

Mixing Crystal Lake to Eradicate Rainbow Smelt (*Osmerus mordax*)



Zach Lawson

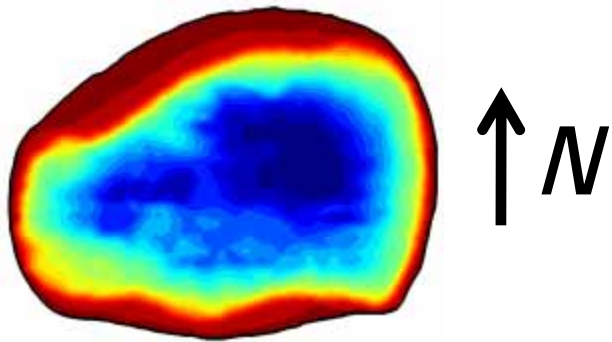
Dr. Jake VanderZanden, Dr. Steve Carpenter, Dr. Tom Hrabik

Today's Presentation

- Crystal Lake/Rainbow Smelt
- Manipulation Design
- Mixing Results
- Smelt Responses

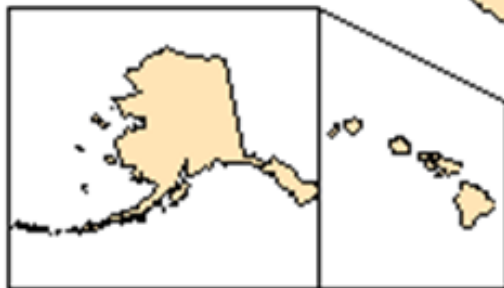
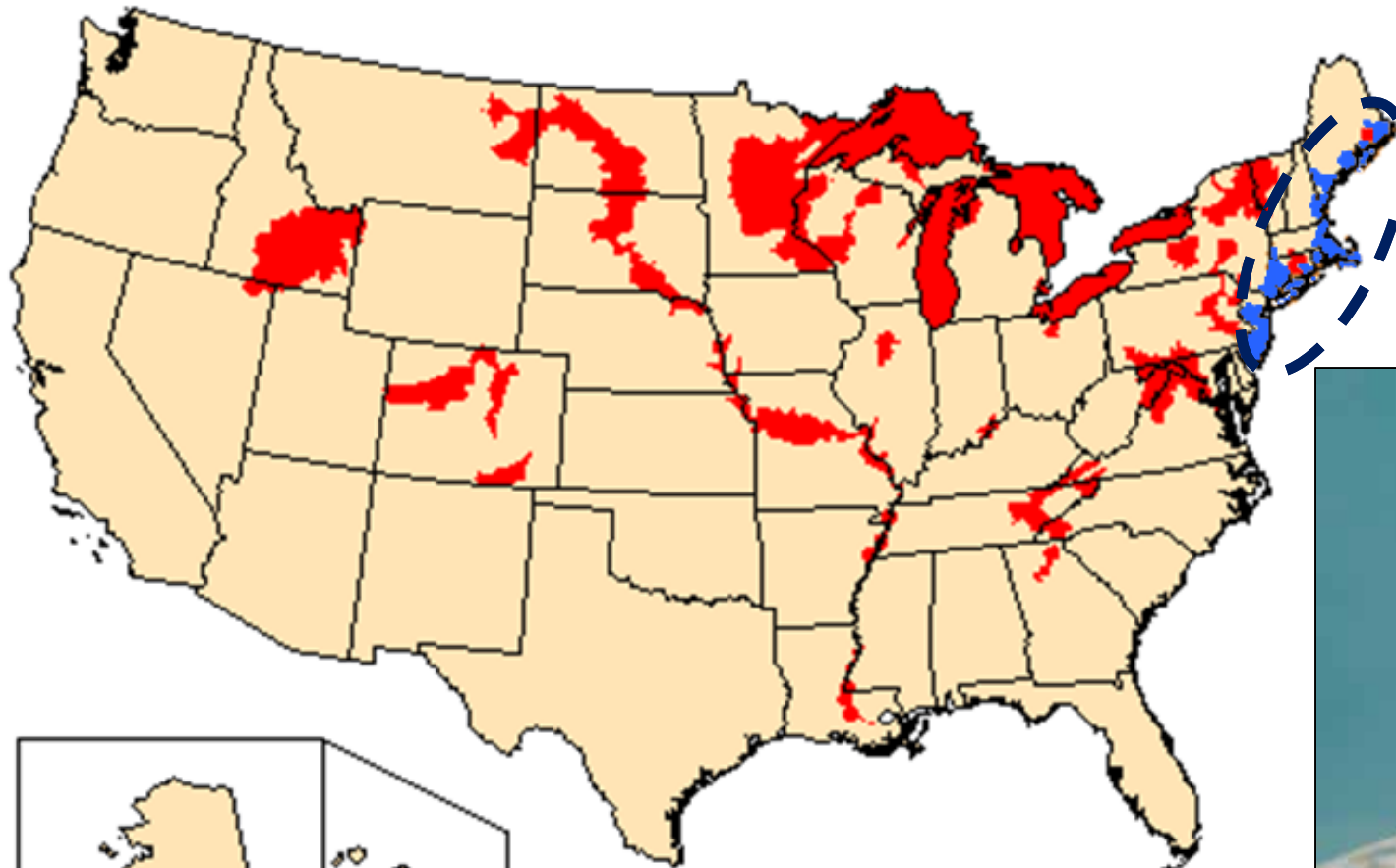




Crystal Lake

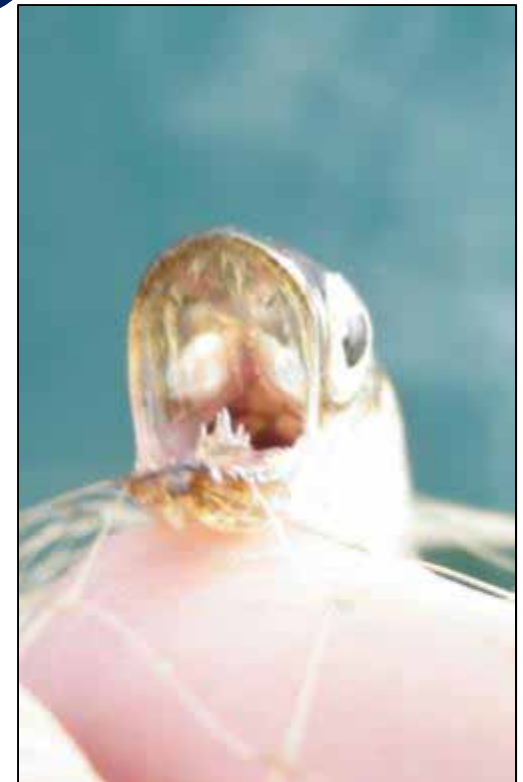




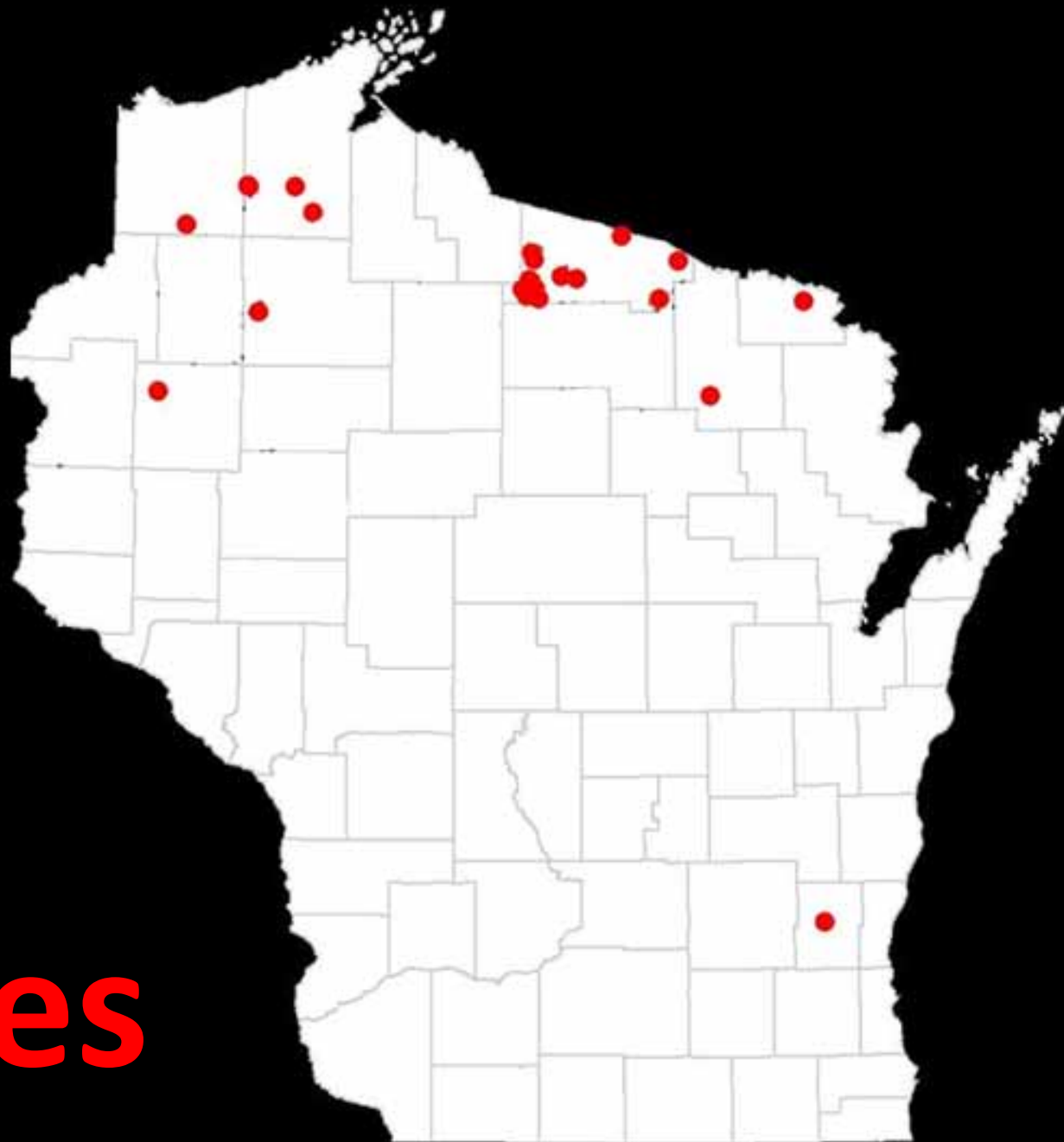
Rainbow Smelt in the US



-  drainages in native range
-  drainages with introductions



Where are
smelt now?



~25 lakes

Rainbow smelt impacts in our lakes



- Reduce cisco/whitefish populations

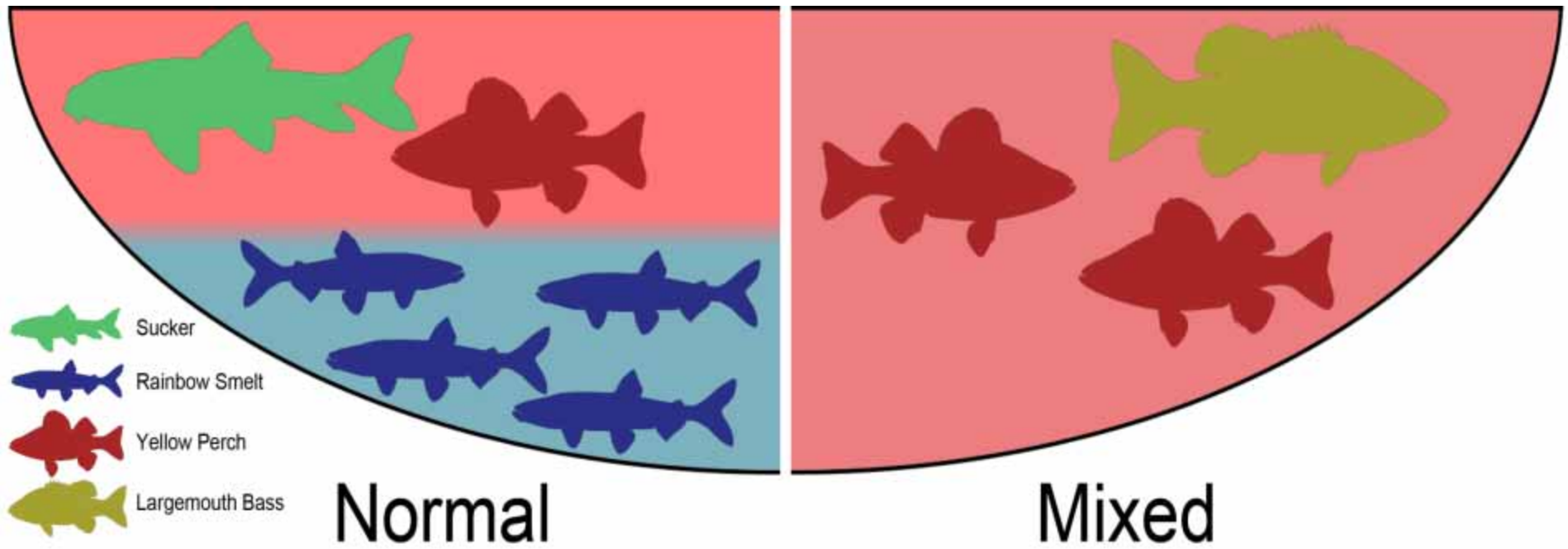


- Reduce yellow perch populations



- Reduce walleye recruitment

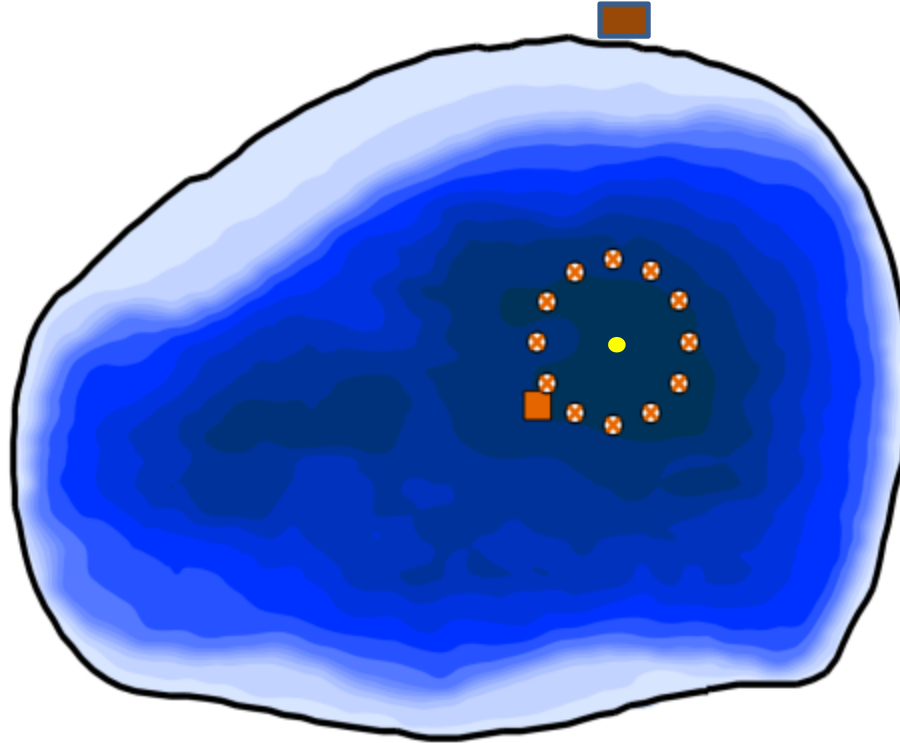
Available Smelt Habitat



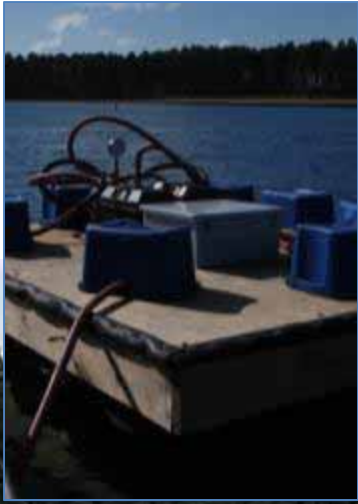
Expected Effects on Smelt



Mixing System



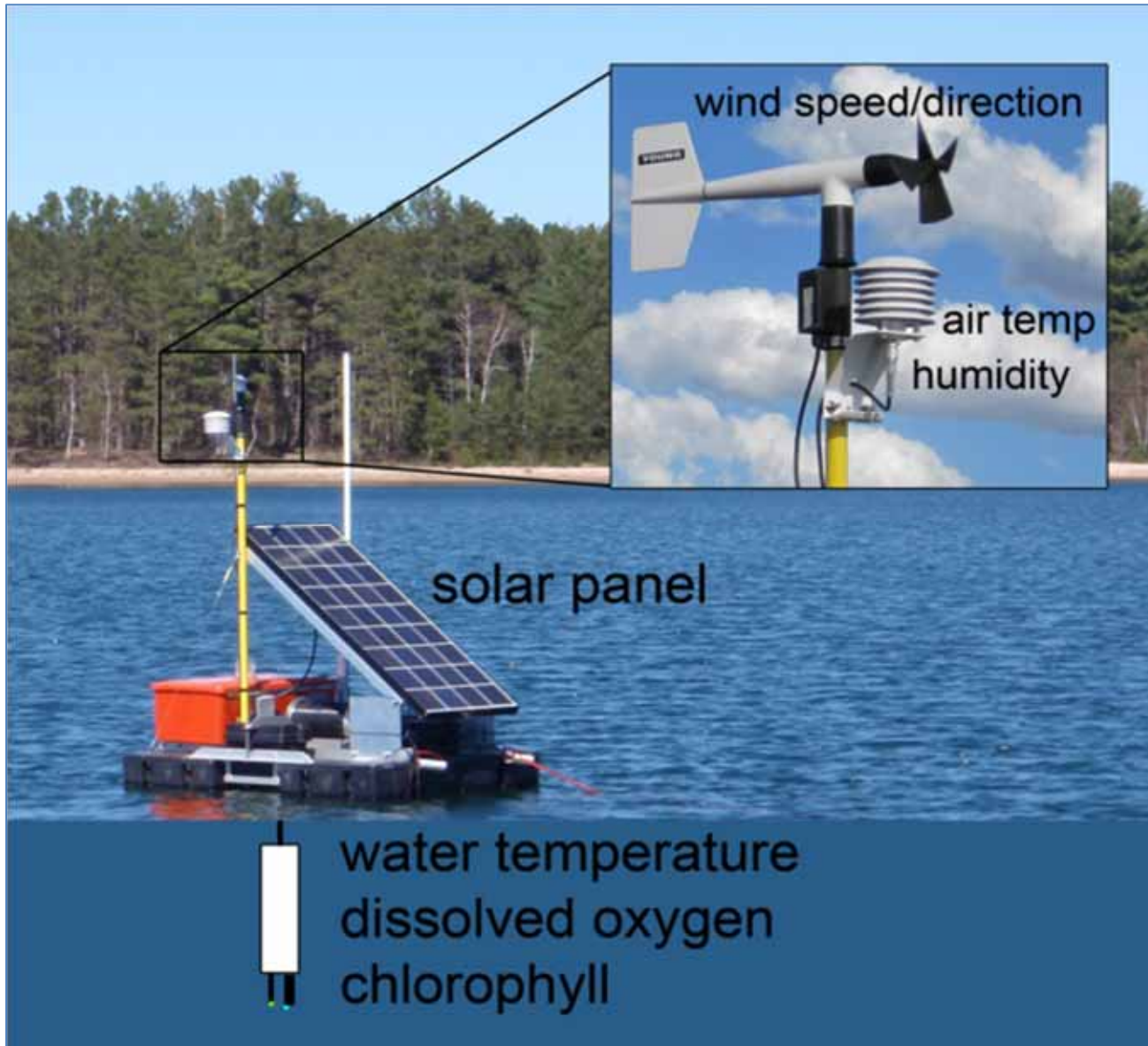
Mixing Design



- 6 GELIs
- ~10,000 cycles/season (4-5 months)
- 20m of travel



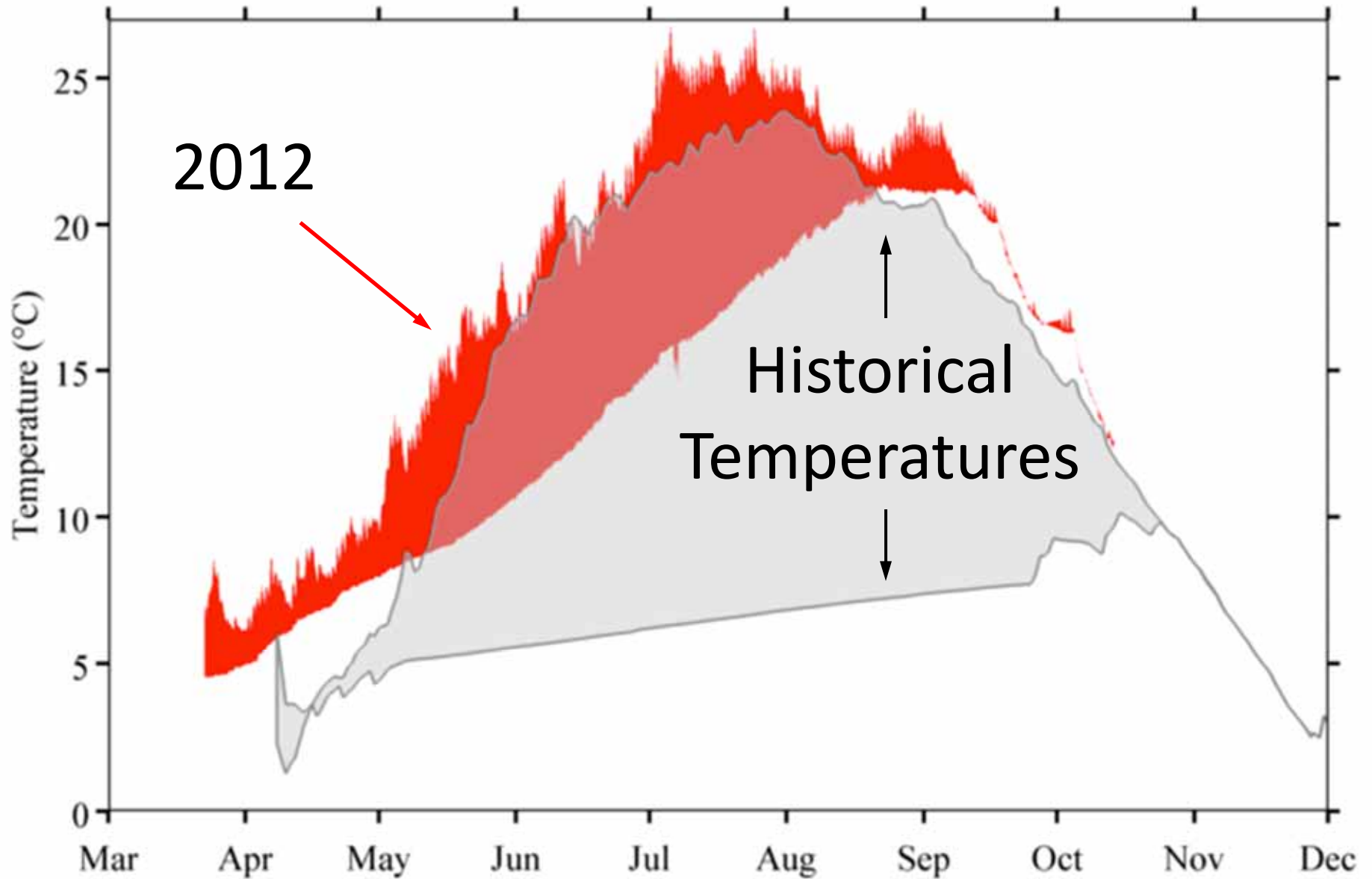
Water Quality Monitoring



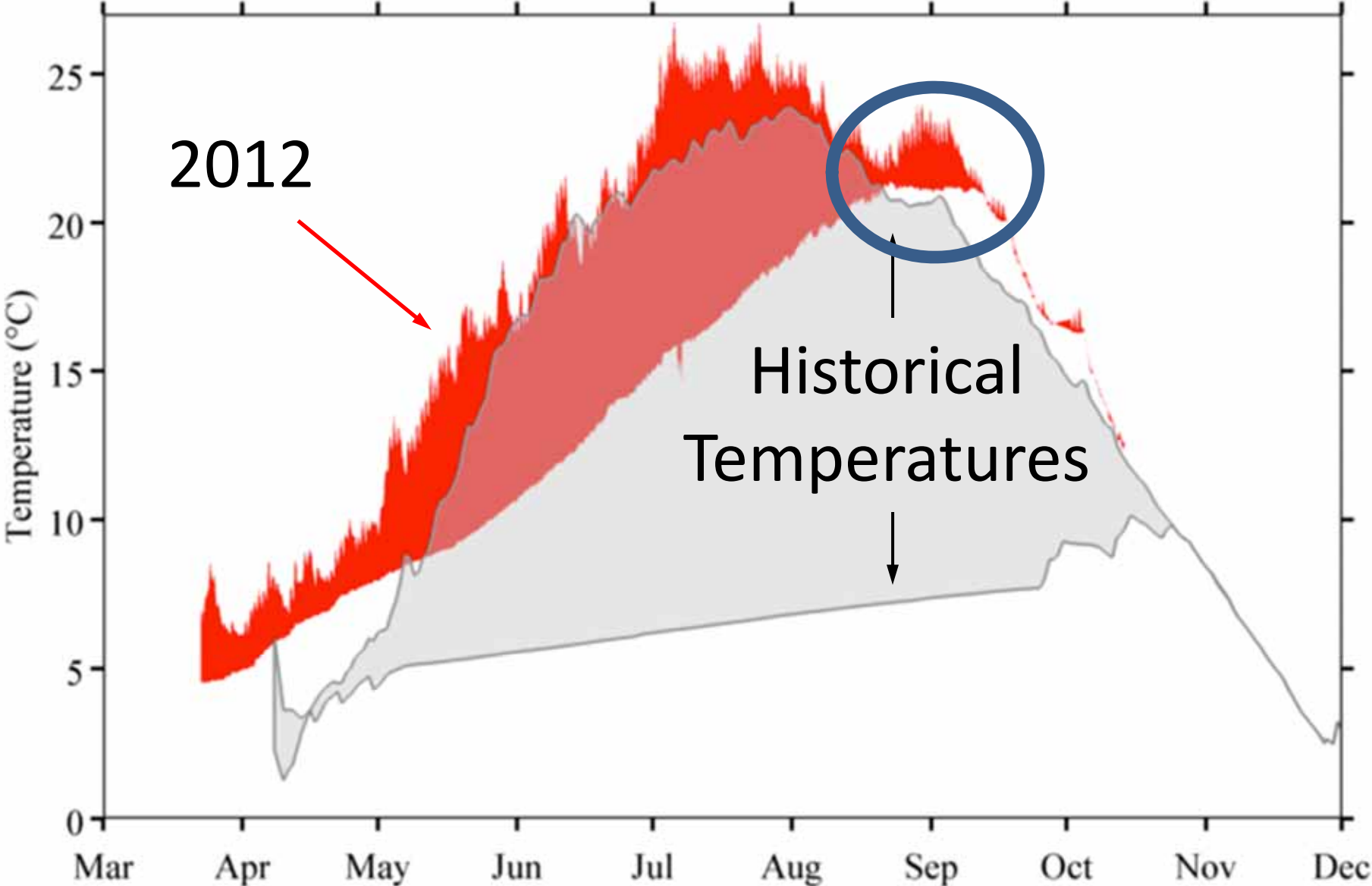
Biological Community Sampling

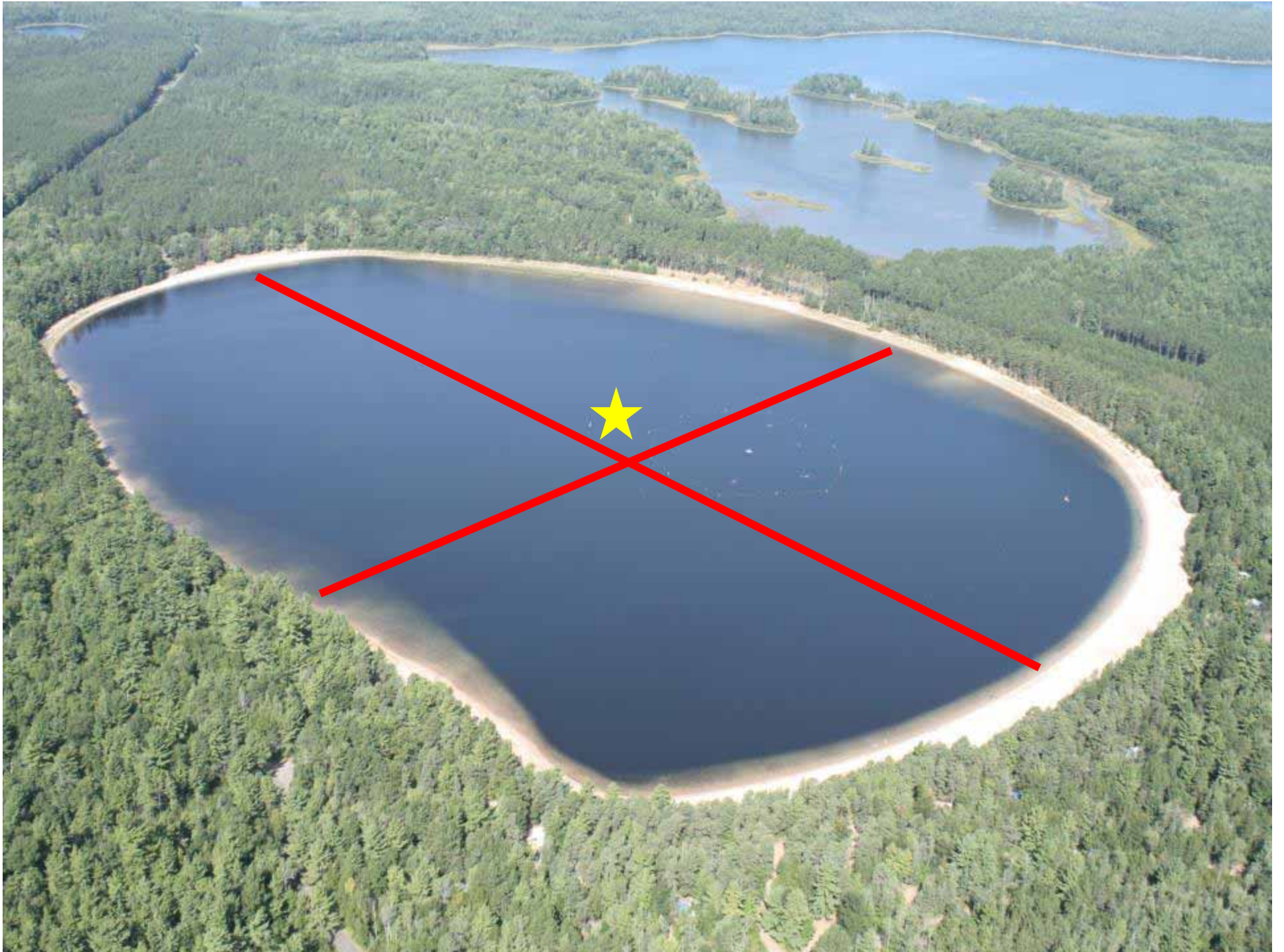


2012 Mixing Results

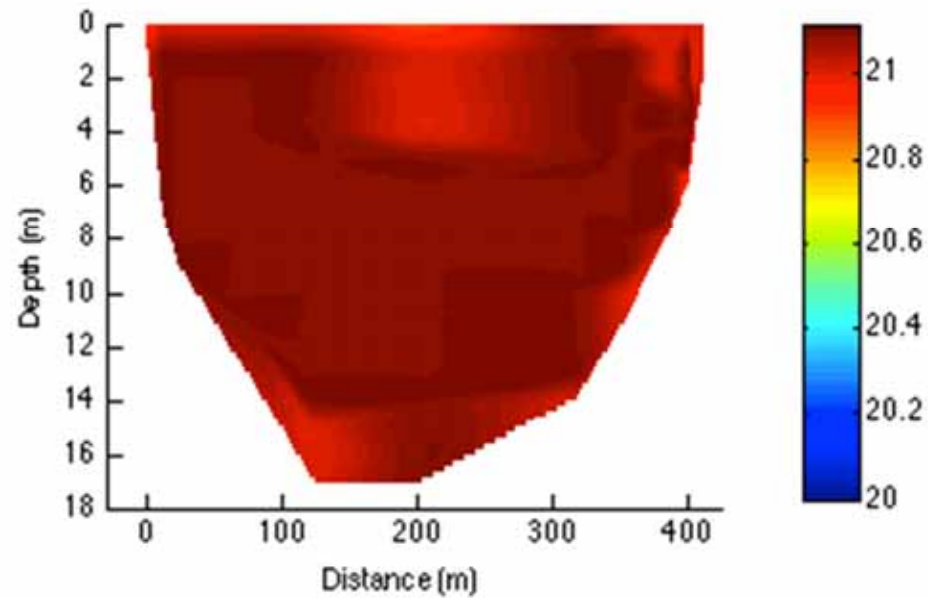
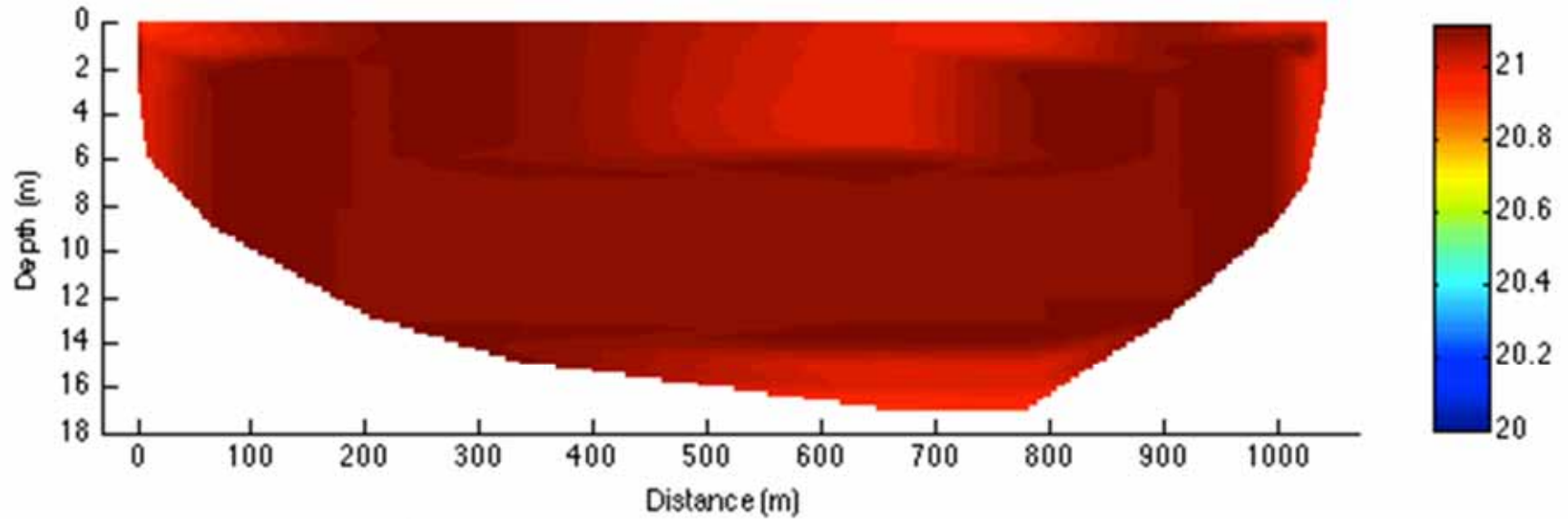


2012 Mixing Results

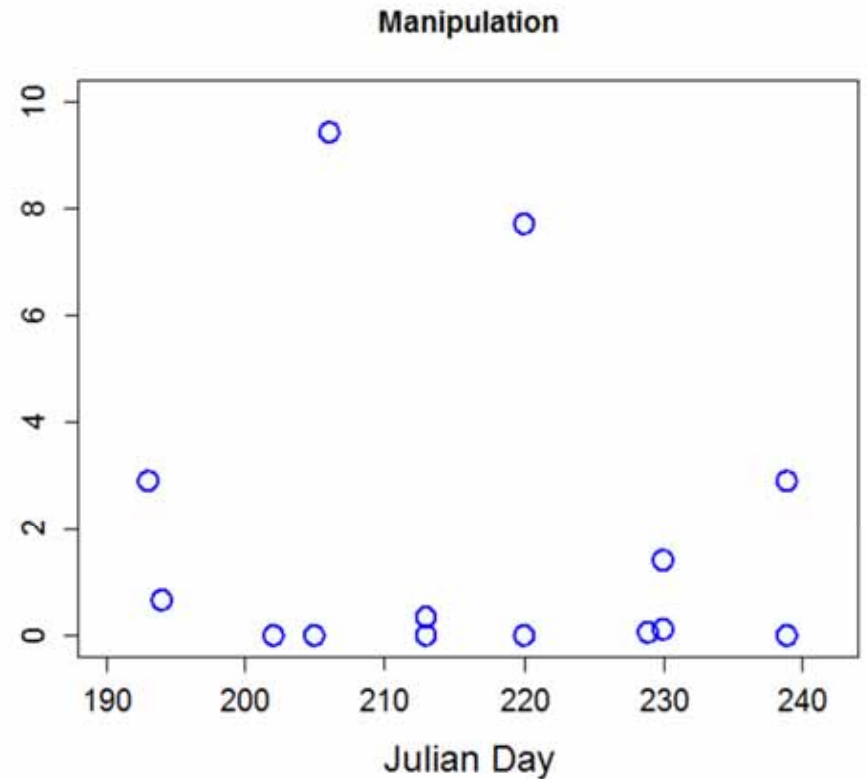
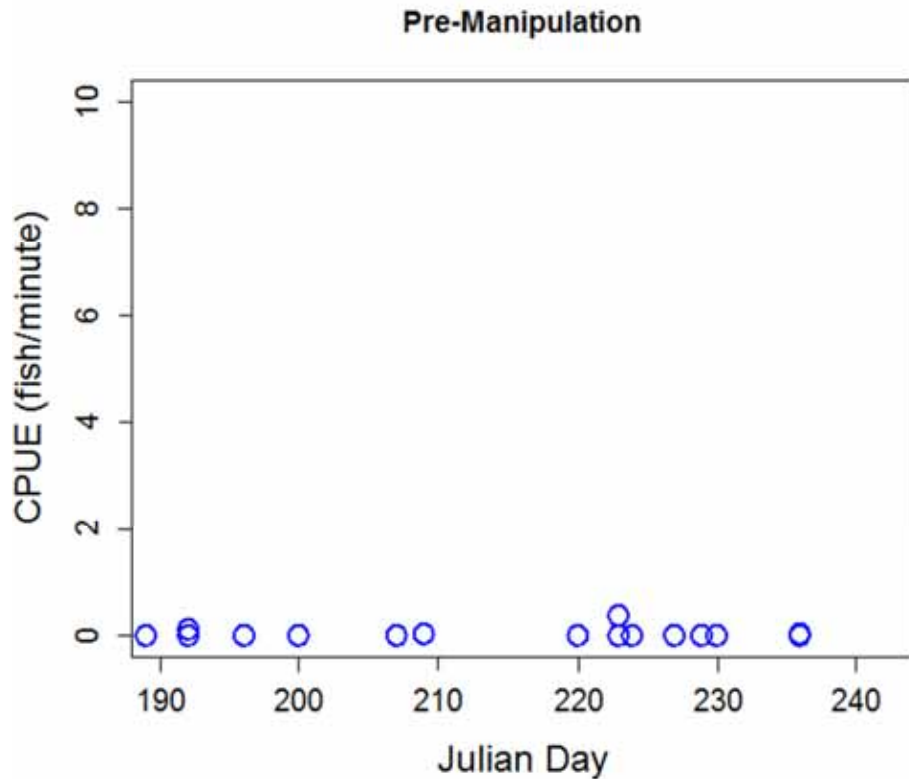




2012 Mixing Results



Smelt Responses to Mixing



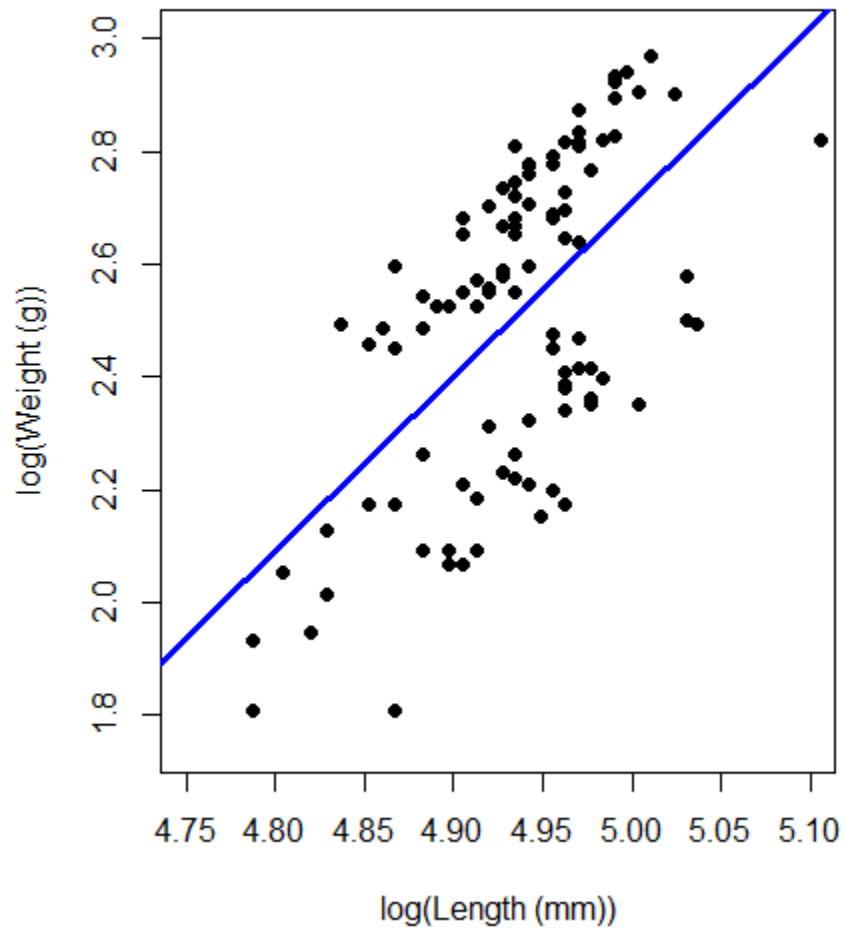
- Shifts in Behavior



•Observed Mortality

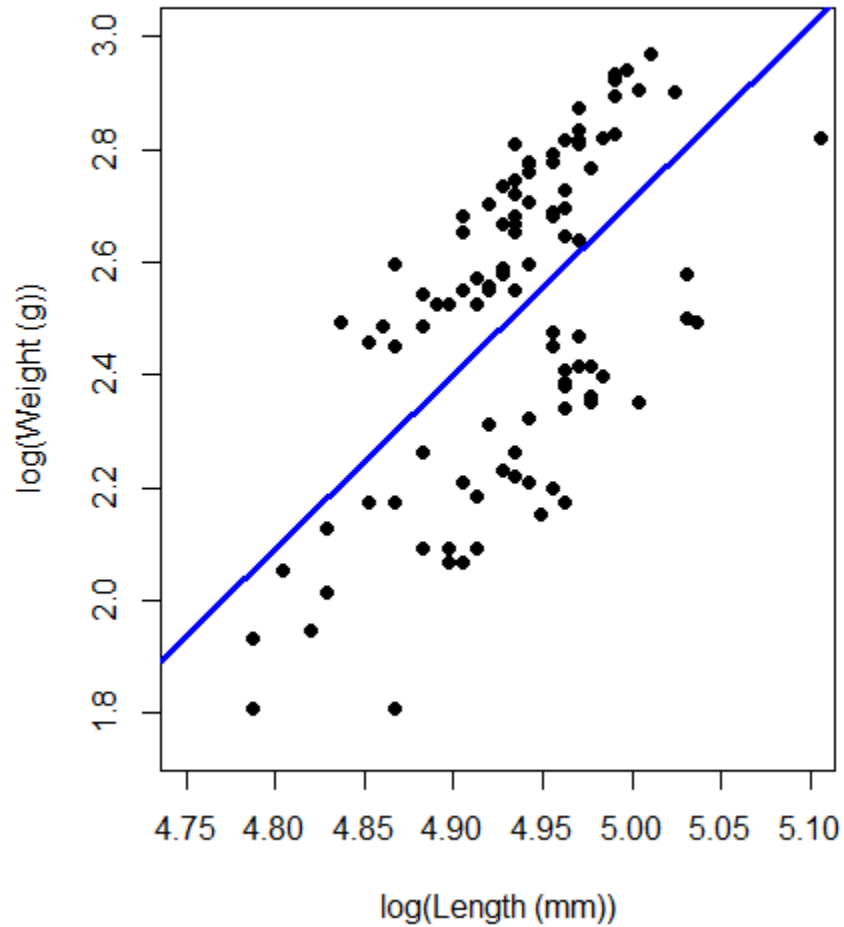
2012 Body Condition

August Smelt

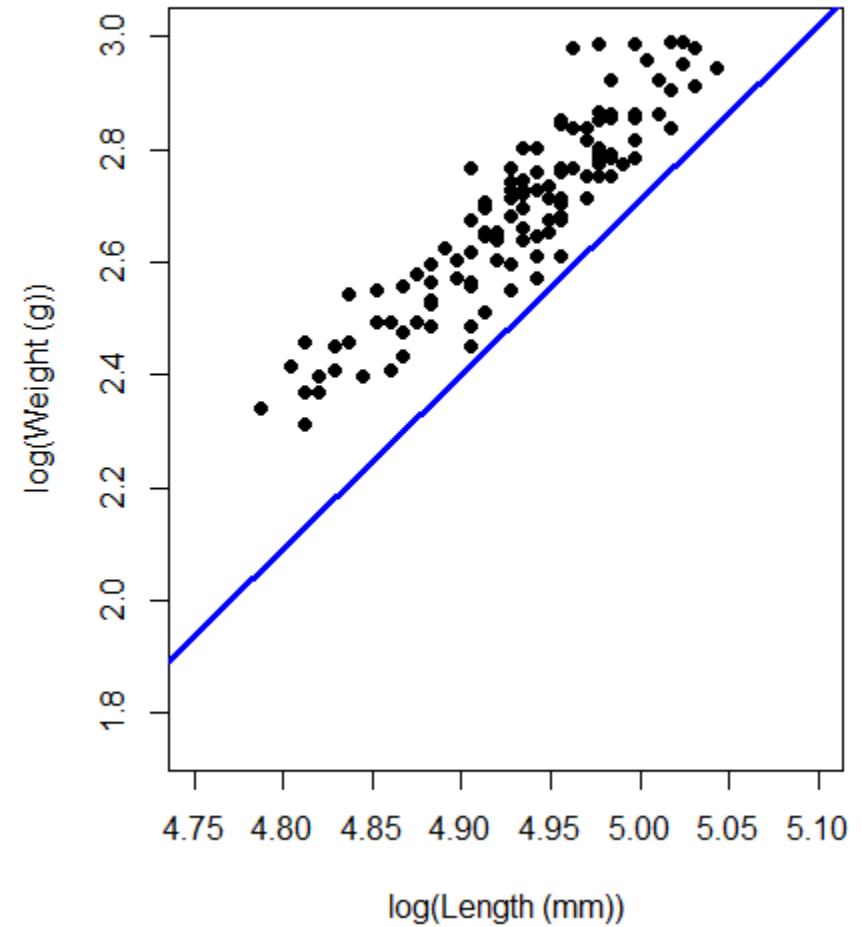


2012 Body Condition

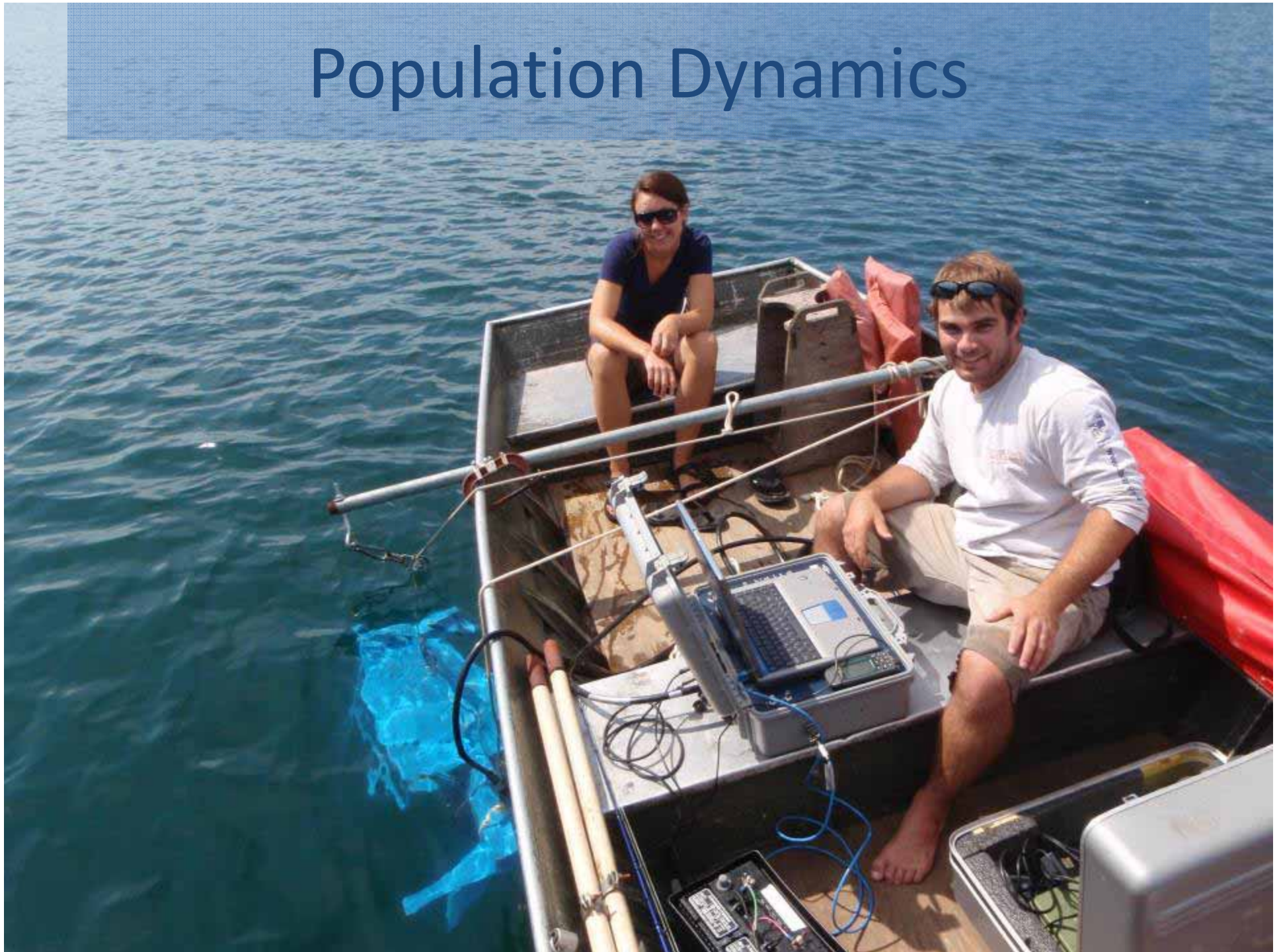
August Smelt



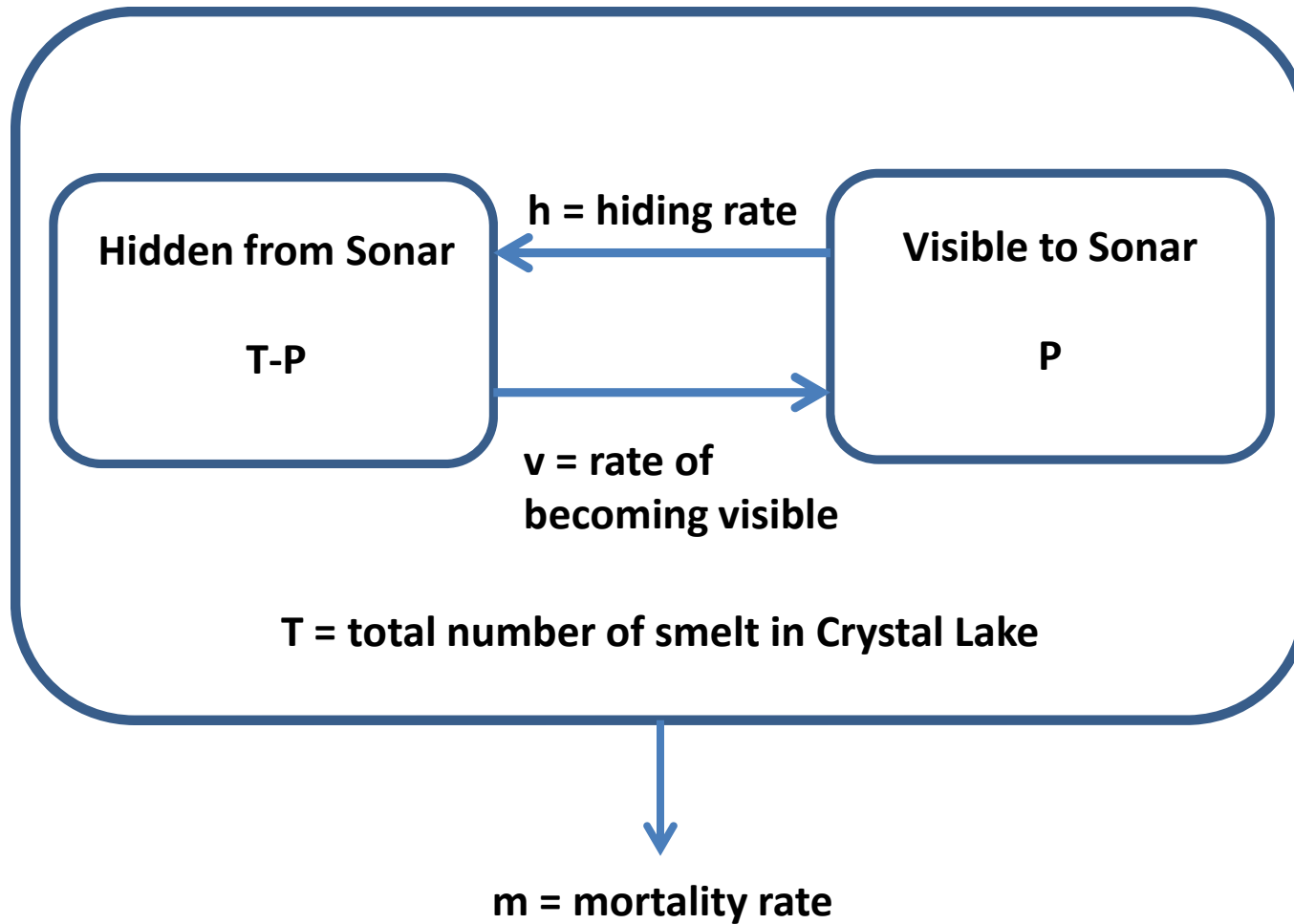
September Smelt



Population Dynamics

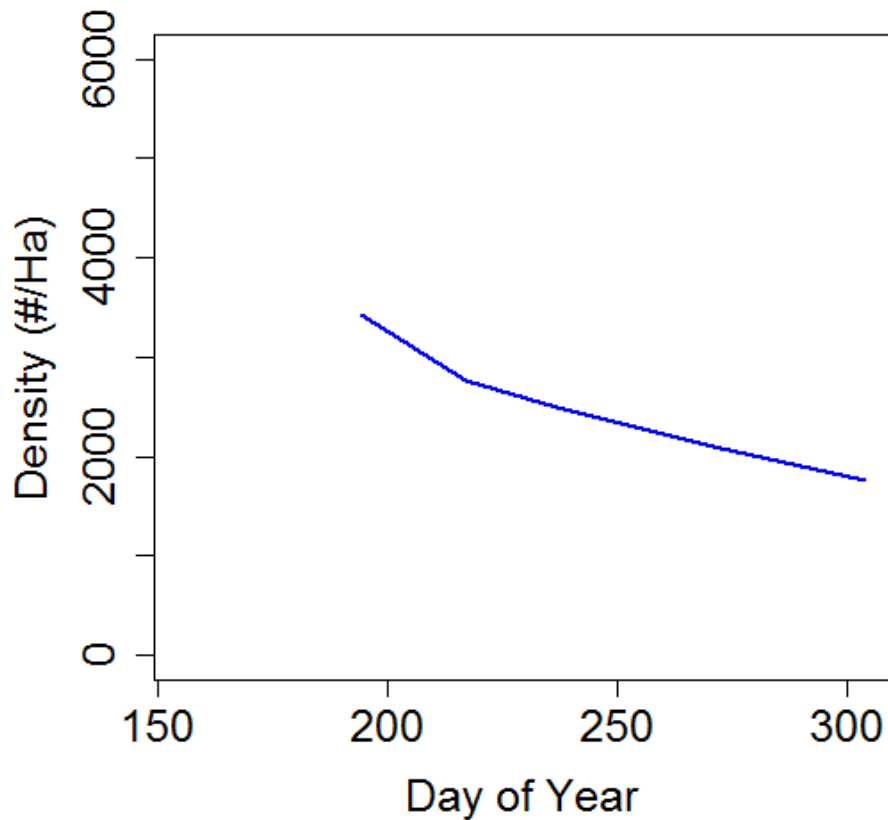


Population Dynamics



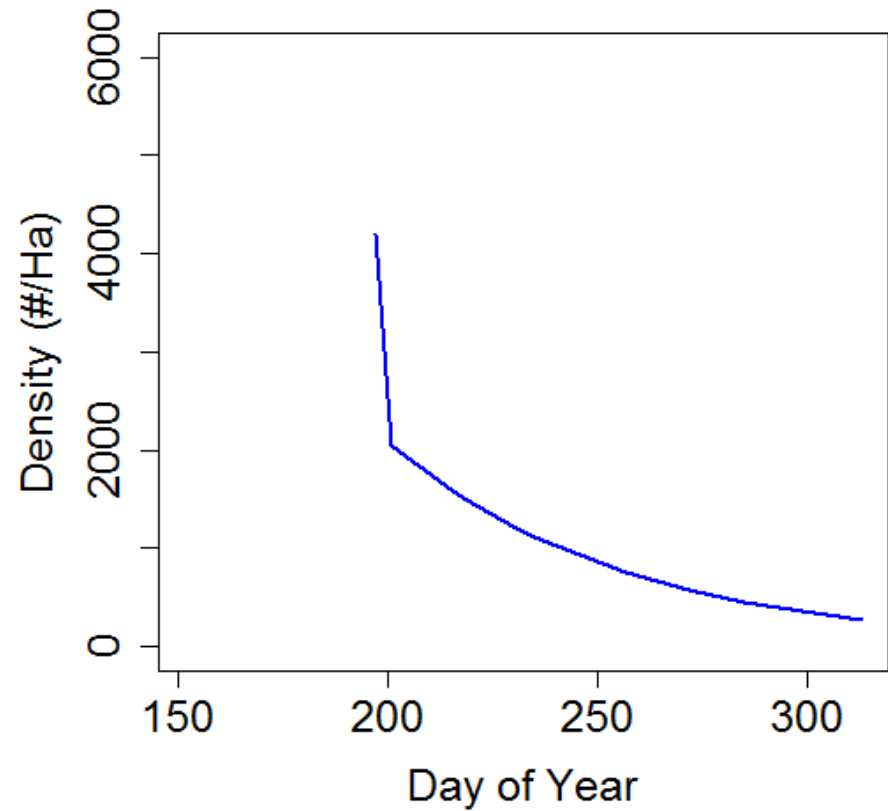
Population Dynamics

2010 Mortality Model Fit



$M \sim 0.4$

2012 Mortality Model Fit



$M \sim 0.9$

Conclusions

- Smelt population declined, but mortality rate remains uncertain
- Some smelt remain in Crystal
- Waiting for ice to melt for an update

Crystal Mixers

Wes Matthews



Tom Thalhuber



Page Mieritz



Ali Branscombe



Colin Smith

Eric Brown

Zach Lawson

Jordan Read

Acknowledgements

Anonymous donor

WDNR

Trout Lake Station

Crystal Lake Contact Station



Questions?



Mortality Model

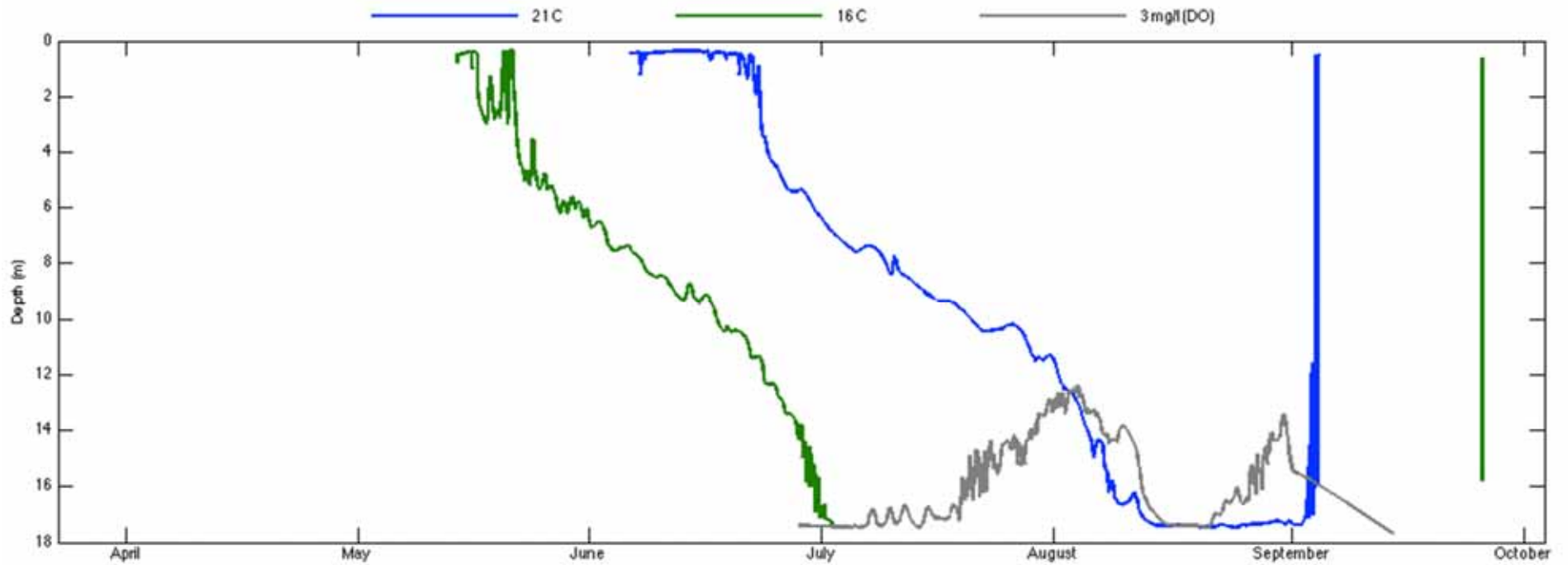
$$\frac{dP}{dt} = -bP + ce^{-mt}$$

$$\int_0^T [dP = -bPdt + ce^{-mt} dt]$$

$$P_T - P_0 = -bP_T + \frac{c}{m}(1 - e^{-mT})$$

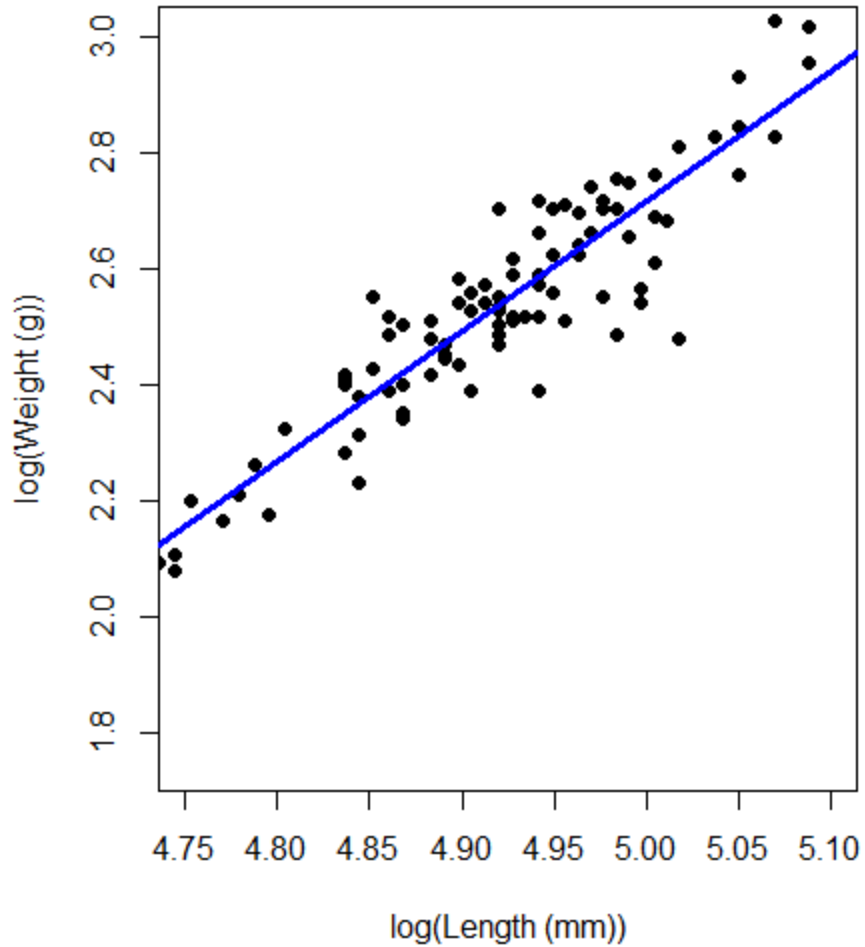
$$P_t = \frac{1}{1+b} \left[P_0 + \frac{c}{m}(1 - e^{-mT}) \right]$$

Habitat Availability

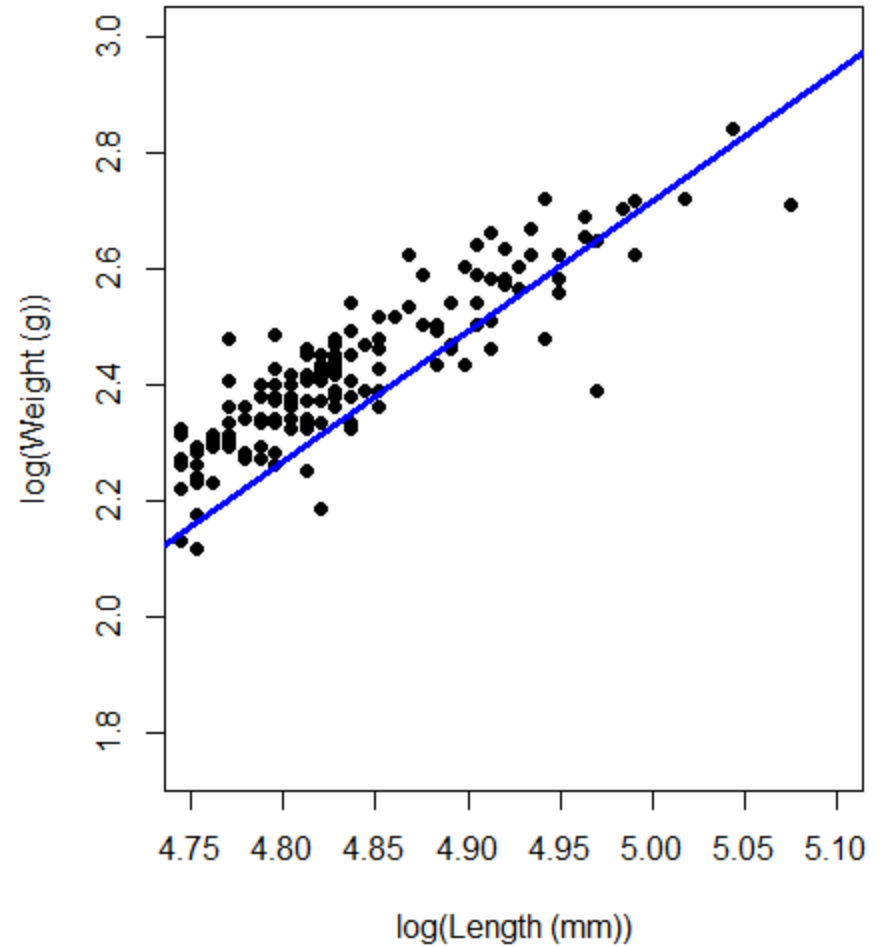


Pre - Body Condition

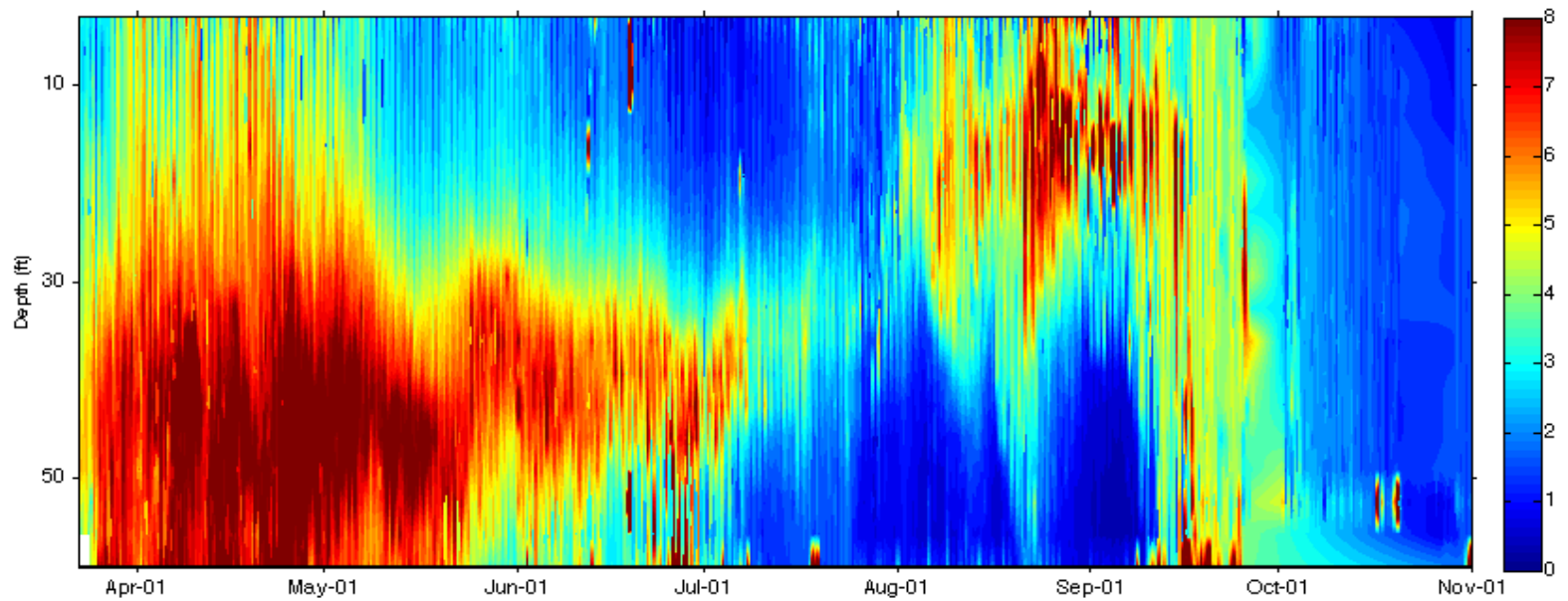
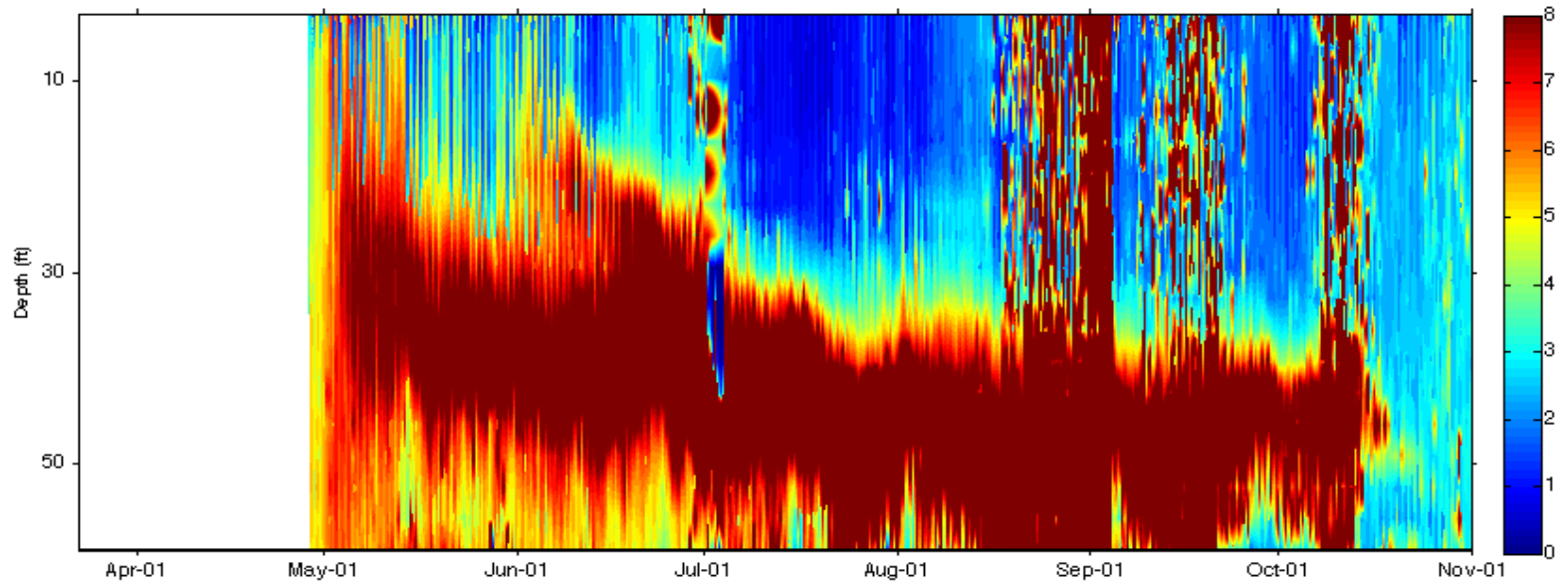
August Smelt



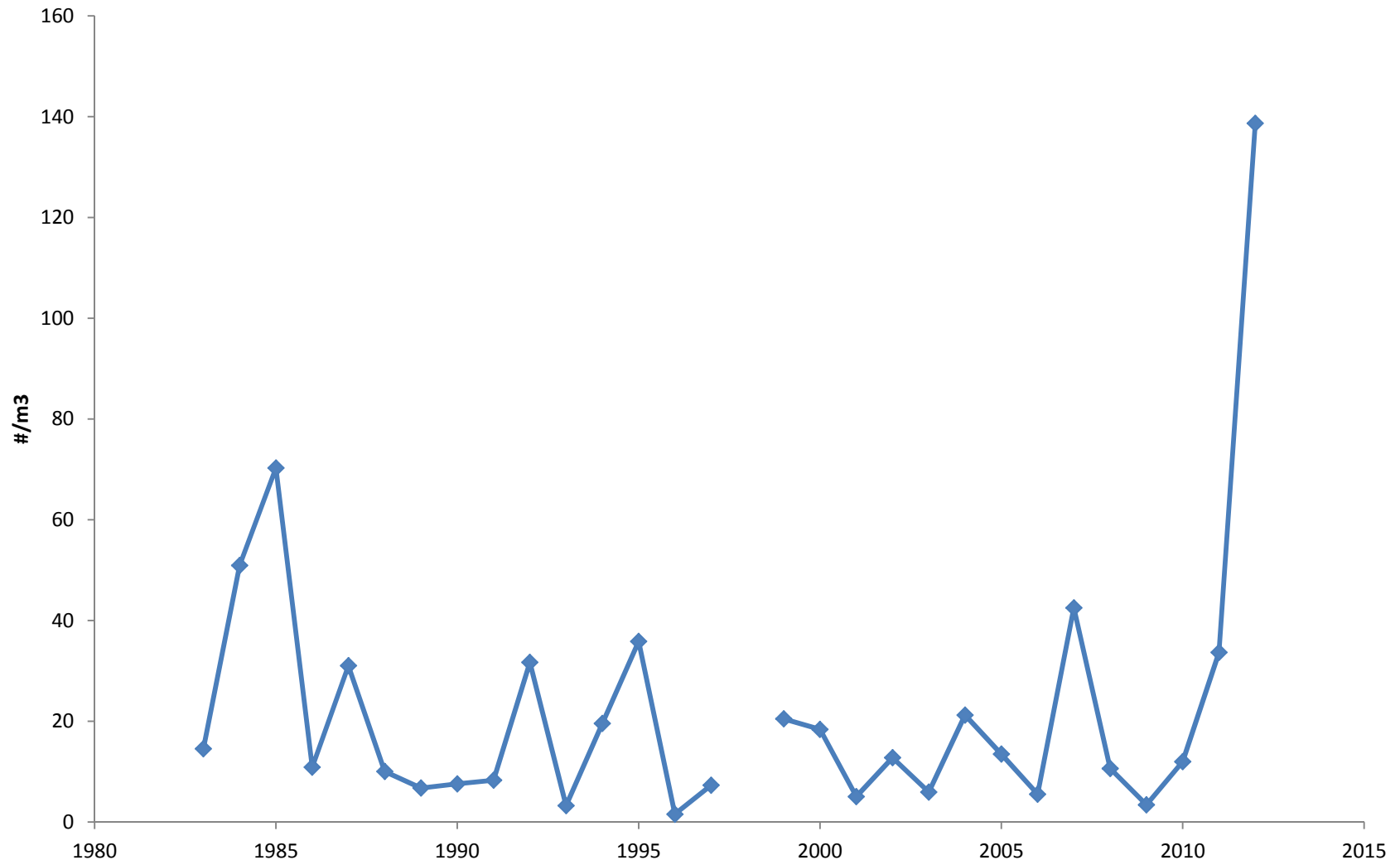
September Smelt



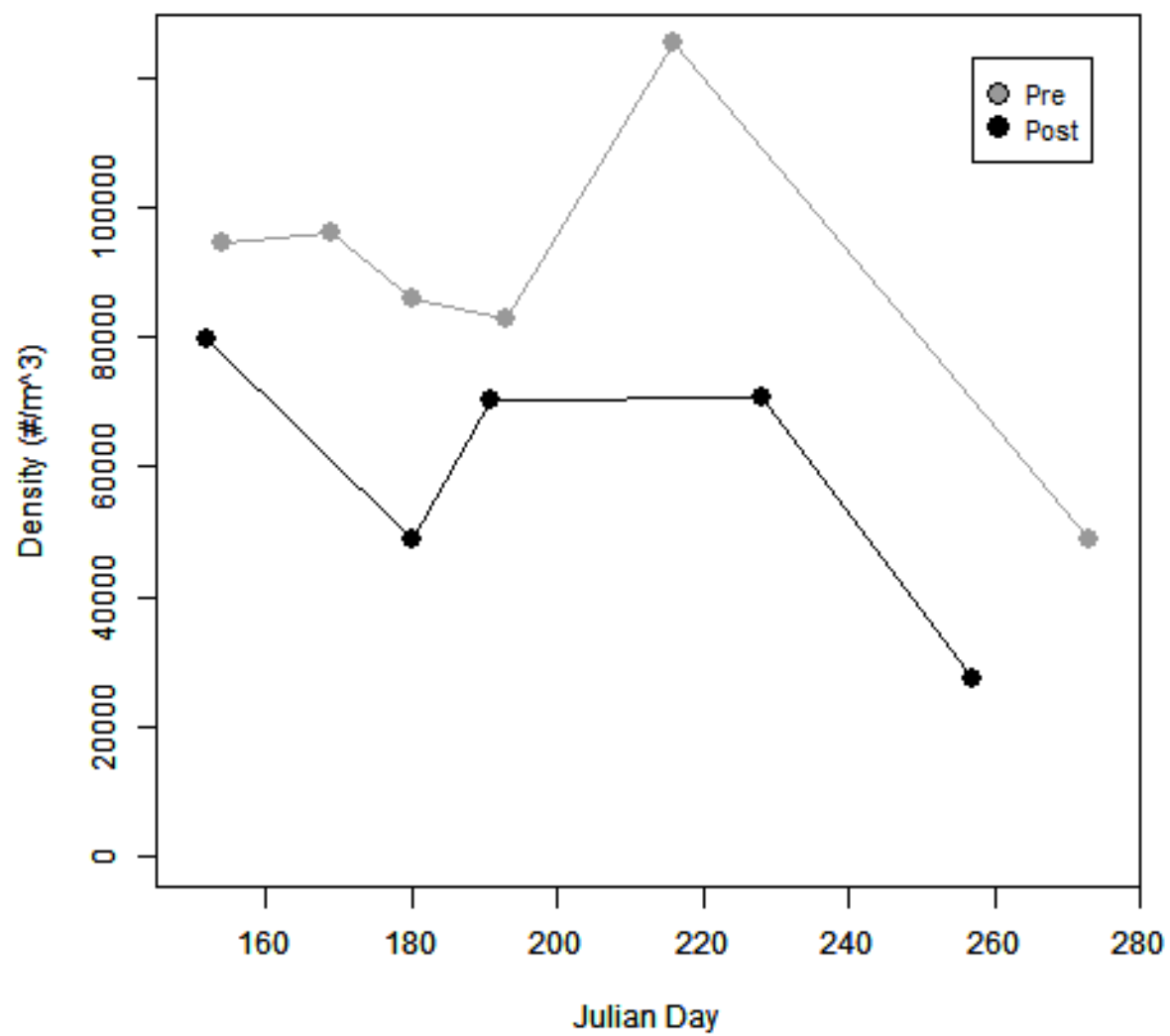
Chlorophyll



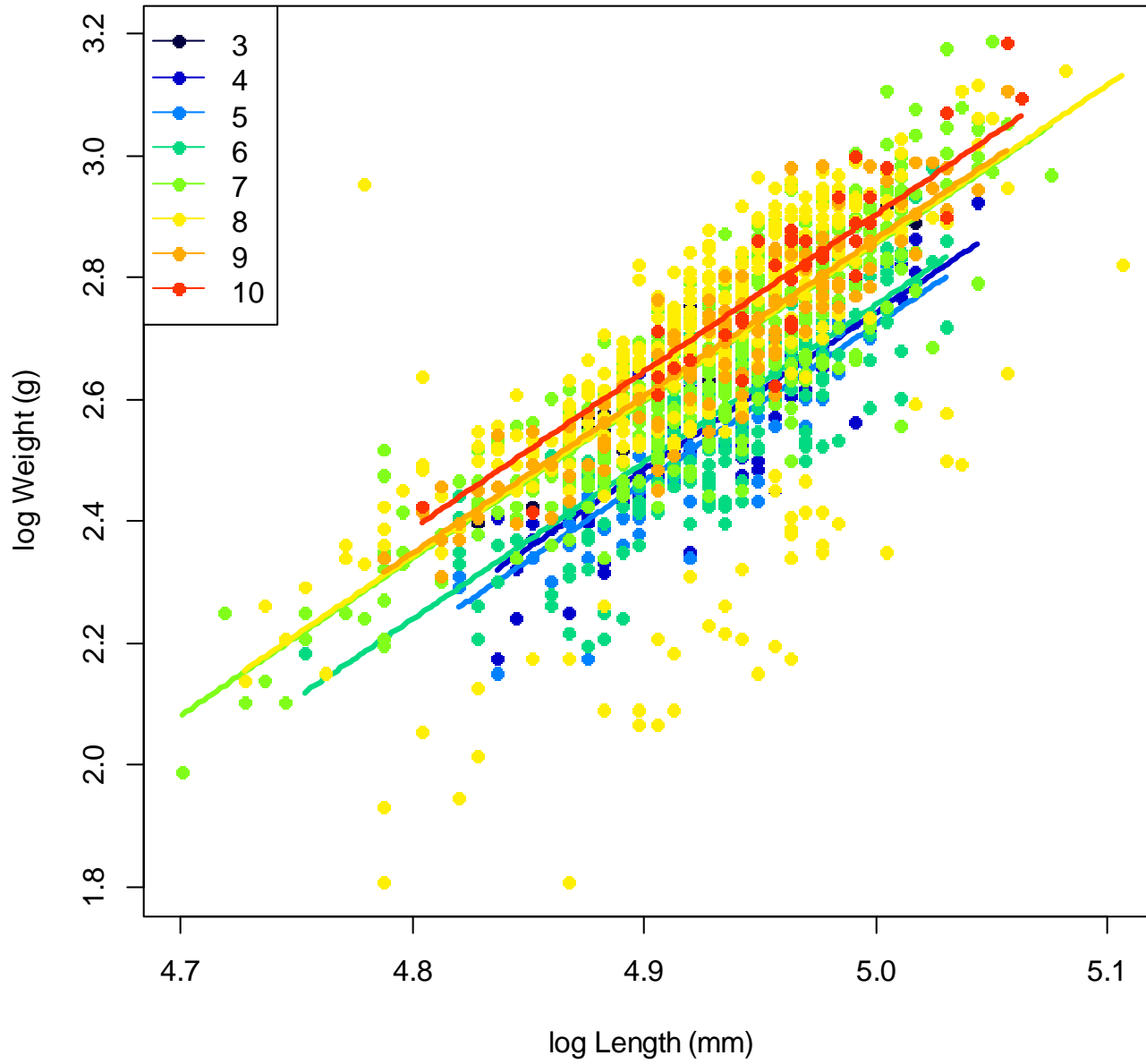
CR Leptodora



Zoop_community

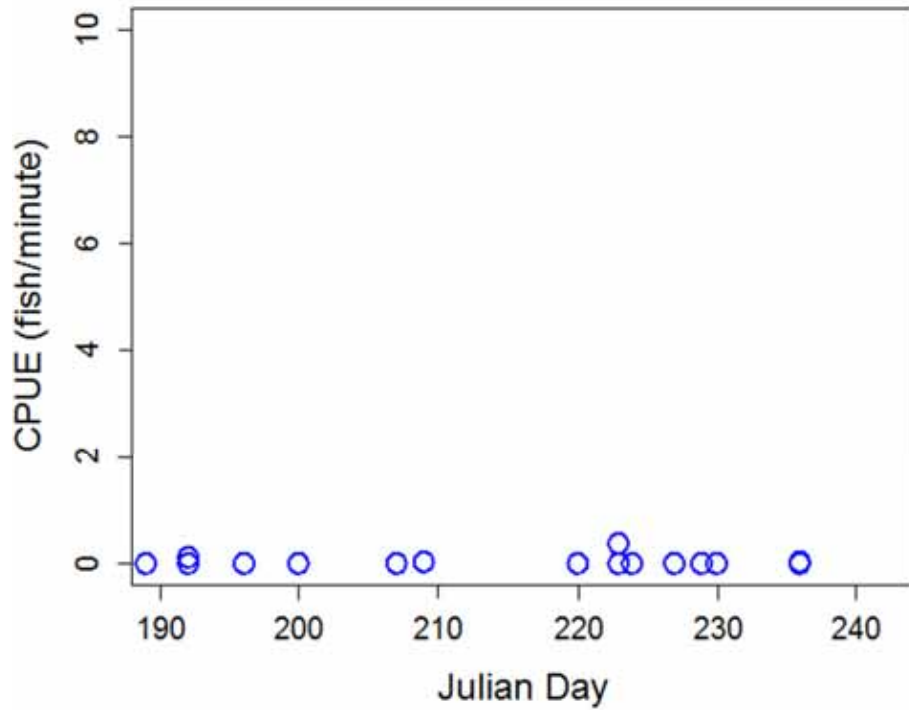


Smelt Throughout 2012

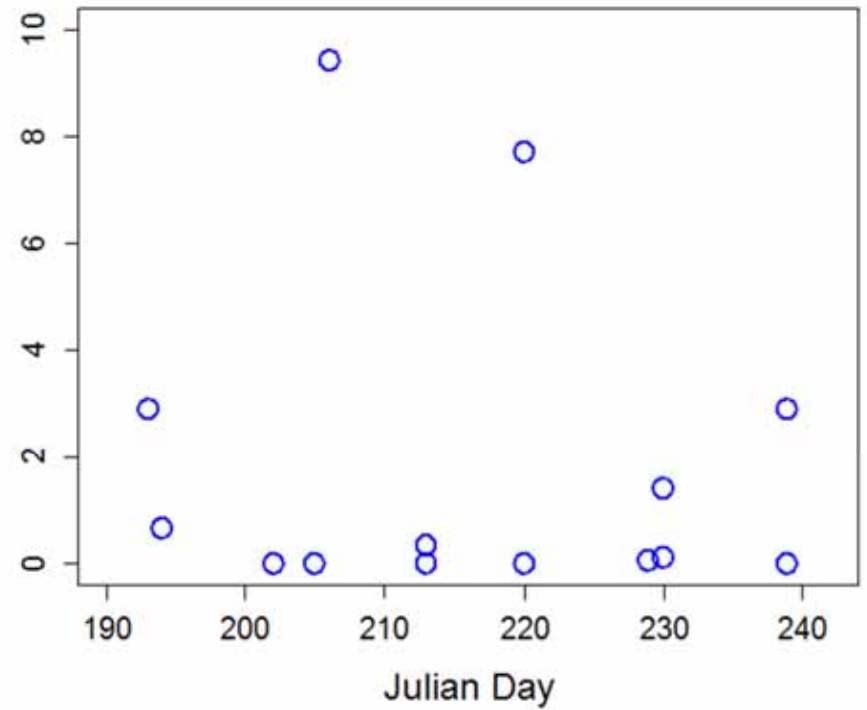


Onshore Movement

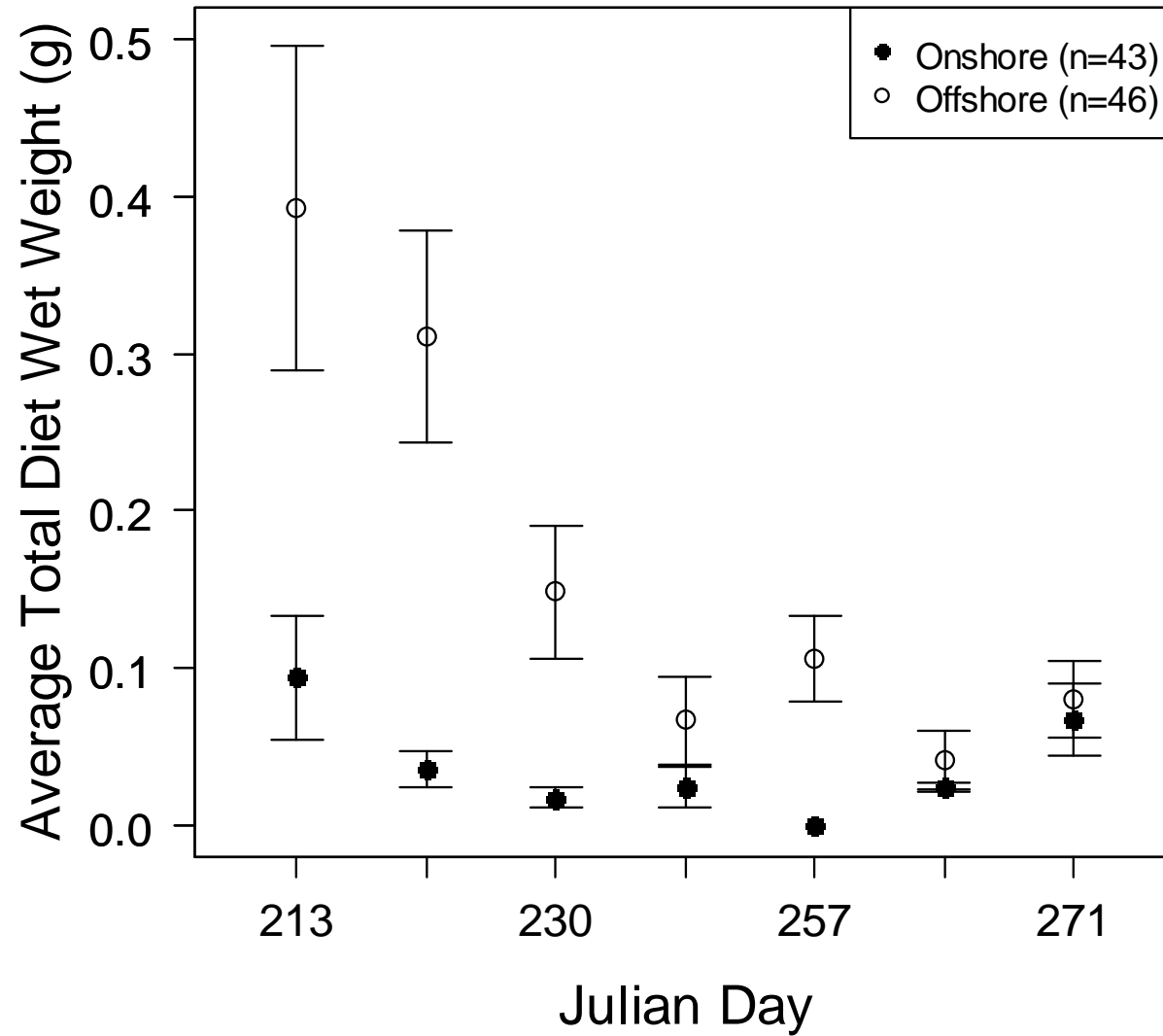
Pre-Manipulation



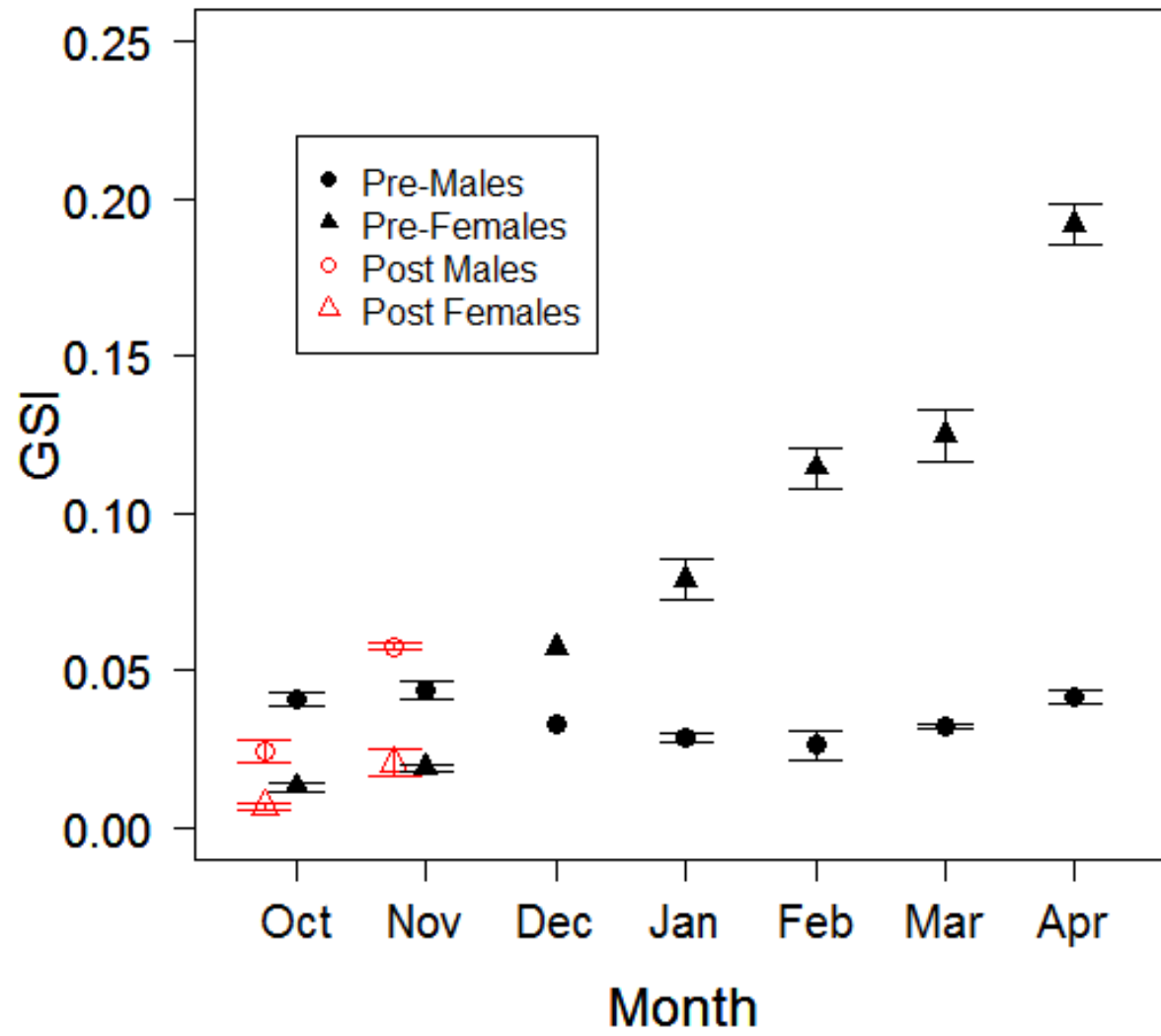
Manipulation



Rainbow Smelt Diets

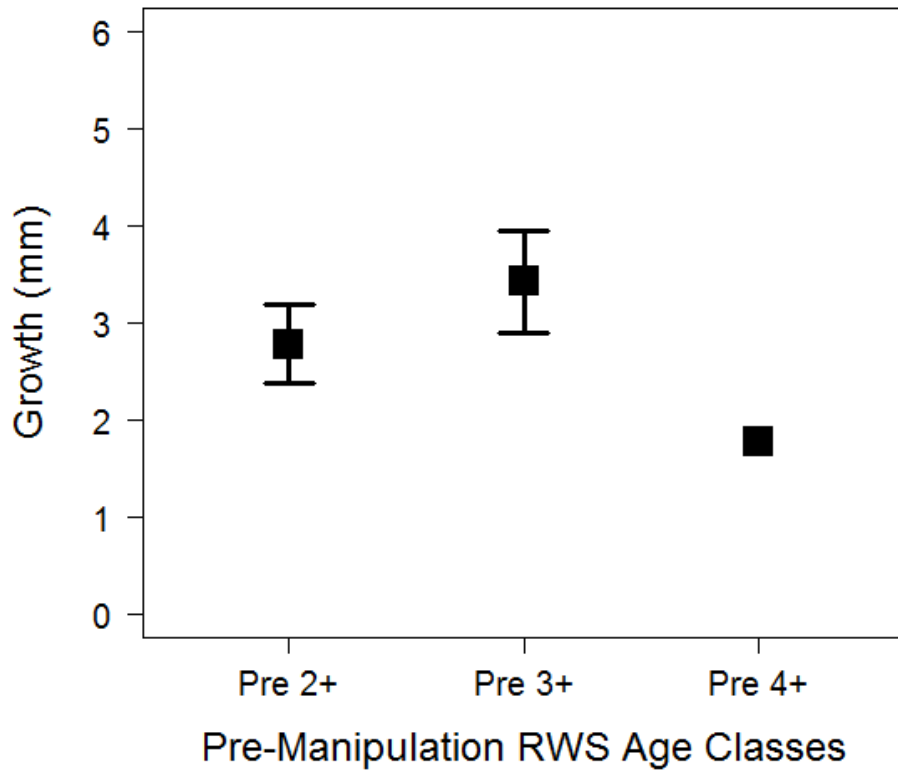


Pre-Post GSI

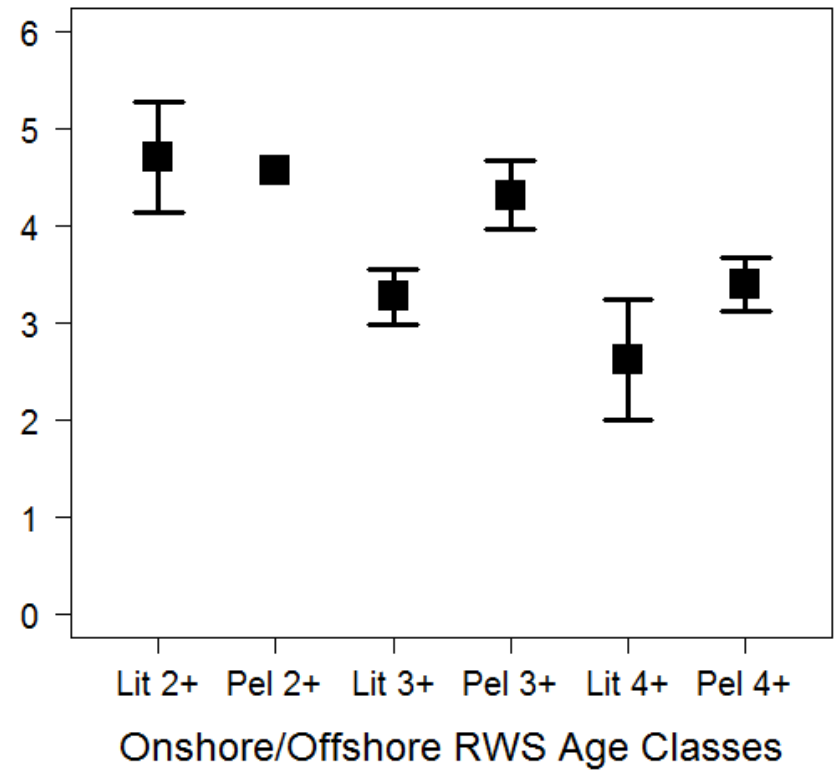


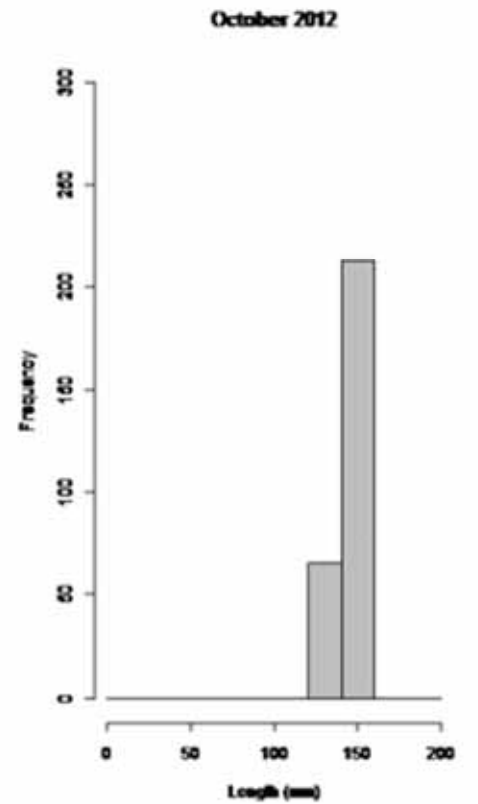
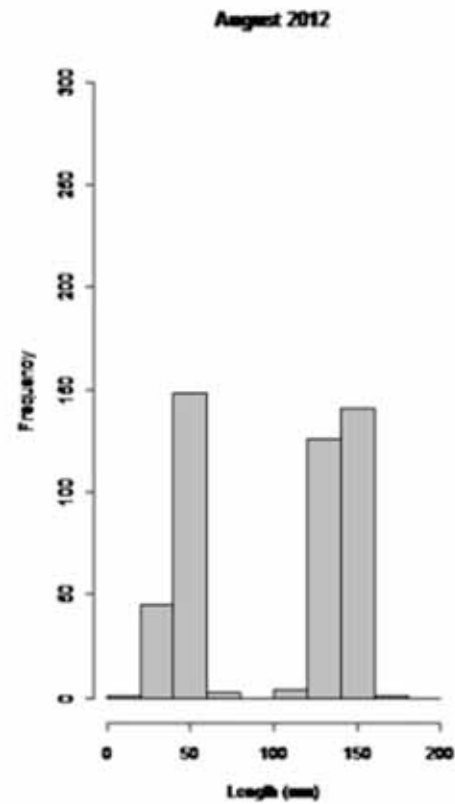
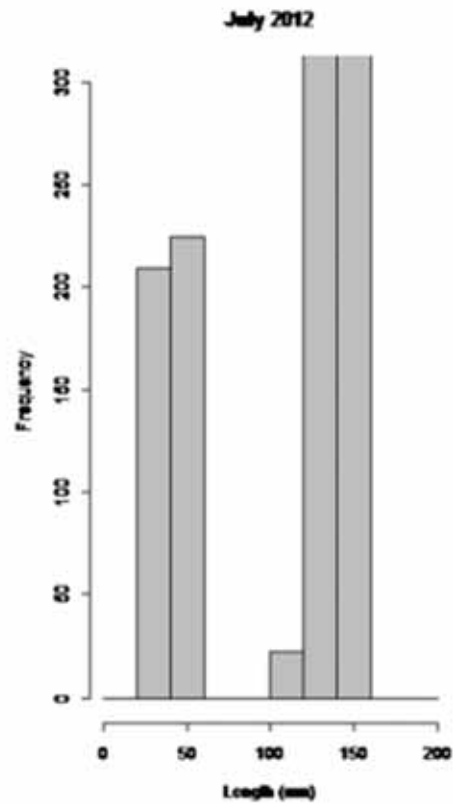
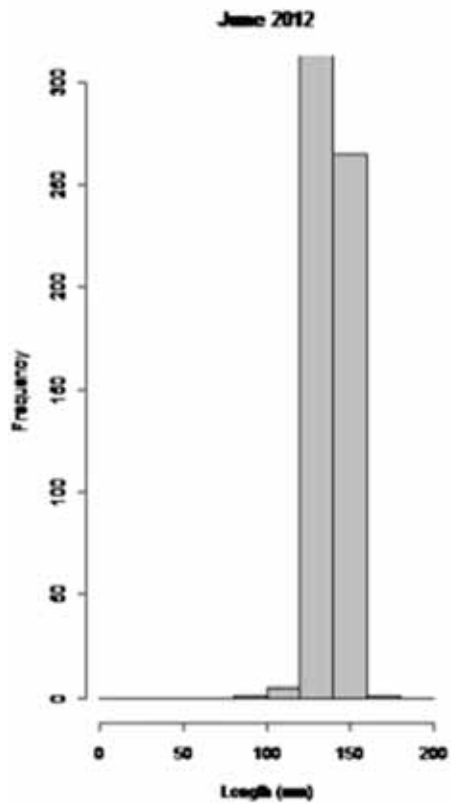
RWS Growth Rates Pre/Manipulation comparison

2011 (Late July)

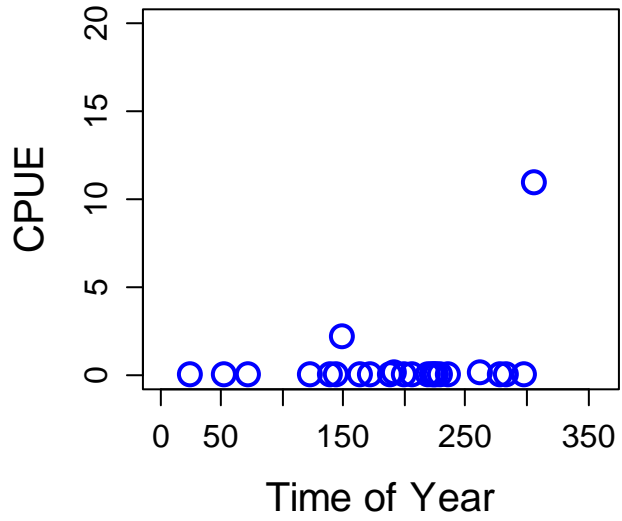


2012 (Late July)

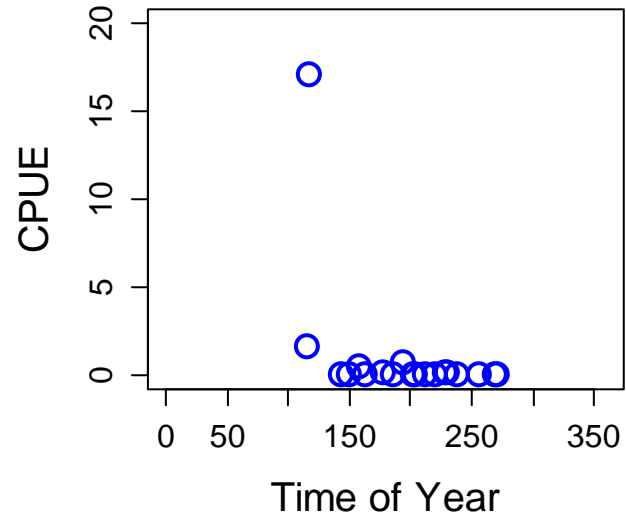




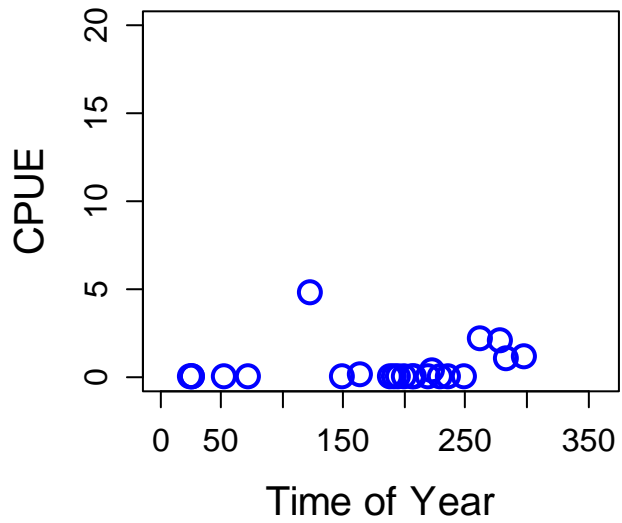
Littoral day 2011



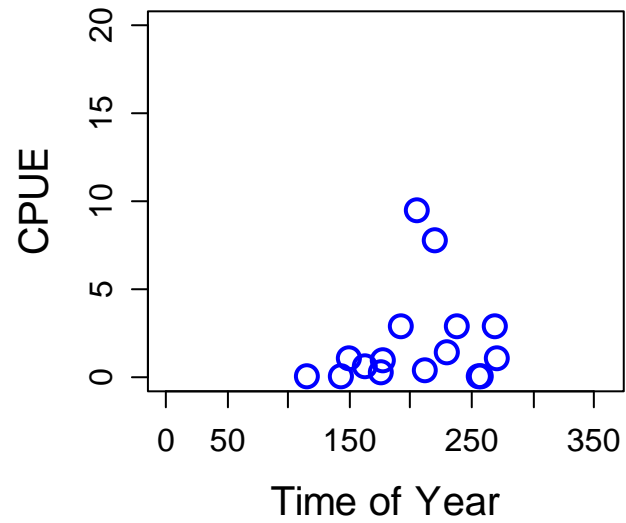
Littoral day 2012



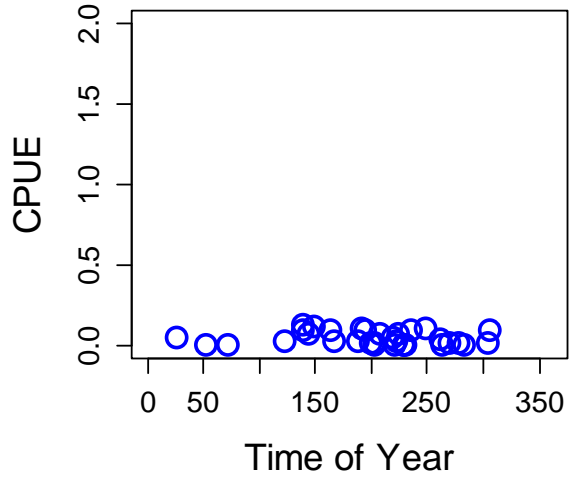
Littoral night 2011



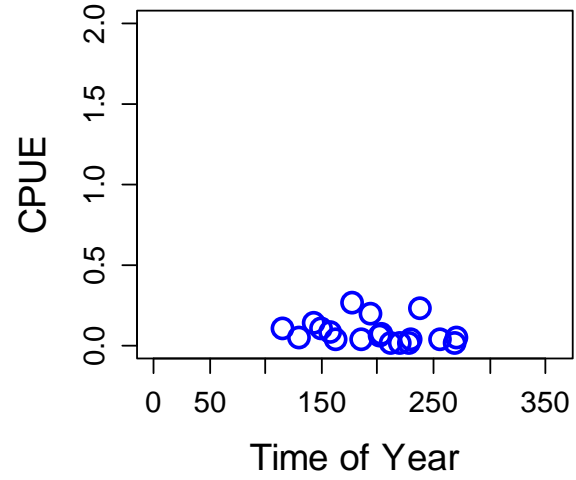
Littoral night 2012



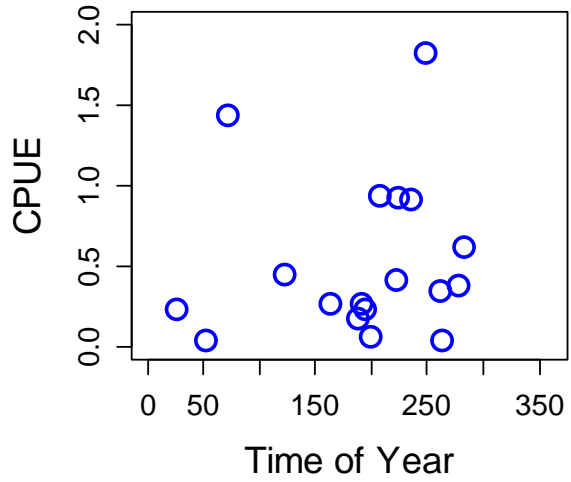
Pelagic day 2011



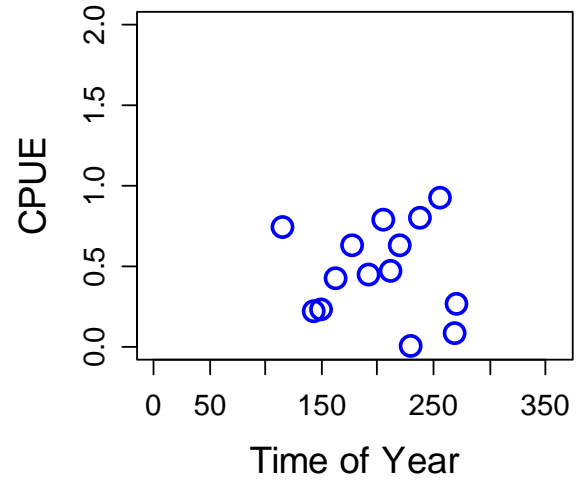
Pelagic day 2012



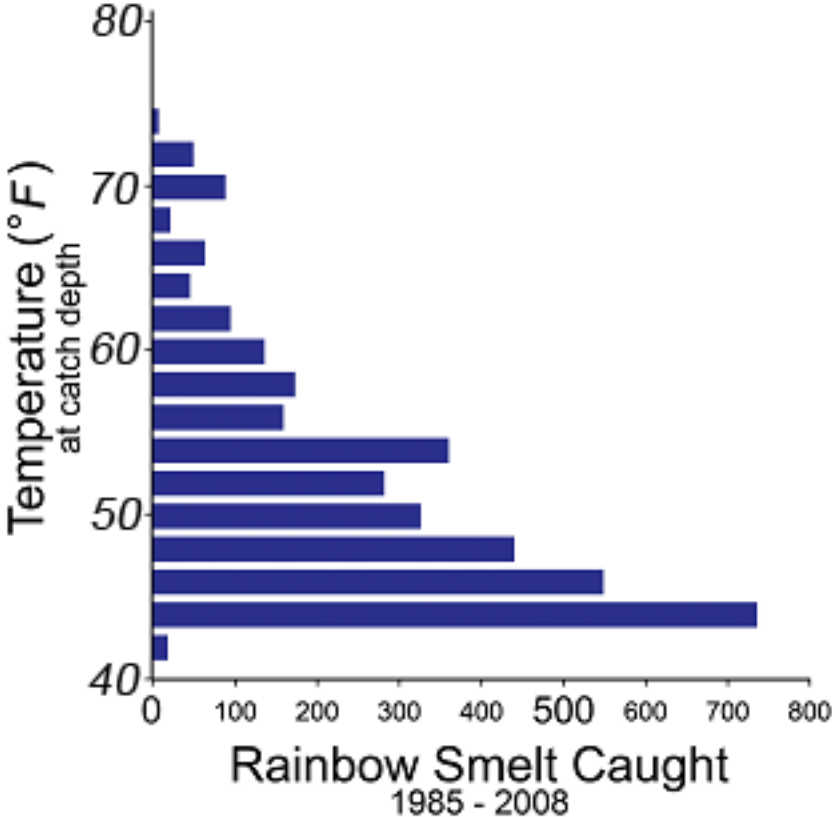
Pelagic night 2011



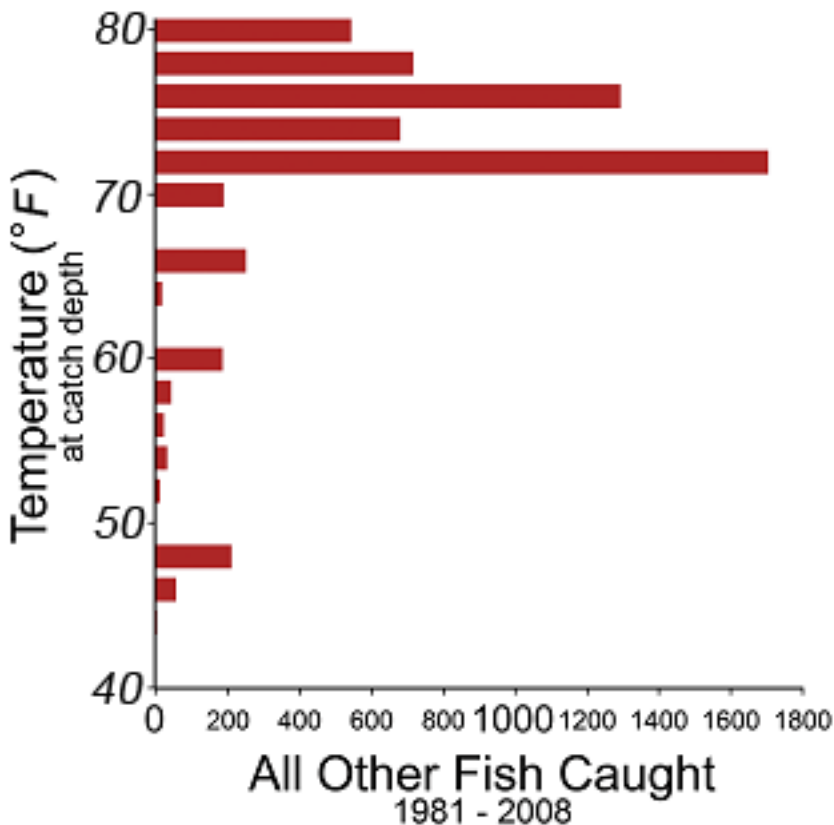
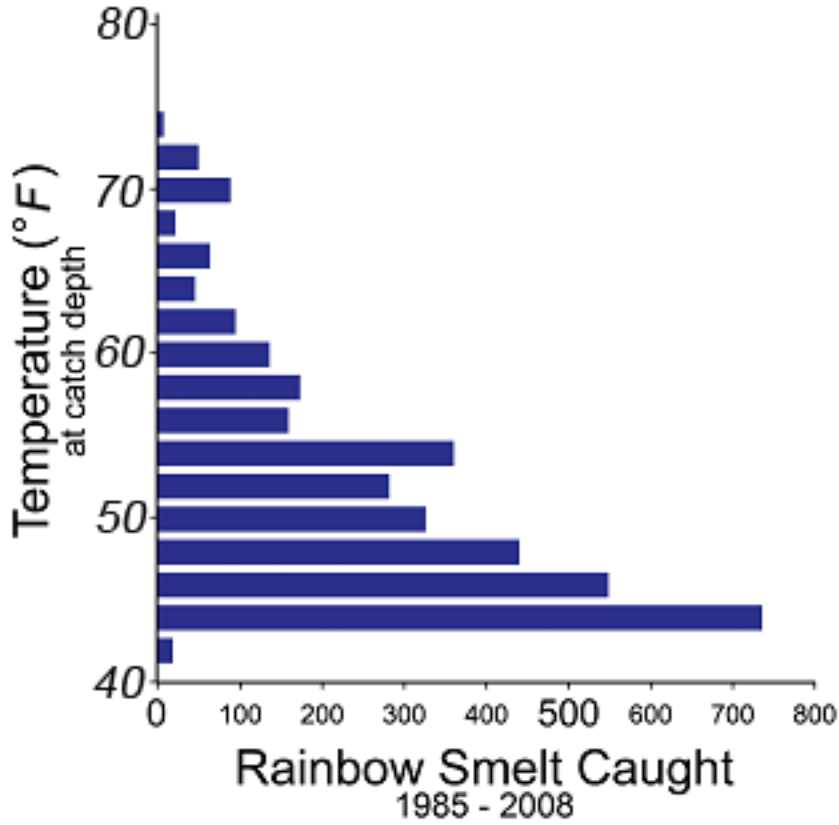
Pelagic night 2012



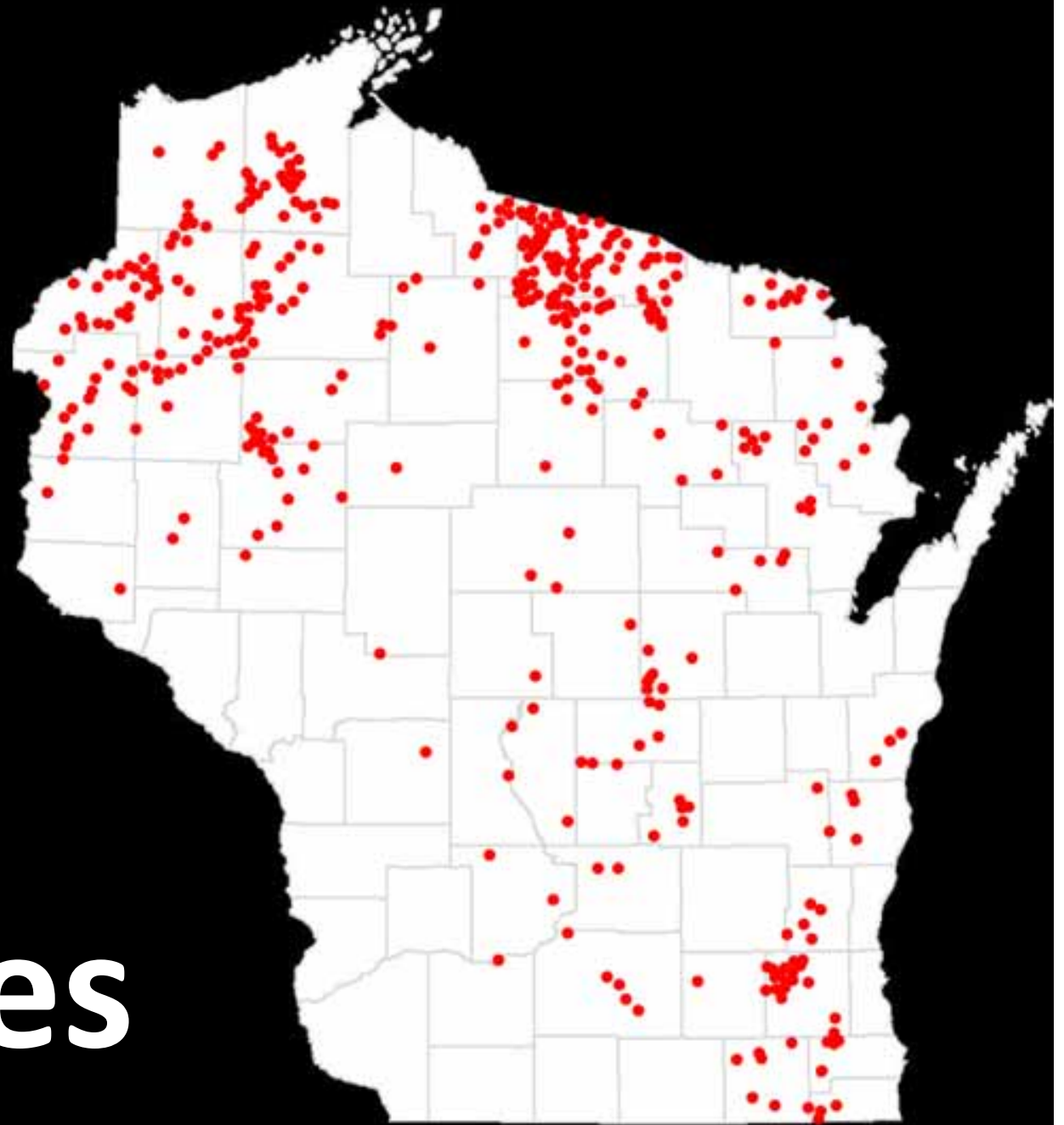
Smelt Thermal Habitat



Smelt Habitat Temperature



How many
lakes have
suitable
habitat?



53 lakes

Project Timeline

