Russian River Estuary Management

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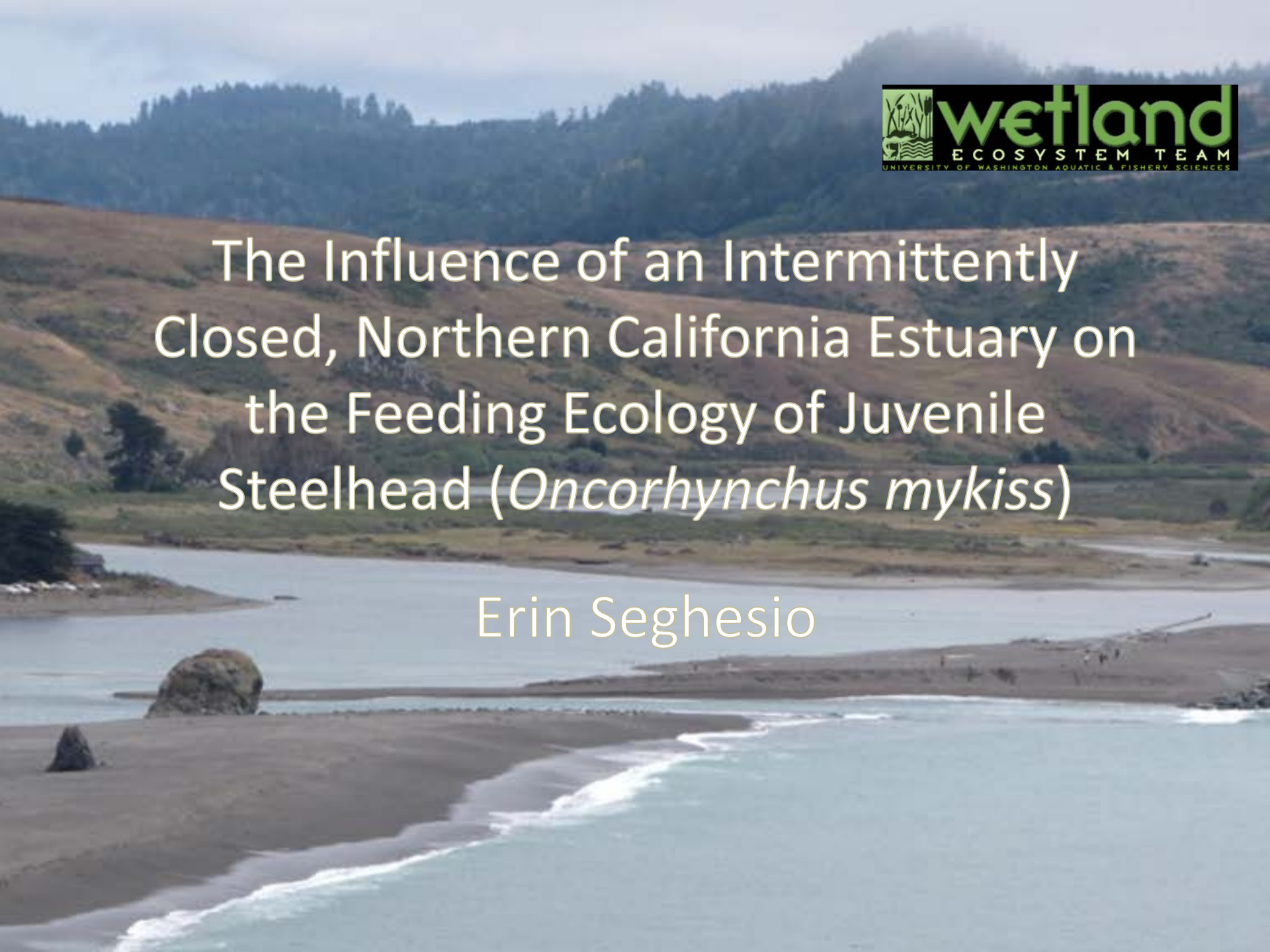
SONOMA COUNTY WATER AGENCY

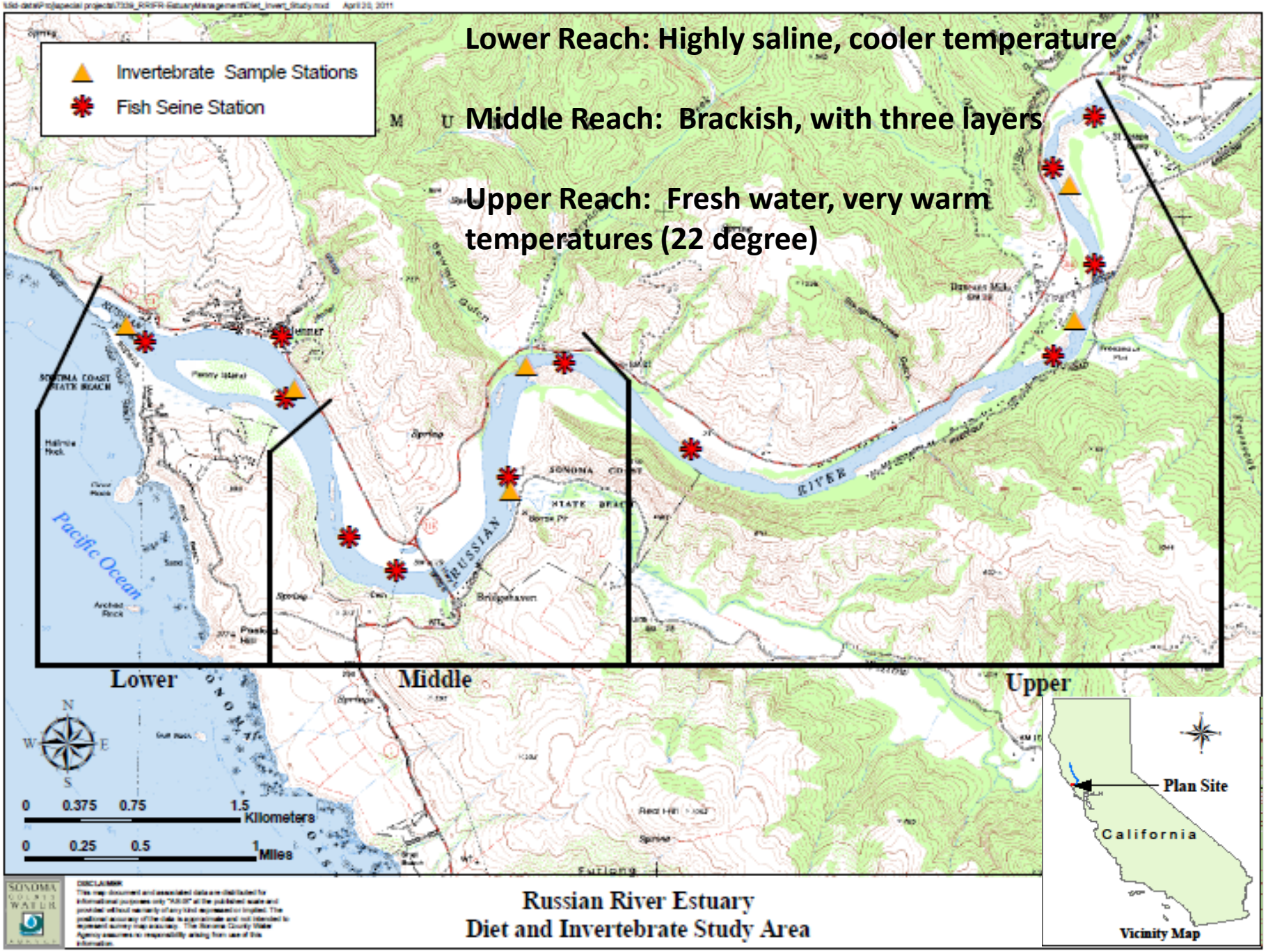


The Influence of an Intermittently Closed, Northern California Estuary on the Feeding Ecology of Juvenile Steelhead (*Oncorhynchus mykiss*)

Erin Seghesio

Study Objective

To determine over time and range, the distribution, composition and relative abundances of potential steelhead prey items and diet before and during a freshwater lagoon conversion.


Invertebrate Sample Stations
Fish Seine Station
Lower Reach: Highly saline, cooler temperature
Middle Reach: Brackish, with three layers
Upper Reach: Fresh water, very warm temperatures (22 degree)
Lower
Middle
Upper
Pacific Ocean
RUSSIAN
RIVER
Bridgehaven
Plan Site
California
Vicinity Map
0 0.375 0.75 1.5 Kilometers
0 0.25 0.5 1 Miles
Russian River Estuary
Diet and Invertebrate Study Area

Empirical Data Questions?

1. What are steelhead primary prey taxa?

2. Does steelhead prey vary by location (from freshwater to more saline)

3. Is there a response of primary salmonid prey to a closure?

Methods: Salmonid Diet Sampling

-Beach seined

-Gastric lavaged

-12 sites

-Monthly

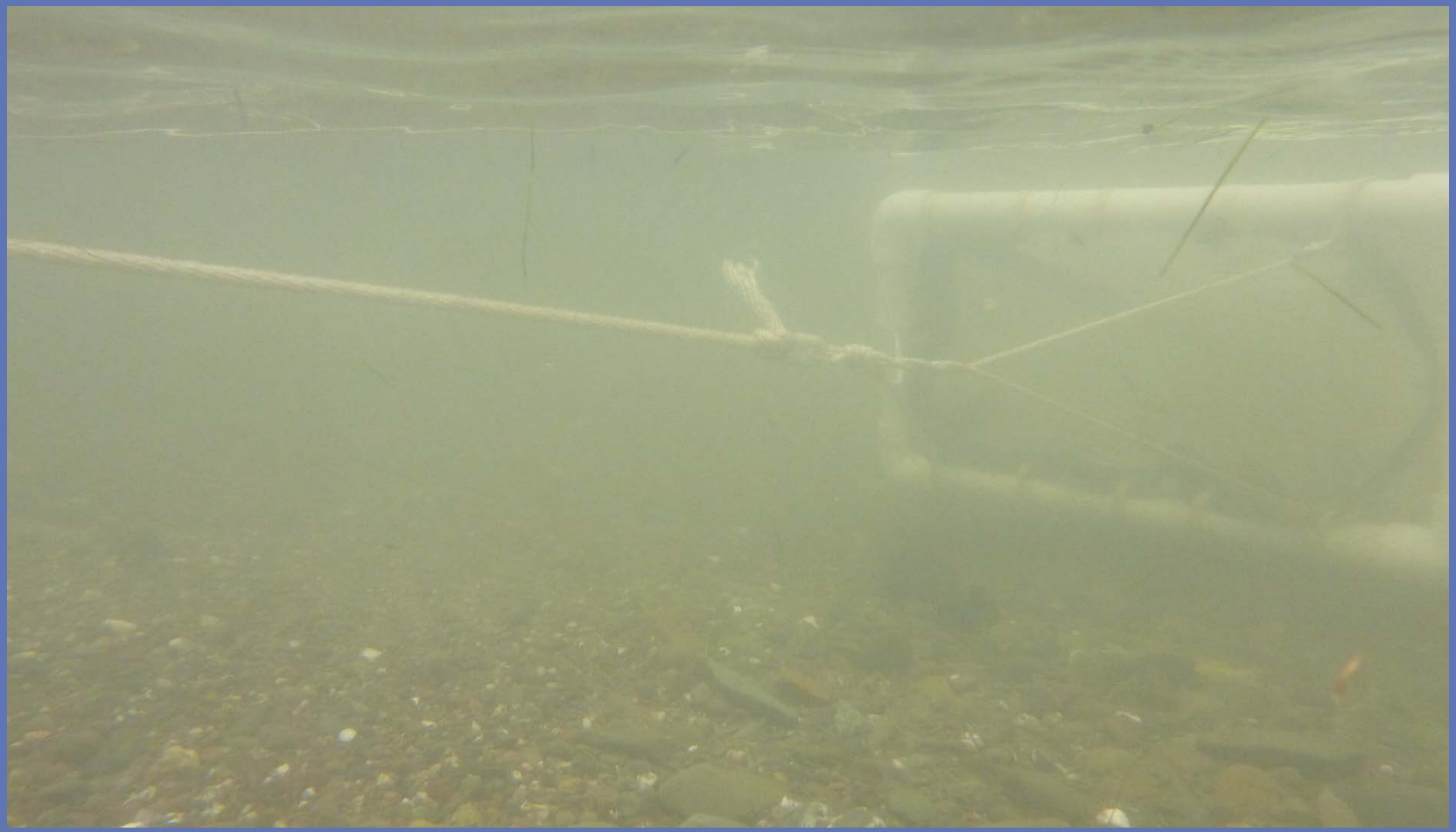
-Jun-Oct 2010

Methods: Invertebrate Sampling

Monthly:

Sampled 6 locations: June-Early September

Sampled 3 locations: June-October



Invertebrate sampling: Benthic Core

-Taken along the shoreline
-5 replicates per site

Invertebrate sampling: Nearshore Epibenthic Hauls

-Pulled 10m perpendicular to the shoreline
-5 replicates per site

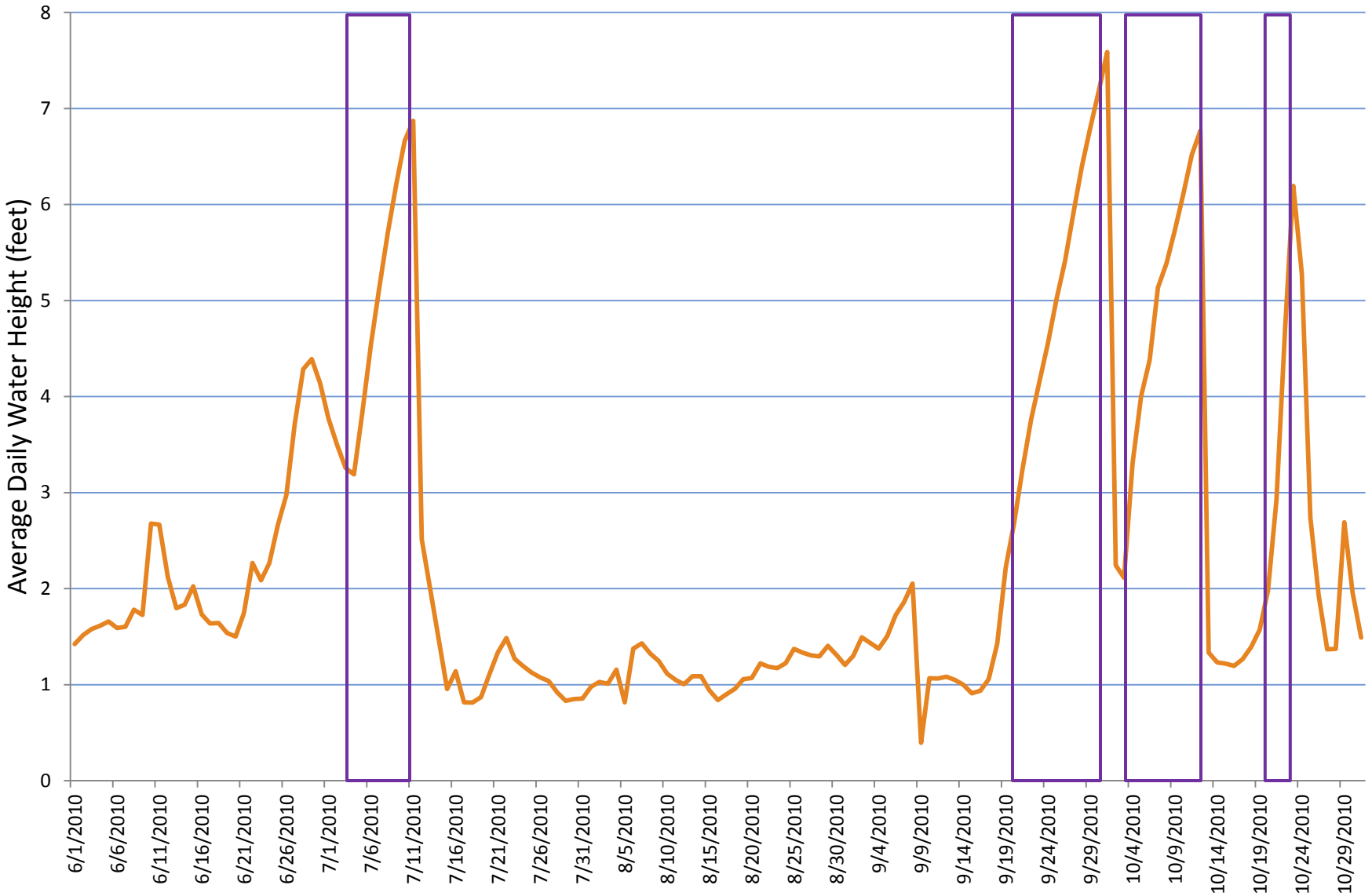
Invertebrate sampling: Thalweg Epibenthic Sled

-Towed from boat in the middle of the channel for 15 meters
-5 replicates per site

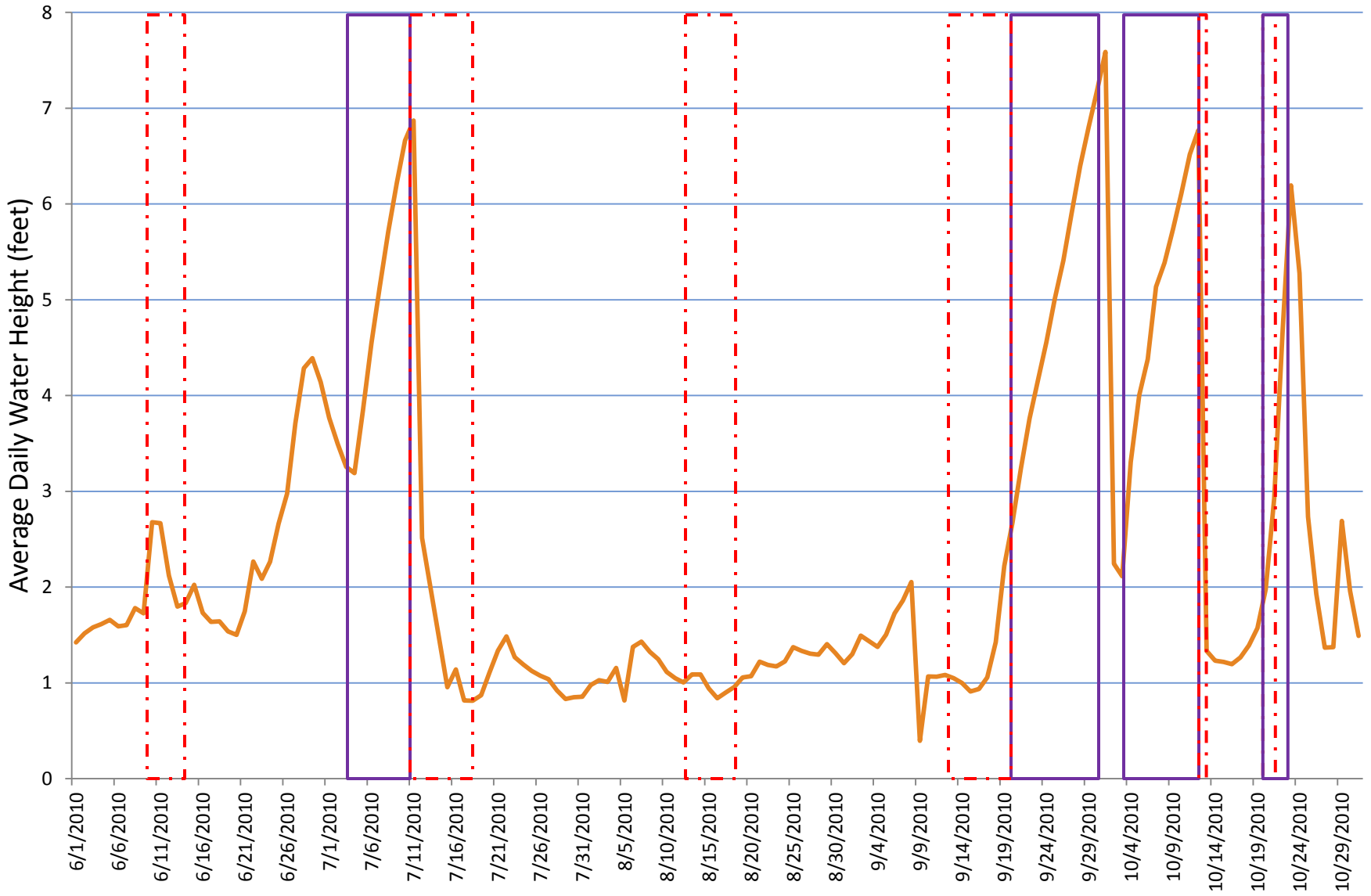
Invertebrate sampling: Insect Fallout Trap and Zooplankton Vertical net hauls

Not going to be covered today because zooplankton was not found in the diets and adult insects in very small quantities

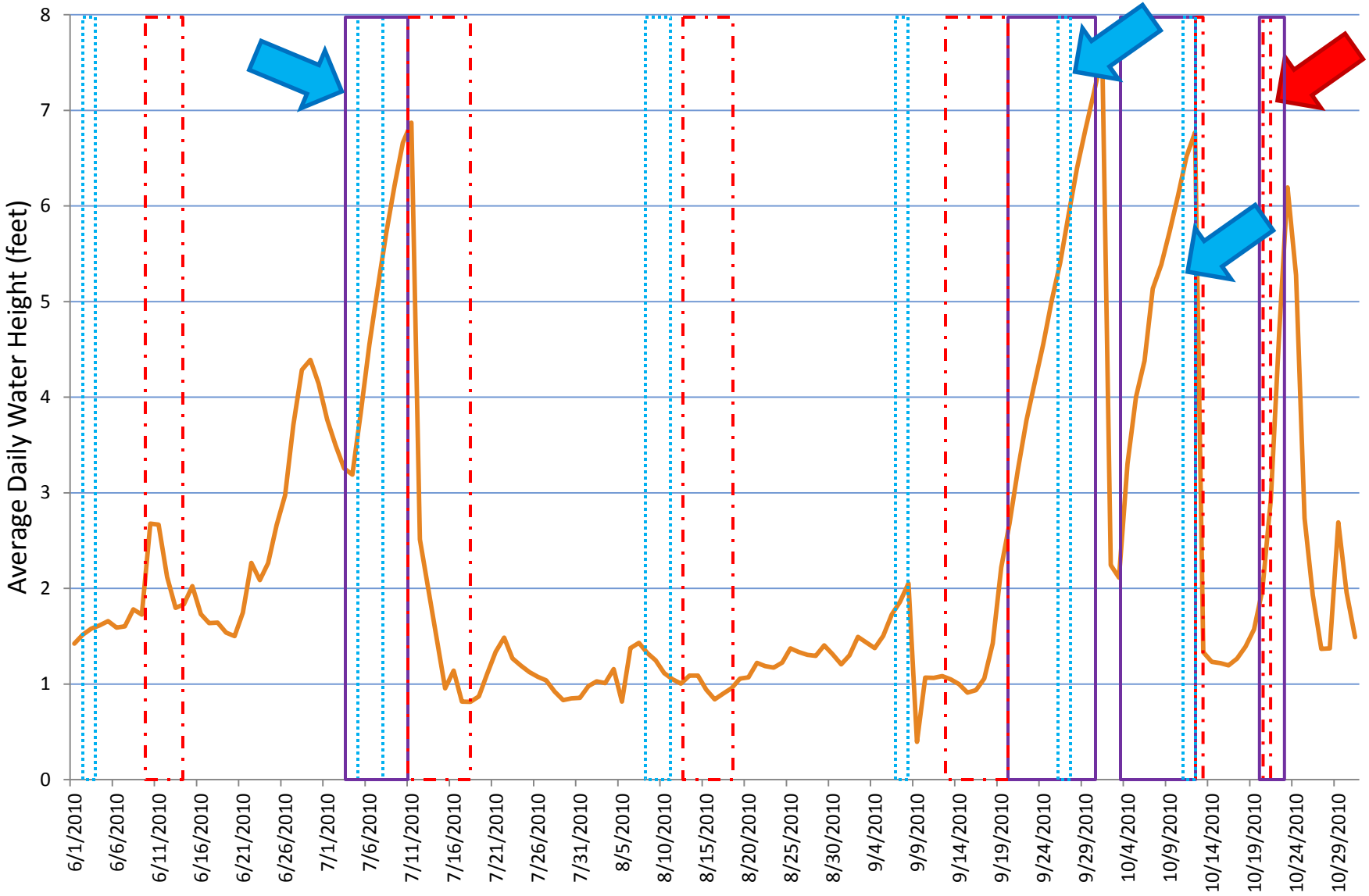
2010 Estuary Closures



2010 Estuary Closures and Seining Dates



2010 Estuary Closures, Seining and Invertebrate Sampling Dates



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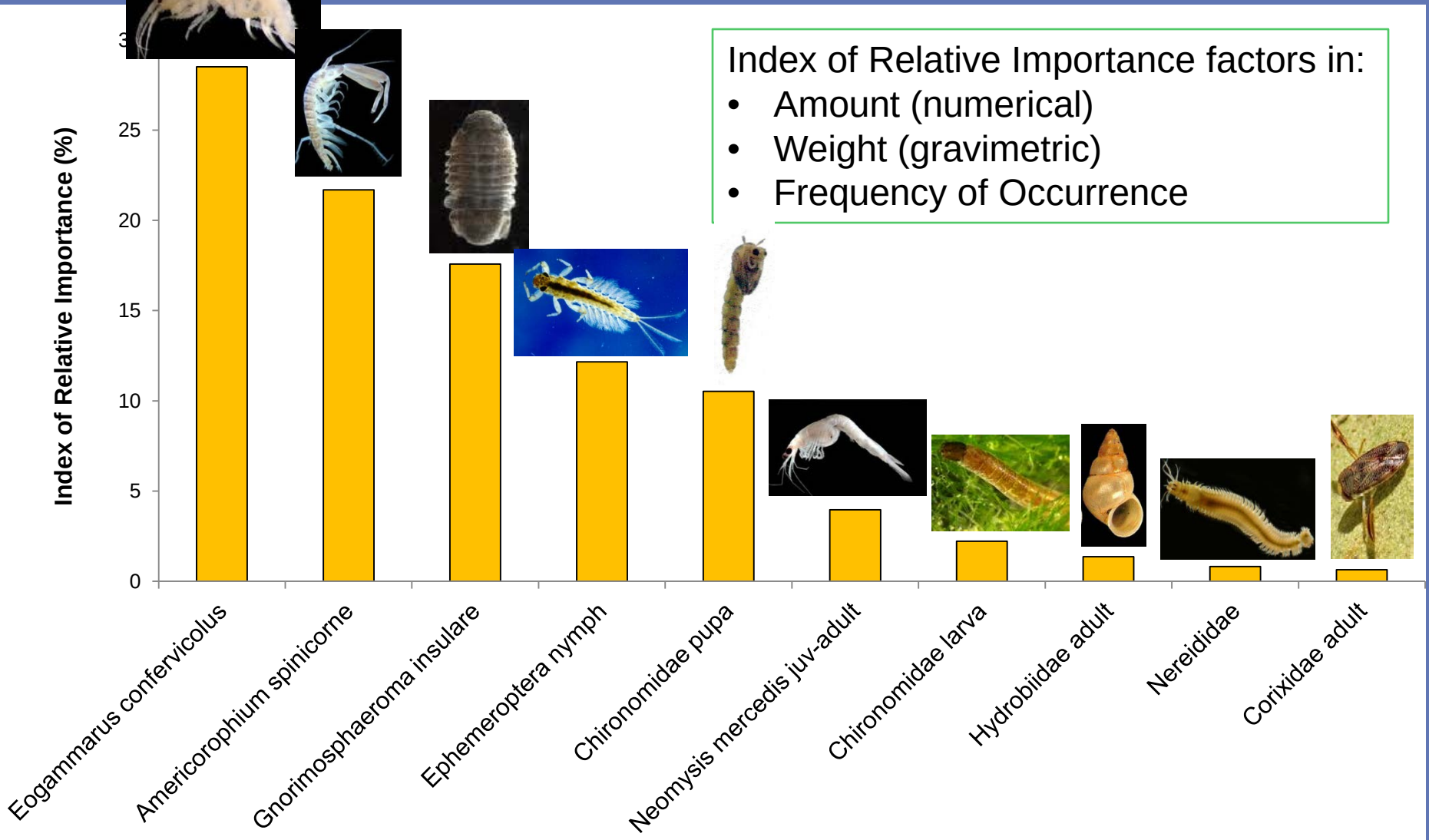
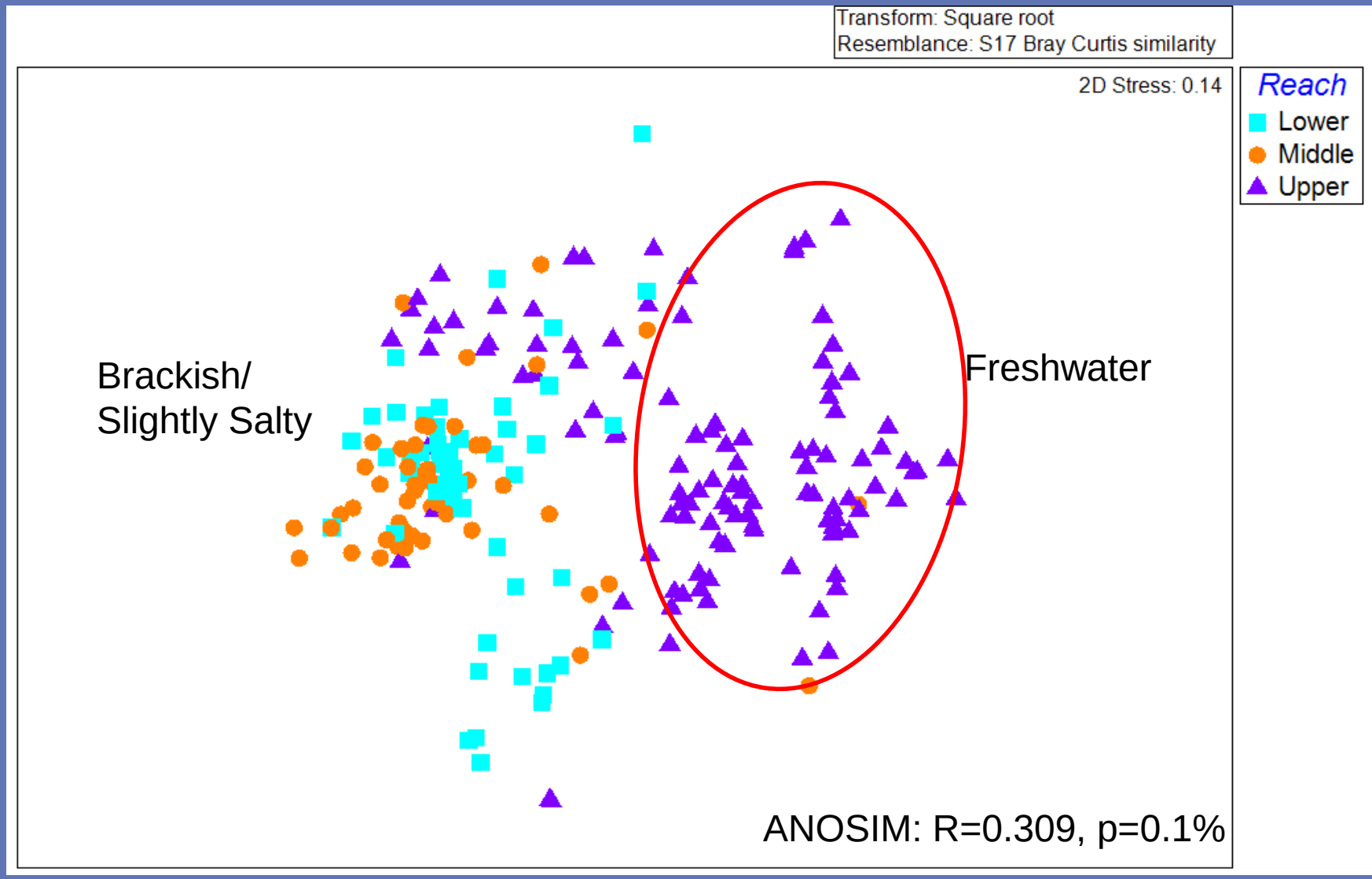
Steelhead feeding primarily on epibenthic taxa



Some separation between reaches



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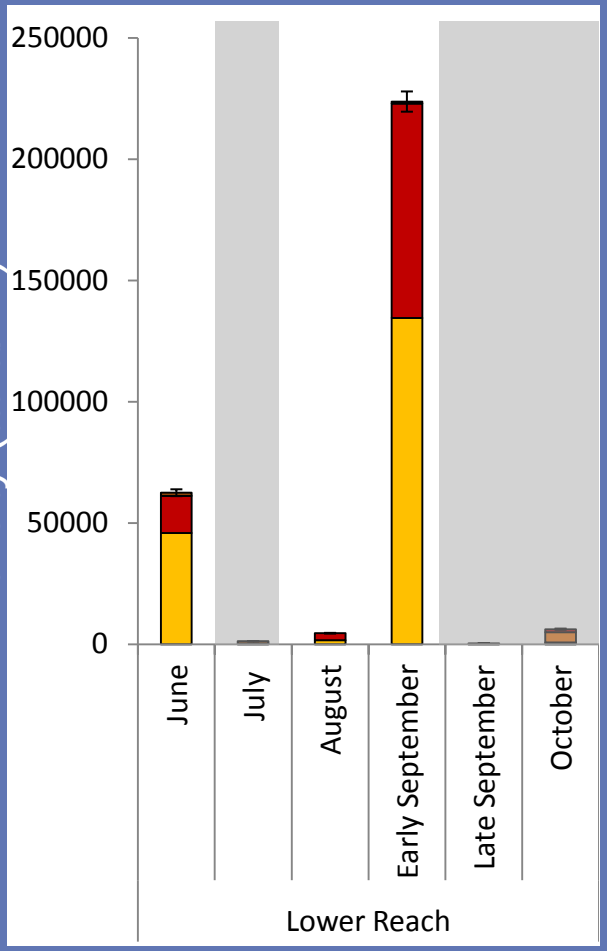
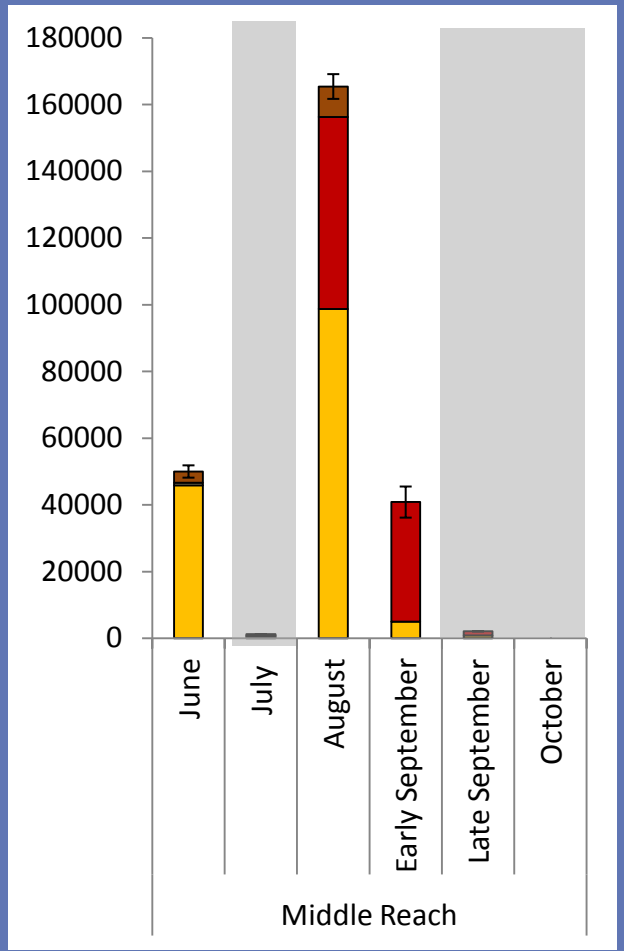
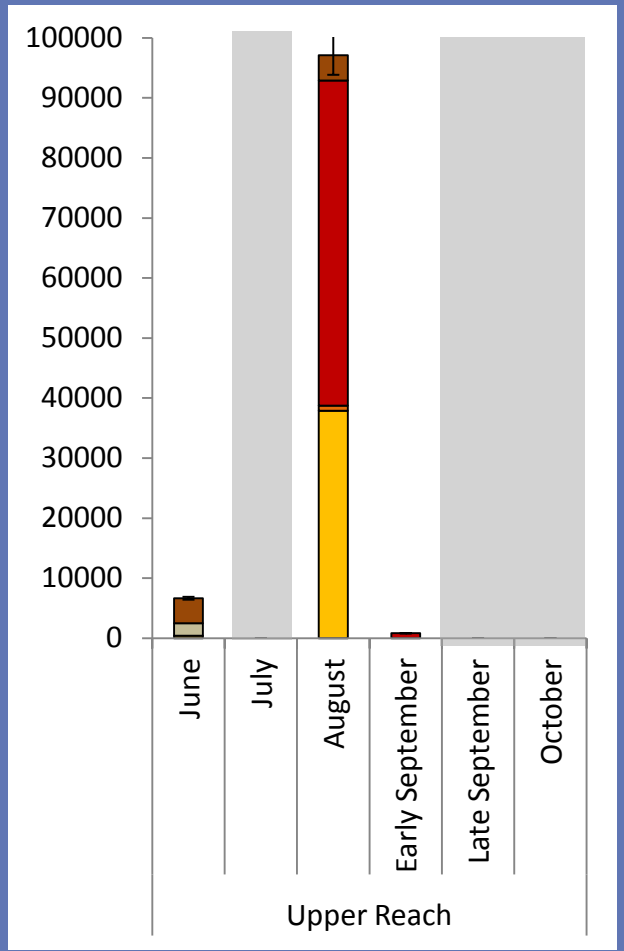
Benthic Core: Taxa did not move with closure

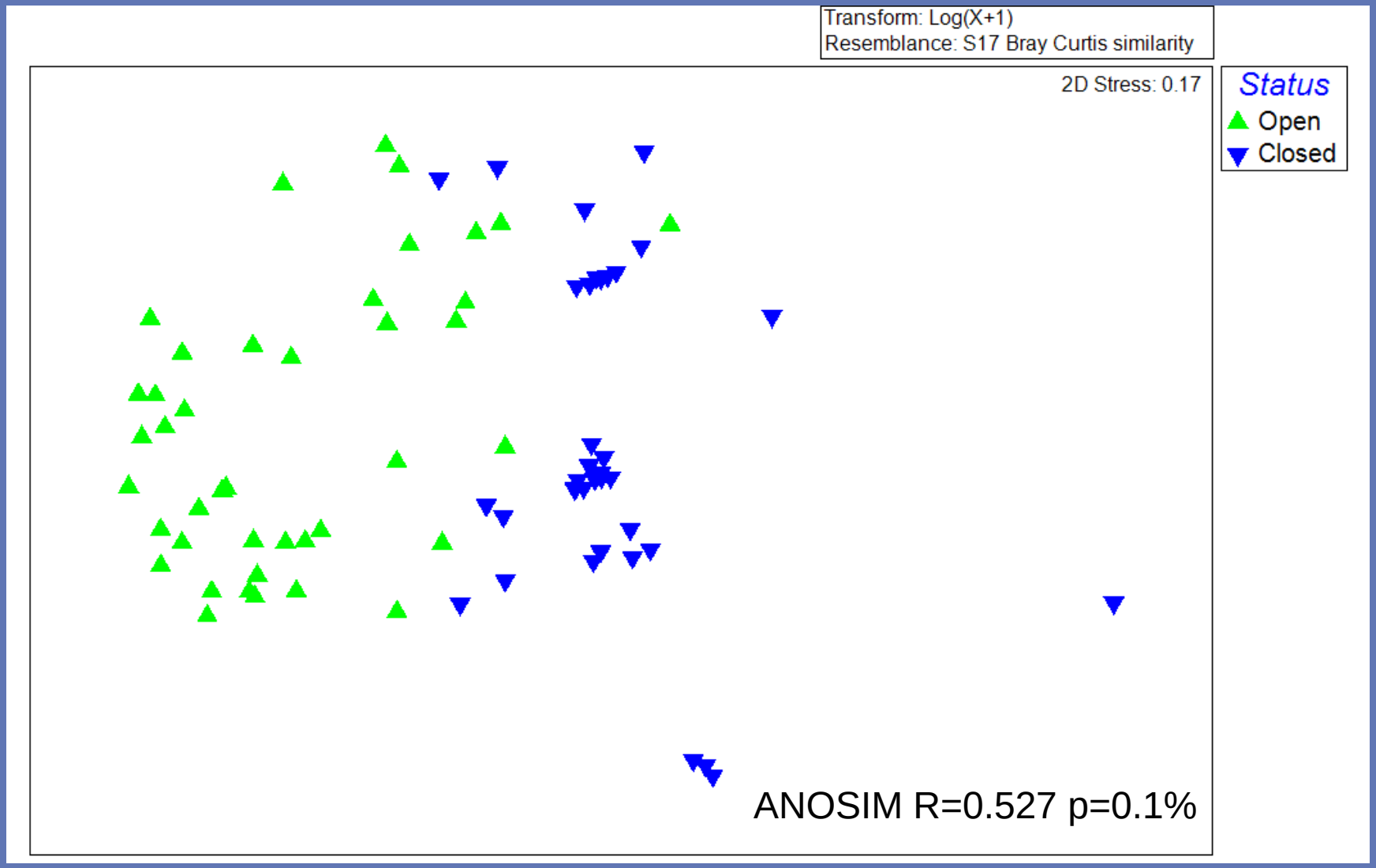
Americorophium spp.
Chironomidae Larva
Eogammarus confervicolus
Gnorimosphaeroma insulare
Nereididae
Shaded= Closed







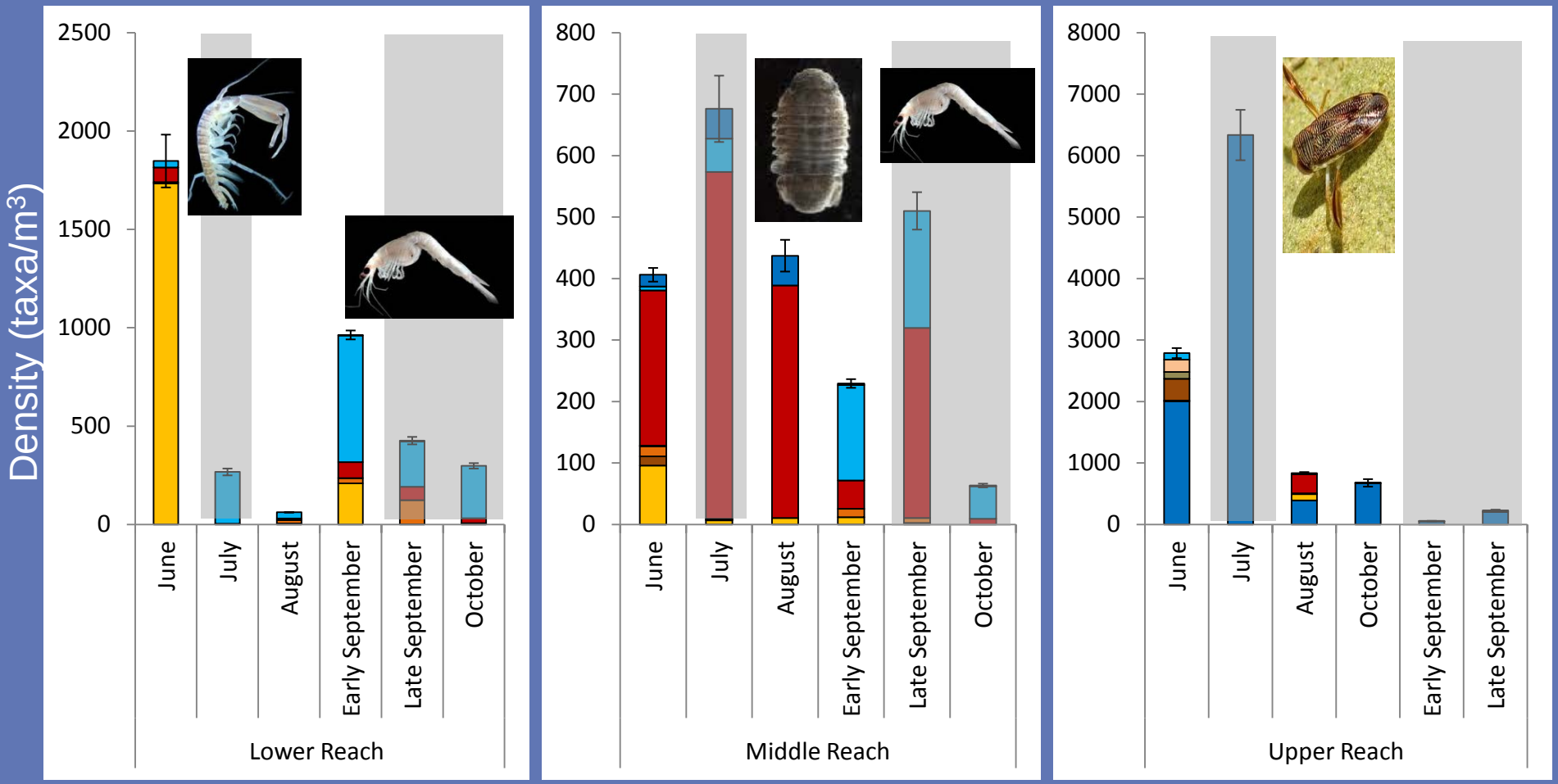
Difference in species assemblages



Nearshore Epibenthic Net: More motile organisms showed more movement with closure

Corixidae
Americorophium spp.
Chironomidae larva
Chironomidae pupa
Eogammarus confervicolus
Ephemeroptera Nymph
Gnorimosphaeroma insulare
Neomysis mercedis

Shaded= Closed



Thalweg Epibenthic Sled: Sites differences


Americorophium spp.
Chironomidae Larva
Chironomidae Pupa
Corixidae
Eogammarus confervicolus
Ephemeroptera Nymph
Gnorimosphaeroma insulare
Neomysis mercedis
Nereididae

Shaded=Closed

Density (taxa/m^3)

Lower Reach

Middle Reach

Upper Reach

June
July
August
Early September
Late September
October

Empirical data findings

-Steelhead are feeding primarily on epibenthic organisms.

-Although the highest density of common prey taxa were found in benthic core samples, the greatest diversity was in the epibenthic sampling.

-The more motile organisms are able to move into the newly flooded habitat during the short closures.

-Invertebrate assemblages varied by reach in response to salinity.

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Steelhead growth

Temperature
Prey Quality
Competition
Consumption Rate
Prey Abundance

Question?

Q: Is steelhead growth going to be affected by an extended closure?

A: There was not an extended closure to sample

So we must model!

Wisconsin Bioenergetics Model *(Hanson et. al 1997)*

Consumption = Waste + Metabolism + Growth

An energy balance equation

Consumption= p* Cmax

P-value: proportion of theoretical maximum consumption

Metabolic Costs

Consumption

Temperature
Body mass
Prey Energy (J)
Prey Composition

Growth

Waste Loses

Diet composed of mostly lower caloric valued organisms

Neomysis mercedis

Ephemeroptera nymph

Chironomidae Adult

Eogammarus confervicolus

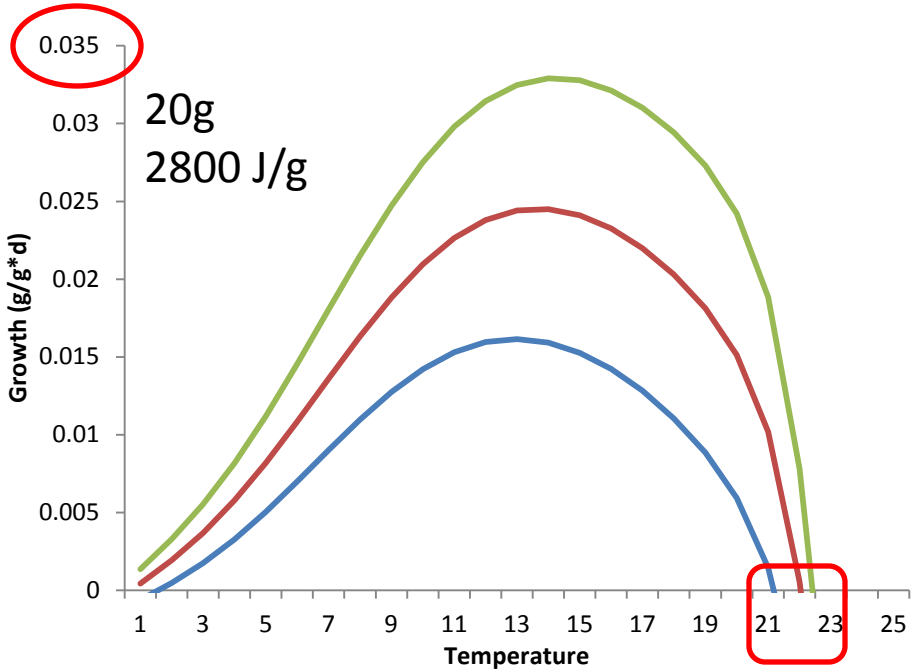
Americorophium spinicorne

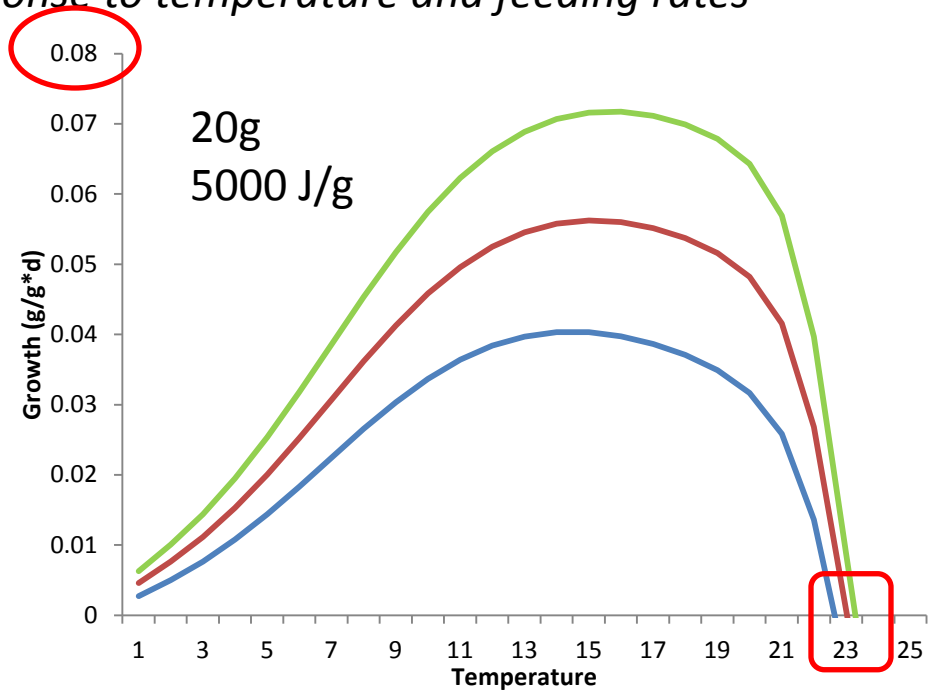
Corixidae (water boatman)

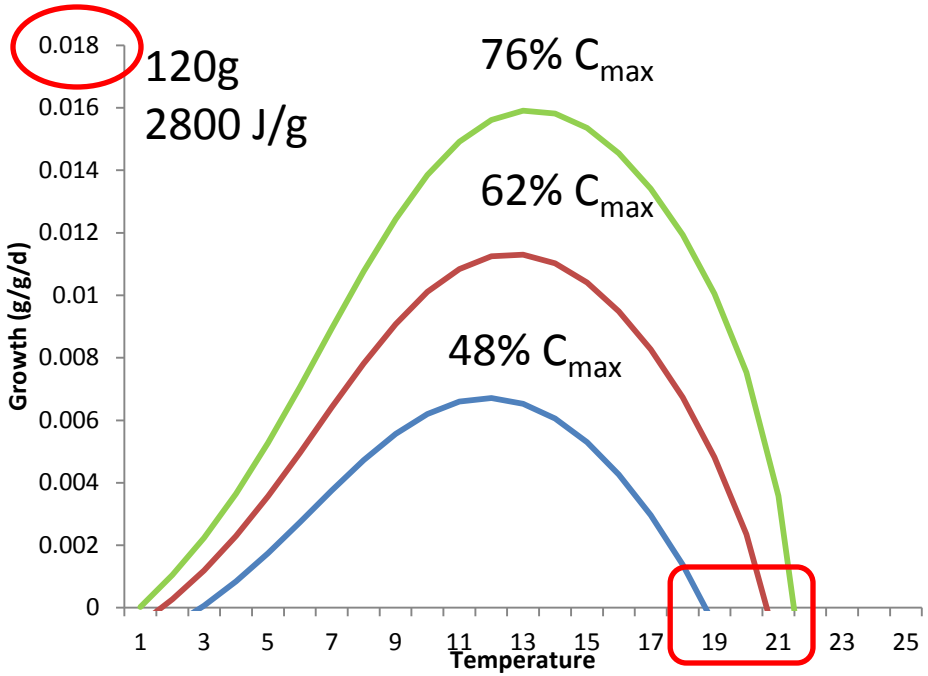
Gnorimosph-aeroma insulare

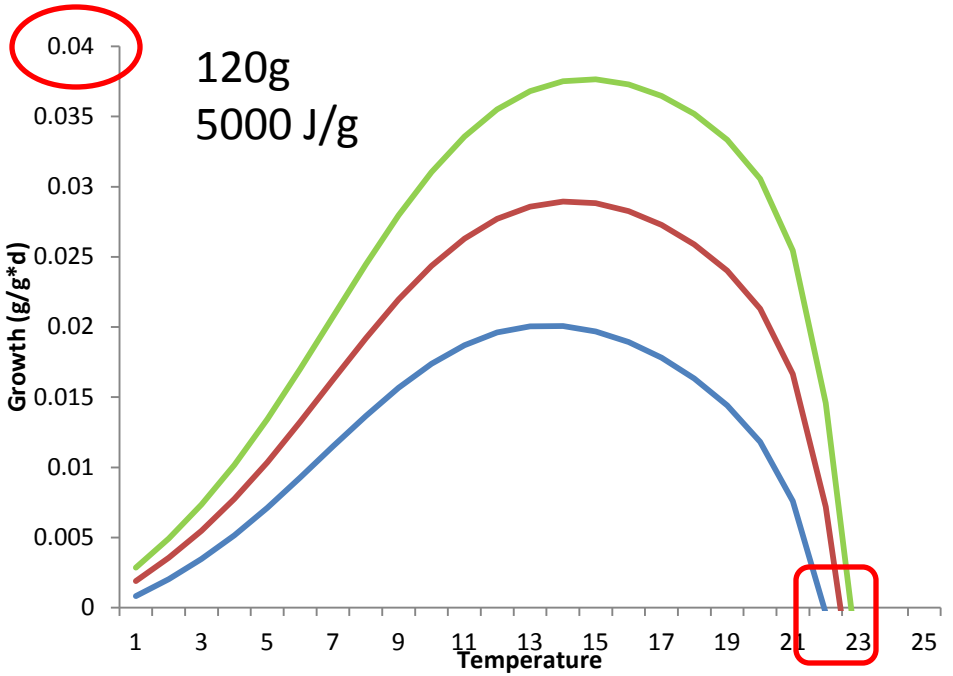
Pictures from Jeff Cordell

The change in daily growth rate in response to temperature and feeding rates









Review of primary model findings

- The more you eat the more you grow!
- Smaller fish are able to grow at a faster rate than larger fish, under the same circumstances.
- Steelhead can better buffer the stresses of increasing temperature and continue to grow by having at least one of the following:
    1. ***Consuming higher quality prey***
    2. Consuming more prey
    3. Being smaller
- Worst Case Scenario: 120g steelhead feeding at 48% of maximum consumption starts seeing no growth at 18°C

To overcome warmer temperature potentially associated with closure

- Find refuge
- Feed on higher quality prey
- Increase consumption rate

Final Conclusions

- Steelhead are feeding primarily on lower calorie epibenthic organisms
- Although the highest density of common prey taxa were found in benthic core samples, the species were not able to move up the shoreline during the short closures
- Higher quality prey organisms do exist in estuary
- Higher prey energy values/greater consumption or finding refuge may allow steelhead to withstand warmer temperatures longer

Pescadero Creek Estuary

J. Martin 1995 and M. Robinson 1993 studied fish diets and invertebrate populations

- Estuary went completely anoxic before converting to freshwater lagoon
  - Killed significant amount of invertebrate population
  - Steelhead decreased stomach fullness factors and growth rate

- Freshwater lagoon
  - Less diversity but greater abundances of invertebrate
  - Steelhead shifted diet from epibenthic crustaceans and mysids to freshwater dependent nymphs and midges

Can be expected that steelhead in RR would make similar shift in diet

Flooded habitat created by closure

Previous research:

-Shallow water habitat

-Increase growth rate

-Spatial segregation

-Alleviate competition

-Absence of predators

-Increase in invertebrate production

My final thought

The water quality during and after a closure is going to determine if the estuary/freshwater lagoon will be beneficial for steelhead

Thank you!

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Field Support- Marshall Olin and Sonoma County Water Agency Staff

Lab and Data Support - Beth Armbrust, Claire Levy, Lia Stamatiou, Jeff Cordell, Jason Toft, Alex Ulmke, Ricky Tran and Wetlab Ecosystem Team

Committee Members- Charles “Si” Simenstad (PI), David Beauchamp, and Jeff Cordell (University of Washington)