The Biodiversity and Species Richness of Invertebrates in the New York Harbor Estuary

Abstract

Habitat complexity is reduced when natural estuarine shorelines are replaced with concrete seawalls in highly urbanized regions(Levinton,2015). In order to determine if spatial complexity increases the biodiversity of invertebrates inhabiting the Estuary different cage set-ups were deployed: 01) the experimental cages had eastern oysters and blue stone rock and 02) the control cages were empty. The invertebrates found in the control cages were barnacles, amphipods, sponge colonies, and tunicate colonies. The invertebrates found in the experimental cages were barnacles, tunicate colonies, amphipods, sponge colonies, oyster drills, mud crabs, glass shrimp, sea squirts, and slipper shells. There was a higher biodiversity in control cages due to more species evenness but a higher species richness and abundance on the experimental cages. These results support the hypothesis that the presence of spatial complexity in the form of oysters and blue stone rock in an environment promotes a higher species richness of invertebrates.

Problem/Objectives

P: Does spatial complexity increase the biodiversity of marine natural resources in the intertidal sea wall of the Harlem/East River?

O1: Measure the biodiversity of invertebrates with and without natural substrate in the River using Hill numbers

O2. Identify the species richness of sessile invertebrates using Hill numbers

O3. Determine the species evenness of invertebrates in the Harlem River

Background

This project was an observational study to determine the effects of adding spatial complexity in the form of cages with live oysters and blue stone on the biodiversity of marine invertebrates at 2 sites: 102rd St. under Ward's Bridge and 116th St. in front of Jefferson Park on the Harlem/East River . This study took place from January 2017 to October 2017.

There is an entire ecosystem of invertebrates that are essential to the New York Harbor Estuary. In order to identify the biodiversity of invertebrates inhabiting the Estuary different cage set-ups were deployed: 01) experimental cages had eastern oysters and blue stone rock and 02) the control cages were empty.

Hill Number diversity indexes were generated from percent cover of each species inhabiting the Harlem/East River to identify the biodiversity.

Biodiversity, species richness, and species evenness give us an idea of the health of the harbor and its ability to support organisms as well as what can done to restore the East/Harlem River.

Results

Figure 01 An image of the experimental cage on its 1st check since being deployed

Figure 02 A live eastern oyster with colonies of tunicate growing on it

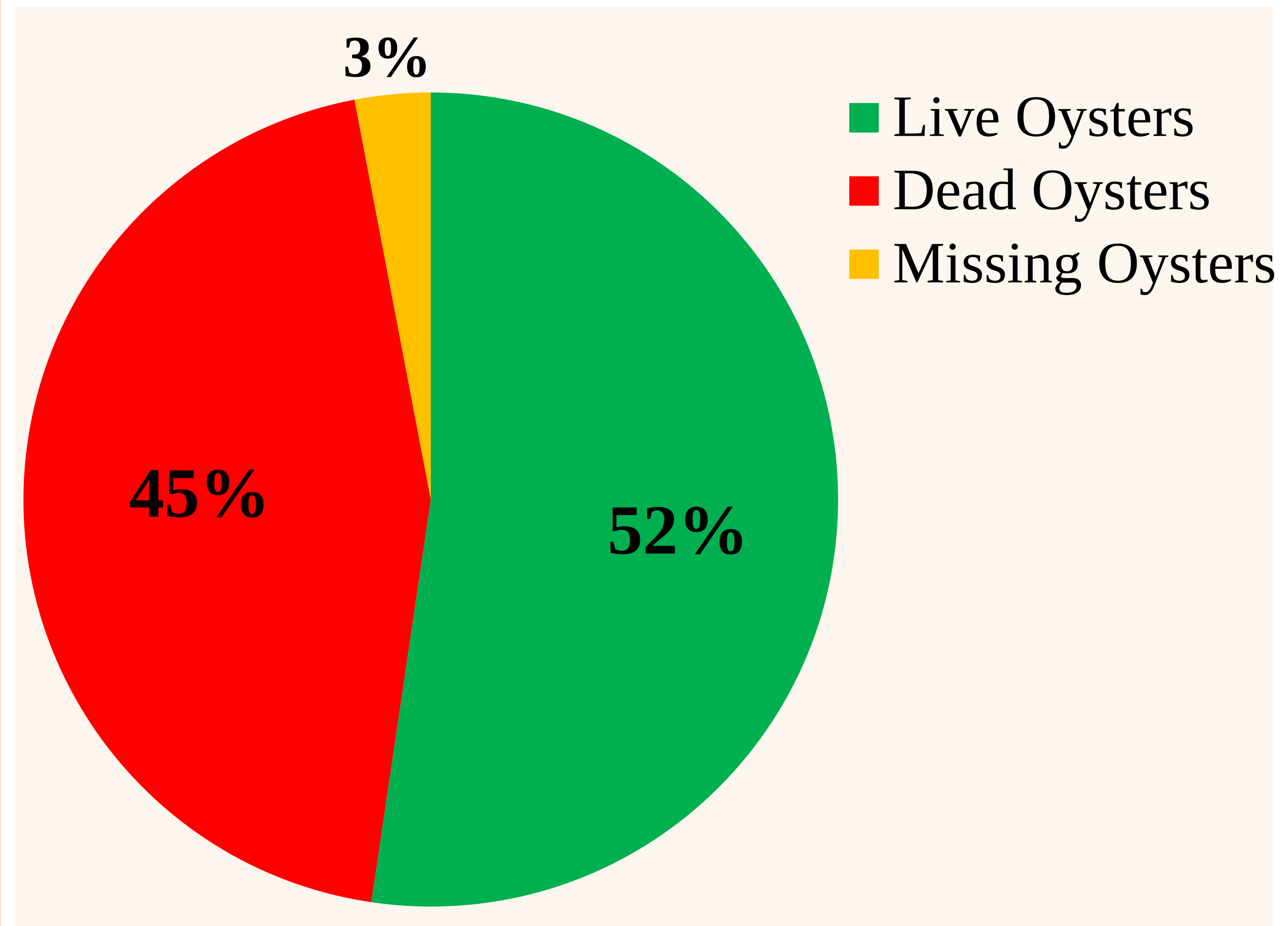

Figure 03 Out of the 360 live eastern oysters used in the deployment 52% survived, 45% died, and 3% fell through the holes in the cages

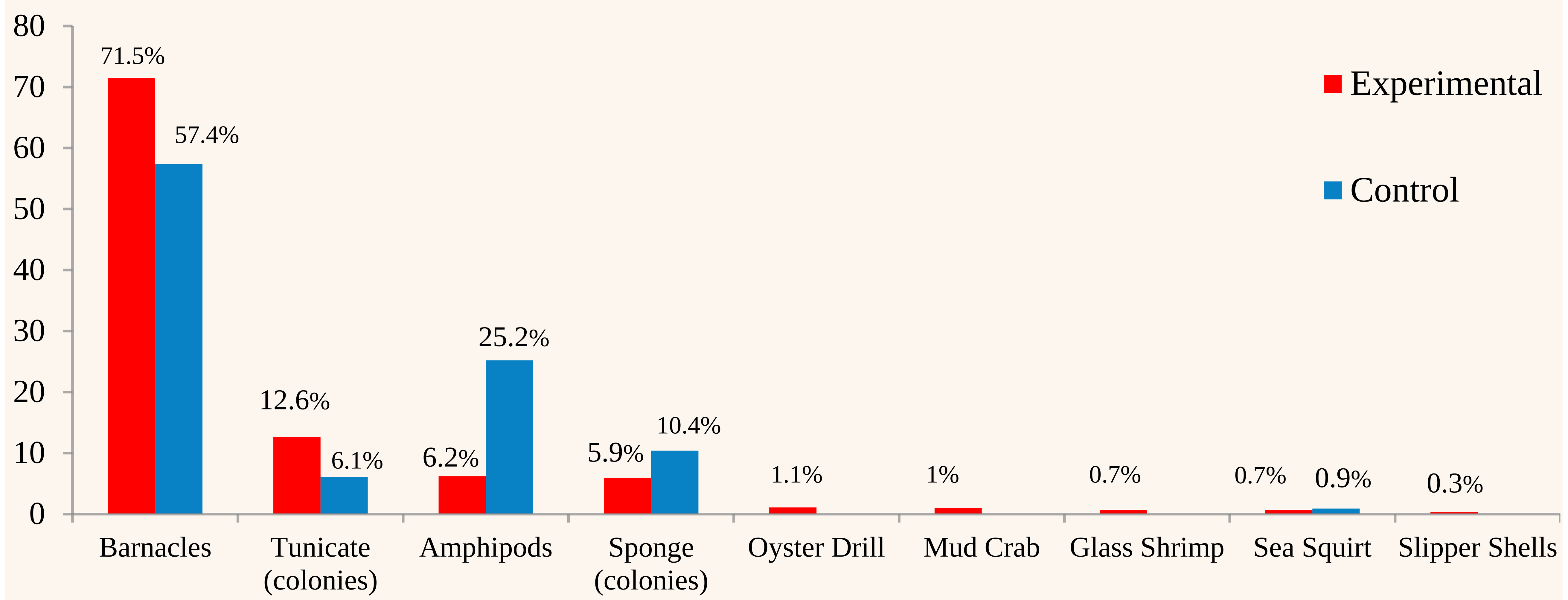

Figure 04 Percent % abundance comparison of Invertebrates found in the experimental vs. the control cages

Table 01 The sessile and motile invertebrates found in the experiment as a whole. Only sessile invertebrates were being looked at, the deployment attracted both sessile and motile invertebrates

Sessile	Motile
Barnacles	Polychaetes
Tunicate (colonies)	Oyster Drill
Sponge (colonies)	Slipper shells
Sea squirt	Glass Shrimp
Ribbed Mussel	Mud Crab

Table 02 The species diversity, species richness, and species evenness of the control cages, experimental cages, and the consolidated data of the control and experimental cages

	Consolidated	Control Cages	Experimental
Species Diversity (H1)	3.05	3.05	2.78
Species Richness (H0)	11	5	9
Species Evenness (H2)	1.96	2.45	1.87

Methods

Counting oysters

- Measure 360 oysters between 2.5 in and 3.5 in
- Store oysters in cages and underwater
- Once at the deployment site place 30 oysters in every experimental cage

Constructing the cages

- Using wire cutters cut 10 main box panels, 10 back panel, 10 center dividers, and 20 side panels
- Align all edges and attach using hog rings

Discharging the set-ups

- Label north and south on the wooden platform
- Using vinyl covered wire hang the moving platform from the sea-wall fence
- Set platform 4ft from the benthic floor

Hill Number Index: Formula

$$H_a=(\Sigma P_i^{a})^{(1/1-a)}$$

- H(0): Species richness
- H(1): Species diversity
- H(2): Species evenness

The abundance data was imputed into the Hill algorithm to generate biodiversity index

Discussion

1. Experimental cages have a higher Hill (H0) richness and abundance than control cages, supporting the hypothesis that introducing spatial complexity with natural substrate increases diversity.
2. The control cages and the consolidated data have the same diversity (H1), this is because the control cages had lower species richness and more evenness (H2), while the experimental cages had a high species richness and lower evenness. Barnacles are responsible for the high unevenness.
3. An increased diversity of motile invertebrates makes for a more complex food web (Brose & Dunne, 2009).
4. An increase in diversity and abundance makes for a healthier ecosystem, healthier inhabitants (Pasari *et al*, 2013) and in the future, the rebuilding of the Harlem River Esplanade.

Suggestions for Future Research

This experiment supports the hypothesis that introducing natural substrate to an area increases the diversity of the area. However, this experiment had 2 different natural substrate in the same cage. For future research I suggest there are four (4) different types of cages. (1) The control cage with no natural substrate (2) a cage only with oysters (3) a cage only with blue stone rock and (4) a cage with both blue stone rock and oysters. This way you're able to get more data: what invertebrates do oysters attract on there own? What invertebrates do the blue stone rock attract? Do live oysters attract a larger variety of organisms than dead oysters shells?