Washington Sea Grant
Geoduck Aquaculture Research Program Update:

Effects of cultured geoduck harvest disturbances on infaunal benthic communities of intertidal flats in southern Puget Sound

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Shellfish Aquaculture Regulatory Committee
Update on Research, Permitting and Rulemaking

Wednesday, June 2, 2010 • 10:00 a.m. – 3:15 p.m.

WA Department of Ecology, Headquarters
300 Desmond Drive SE, Lacey, WA
Auditorium, Rm. 32 & 34

NOTICE: This presentation reports preliminary information not yet subject to formal peer review, and subject to change based on further sampling and data analyses. Citation of this material as final should not be done under any circumstances.

Project objectives and foci:

Measurement of effects of five categories of disturbance, all associated with geoduck aquaculture activities, on the benthic infauna of intertidal sand habitats in the Puget Sound region:

1) **Predator exclusion structure placement;**
2) **Predator exclusion structure presence;**
3) **Predator exclusion structure removal;**
4) **Enhanced geoduck densities in cultured areas;**
5) **Harvest of geoducks from cultured areas.**

G VanBlaricom (all)

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General characteristics of the benthic infauna

1) Live on or in sediments;
2) Mostly invertebrates, but may include vertebrates;
3) Highly diverse;
4) Dominant groups are usually crustaceans, polychaete worms, and small bivalves;
5) Often abundant (commonly > 10,000 individuals per m^2);
6) Generally quite small (body lengths < 1 cm);
7) Our project is focusing on "macroinfauna" (Animals retained on a 0.5 mm sieve).

Study site locations for evaluation of harvest effects

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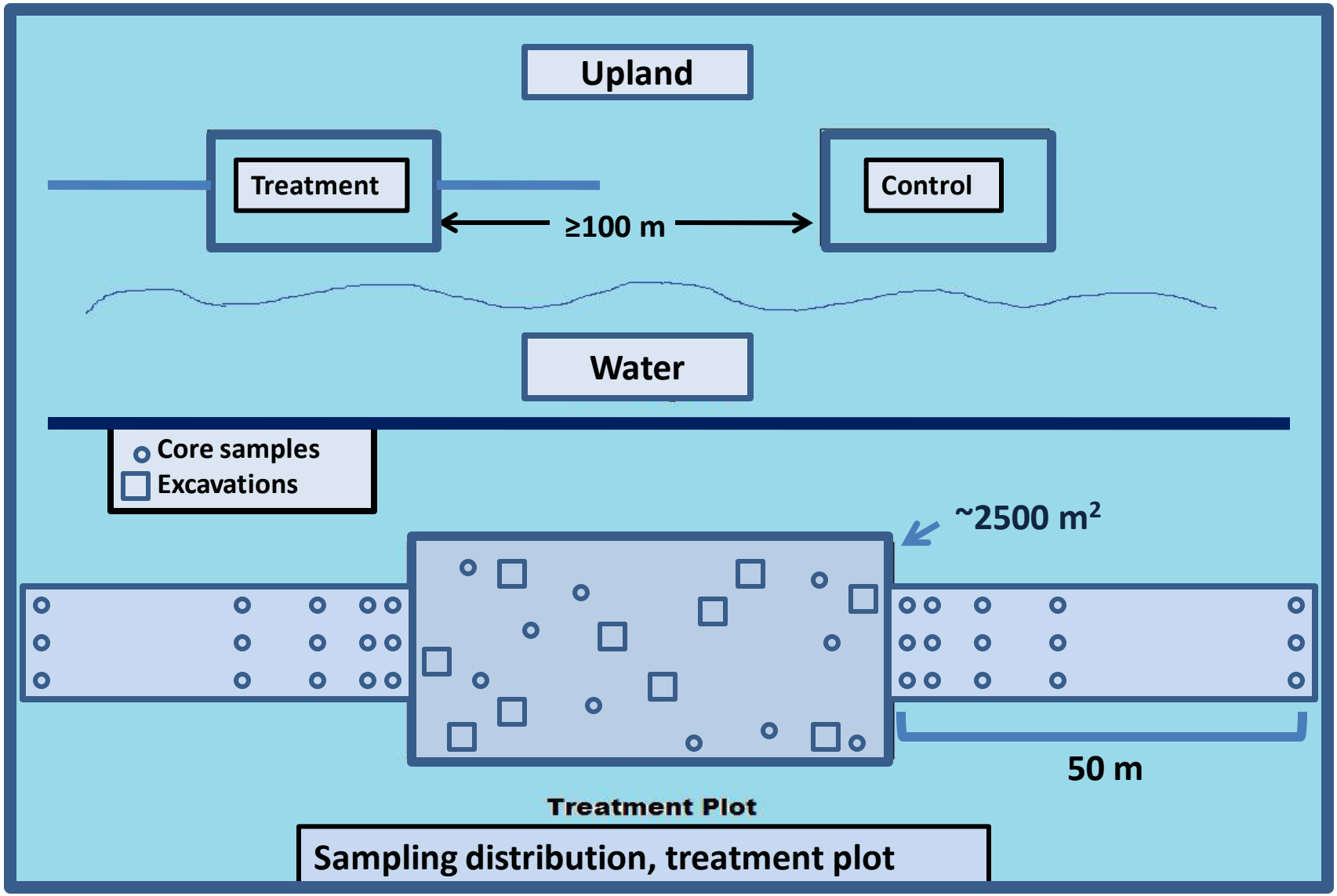
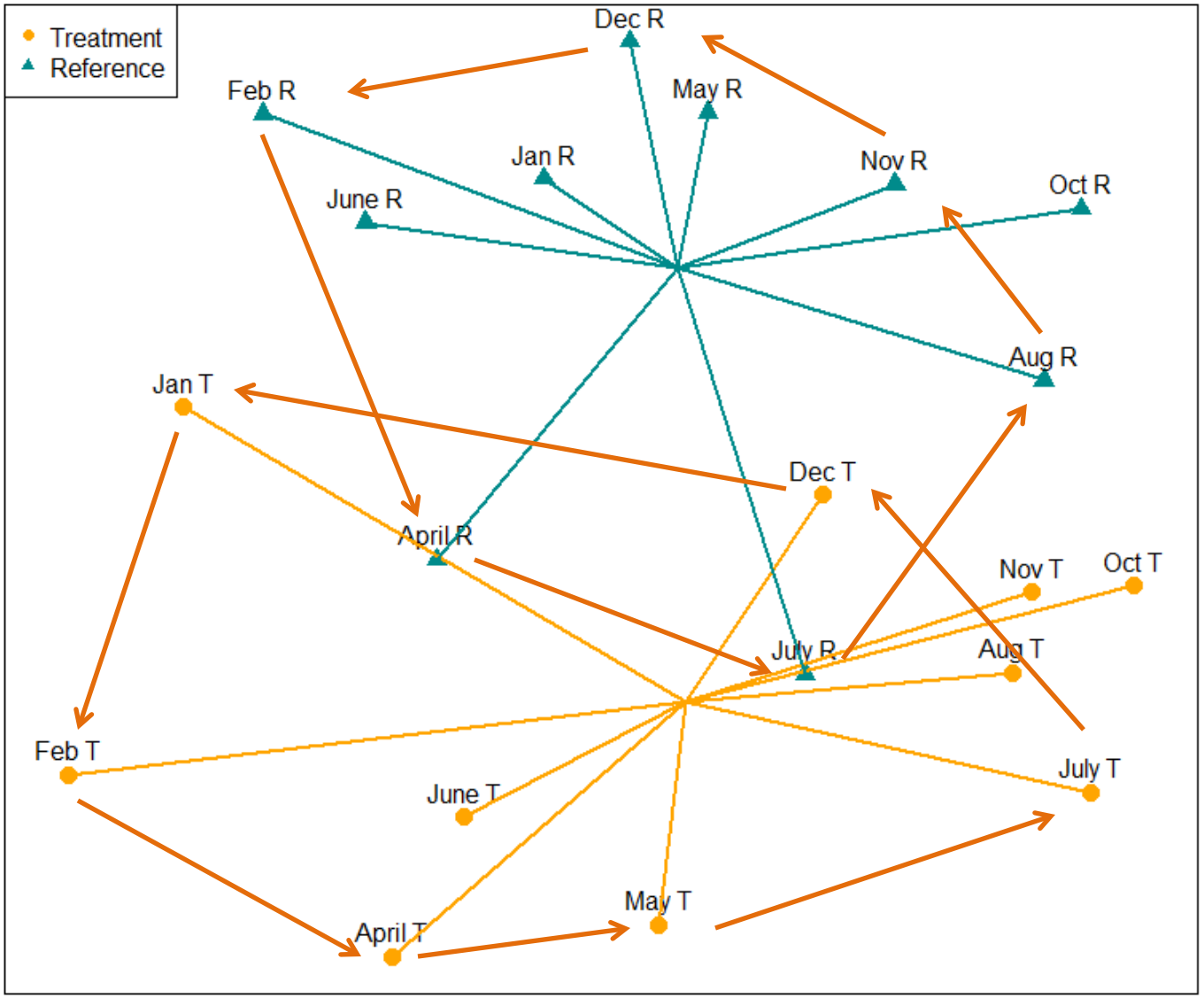
Study Site Layout

Not to scale



NMDS Ordination of Treatment and Reference Plots
3 dimensional solution, tolerance=1e-5, stress=10.5



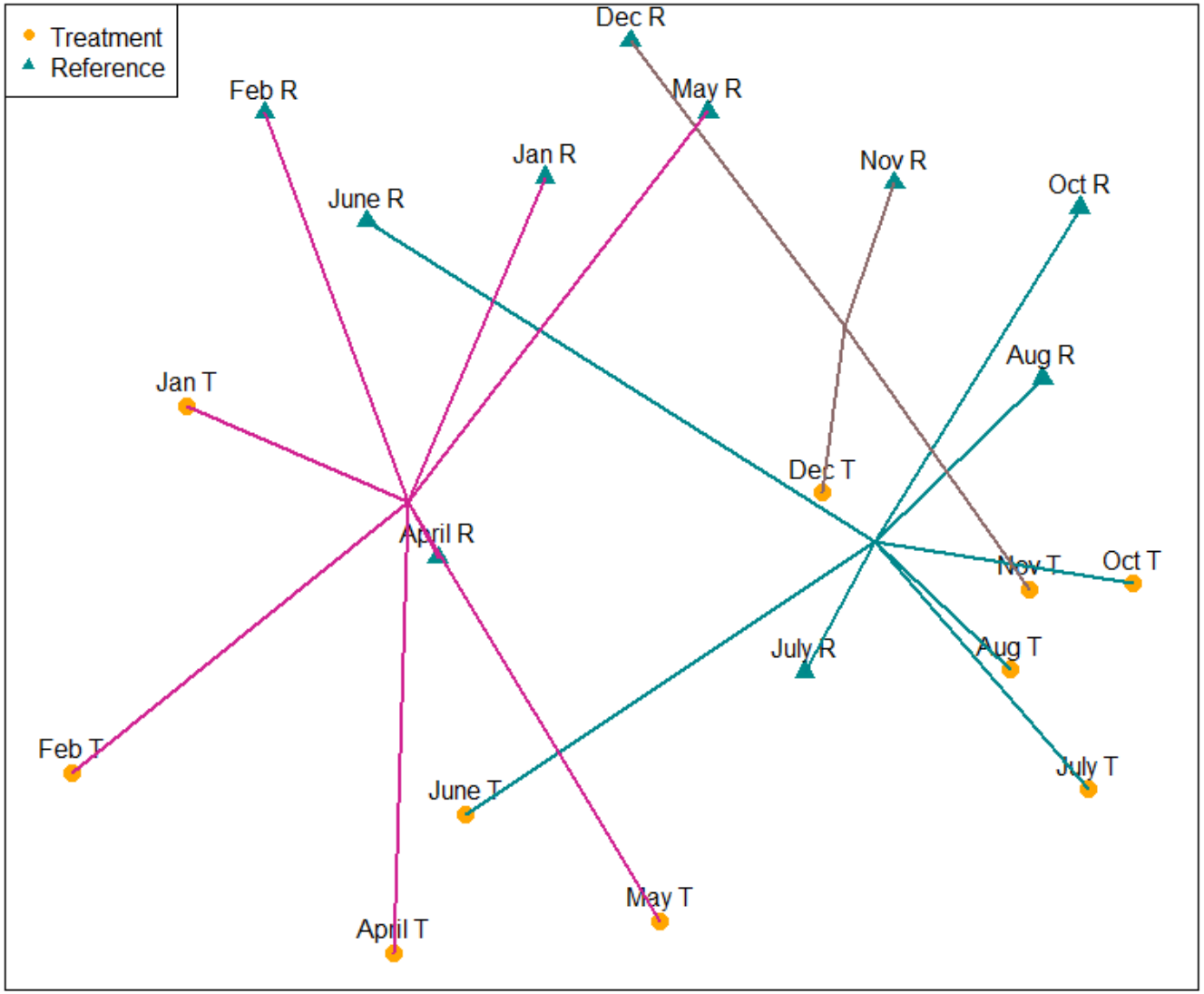
Results

- Secondary Model
  - Species composition ~ Harvest State: Treatment

	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)	
STATE	2.00000	0.72731	0.36365	2.54090	0.2138	0.0005	***
TREAT	1.00000	0.49717	0.49717	3.47381	0.1461	0.0001	***
STATE:TREAT	2.00000	0.17428	0.08714	0.60886	0.0512	0.9386	
Residuals	14.00000	2.00368	0.14312	0.5889			
Total	19.00000	3.40244	1.0000				

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

NMDS Ordination of Pre-Mid-Post Harvest Groupings
3 dimensional solution, tolerance=1e-5, stress=10.5



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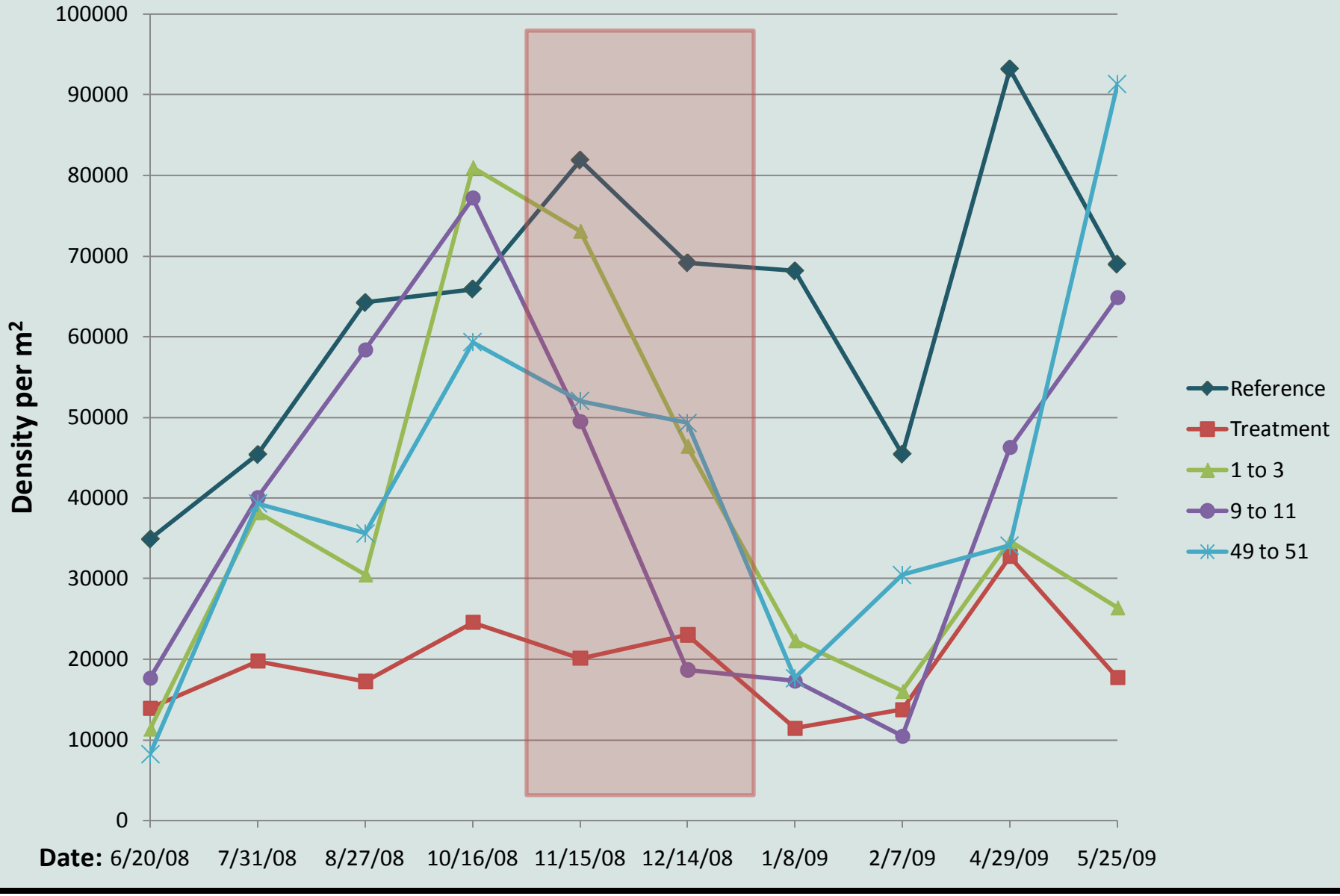
Average Abundance of All Organisms



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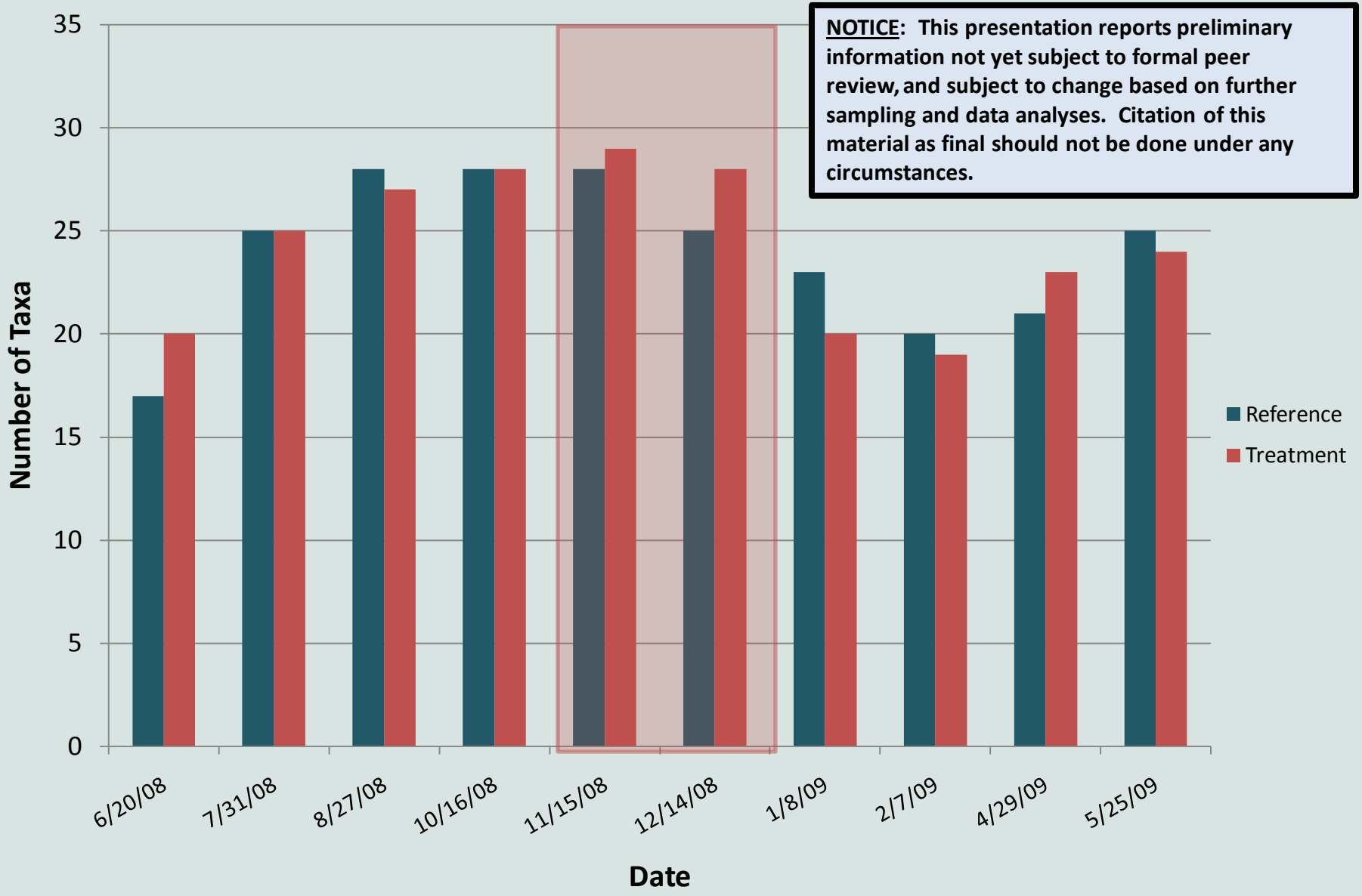
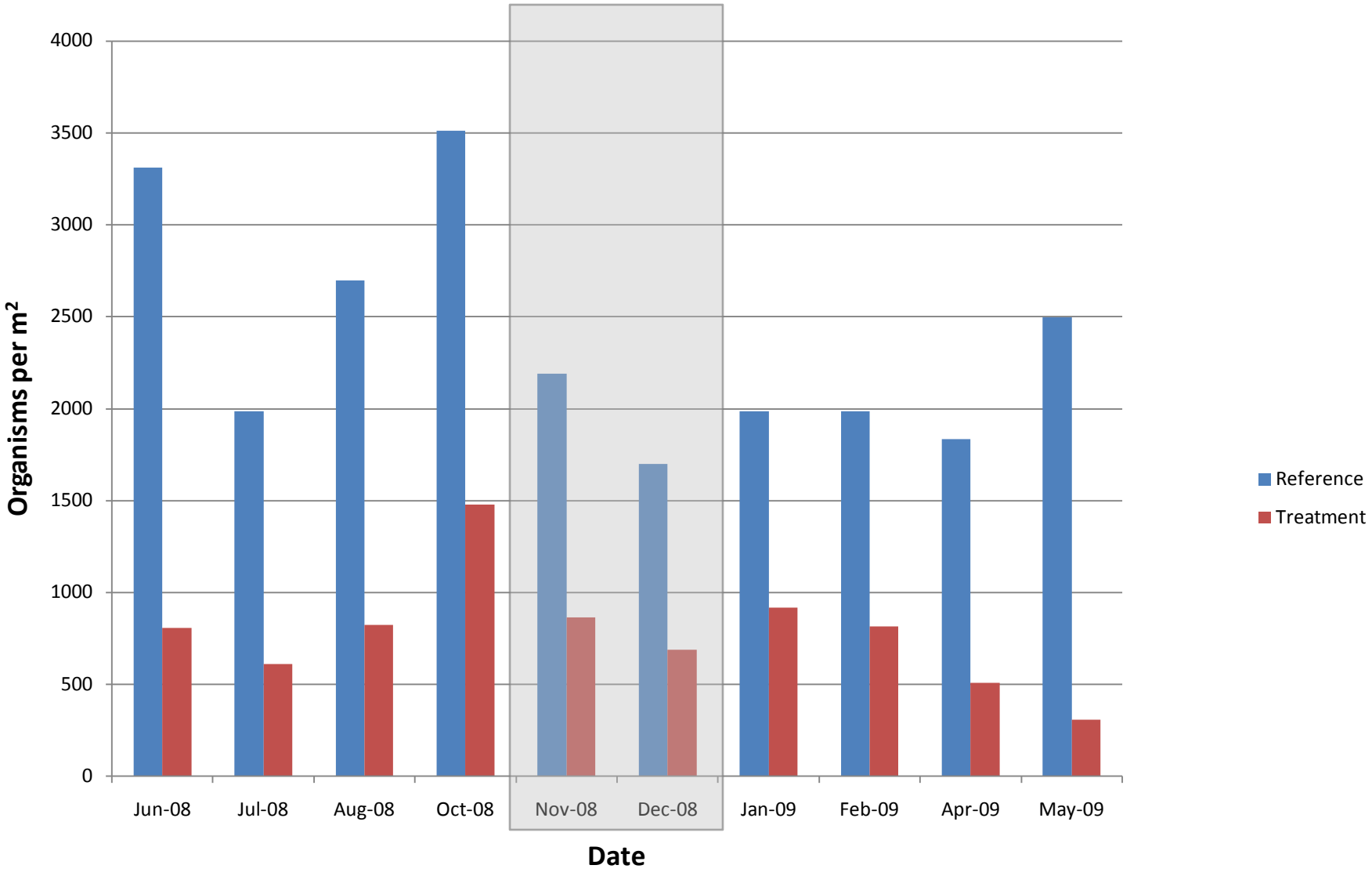
Total Taxa Richness by Month



Polychaete Worms: Glyceridae



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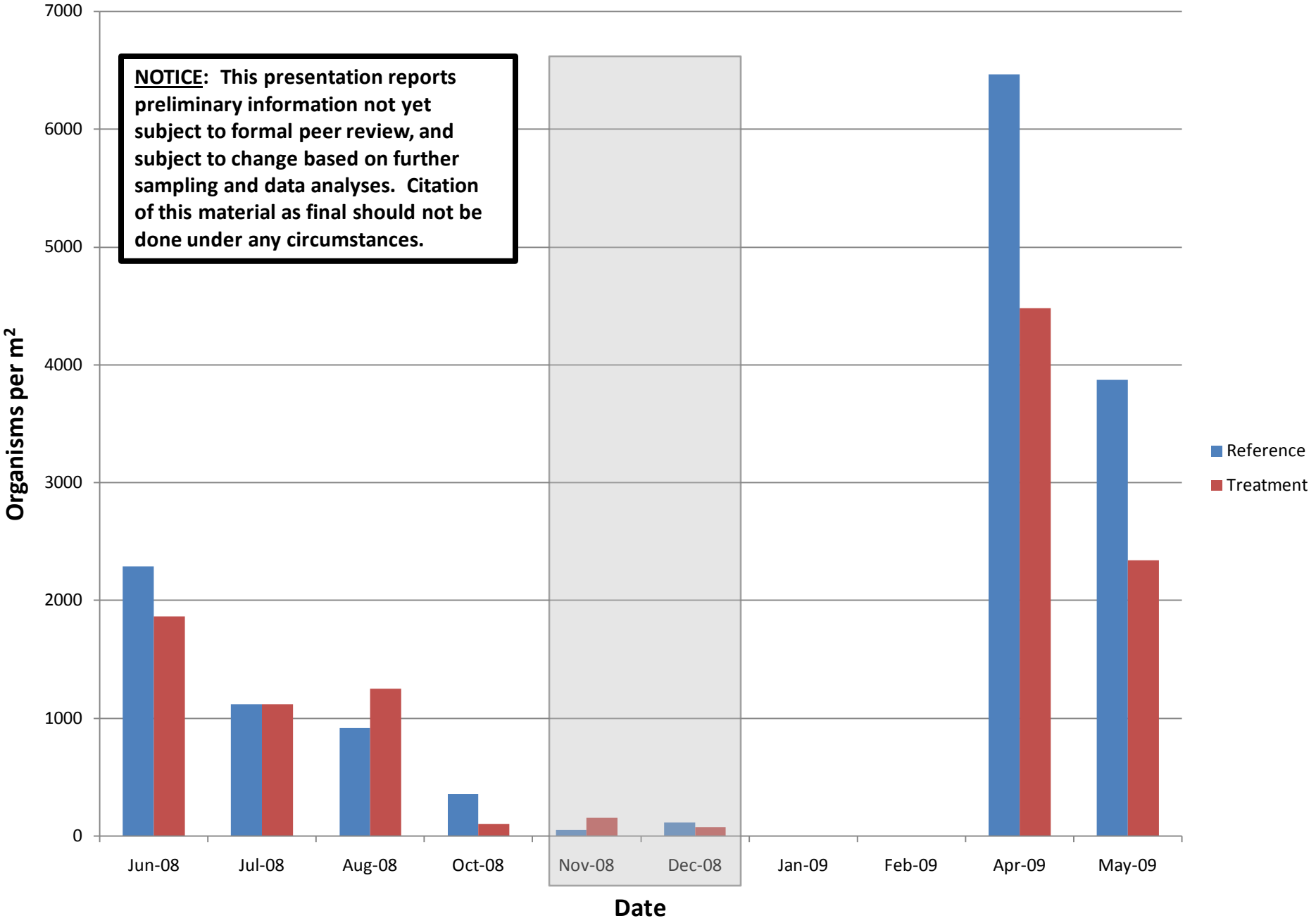
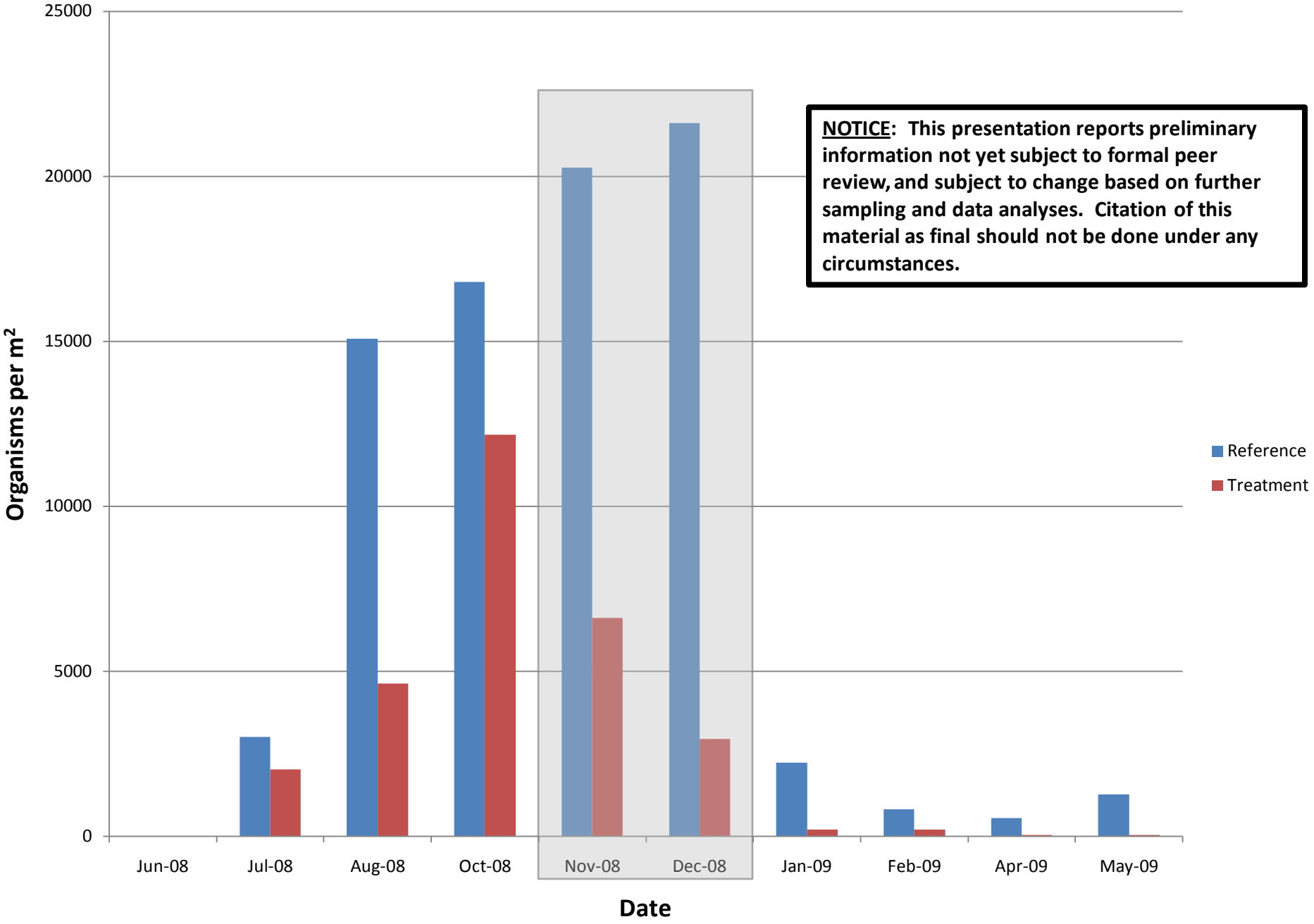
Polychaete Worms: Goniadidae



Polychaete Worms: Hesionidae - Ophidromus



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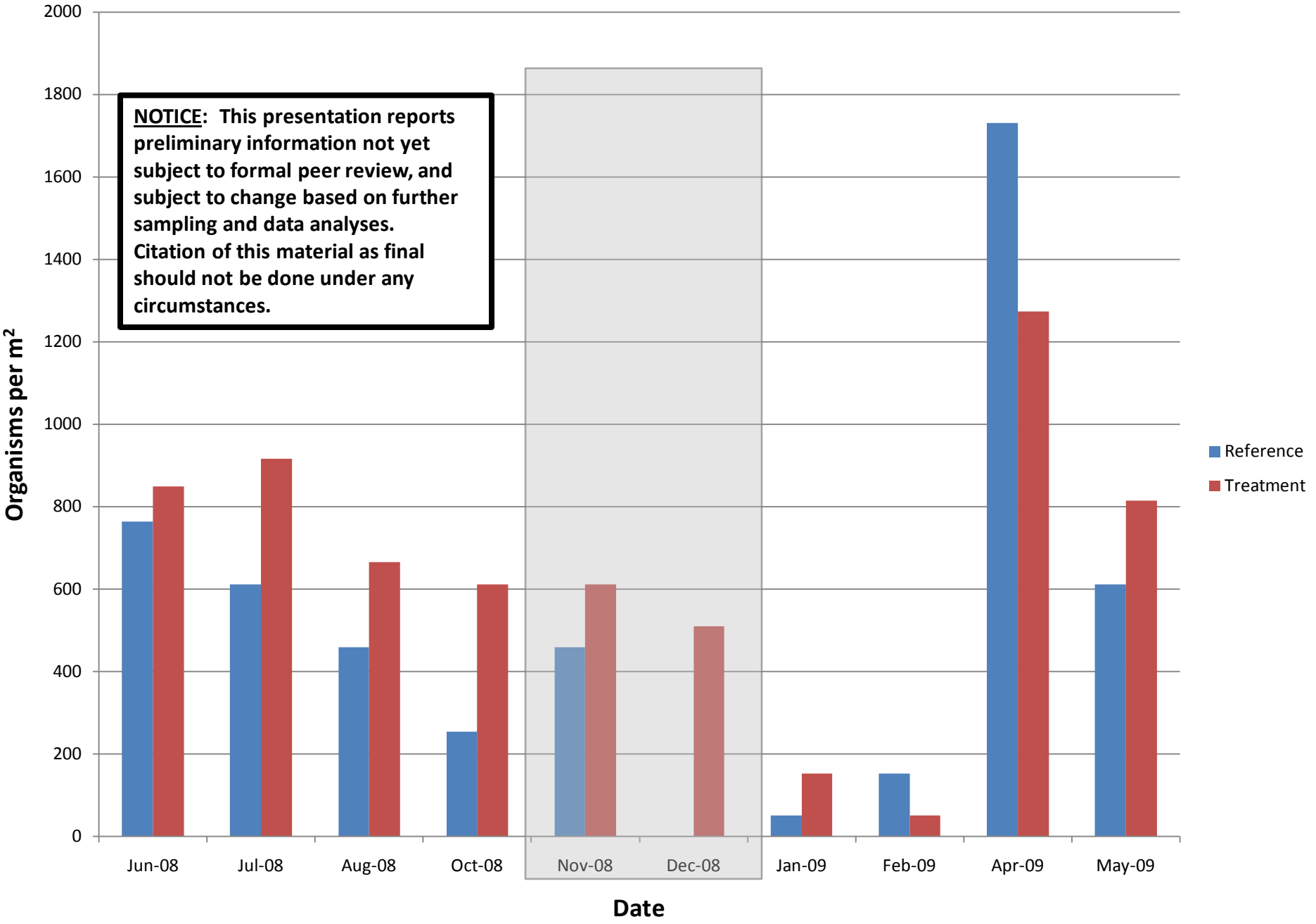
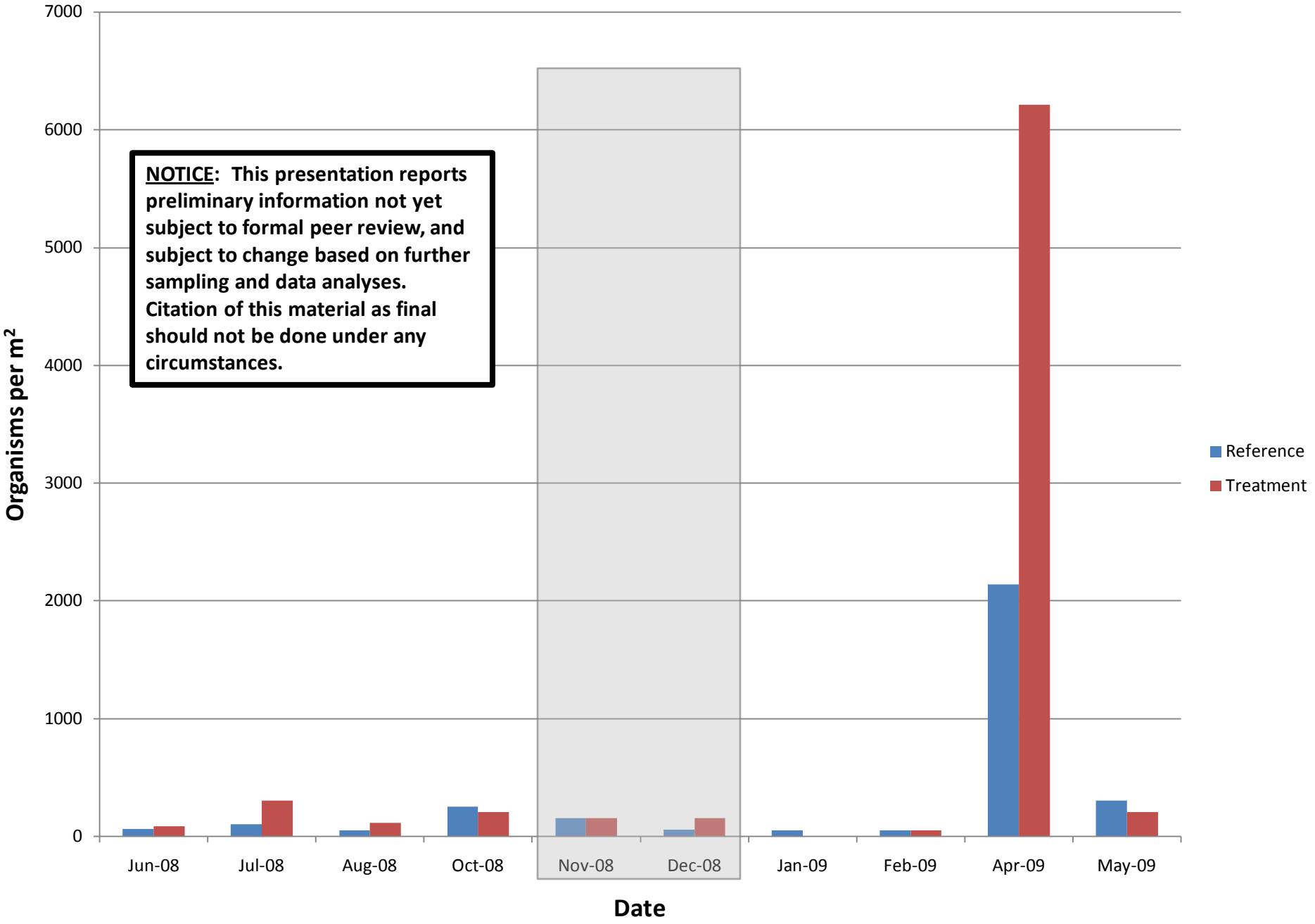
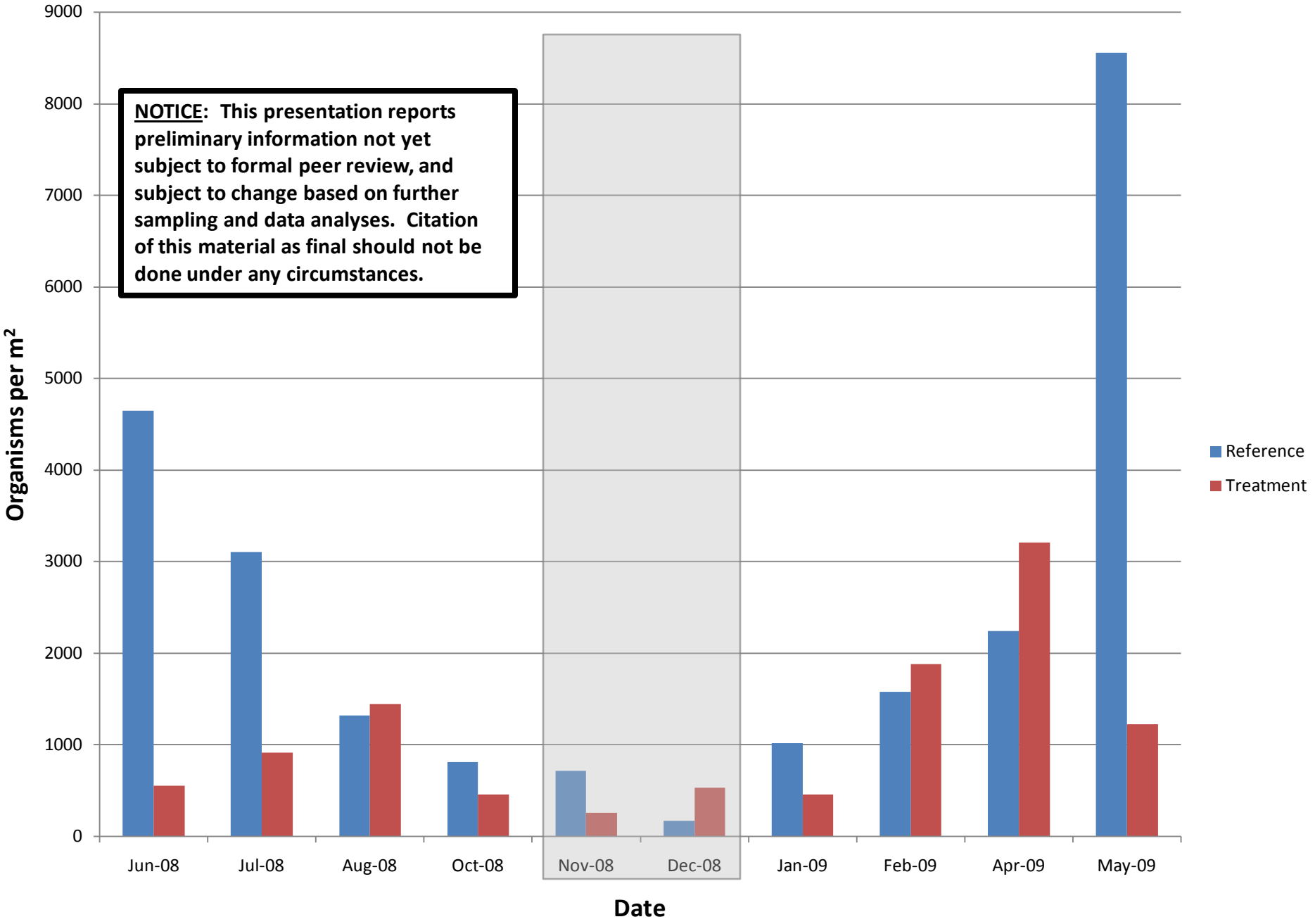
Polychaete Worms: Spionidae



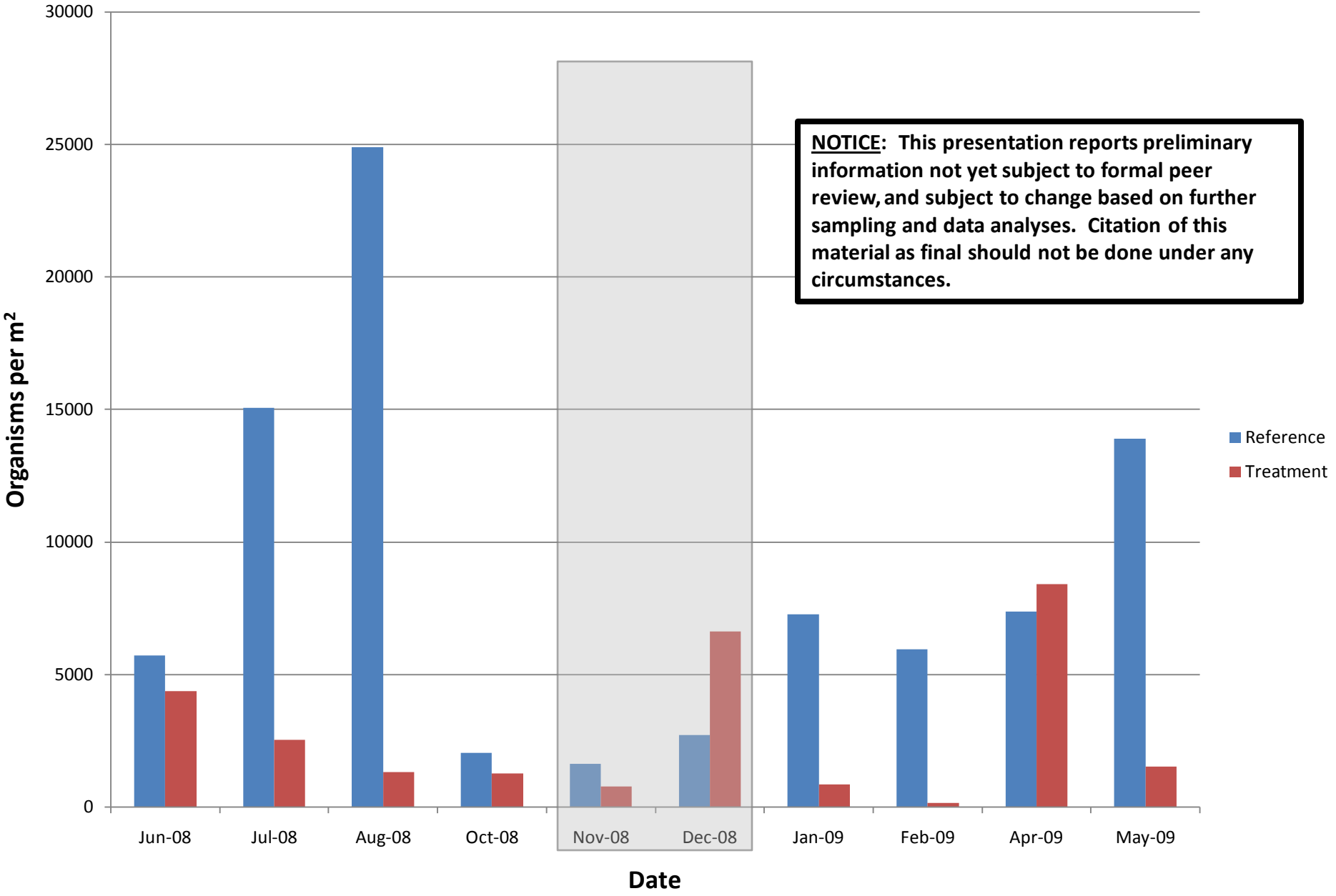
Polychaete Worms: Capitellidae



Oligochaete Worms



Amphipod Crustaceans: Corophium group (important prey for juvenile salmonids)



Cumacean Crustaceans: Cumella vulgaris

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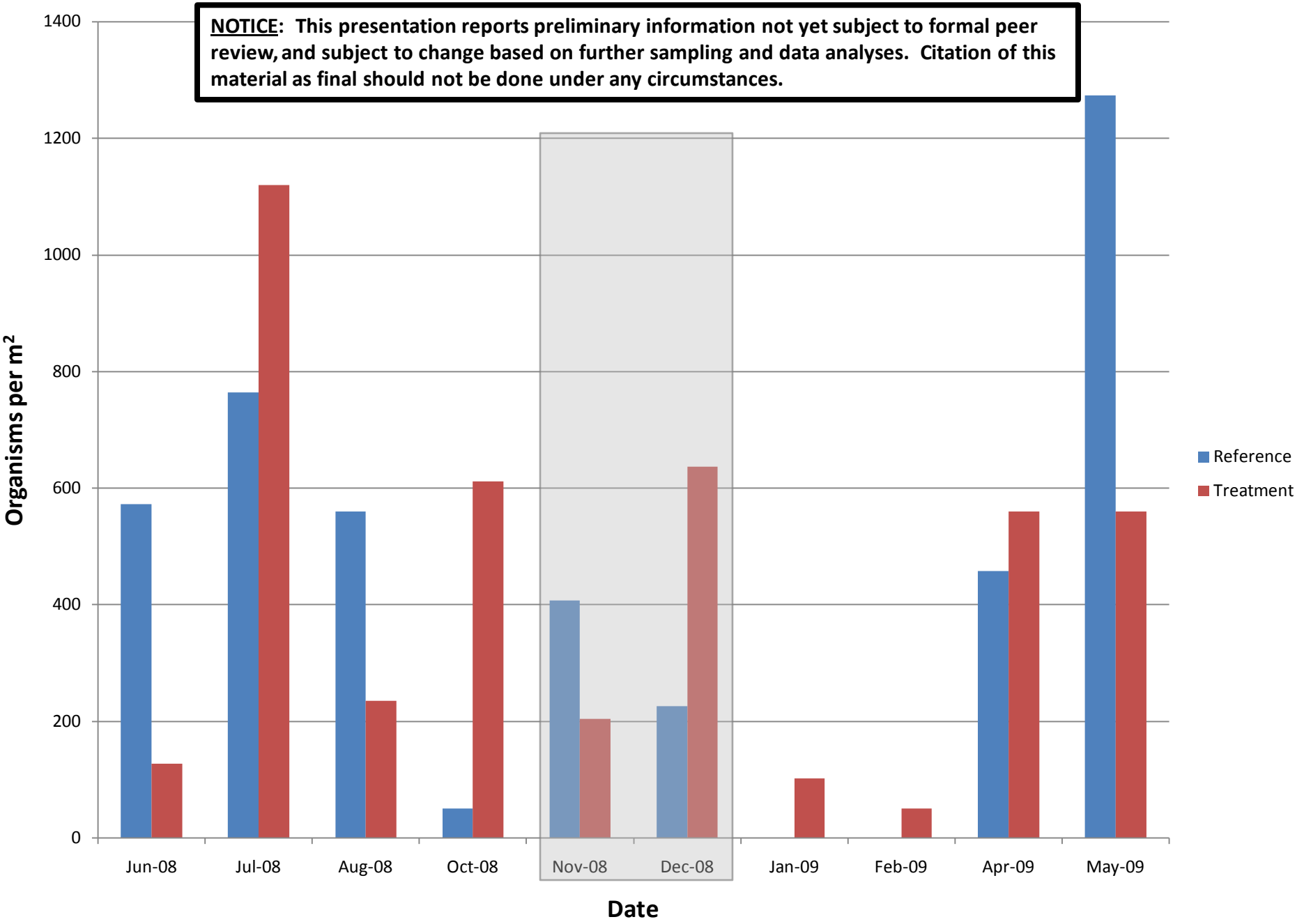
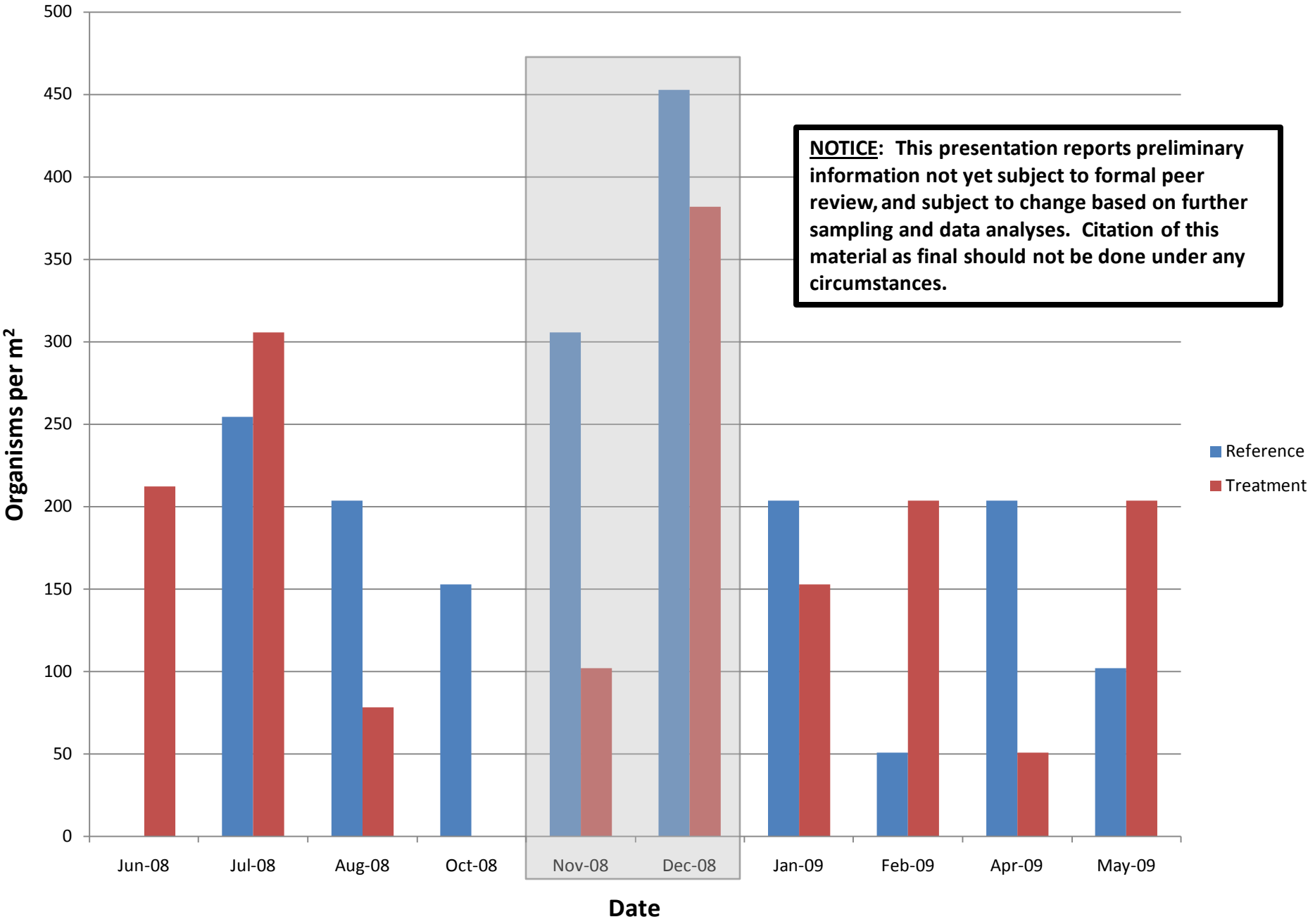
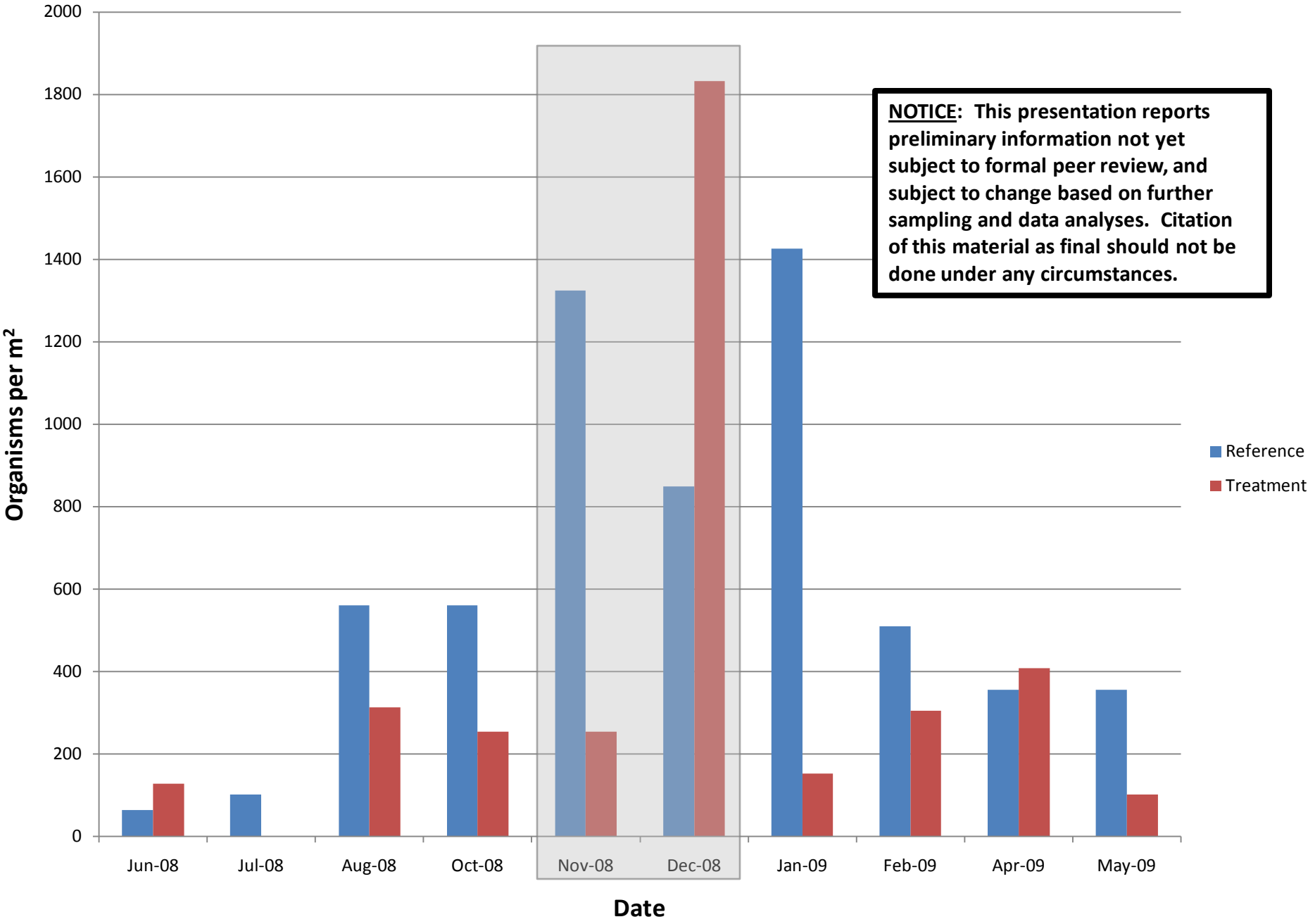


Sea Cucumber



Sand Dollar


2000
1800
1600
1400
1200
1000
800
600
400
200
0
Organisms per m2
Jun-08
Jul-08
Aug-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Apr-09
May-09
Date
Reference
Treatment
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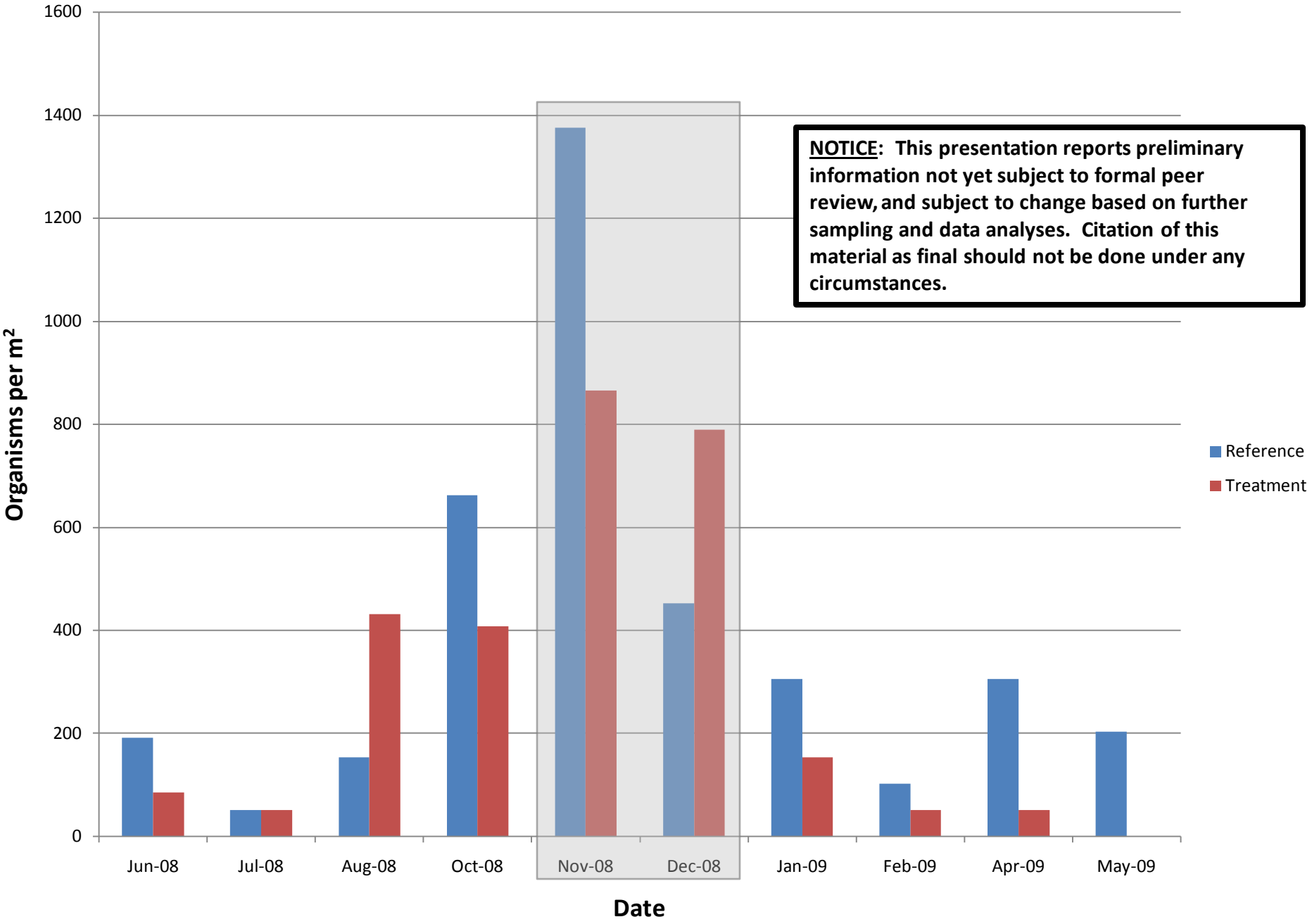
Small Clams: Rochefortia



Conclusions to date:

- **Time of year, plot category, and harvest timeline all explain significant portions of variance in infaunal communities proximate to geoduck aquaculture operations;**
- **Individual species can be found that display patterns relating to single explanatory variables (as listed immediately above), or to combinations of more than one variable;**
- **For some species, simple presence of adult geoducks at high density may have as much impact on density as disturbances associated with harvest of cultured geoducks;**
- **A spillover effect from harvested plots into adjacent unharvested grounds is apparent in the data. The spillover is detectable to at least 50 m from edges of plot margins, and persists for ~6 months;**
- **Our data do not provide any evidence to date of permanent damage or disruption to infaunal communities in the study area as a consequence of geoduck aquaculture activities;**
- **Additional analyses from samples collected at two other study areas will be helpful in evaluating the generality of our conclusions to date from the Foss study area.**

Our research team:

- David Armstrong
- Jeff Cordell
- Brittany Cummings
- Megan Dethier
- Tim Essington
- Aaron Galloway
- Mariko Langness
- Sean McDonald
- Jenny Price
- Paul Stevick
- Jason Toft
- Glenn VanBlaricom

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