

Evaluating the Effects of Spawning Bed Enhancement on Salmon Habitat, Water Quality, and Benthic Communities in a Yuba River Tributary in Northern California

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Sierra Streams Institute

Linking Water, Science and People

Started in 1996 as Friends of Deer Creek by group of concerned local citizens and property owners, when Nevada City was replacing the historic Pine Street Bridge.

Focus on scientific investigation to find solutions to Deer Creek's problems.

Changed name to Sierra Streams Institute in 2011, to reflect expanding regional focus.

Sierra Streams Institute Programs



Restoration

Salmon habitat

Abandoned mining sites

Education

Place-based science

Research

Transport of mercury over dams

Health impacts of mining contaminants

Laboratory

Chemical and biological analysis

Training

State protocols for watershed groups

Community-based Participatory Research

Citizens participate in all levels of work



Some Current Projects:

- ❖ Monthly water quality monitoring, SWAMP-based assessments
- ❖ Salmon habitat and native plant restoration
- ❖ Health impacts/remediation of mining contaminants
- ❖ Macroinvertebrate identification and Index of Biotic Integrity (IBI)



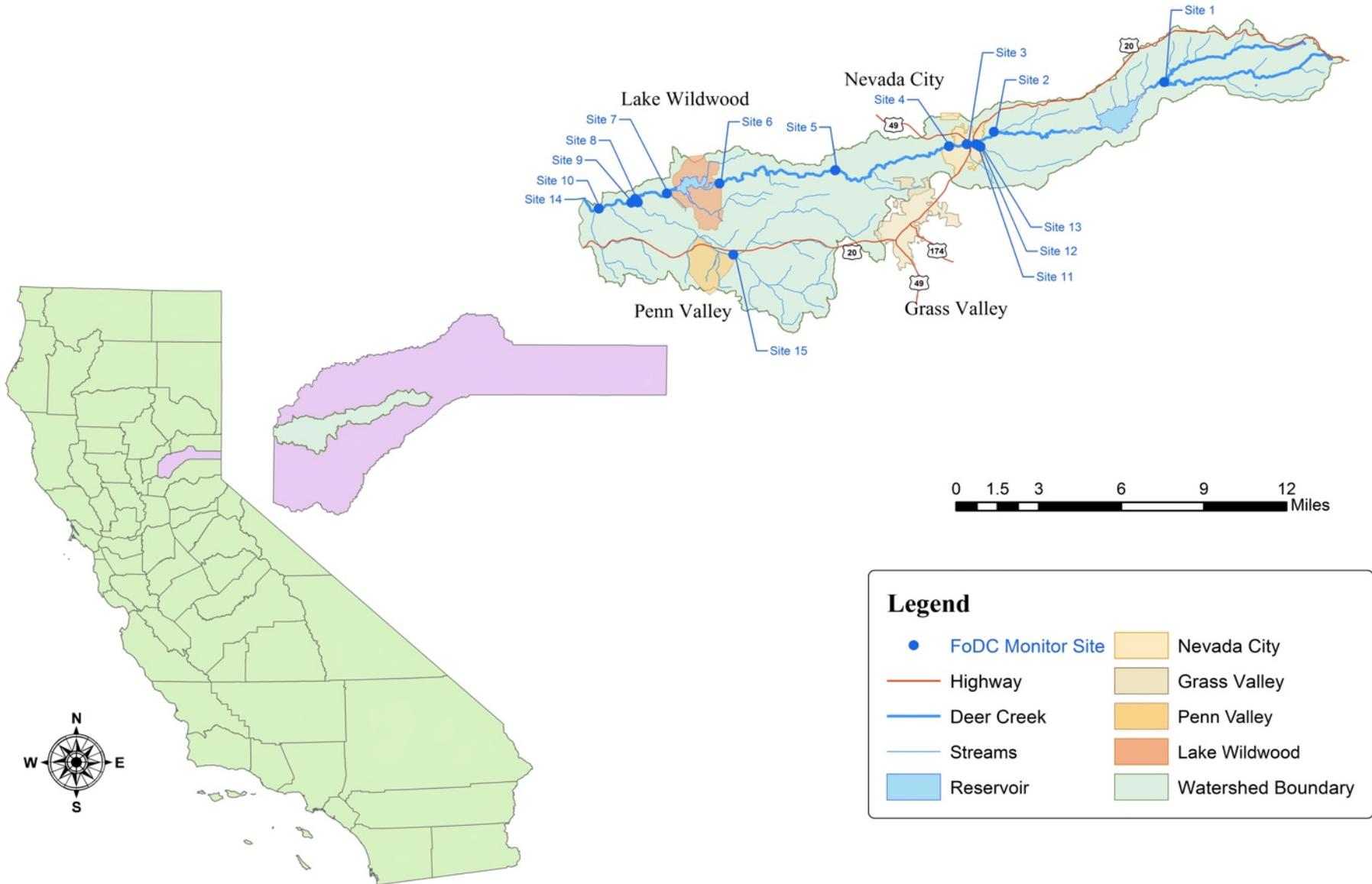
The Bug Book

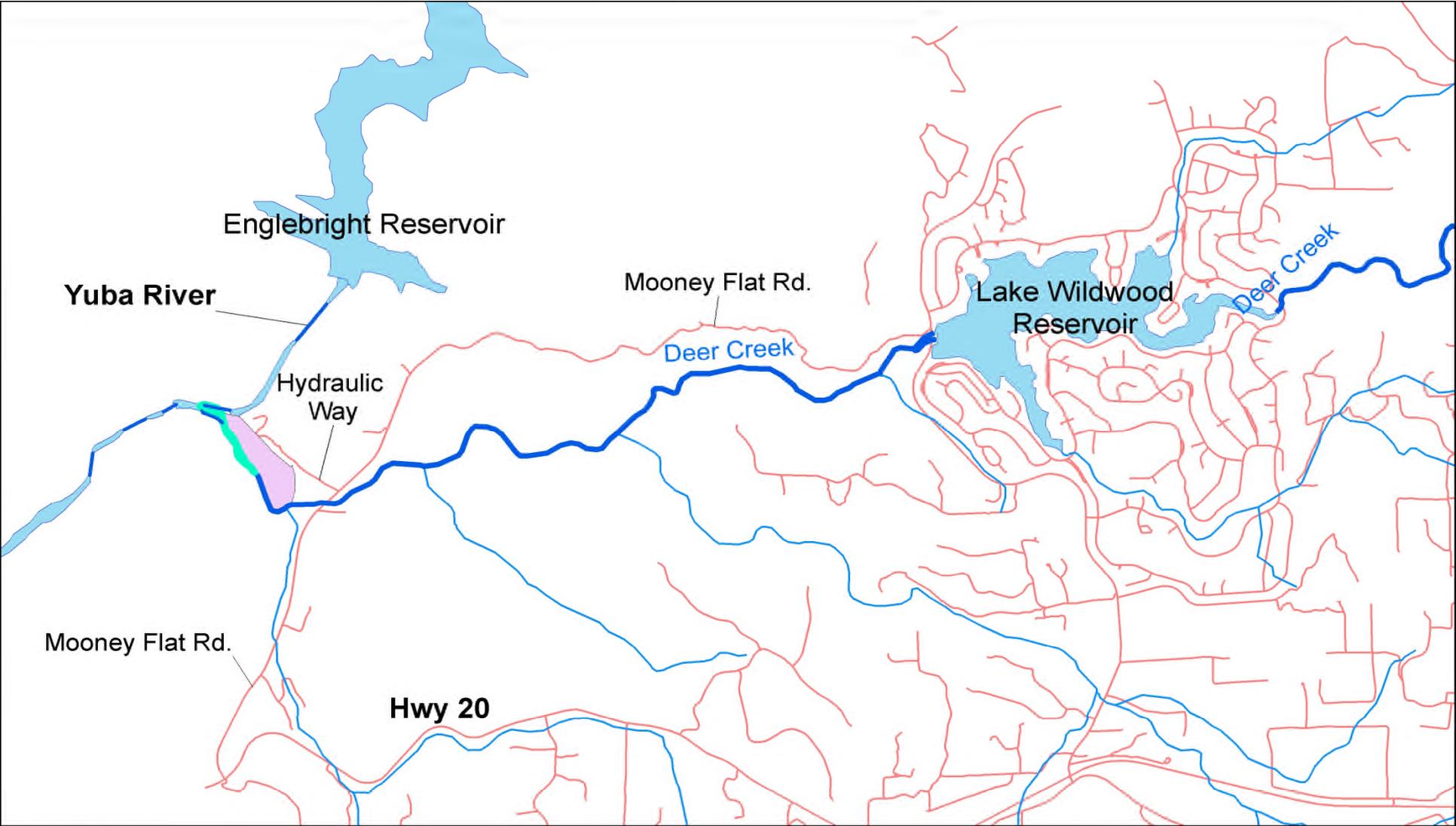
A Guide to the Identification of Common Aquatic
Benthic Macroinvertebrate Families of California
and Western North America



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Deer Creek Watershed

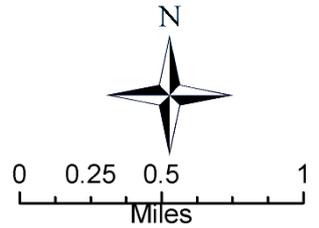




Deer Creek Spawning Bed Enhancement Project
 State of California Department of Fish and Game
 Notification of Lake or Streambed Alteration

Deer Creek
 Nevada County
 Applicant: Joanne Hild-Sierra Streams Institute
 7/23/2011
 Smartville Quadrangle
 Township 16N Range: 6E Section: (22, 23)

Figure 1 - Vicinity Map



Anadromous Fish in Deer Creek

Obstacles to Spawning

- Lack of spawning habitat
 - Upstream dams
- Reservoir Management
 - Lake Wildwood
- Water Quality (Temperature, pH)
 - Reservoir and Wastewater Treatment Plant
 - Degraded riparian habitat



Habitat Enhancement Efforts

A scenic view of a river with a rocky bank and a gravelly shore. The water is clear and reflects the surrounding greenery and rocks. The background shows a steep, rocky bank with some sparse vegetation. The foreground is dominated by a wide, shallow area of light-colored gravel and small stones.

Gravel Augmentation (August 2011)

- 150 tons of placed at Mooney Flat Road

Spawning Bed Enhancement (September 2012)

- 250 tons placed upstream of Yuba River confluence

Spawning Bed Enhancement (September 2013)

- 450 tons placed upstream of Yuba River confluence

Native Plant Restoration (2009 – present)

- 5 acres of Riparian and Meadow Habitat in lower Deer Creek

• Lake Wildwood Reservoir Management

- October Reservoir Drawdown; Low Flow releases

Spawning Bed Enhancement







Spawning Bed Enhancement





Yuba River

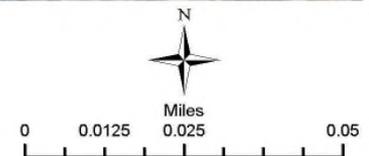
Project Monitoring

- Water Quality
 - Surface, inter-gravel
- Benthic Macroinvertebrates
- Algae
 - Biomass
- Physical Habitat
 - Pebble counts
 - Bulk samples
- Gravel Mobility
- Fish
 - Adult surveys
 - Redd surveys
 - Carcass surveys
 - Juvenile surveys

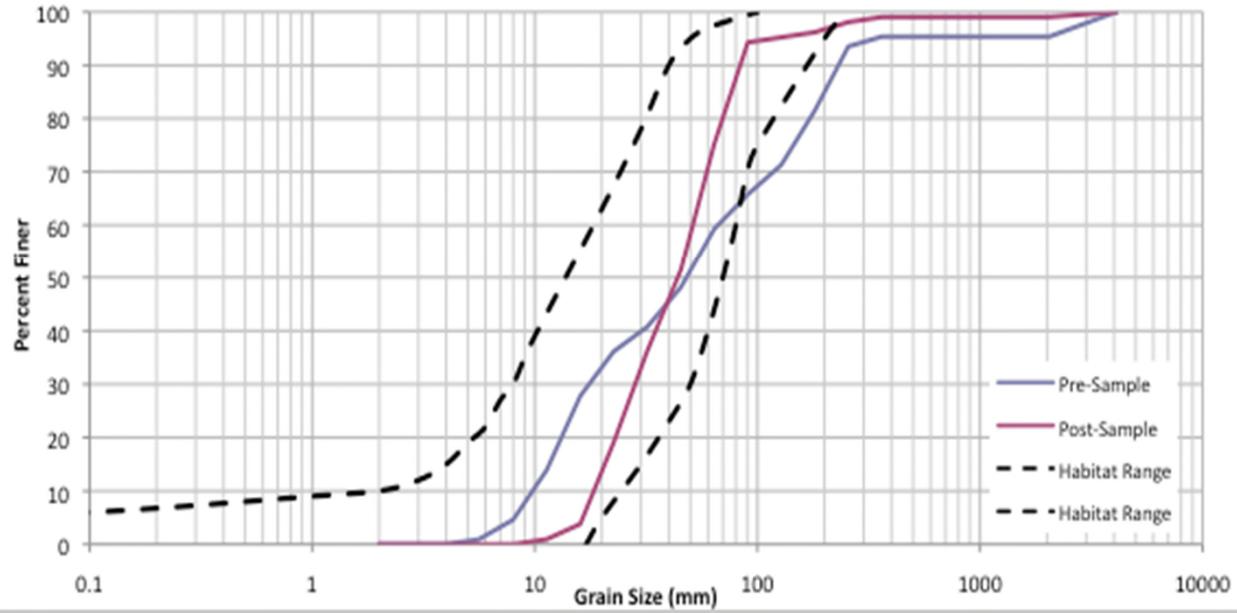
Deer Creek

Legend	
 Stream Flow Transect Locations	 Spawning Bed Enhancement Work Areas
 Gravel Tracer Transects	 Post
 Scour Chains	 Pre
 Water Temperature Loggers	

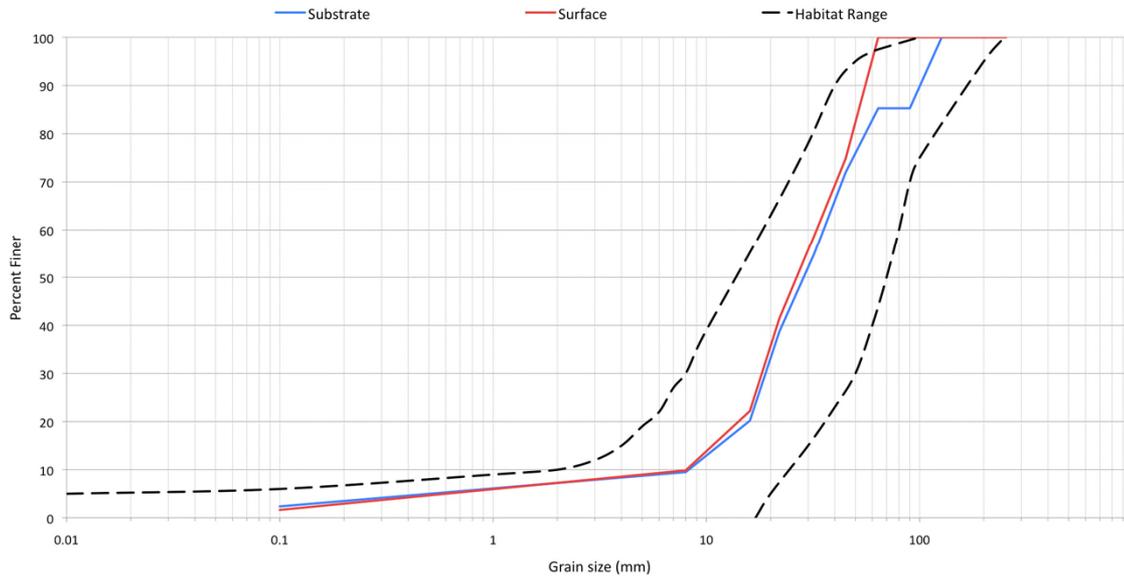
Sierra Streams Institute Spawning Bed Enhancement Project Monitoring Location Map



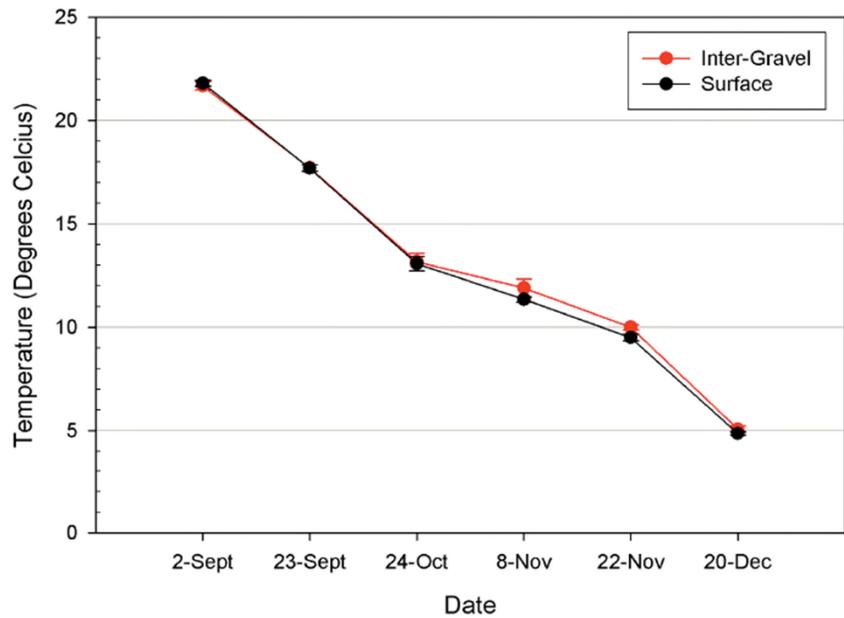
Deer Creek Spawning Bed Enhancement Project Work Area 1 Pebble Count 2013



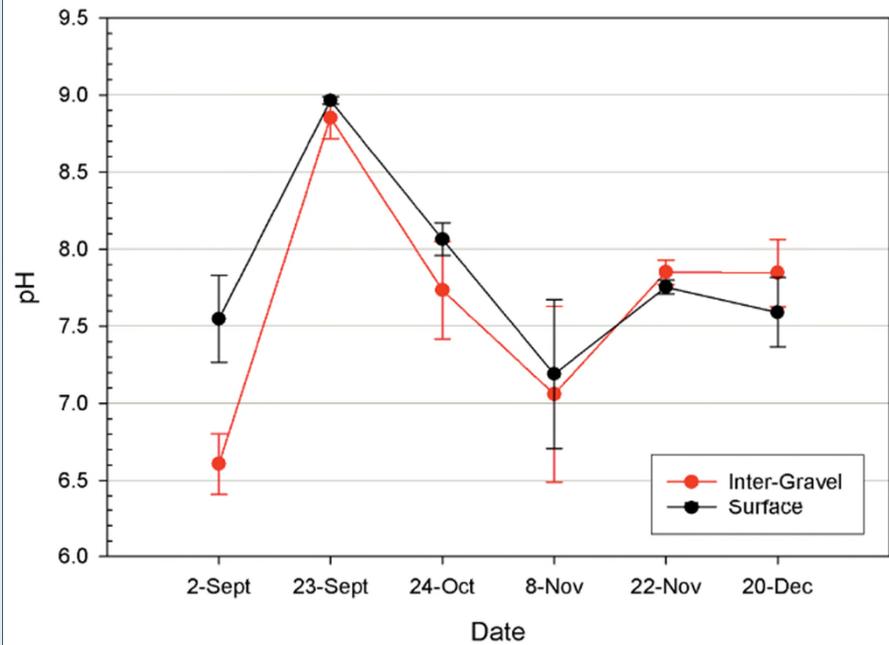
Bulk Sample for Deer Creek After Restoration - Work Area 1 September 19, 2013



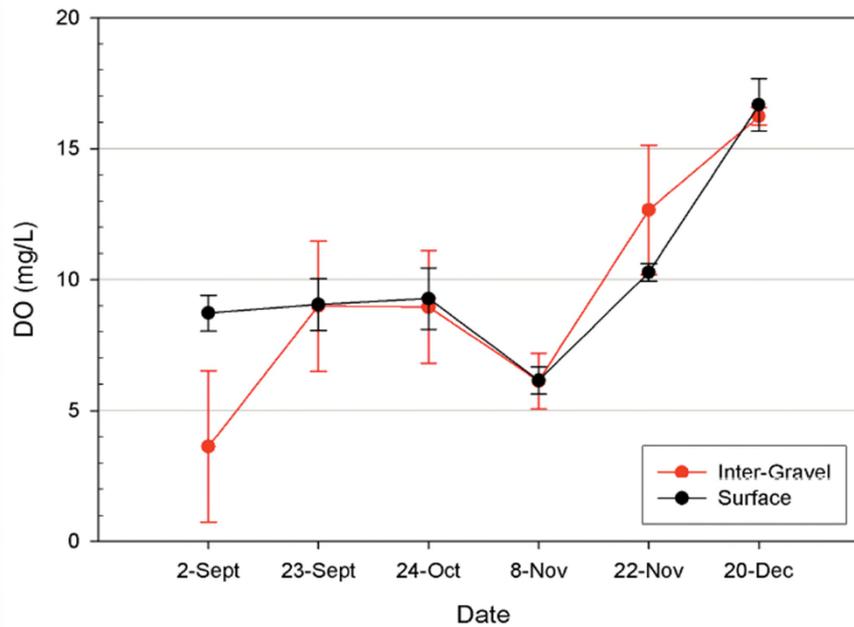
2013 Spawning Bed Enhancement: Work Area 3 Temperature



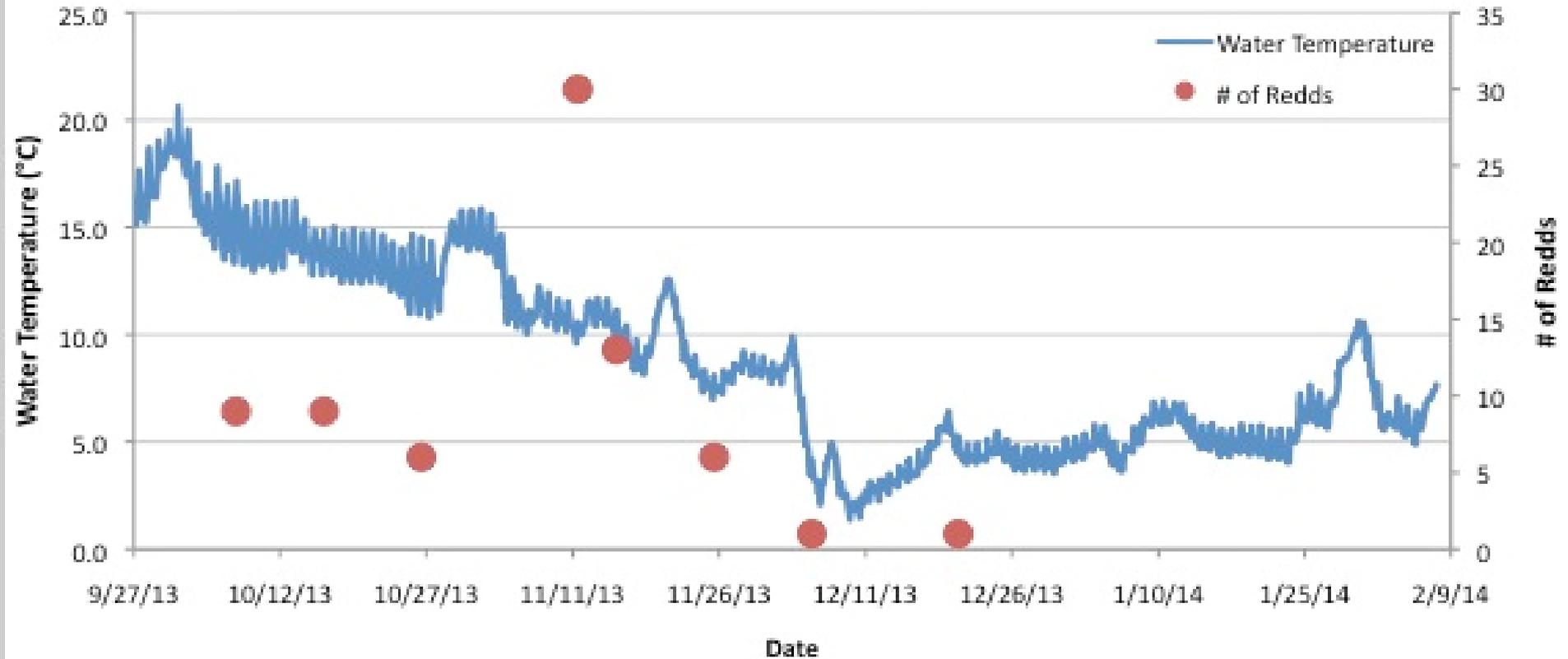
2013 Spawning Bed Enhancement: Work Area 3 pH



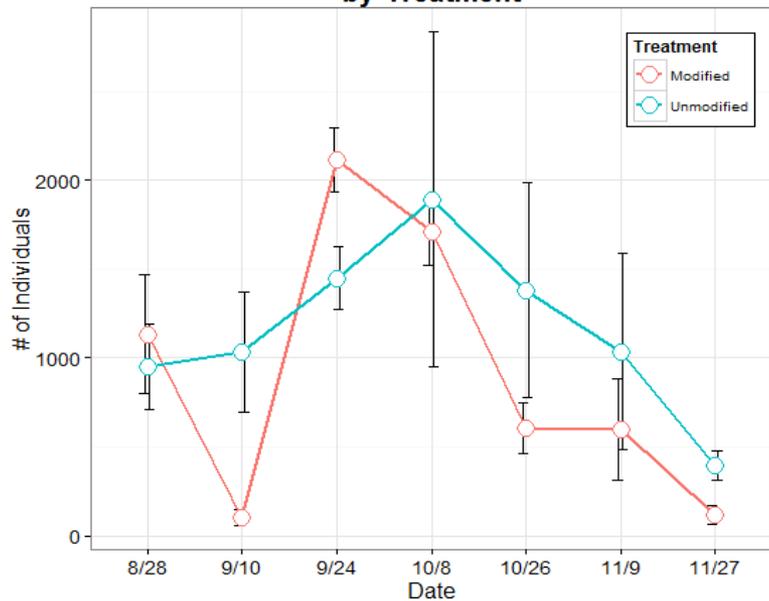
2013 Spawning Bed Enhancement: Work Area 3 Dissolved Oxygen



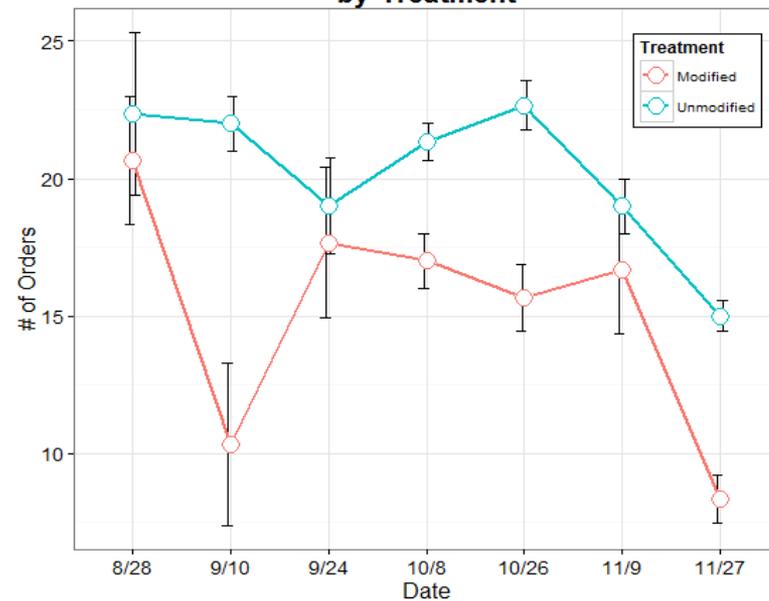
2013 Surface Water Temperature vs Chinook Salmon Redds



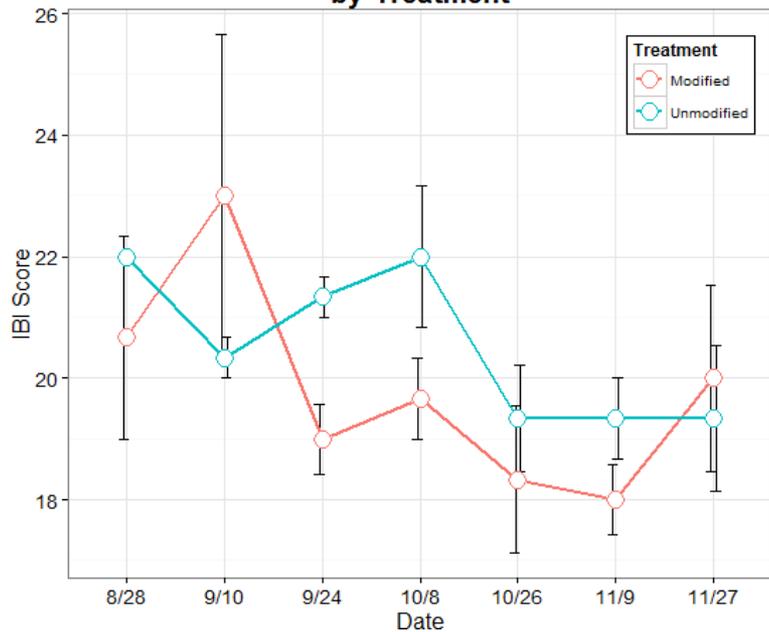
Number of Individuals by Treatment



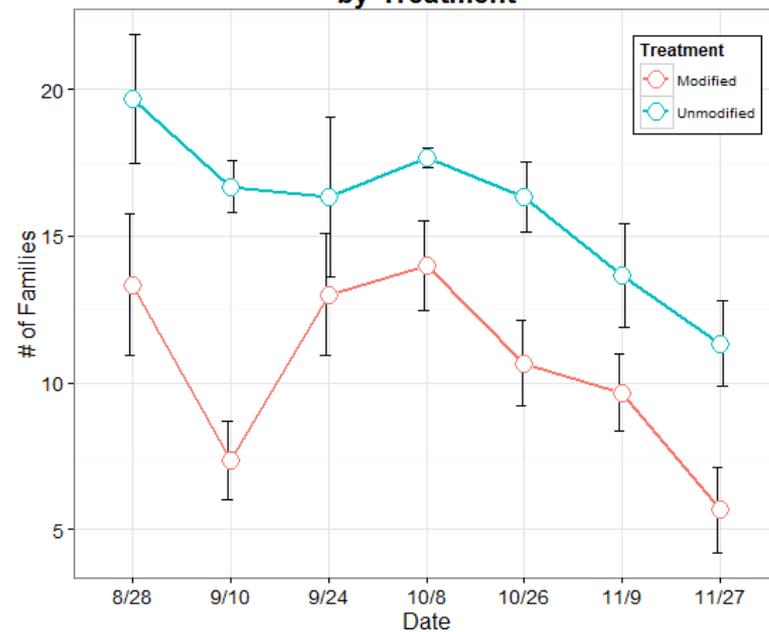
Number of Distinct Orders by Treatment



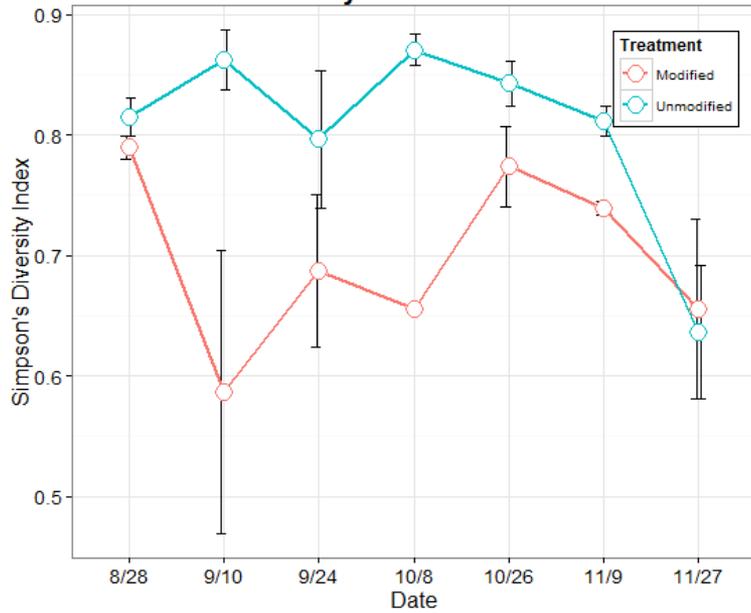
IBI Scores by Treatment



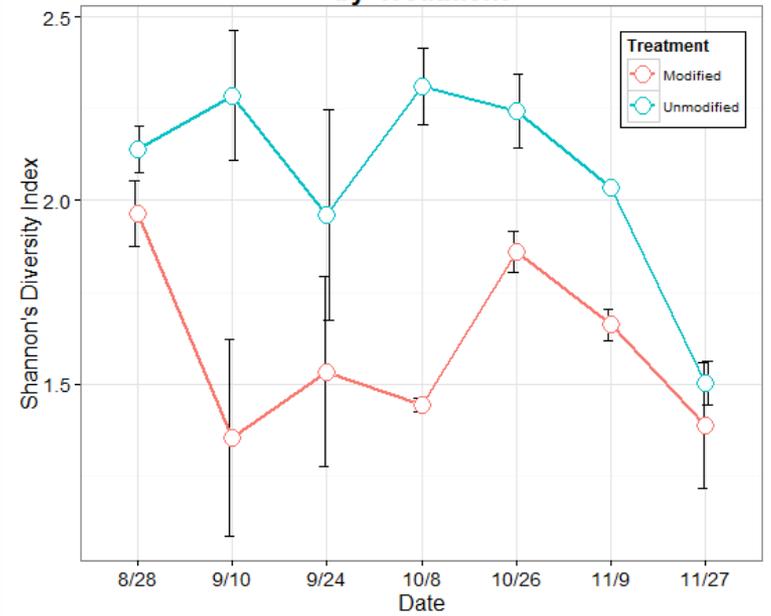
Number of Distinct Families by Treatment



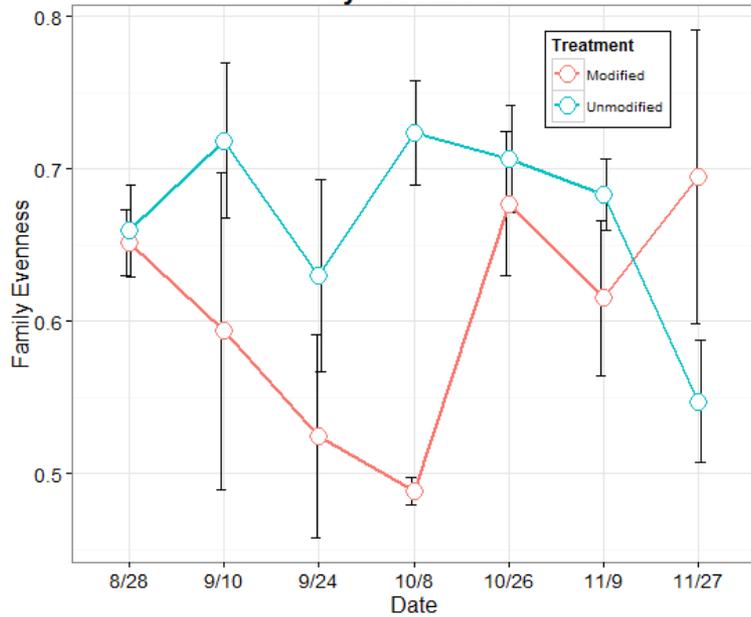
Simpson's Diversity by Treatment



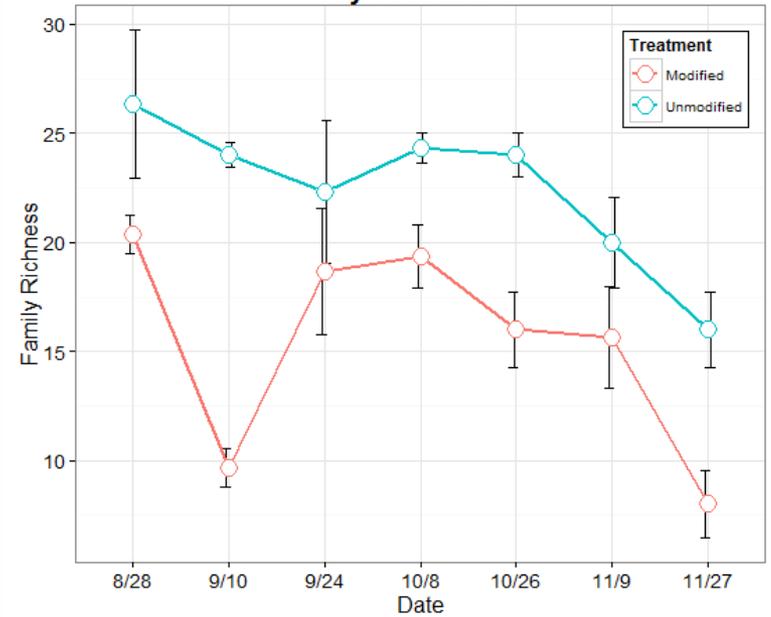
Shannon's Diversity by Treatment



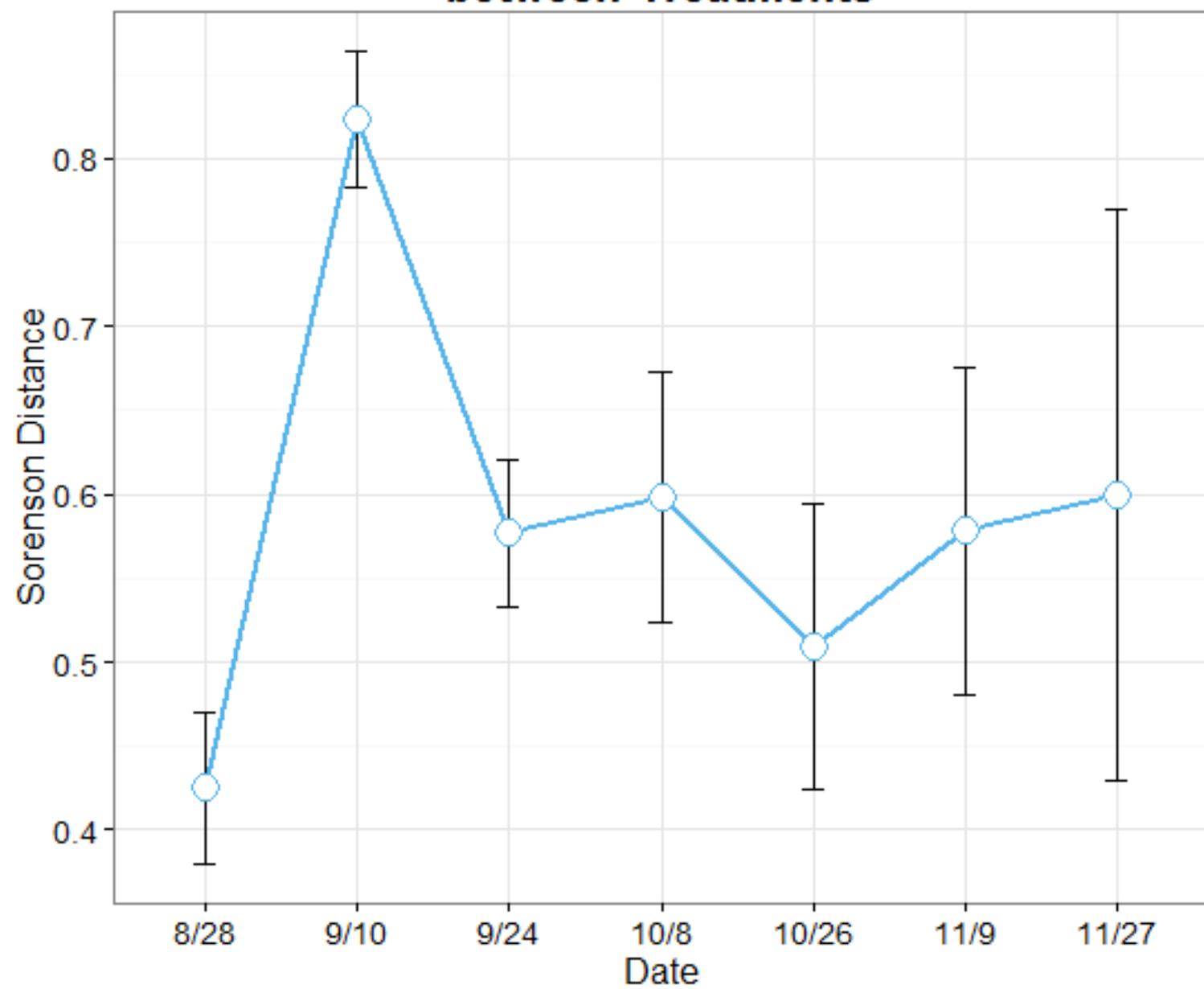
Family Evenness by Treatment



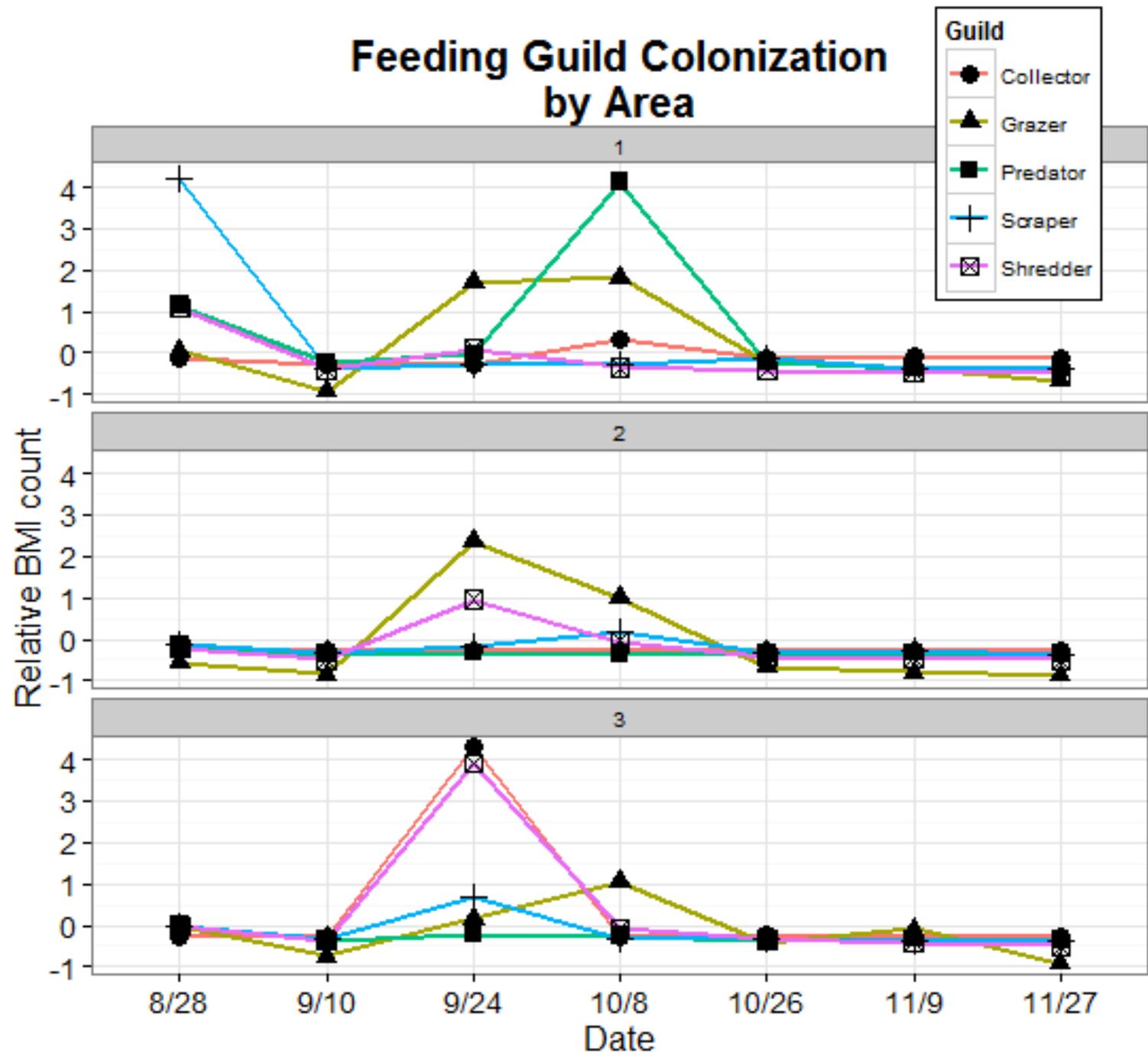
Family Richness by Treatment



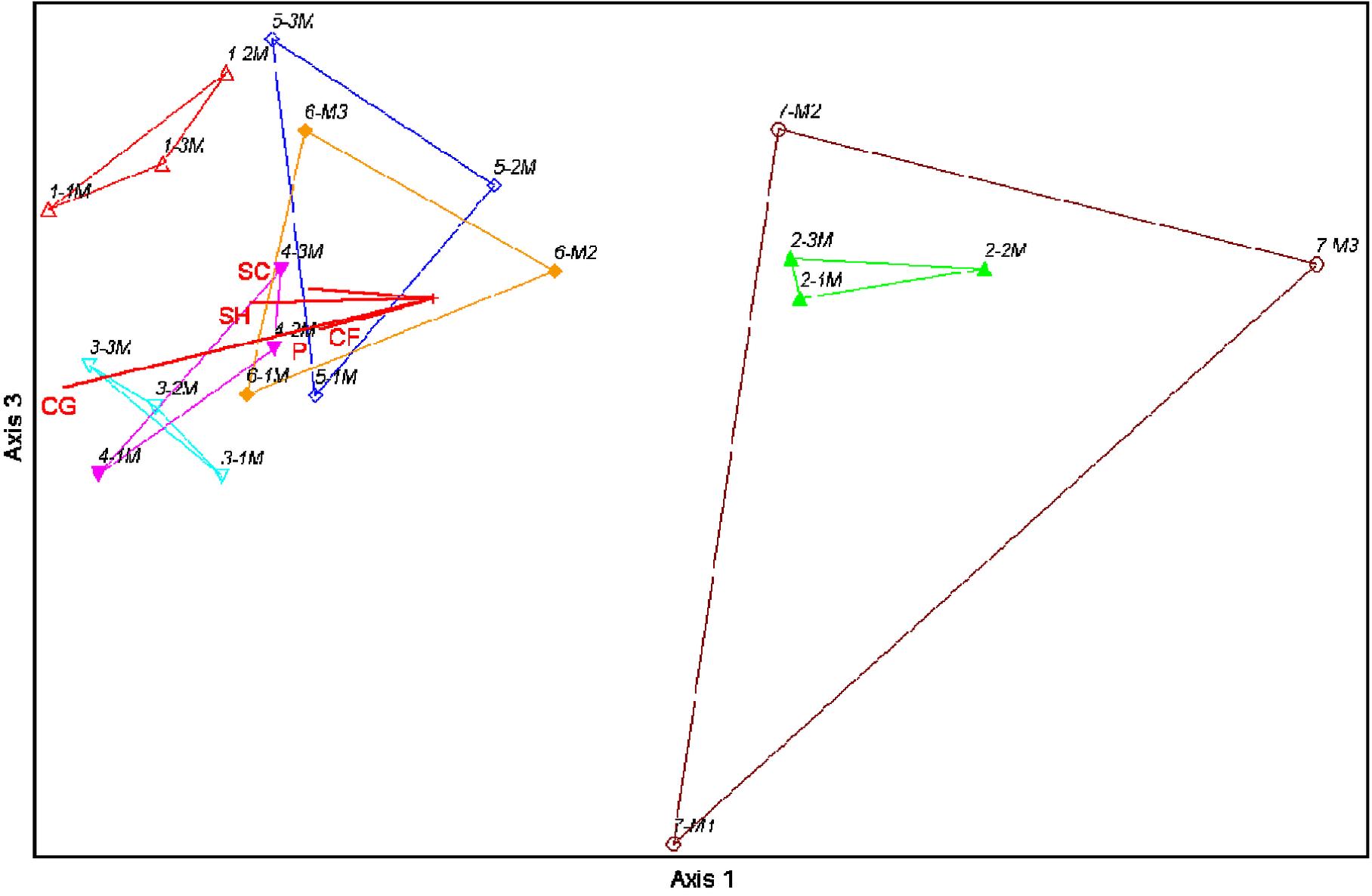
Sorenson Distance between Treatments



Feeding Guild Colonization by Area

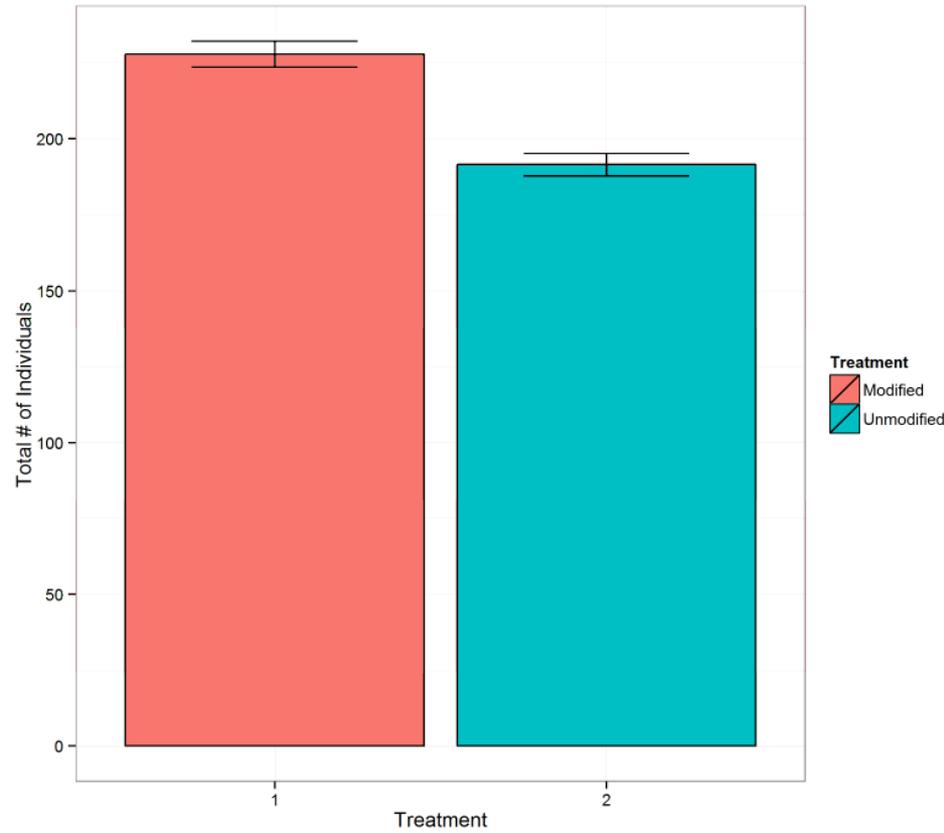


BMI Colonization

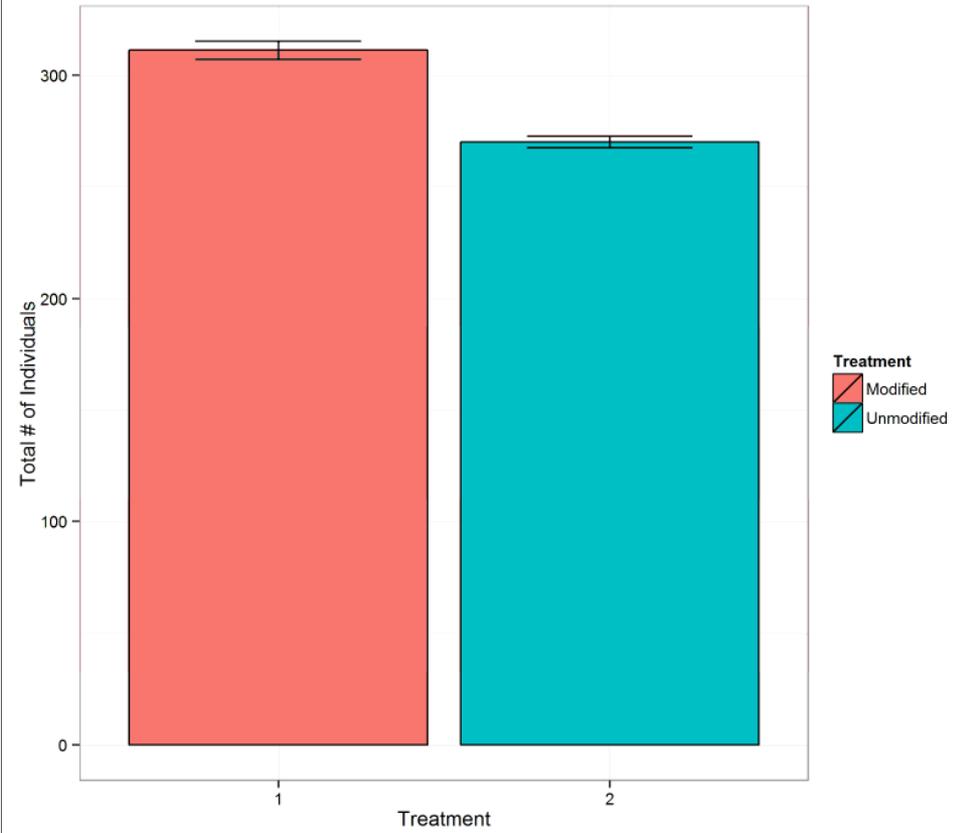


Chinook salmon prey item abundance

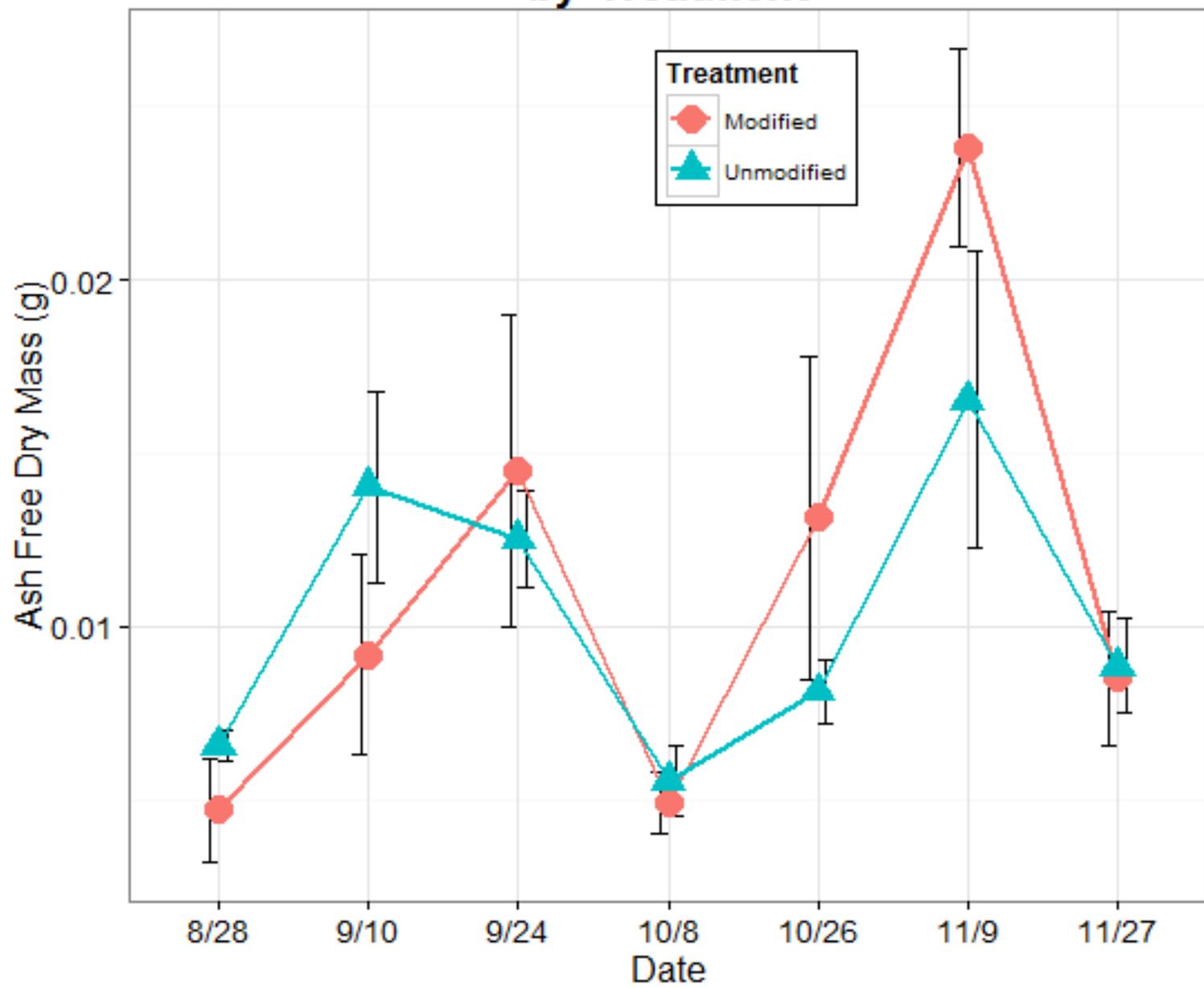
Diptera, Chironomidae



Ephemeroptera, Baetidae



Algal biomass by Treatment





10/03/13 4:07 AM



Summary

- Total of 850 tons of spawning gravel placed
- Pre-project: 9 redds in 2003, 15 redds in 2011
 - Post-project: 51 redds in 2012/13, 78 redds in 2013/14
- 75% of spawning activity took place in enhanced areas; over 95% of enhanced areas used by spawning salmon
- Spawning material rapidly incorporated into aquatic system
- Family level macro data used to evaluate project success
- Considerable transport of material each year

Next Steps

Continue monitoring of salmon populations and project results

Additional Data Analysis

- Mixed models (water quality, macros, algae, substrates, flow)

Continue collaboration with Lake Wildwood on flow management

- Low Flow Release
- Reservoir Drawdown

Explore options for long-term project sustainability

- Use of dredged gravels from Lake Wildwood

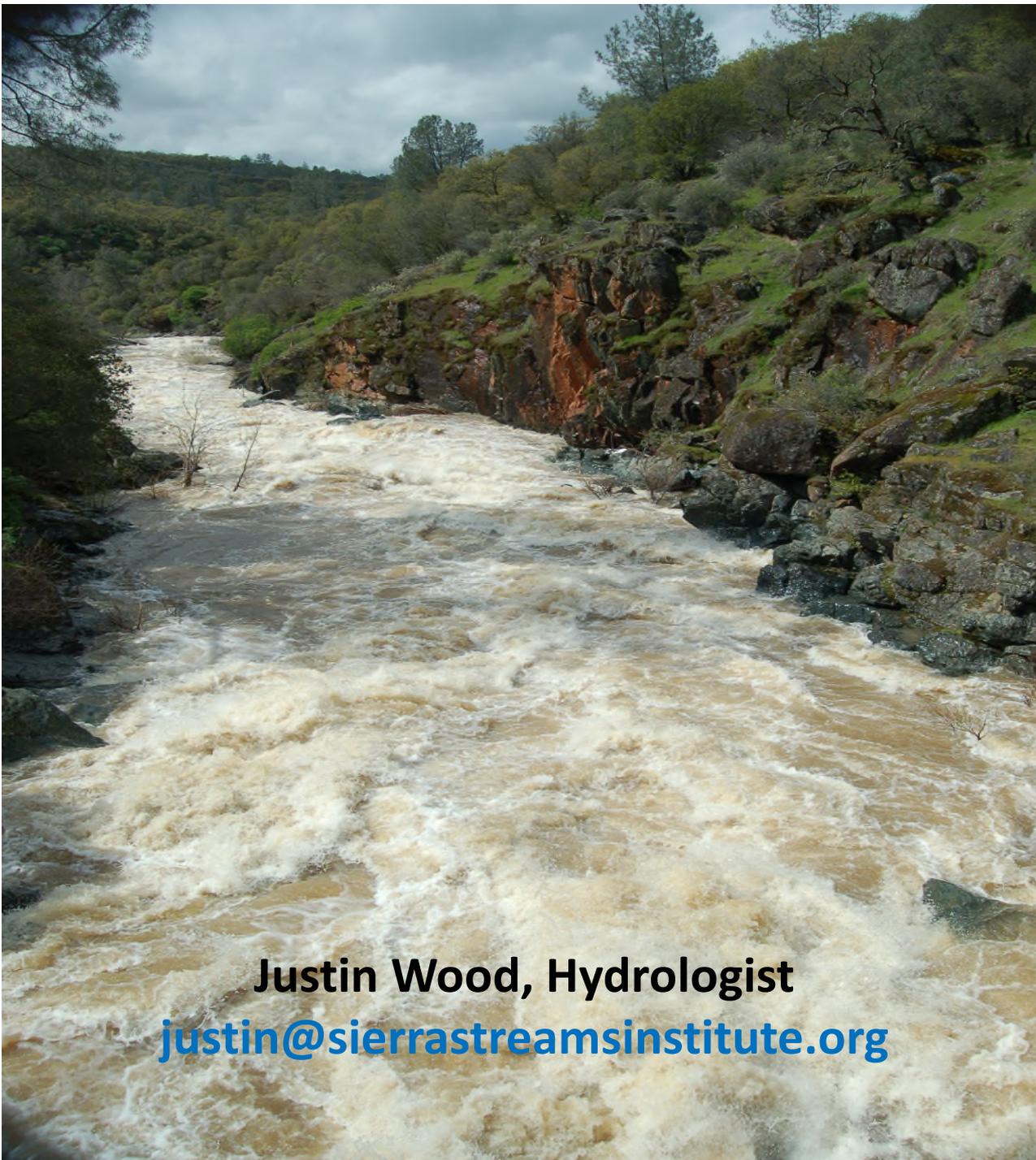
Acknowledgements

Bella Vista
FOUNDATION



patagonia

- We would like to thank all of our volunteers, whose hard work, dedication, enthusiasm, and interest allow us to monitor Deer Creek.
- Sandy Williamson, a volunteer taxonomist, without whom none of this would be possible.



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