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Macroinvertebrate Assemblages and Dynamic Soil Properties: Influence of Dredging

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Introduction

Over the last 20 years soil scientists have been studying subtidal substrates through a pedological perspective. They found that subaqueous soils support rooted vegetation and are distributed across the estuarine landscape in a pattern that is governed by a range of pedogenic, biologic, and geologic processes, mechanisms, and transformations. Estuarine subaqueous soils occur in the subtidal zone of protected coves, bays, inlets, and lagoons (Bradley and Stolt, 2003). These soils provide a range of ecosystem services such as carbon sequestration, carbon storage, nutrient sinks, habitat for juvenile fisheries, and the structure for shellfish aquaculture. Most estuaries are subject to a variety of anthropogenic disturbances such as dredging and nutrient enrichment which may influence the physical, chemical, and biological aspects of subaqueous soils. Therefore, it is essential that estuarine subaqueous soils be inventoried and monitored to understand degradation to these systems and to ensure that they continue to provide valued ecosystem services.

In this study, I examined the effects of dredging activities on the dynamics of benthic macroinvertebrate assemblages (>2 mm) in the subaqueous soils of three estuaries in Southern Rhode Island. A paired site approach (control vs. dredged) was used to inventory macroinvertebrates and soils at each estuary. I hypothesized that macroinvertebrate communities of dredged soils would differ from their natural state because of changes in the physical and chemical parameters of the soil. The resilience of ecosystem dynamics may also be influenced by soil type. In this study, two different soils (Psammowassents and Sulfiwassents) were sampled to distinguish if variation in soil and biological dynamics between soil types exist.

Objectives

1. Compare macroinvertebrate communities and soil dynamics between dredged and reference states
2. Determine the resistance and resilience of dynamic soil properties in selected soil types subject to dredging activities

Methods

Site Selection

One previously dredged and one relatively undisturbed soil, were selected for study in three different estuaries in Southern Rhode Island: Point Judith Pond, Wickford Cove, and Ninigret Pond. Dynamic properties of the Massapog soil series (sandy soils) and the Pishagqua series (silty soils) were studied.

Sample Collection

Soils were described to a minimum of 1 meter and subsamples of each horizon were taken for laboratory analysis. Massapog soils were sampled using a vibracore sampler and Pishagqua soils were sampled using a Macaulay peat sampler. Five replicates soil samples were collected for invertebrate analysis using a Petit Ponar sampler.

Laboratory Analysis

Invertebrate samples were be passed through a 2 mm sieve, and preserved in a 10% formalin solution containing rose bengal dye until laboratory analysis. Benthic invertebrates were sorted and identified in the lab to the species level when possible. Along with morphological properties, soil organic matter, particle size, initial and incubation pH, and particle size were measured for each horizon.

Statistical Analysis

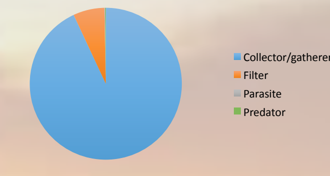
Unpaired t-tests using SigmaPlot statistical software (Systat, Inc. San Jose, CA, USA) to compare dredged vs. control sites and sandy vs. silty soils.

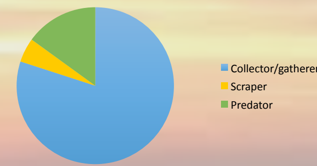
Results and Discussion

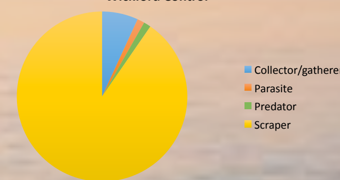
Eelgrass Present　Eelgrass Not Present

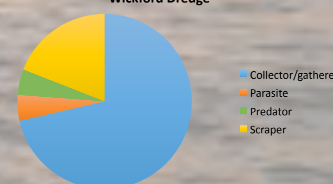
Ninigret Pond Soil Cores

Benthic Assemblages



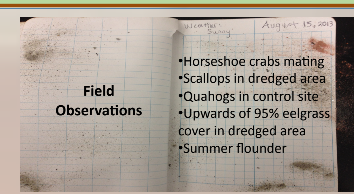




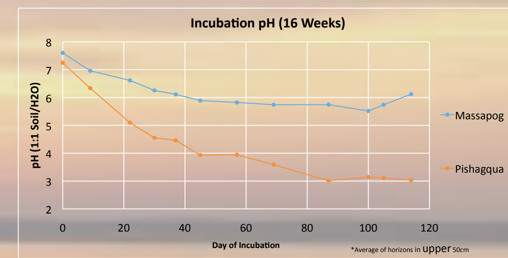


No statistical difference in invertebrate abundance and diversity was found between dredged and control sites. Collectors/gatherers and scrapers were found most frequently in the samples.

Filter feeders were only found in the Ninigret control site. The pristine water quality here makes it an ideal habitat for filter feeders.



Dynamic Soil Properties

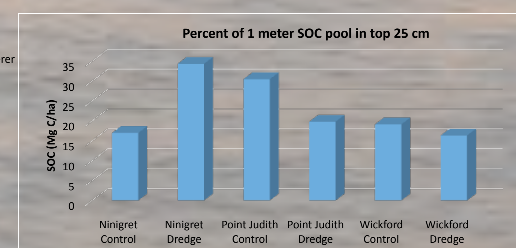


Incubation pH

Significant difference between soil types (Massapog and Pishagqua) ($p = 0.049$)

No significant difference between dredged and control sites ($p = 0.962$)

For Massapog soils, trends were observed between paired sites with and without eel grass (PJ Control and Ninigret). Sites with eelgrass were more acidic, but this was not significant ($p = 0.117$)



Soil Organic Carbon

Significant difference between sites with and without eelgrass ($p = 0.011$)

Conclusions

Soil properties influence invertebrate communities. While I found no significant difference between functional feeding groups of sites, the data revealed definite trends. The Ninigret site had significantly more individuals, consisting of both filter feeders and collectors/gatherers. This could be due to the presence of the eelgrass habitat and the pristine water quality. The soft shell clams I observed were proof that this is an important site for valuable shellfish resources. Therefore it should be preserved, as it serves as food for higher trophic levels.

Invertebrates may have contributed to the soil organic carbon levels in the sites. More eelgrass was found in control sites than dredged sites, and the increased number of invertebrates feeding on this eelgrass likely contributed to the higher level of soil organic carbon in control sites. More samples should be obtained in order to increase the likelihood of producing significant results.

Literature Cited and Acknowledgements

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