IS THERE A LINK BETWEEN SHELLFISH DREDGING, CARBONATE CHEMISTRY, AND BIVALVE SETTLEMENT ON THE SURFACE OF MARINE SEDIMENTS?

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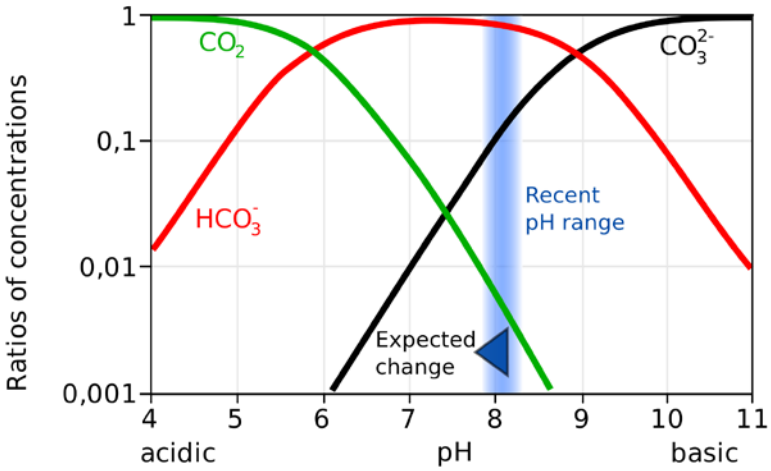
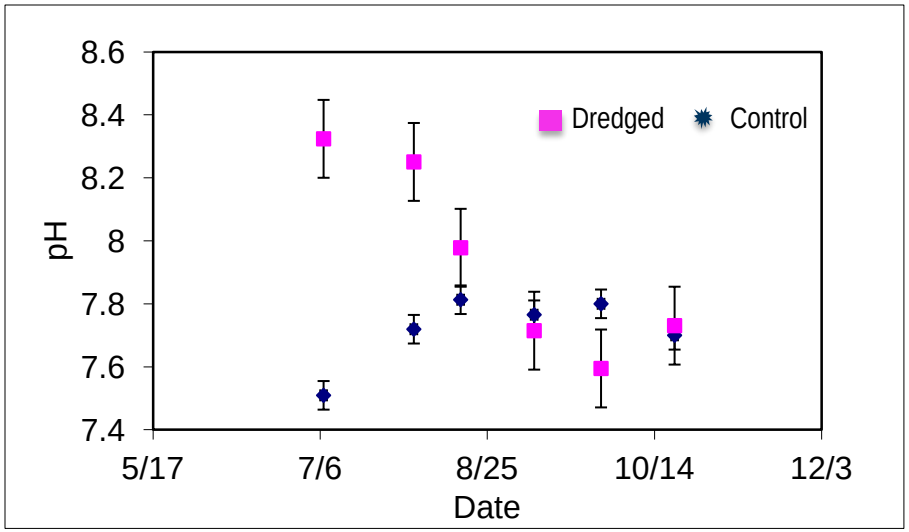
February 25, 2014

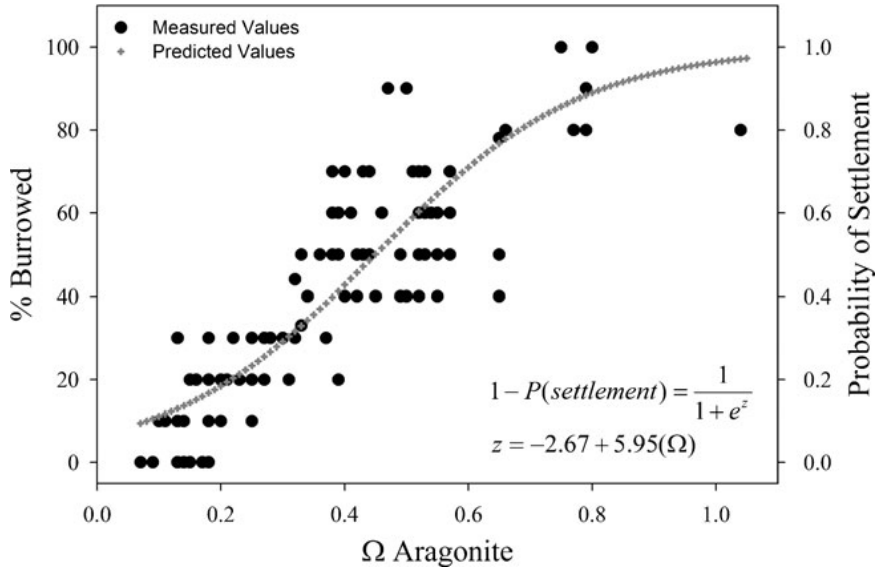
Introduction

- Aragonite saturation state is dependent on the carbonate system and pH
- Dredging can affect pH within sediments
- Aragonite saturation state may be a chemical cue for hard clam settlement



Wolf-Gladrow et al. 2013

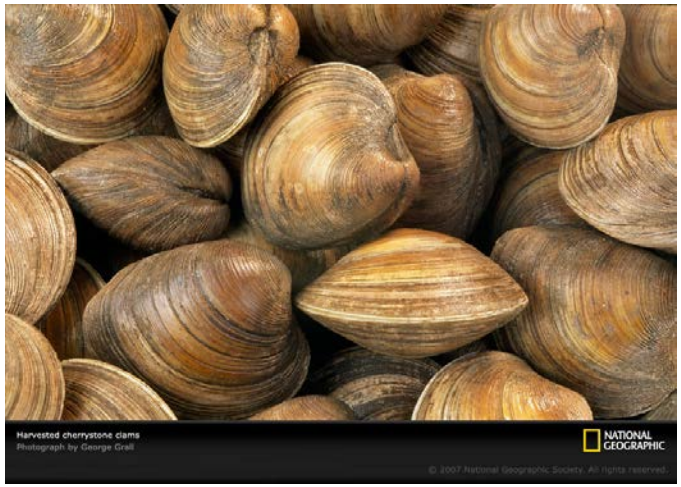




Green et al. 2012

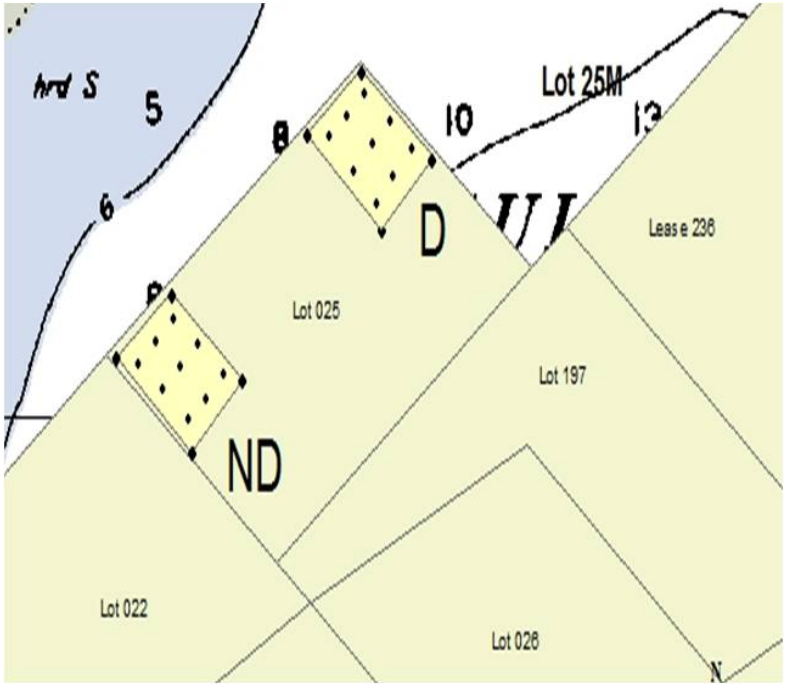
Project Overview

- Examine aragonite saturation levels on a dredged and control (not-dredged) site
  - Is there a difference between dredged and control sites?
  - Is there a correlation between aragonite saturation state and bivalve settlement?



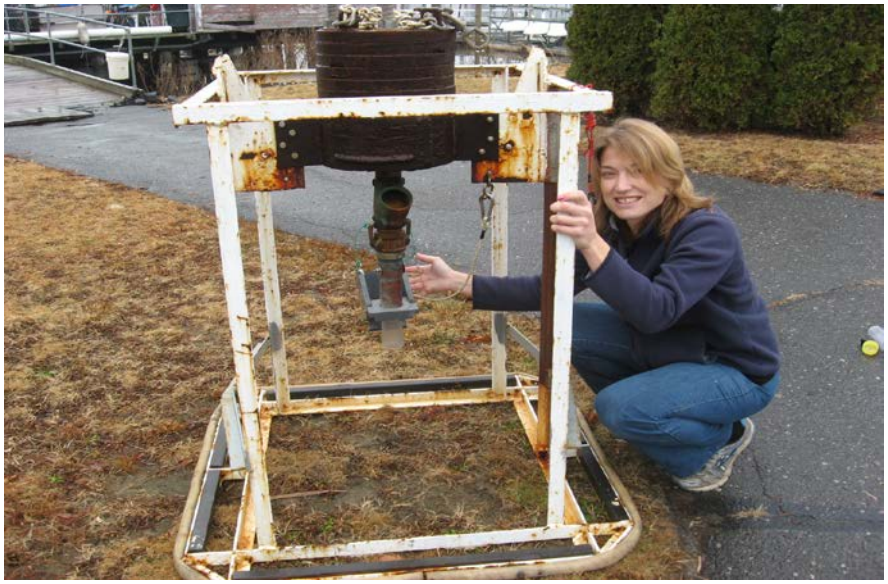
Field Site Design

- Dredged (January 2013) and control beds - split into 9 boxes
- Weekly sampling from July 23 to September 23
- Sediment porewater variables sampled:
  - Oxygen
  - pH
  - Phosphate and silicate
  - Alkalinity
  - DIC
  - Grain size
- Used CO2SYS to calculate aragonite saturation state based on alkalinity and pH

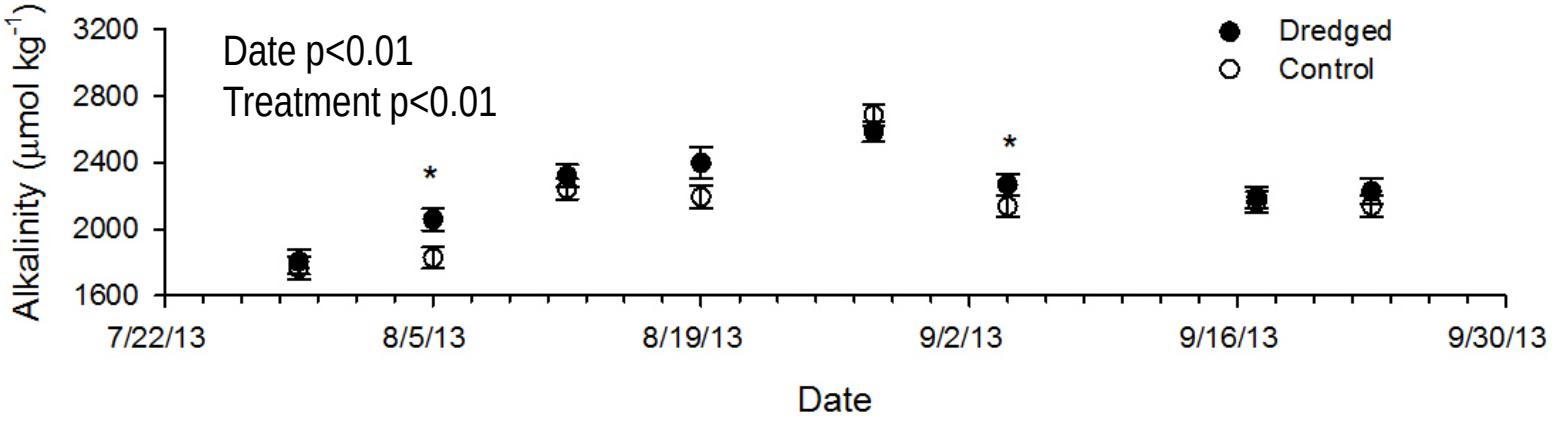


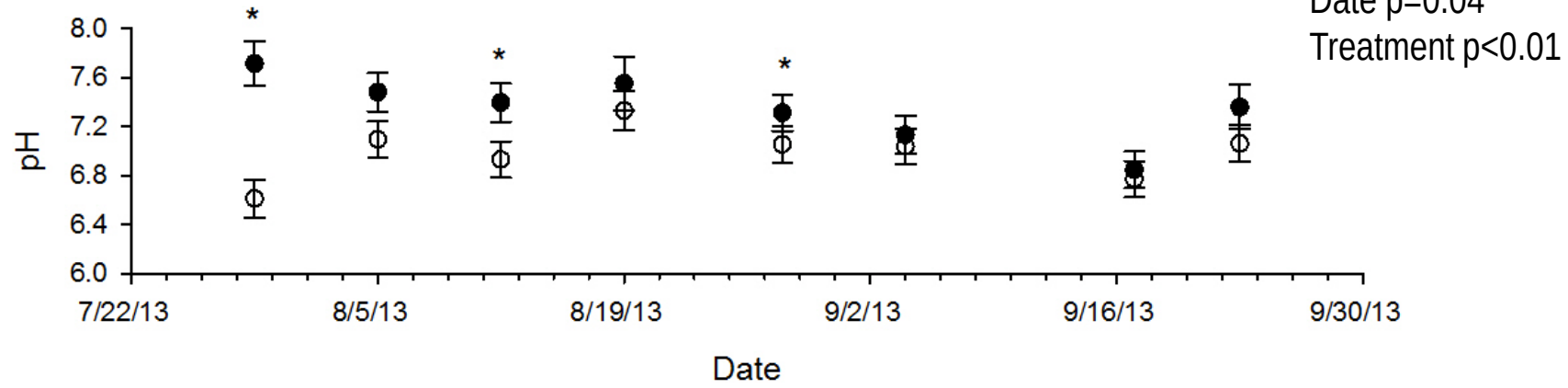
Methods

- One core sampled from each sub-box (n=9 for dredged, n=9 for control)
- Cores 5-12 cm (in length) refrigerated until returned to the lab for analysis
- Within 2 hours UniSense micro-electrodes measured
    - pH
    - Oxygen
- Pore-water from upper 2 cm was collected for alkalinity, DIC, phosphate, and silica concentrations
- Benthic samples analyzed for bivalves only

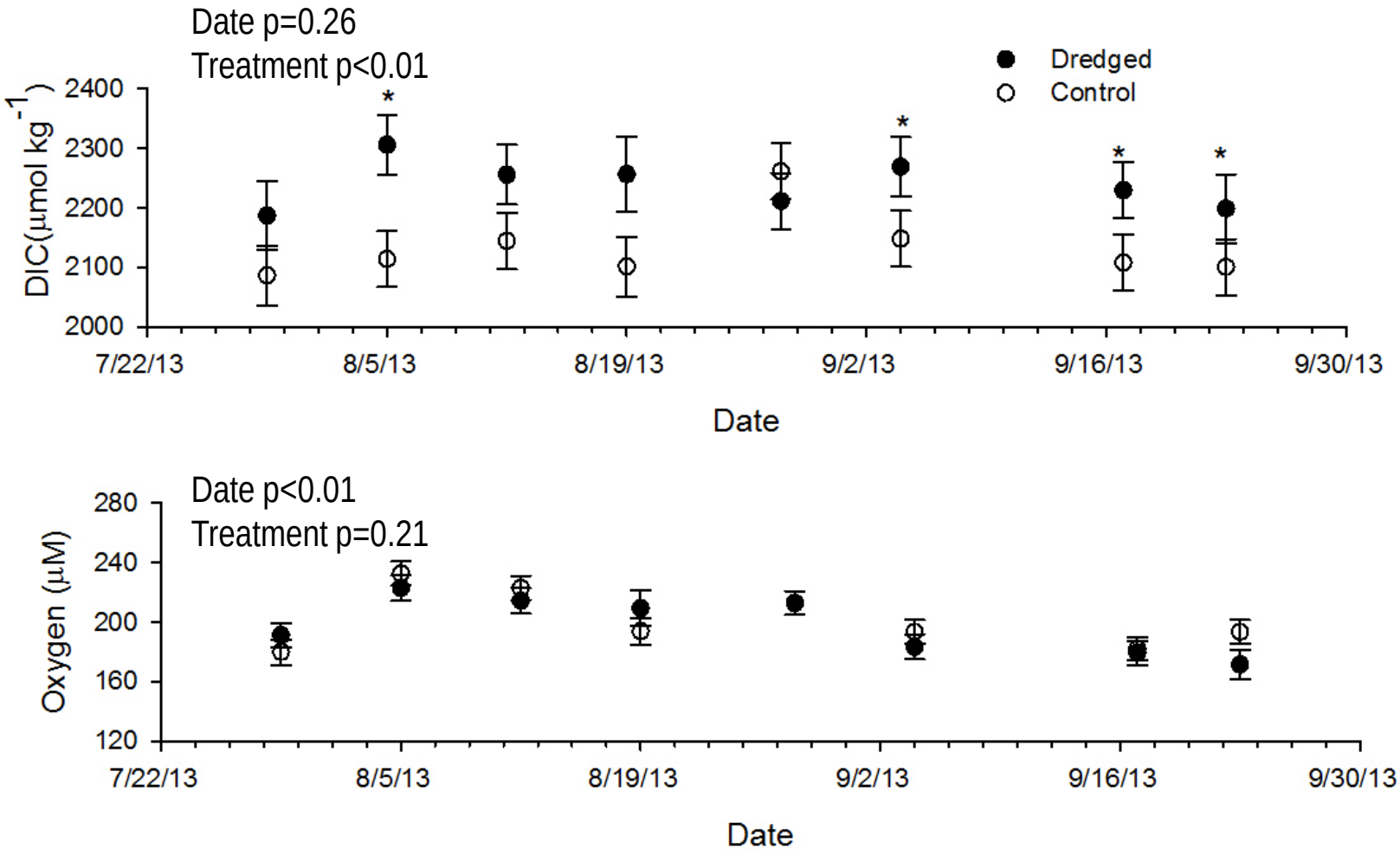


Alkalinity and pH Sediment Characteristics

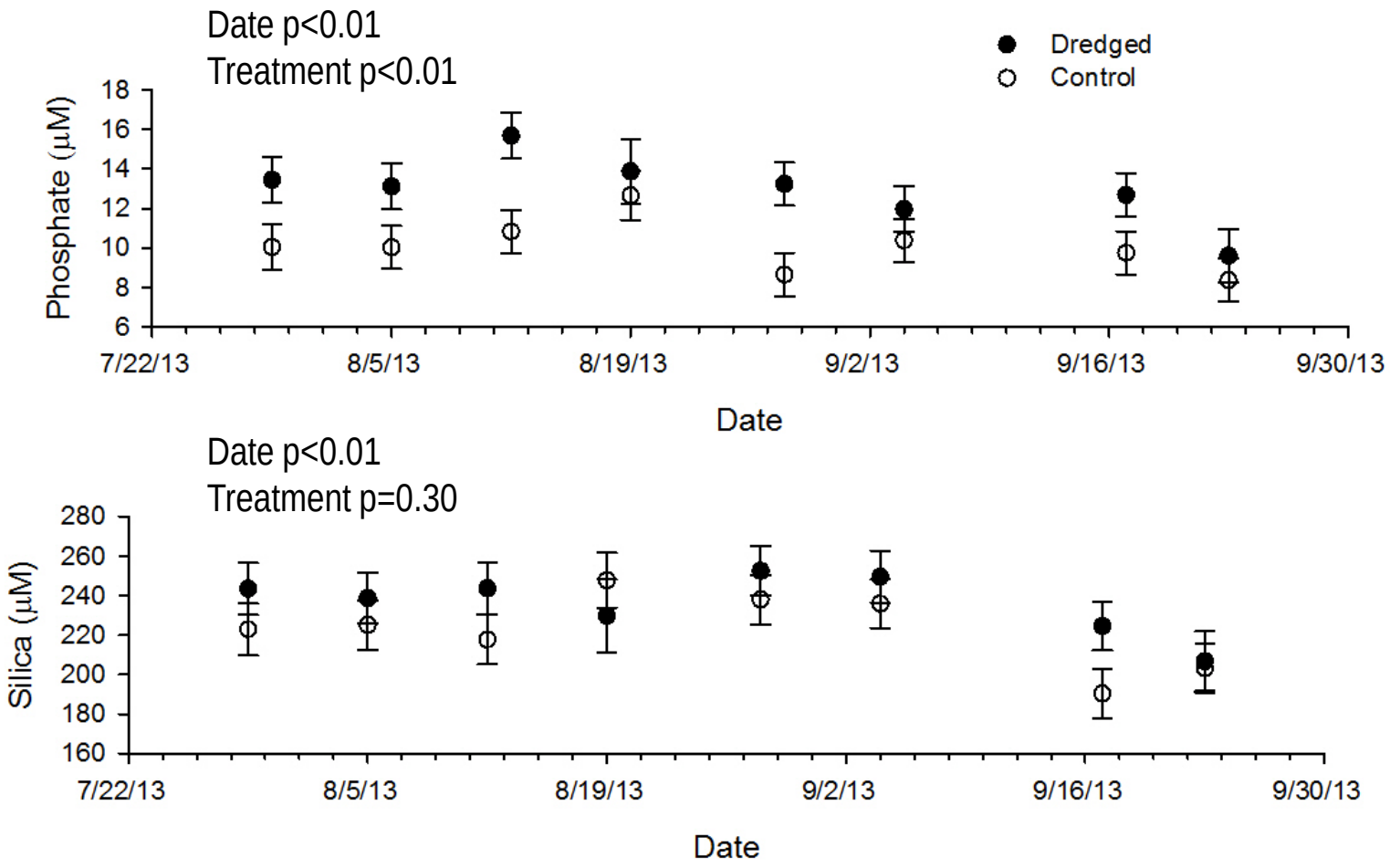




DIC and Oxygen Sediment Characteristics

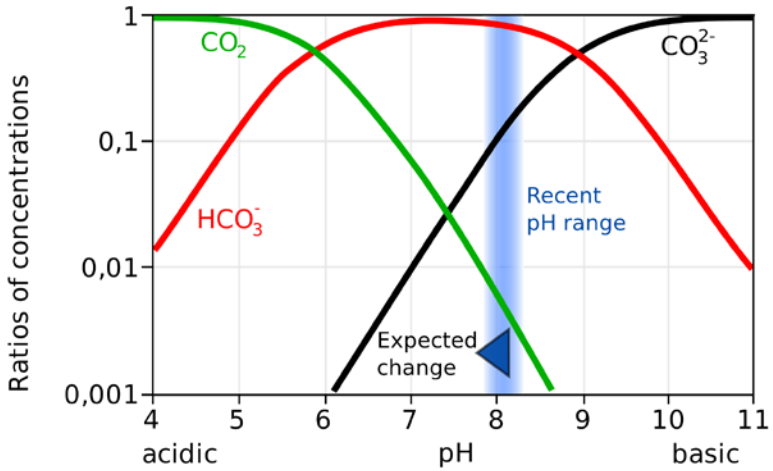


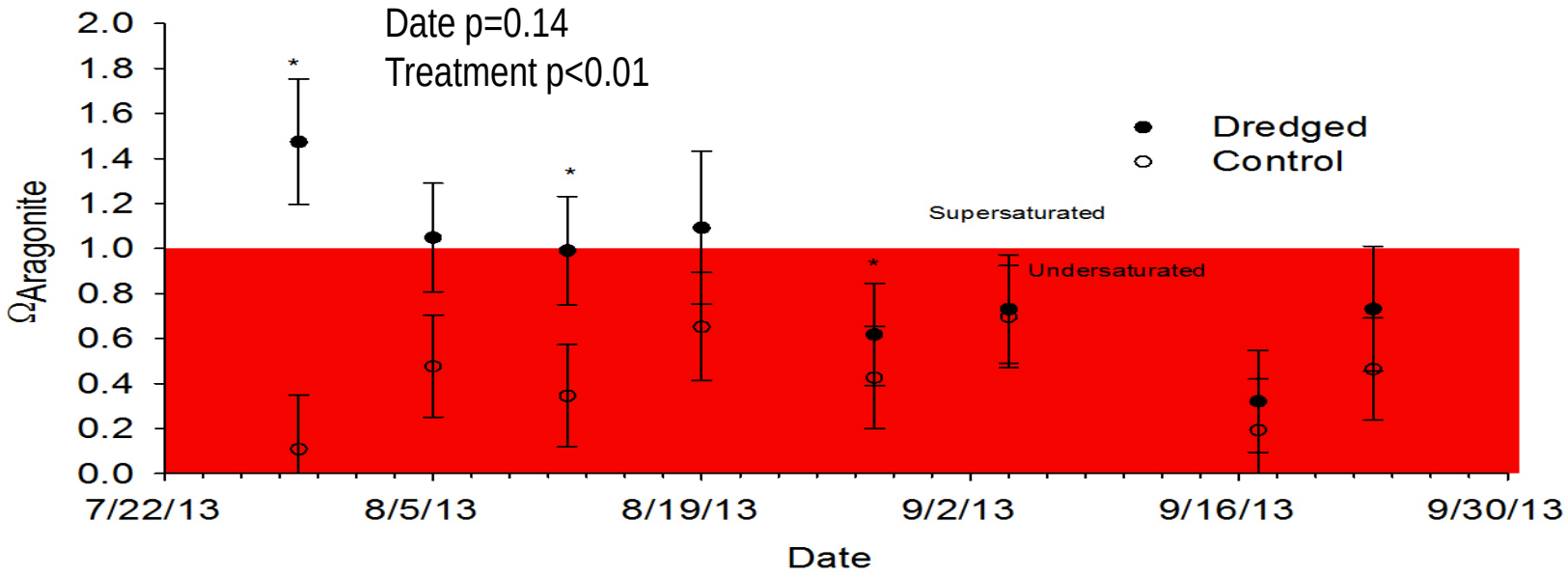
Phosphate and Silica Sediment Characteristics

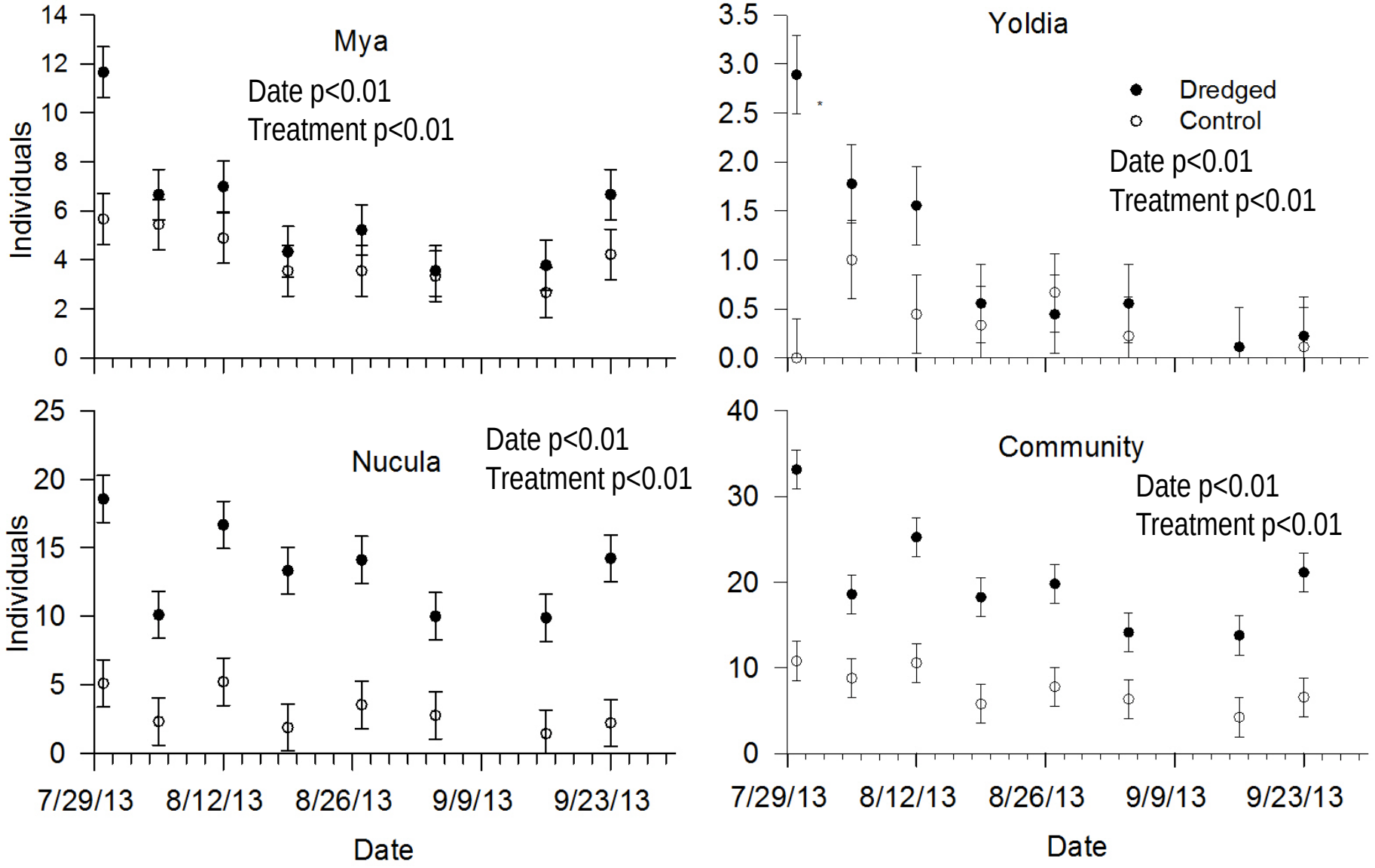


Aragonite Saturation State

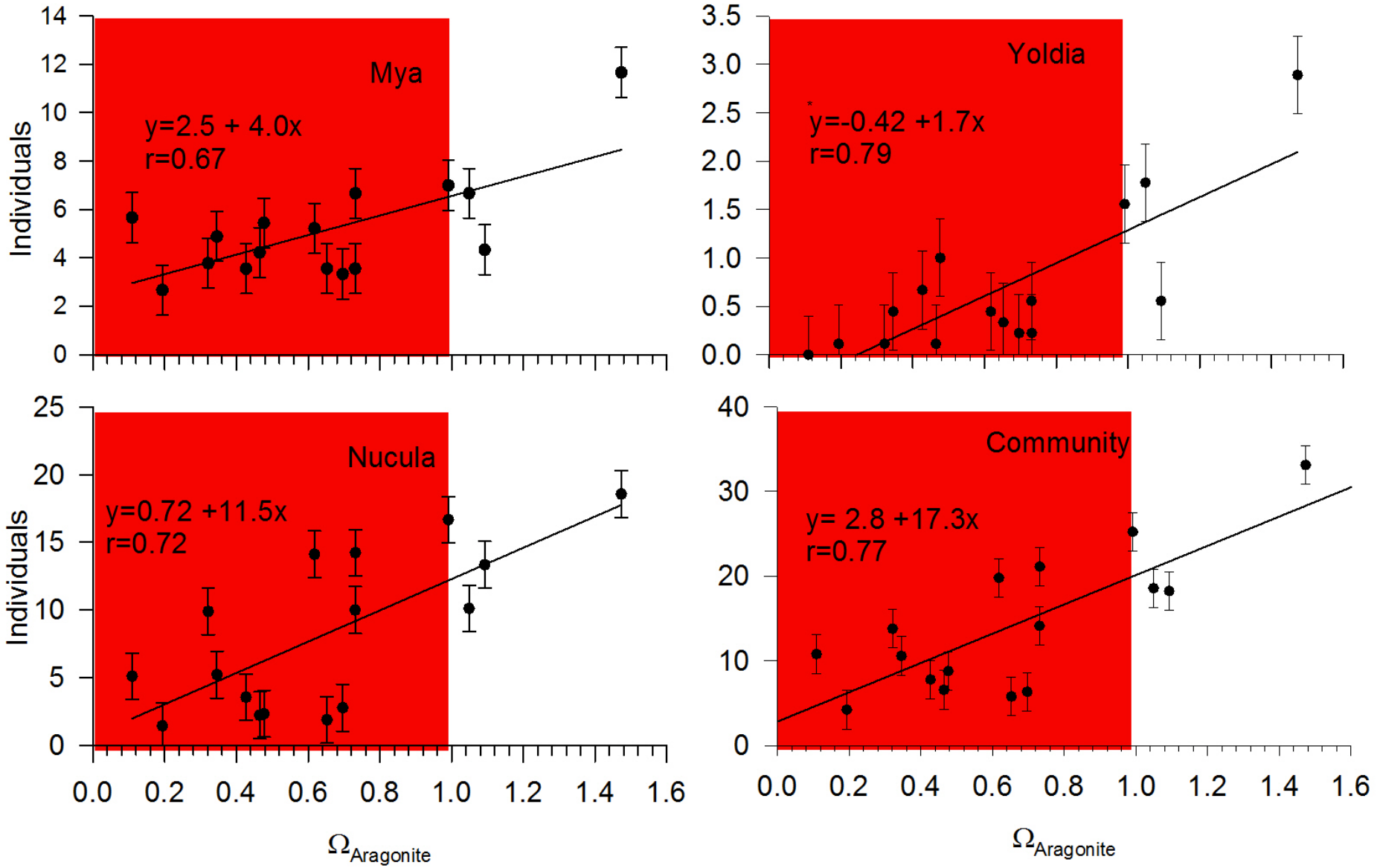
$$\Omega_{argonite} = \frac{[Ca^{2+}][CO_3^{2-}]}{K_{sp\ araginite}}$$



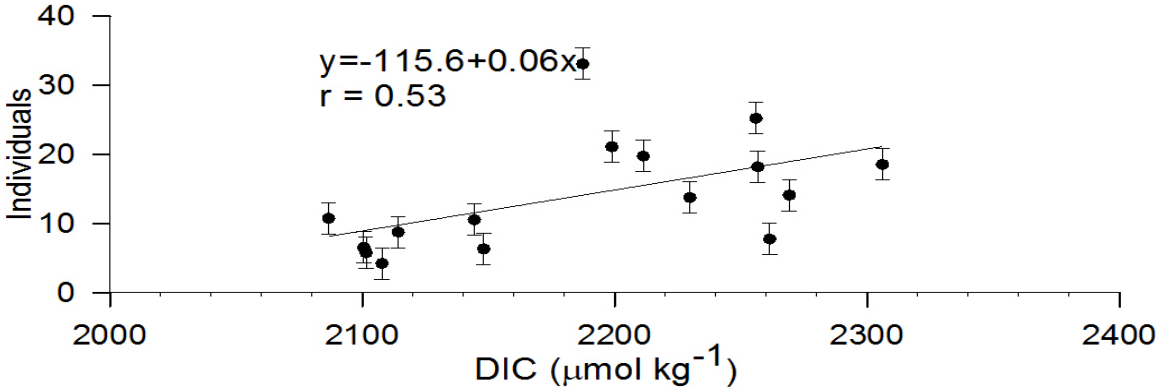


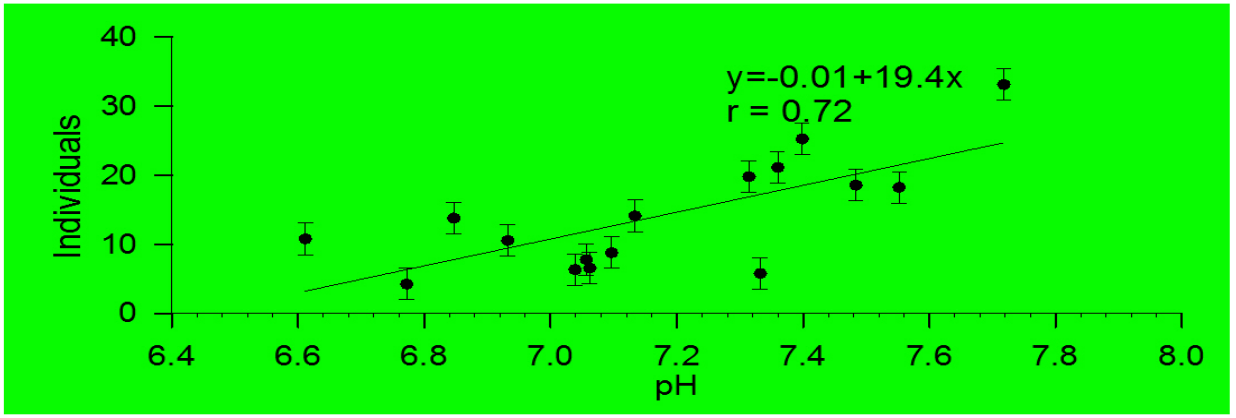

Mya
Date p<0.01
Treatment p<0.01
Individuals
Yoldia
Dredged
Control
Date p<0.01
Treatment p<0.01
Nucula
Date p<0.01
Treatment p<0.01
Individuals
Community
Date p<0.01
Treatment p<0.01
7/29/13
8/12/13
8/26/13
9/9/13
9/23/13
Date
Date

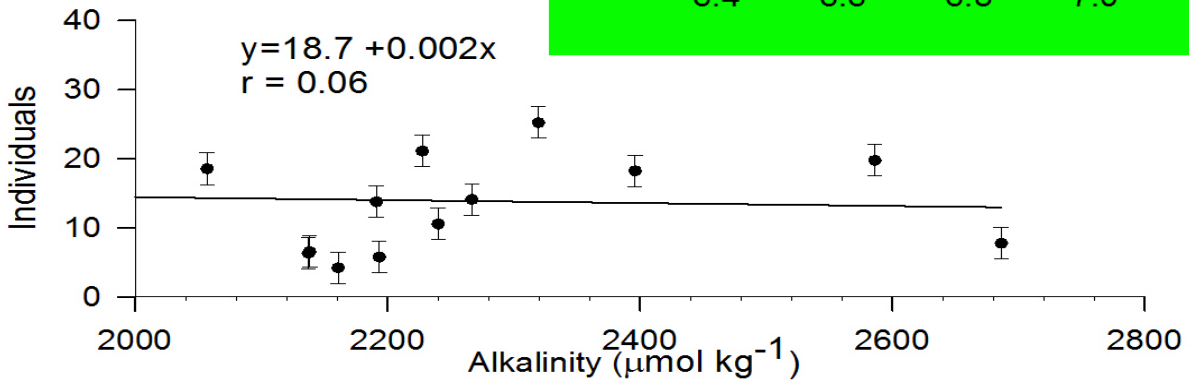
Is there a correlation between bivalve settlement and the $\Omega_{aragonite}$?



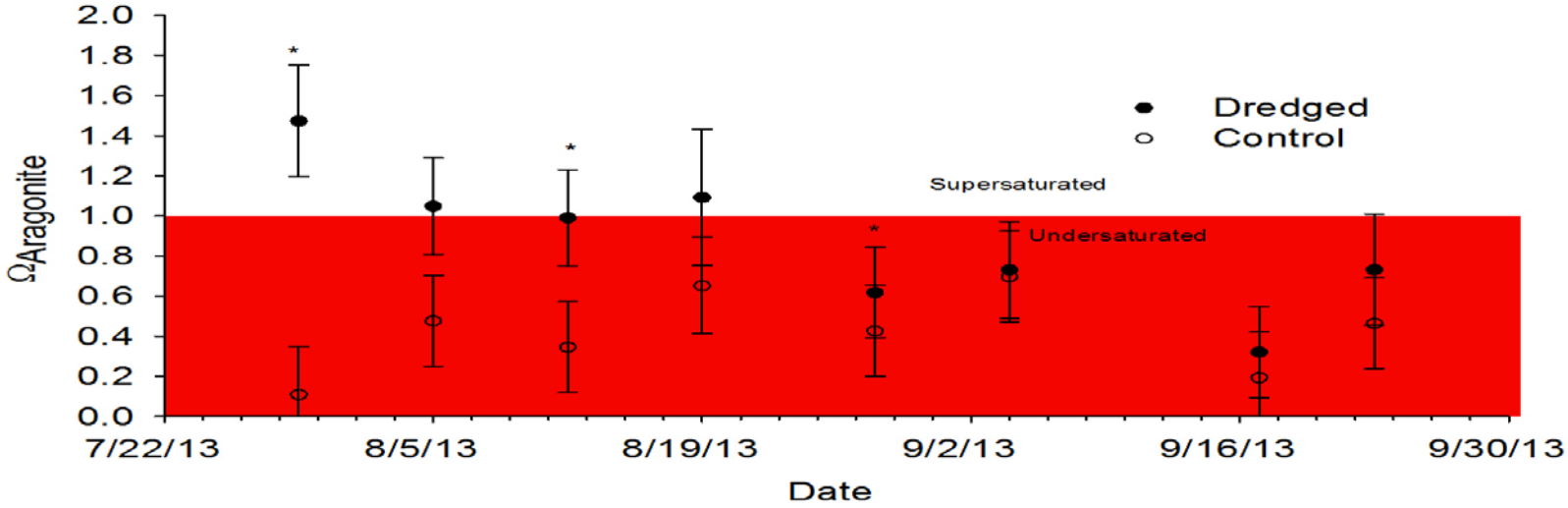
Is there a correlation between any of other chemical variables and bivalve abundance?

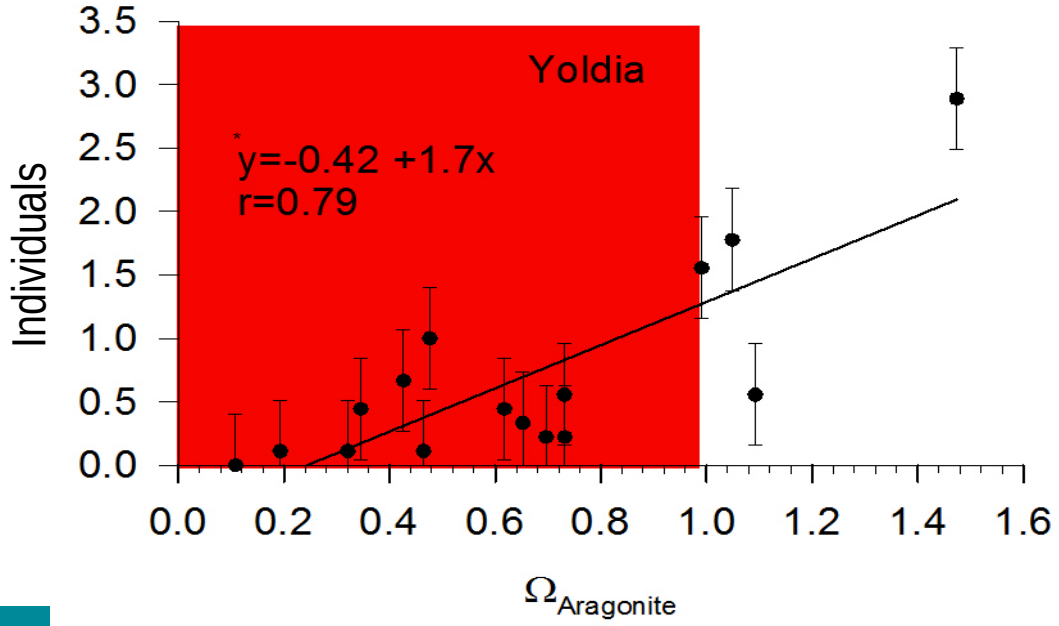






Is Yoldia more sensitive to $\Omega_{aragonite}$ than the other bivalve species?





Conclusions

- A significant difference in chemical variables between dredged and control beds late July/early August
  - DIC
  - Alkalinity
  - Phosphate
  - pH
  - $\Omega_{aragonite}$
- Significant differences in bivalve abundance between dredged and control beds
- A strong correlation between $\Omega_{aragonite}$ and species number for the three species found, with higher number of individuals above $\Omega_{aragonite} > 1$ for all species
- Yoldia appeared to be more sensitive to $\Omega_{aragonite}$ than Mya or Nucula with 0 or only 1 individual found once $\Omega_{aragonite} < 1$
- Important to further examine how dredging might increase settlement by causing short term increases in $\Omega_{aragonite}$ at the surface

Acknowledgements

Captain Robert Alix

Captain Werner Schreiner

Lease-Frank M Flower and Sons Co, Bayville NY.

Dredging by Gary Salce of G&B Shellfish of Fairfield CT