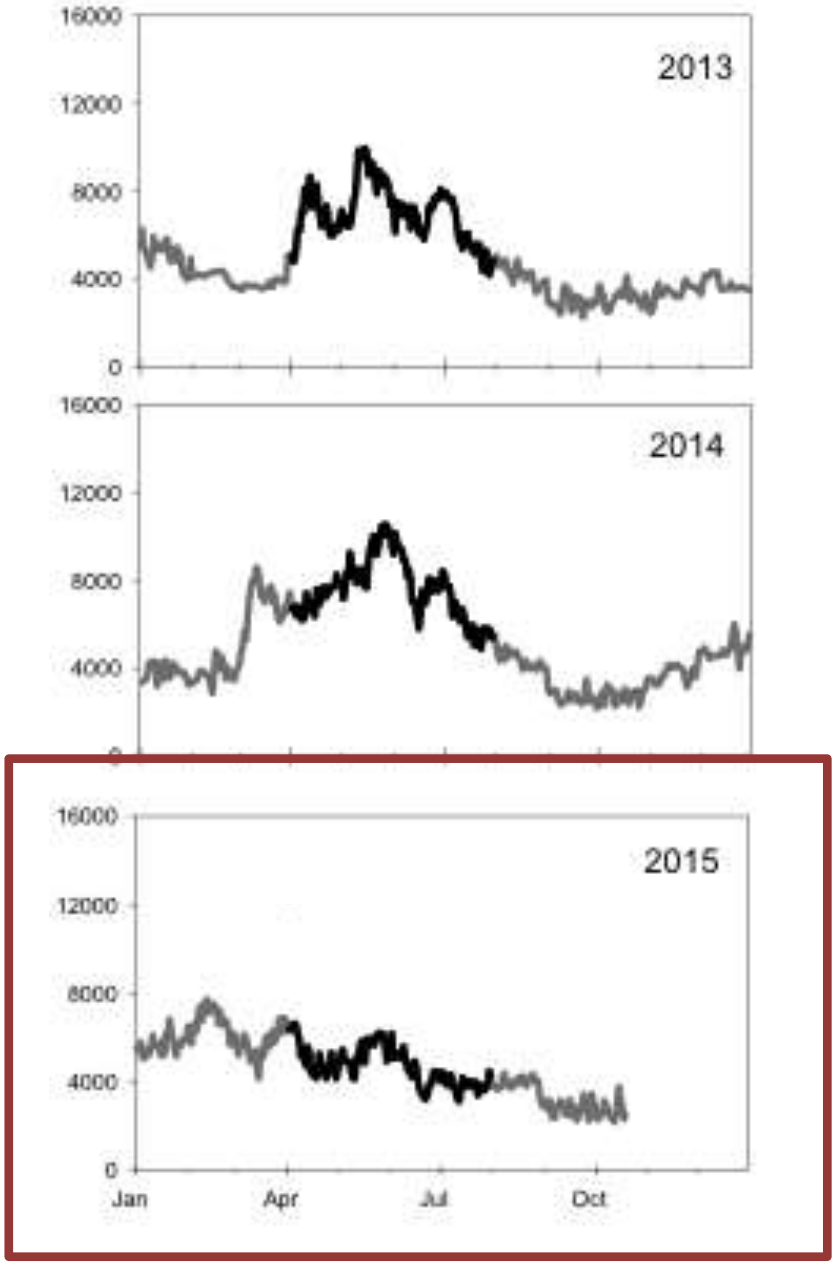
- 2016 sample analysis mostly completed
- Full data set expected by mid-December

Project overview

Aim: Characterize water quality and the lower food web of juvenile salmonids in space and time.

- 6 fixed sites (Franz, Campbell, Whites, Welch, Grays, Ilwaco)
  - nutrients, chlorophyll, phytoplankton, zooplankton species & abundance
- 4 sites (Franz, Campbell, Whites, Ilwaco)
  - stable isotope signatures of organic matter fueling food webs
  - Continuous (hourly) water quality data
- Mainstem (Beaver Army Terminal, Camas)
  - Periodic observations of above parameters for comparison with shallow water sites

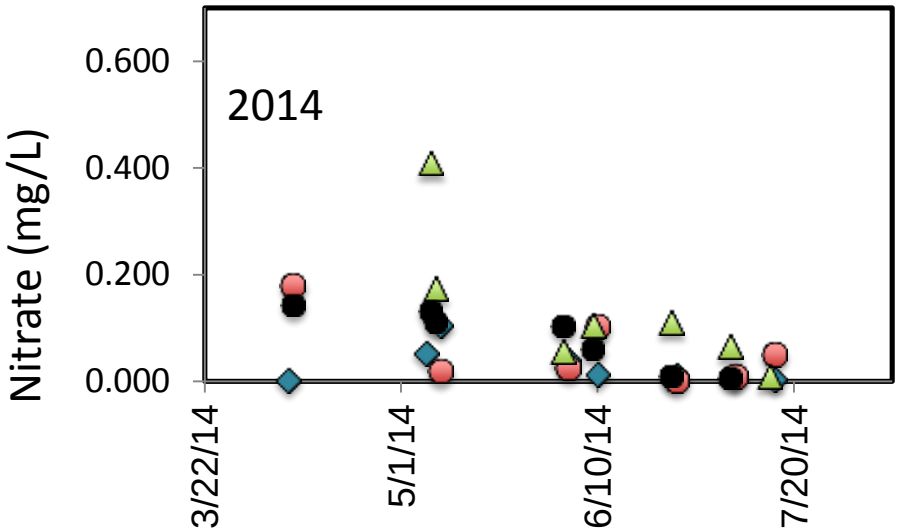


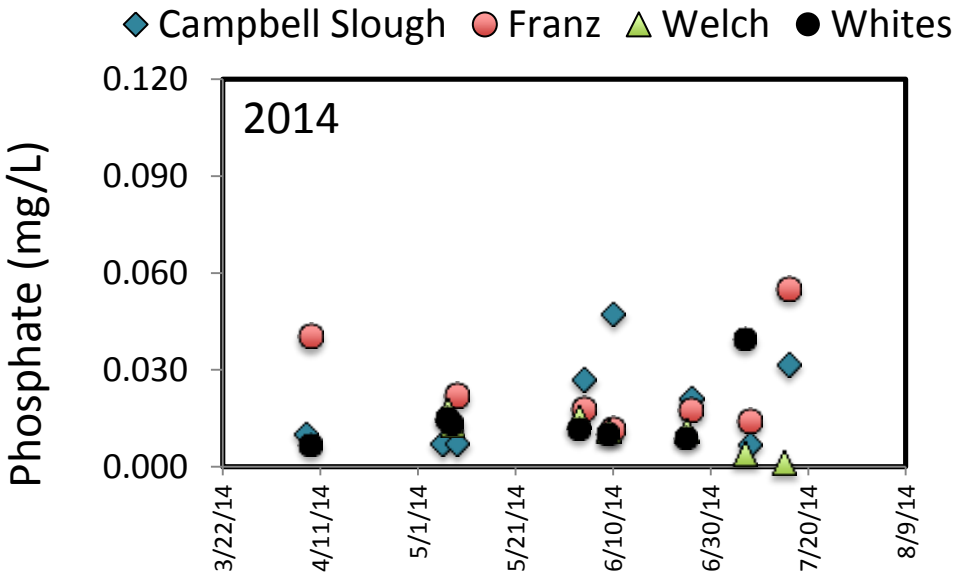


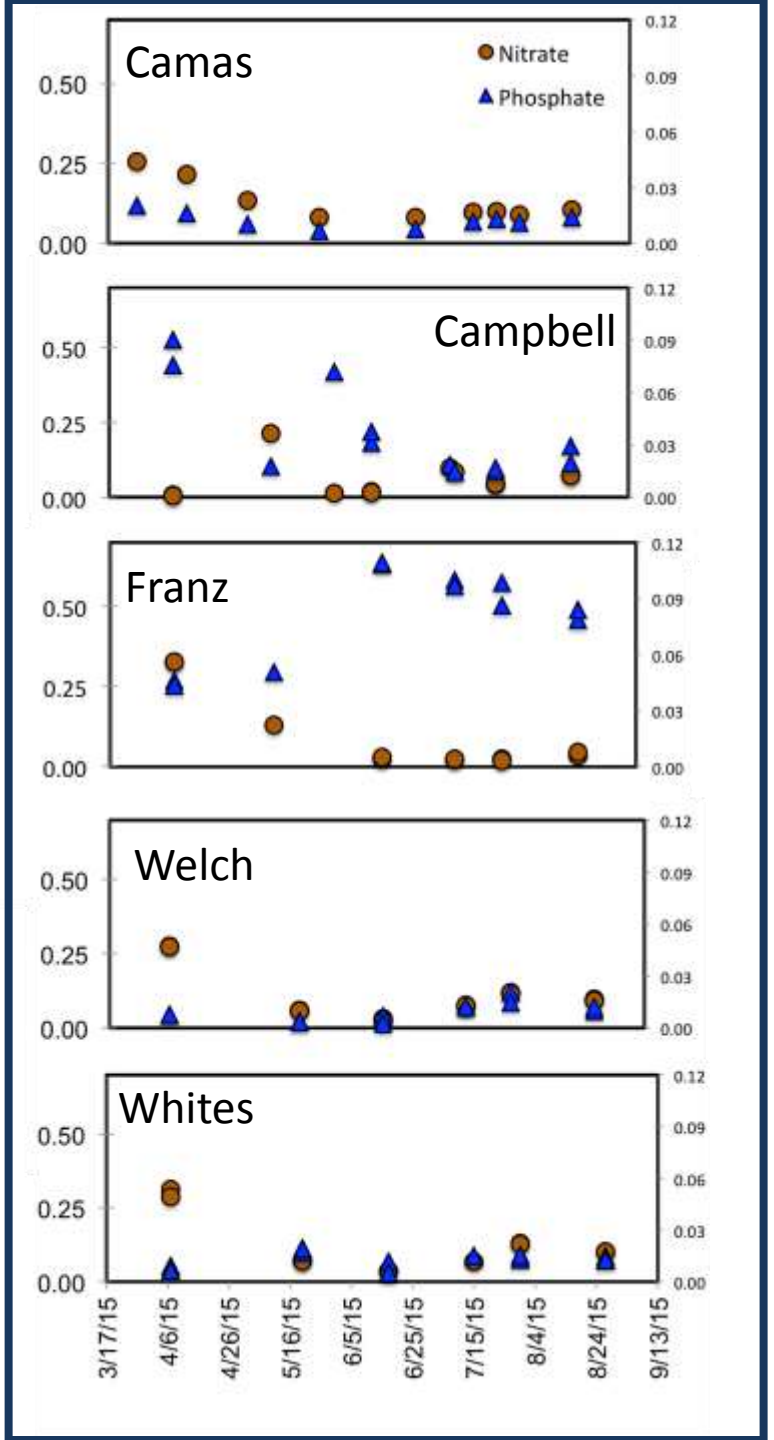
2015 had low flows and warm temps

- 2011: high water
- 2012: high water
- 2013: moderate flow
- 2014: moderate flow
- 2015: **low flow**

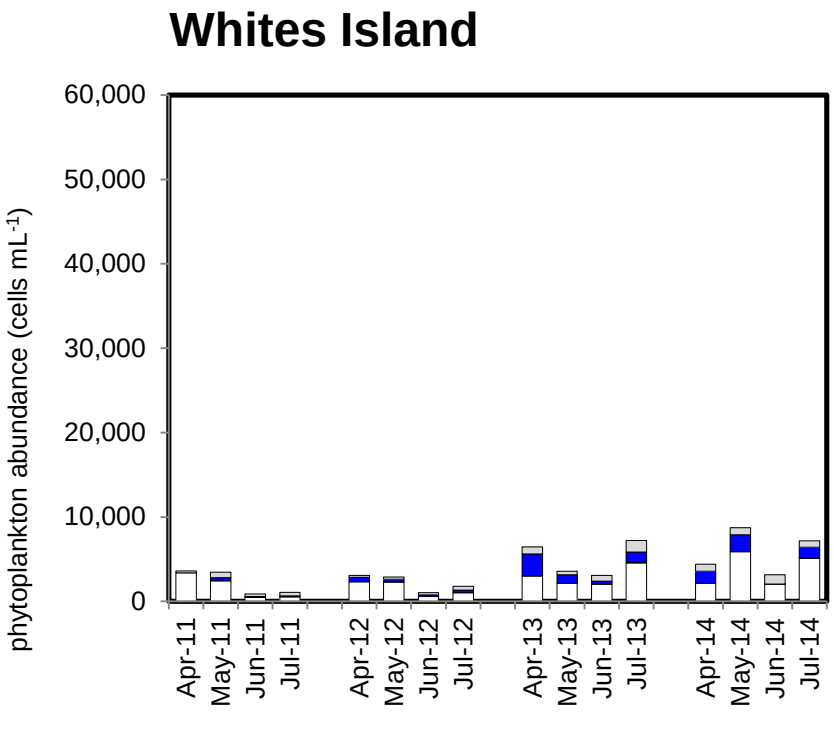
Nutrients (2014-2015)

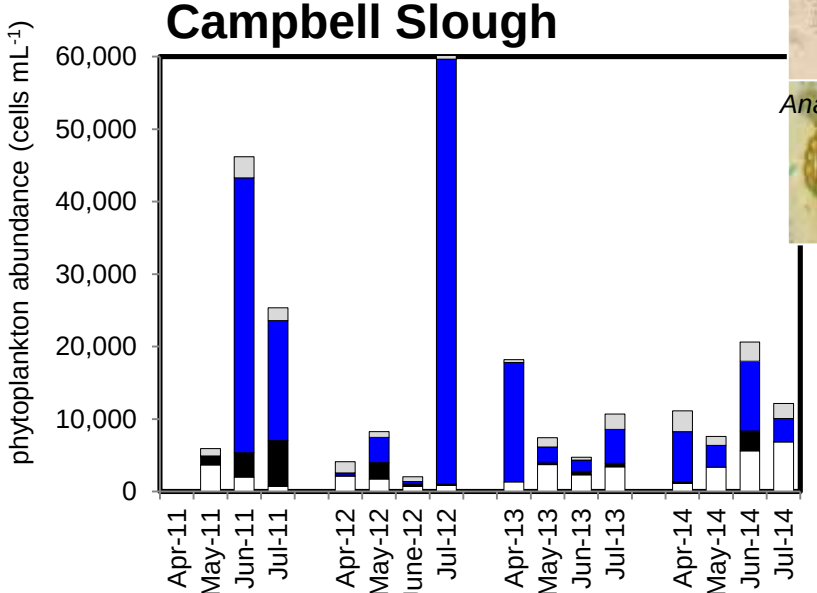


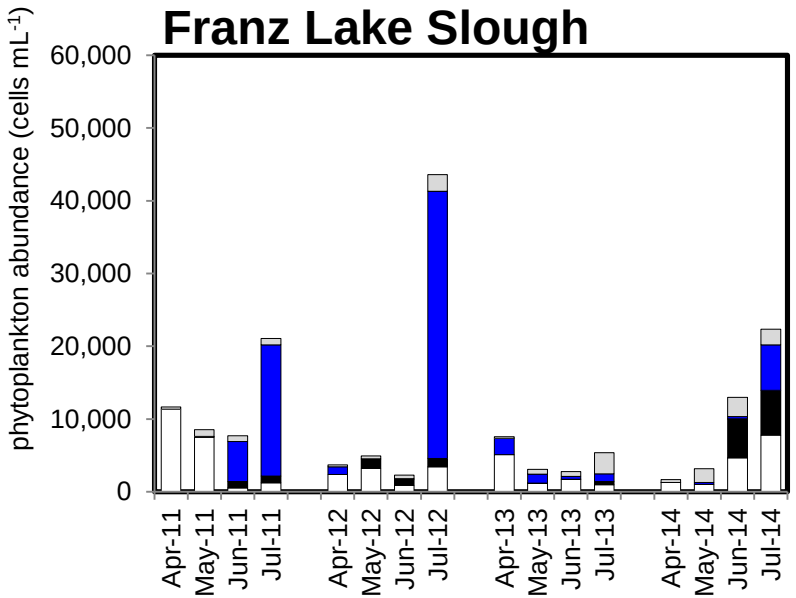




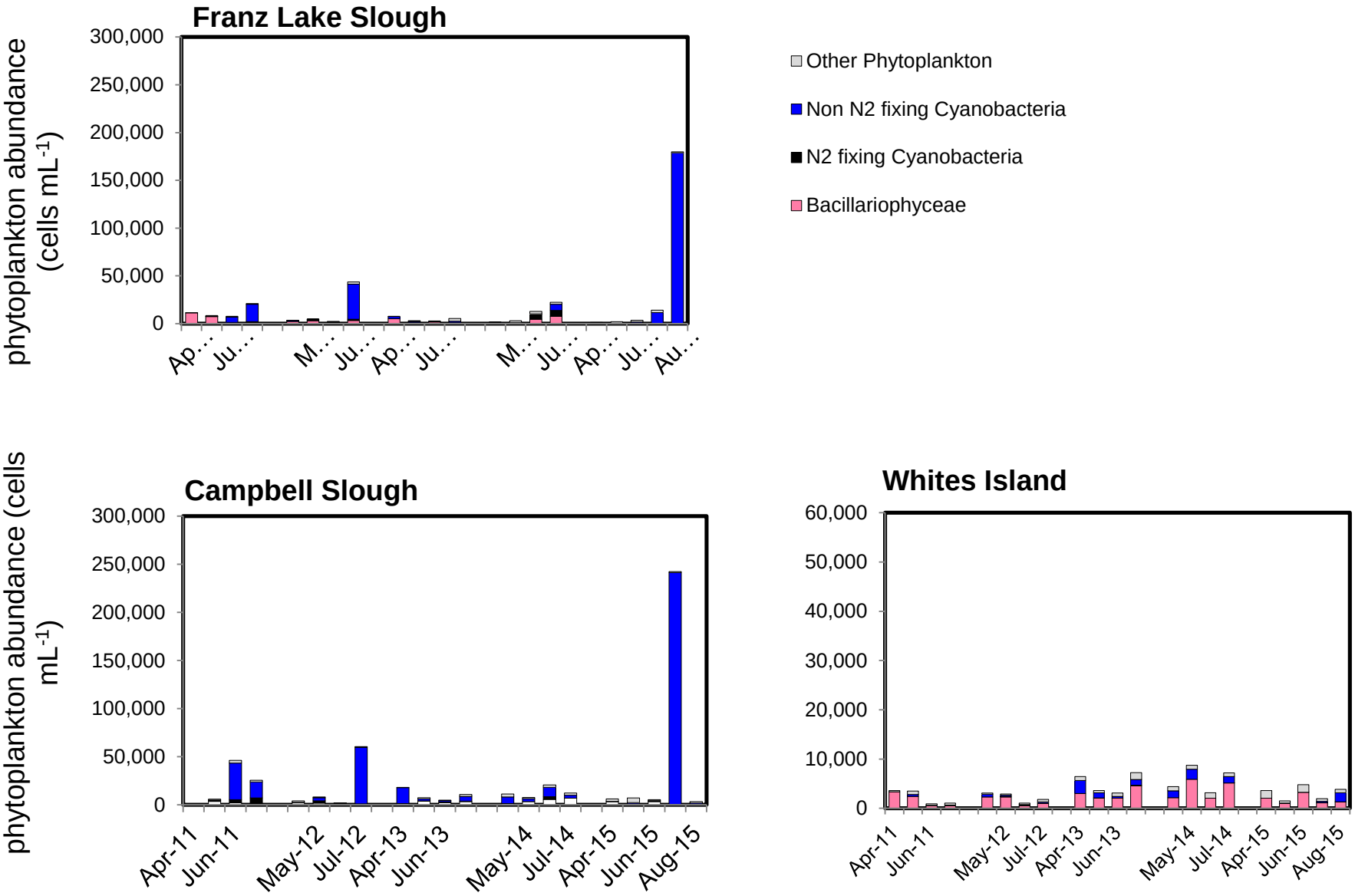
Phytoplankton: 2011-2014







Phytoplankton: 2015



Program elements

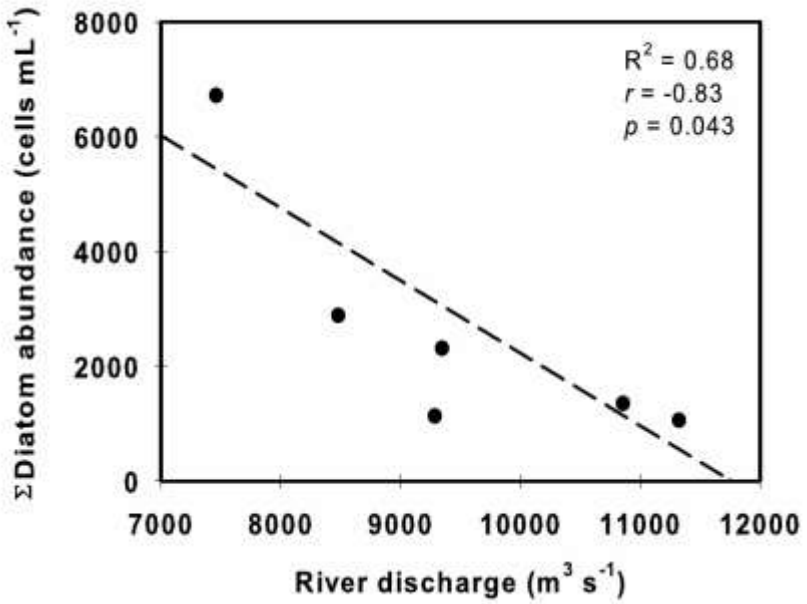
- Phytoplankton and zooplankton abundance and species composition (2011-present)
- Chlorophyll (USGS: 2011-2013; OHSU 2014-present)
- Nutrients (USGS: 2011-2013; OHSU 2014-present)
- Mainstem conditions as viewed by in situ sensors (OHSU: 2011-present)
- Water quality of shallow water habitats (USGS: 2008-2014; OHSU: 2015-onward)
- Natural abundance stable isotopes for dietary analysis (USGS: 2011-2014; OHSU: 2015-onward)
- Other stuff: rates of primary production (USGS: 2011-2013); gut contents of macroinvertebrate prey (chironomids)

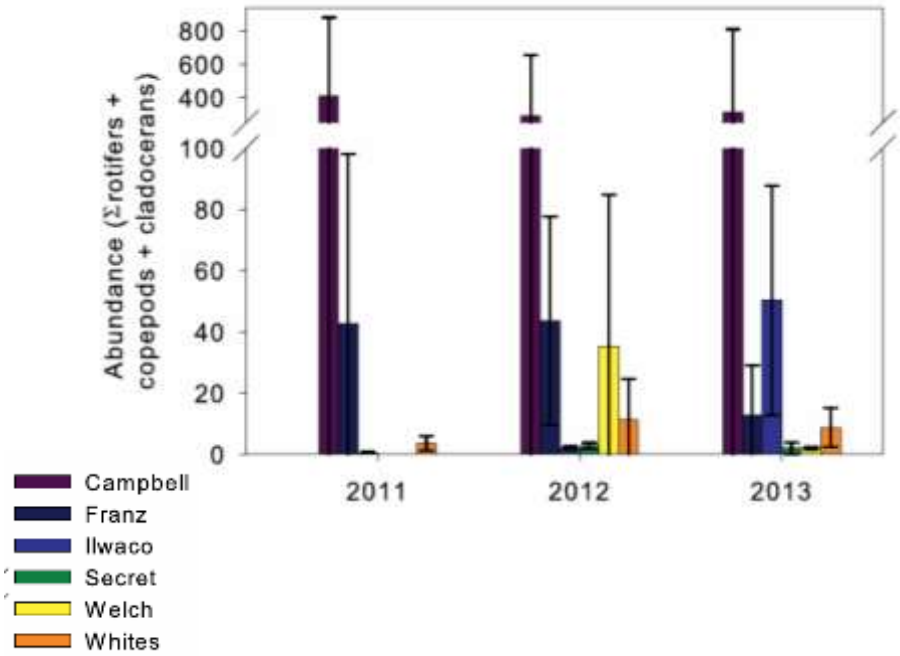
Working Hypothesis

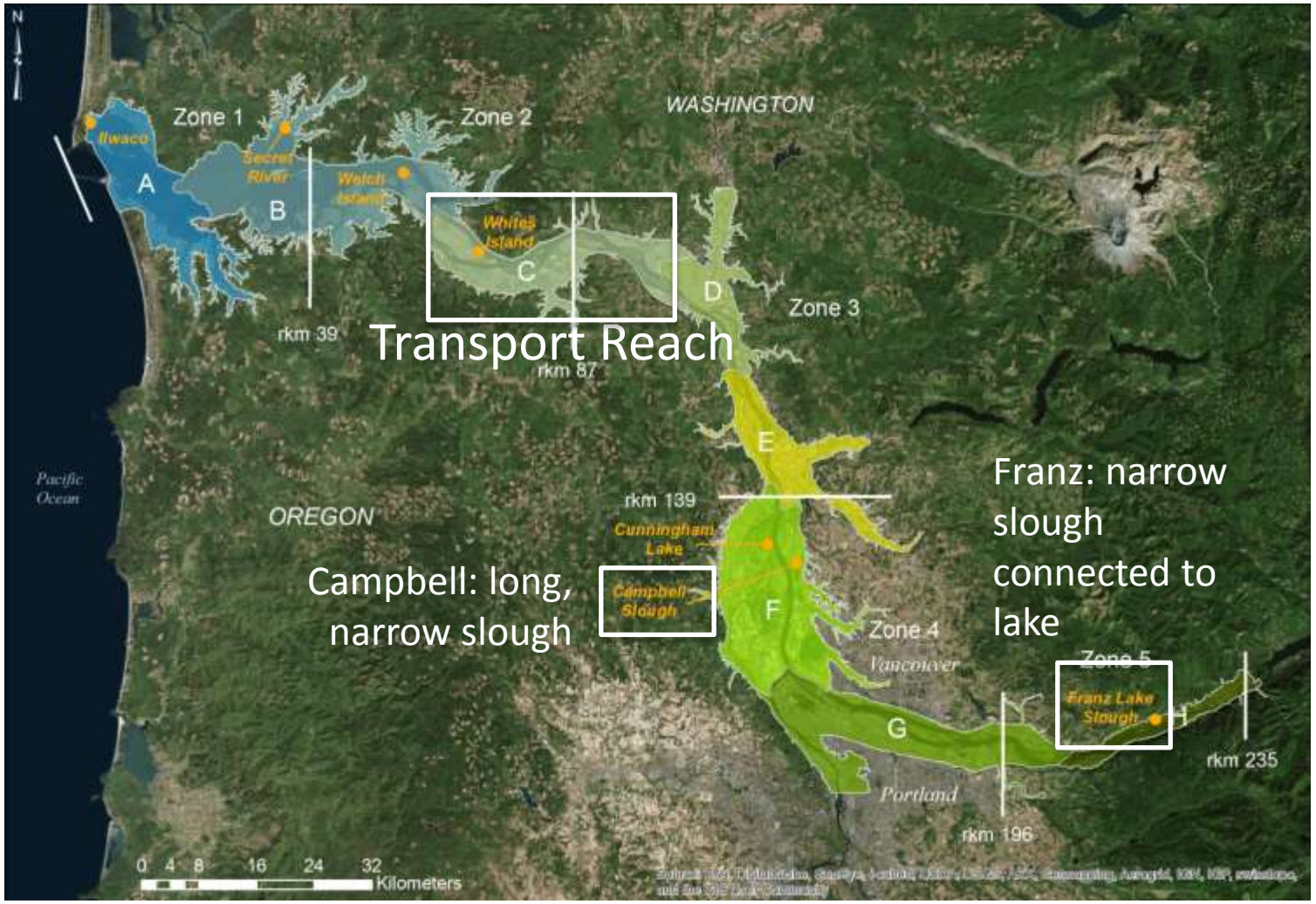
- Phytoplankton growth is controlled by available phosphorus
- River provides a source of phosphorus (likely through adsorption of P to particles)
- Size of freshet determines P load to off-channel habitats where residence times can be high
- Years with high discharge lead to high abundances of N-fixing cyanobacteria in the summer

Trends in plankton abundance

- Phytoplankton abundance
  - inversely correlated with river discharge;
  - higher in shallow water habitats compared to mainstem;
  - abundances higher in areas of longer retention than well-flushed areas
- Zooplankton abundance
  - highest at Campbell Slough







Increasing tidal influence