Phase 01: Baseline Study of the Marine Natural Resources of the Harlem/ East River (Hudson-Raritan Estuary 2017)

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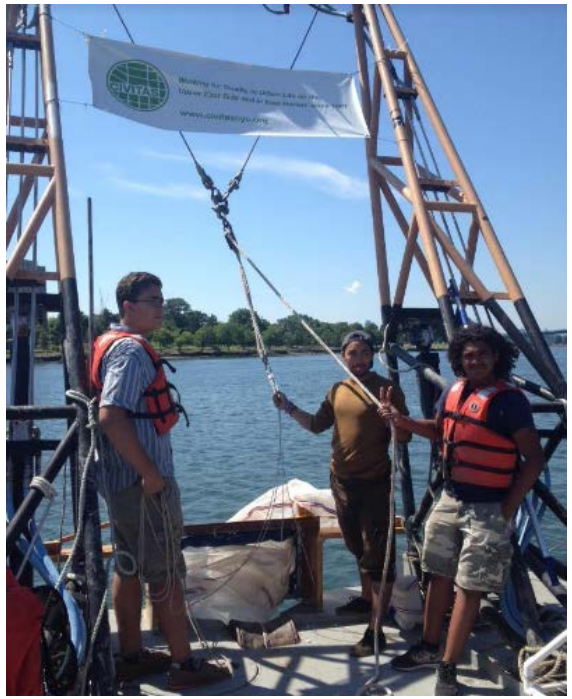

Student Team Leadership

- Melanie Smith, Project Manager
- Cindy Isidoro, Grace Carter, Director of Operations
- Seth Rivera, Nicholas Ring, Physical Chemistry Captains
- Katha Conklin, Phytoplankton Captain
- Jared Rosin, Grace Carter, Biodiversity Captains
- Cindy Isidoro, Benthic Captain
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- Nicholas Ring, Phase 02. Project Manager
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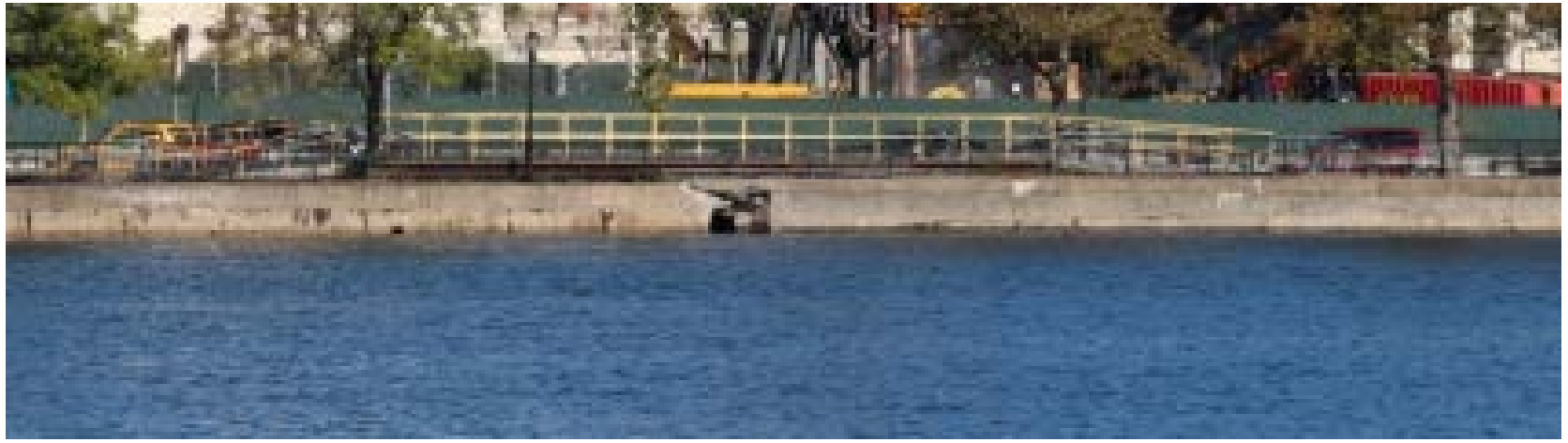
Background

- Goal: East River Esplanade showcases natural beauty of New York City living shoreline with waterway access.
- Existing Condition: Conventional concrete or stone bulkhead wall is in dire disrepair and sparse marine life is only sign of natural ecosystem.
- Needs: Critical attention to keep portions of it from falling into the river within the decade (MNLA, 2014).



OBJECTIVES

1) PERFORM SCIENTIFIC DATA COLLECTION AND ANALYSIS THAT LEADS TO AN UNDERSTANDING OF THE LOWER HARLEM RIVER'S BASELINE CONDITIONS.
2) USE ANALYSIS AS A FOUNDATION FOR PHASE 02. OF THE ECOLOGICAL EDGE STUDY: TO TEST THE ABILITY OF DIFFERENT MATERIALS WITH ESTABLISHMENT AND SUCCESSION OF MARINE LIFE
3) PHASE 01. BASELINE STUDY PARAMETERS FOR MEASUREMENT

- Determine plankton concentrations of the Harlem River.
- Determine benthic density of the Harlem River.
- Determine physical- chemical parameters of the Harlem River.
- Determine species richness of the Harlem River.

Locality

Figure 01. Sample stations in relation to Manhattan.

Figure 02. Sample Sites along East River Esplanade

Site 01. 116th Street

Site 02. Pier 111

Site 03. 103rd Street

Figure 03. Sample site (control) along Governors Island/ Buttermilk Channel.

Site 04.

Hypothesis

- There will be differences between sample sites for each component measured.
- A baseline study will accomplish objectives previously presented:
    - Analysis as foundation for Phase 02.: establish a starting point for determining whether there is room for ecological uplift
    - Allow for Phase 02: Determine the overall effects of different construction materials on marine biodiversity enhancement in this location
    - lead to argument in favor of living shoreline along Esplanade edge

Physical Chemistry Data:

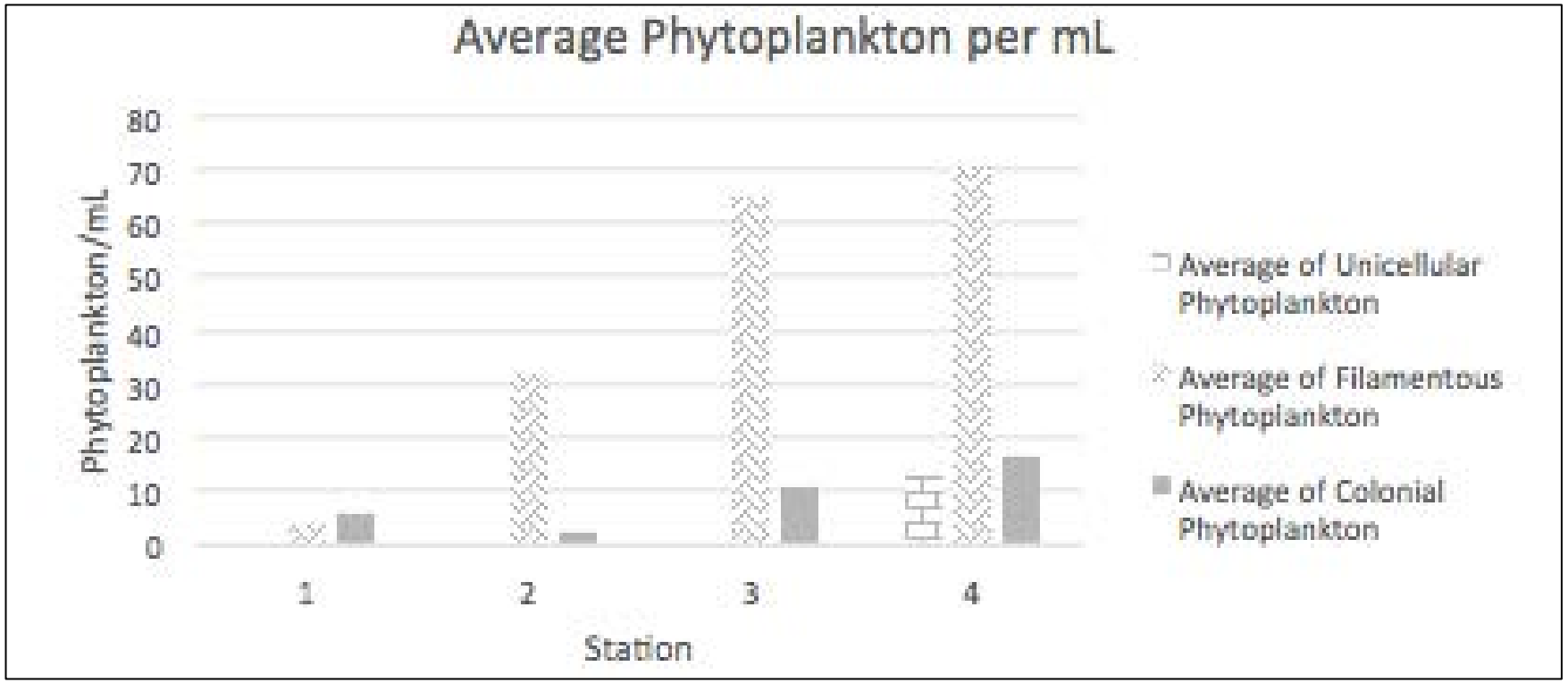
1) pH increases-> toxicity increases-> organisms unable to survive

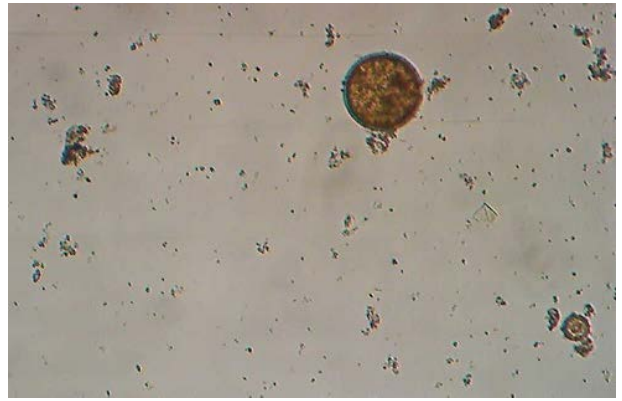
2) Ammonia levels are too high by EPA regulations (.43ppm > .02ppm)

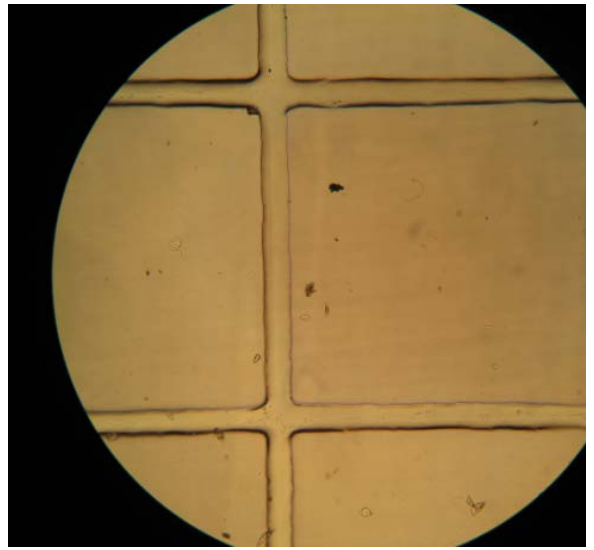
3) Nitrates increase moving south-> impact phytoplankton concentration levels

		Mean (Range)		
Parameter	116th Street	111th Street	103rd Street	GI Oyster Reef
pH*	7.29 (6.45-7.58)	7.44 (6.46-7.6)	7.42 (6.67-7.95)	7.50 (6.32-9.24)
Dissolved Oxygen (ppm)	8.36 (6.6-9.95)	7.81 (6.71-9.51)	8.85 (6.81-11.78)	4.67 (3-6)
Water Temperature (°C)	16.78 (8.4-22.8)	17.11 (8.4-22.4)	15.89 (8.3-22.8)	12.56 (7.8-17.2)
Salinity (ppt)	22.06 (16.33-24.86)	23.83 (20.26-25.3)	21.01 (15.32-24.8)	24.67 (18.09-33)
Ammonia (ppm)	0.43 (0-1)	0.14 (0-0.5)	0 (0-0)	0.2 (0-0.3)
Nitrite (ppm)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Nitrate (ppm)	0 (0-0)	0 (0-0)	3.33 (0-20)	3.5 (0-15)
Silicate (ppm)	93.75 (7.5-180)	80 (80-80)	None	50 (50-50)
Phosphate (ppm)	9.42 (1.5-15)	10 (5-20)	10 (0-30)	10 (5-20)
Secchi Depth (cm)	221.42 (100-500)	283.33 (125-500)	258.33 (125-500)	100 (100-100)

Phytoplankton Data

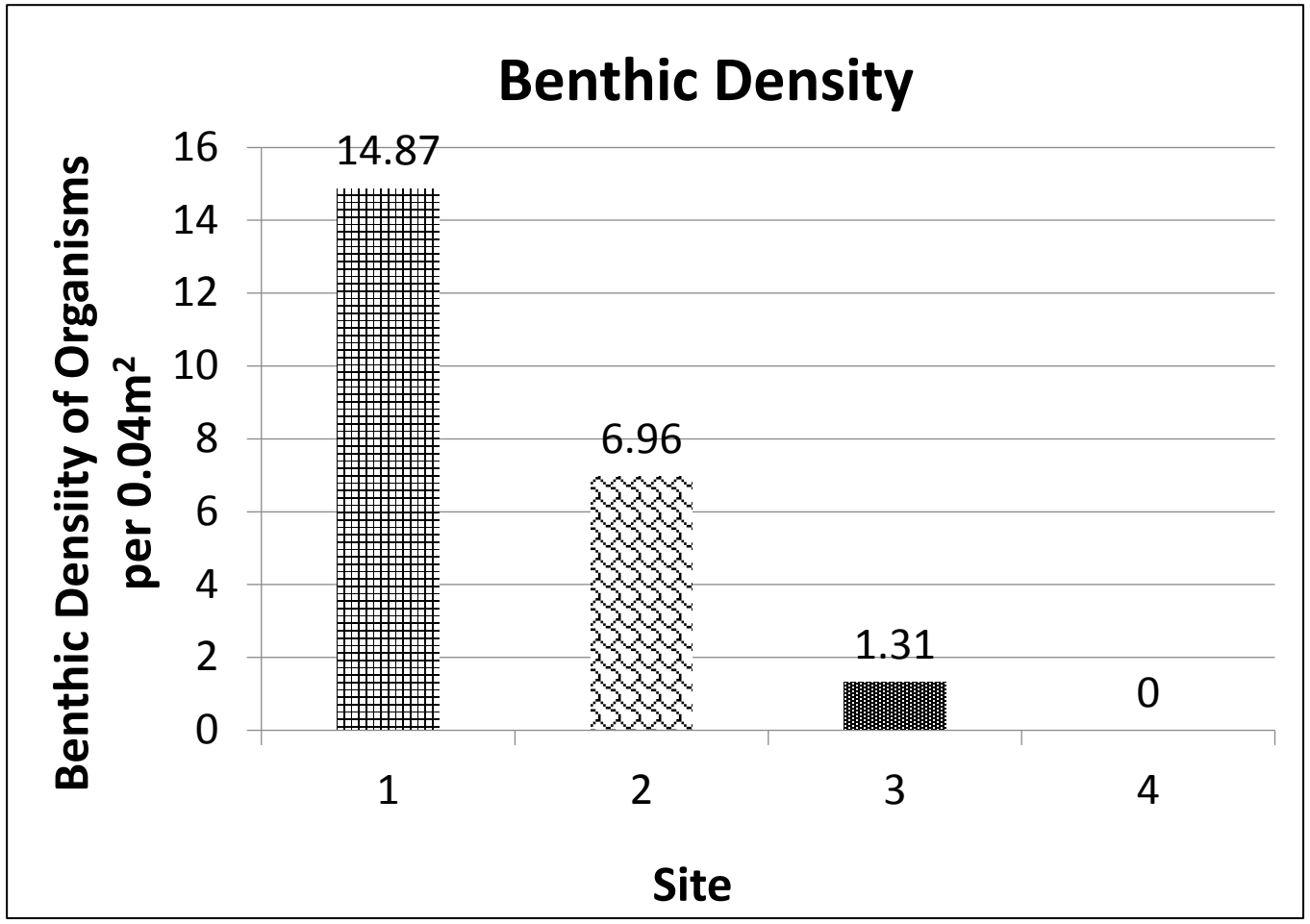


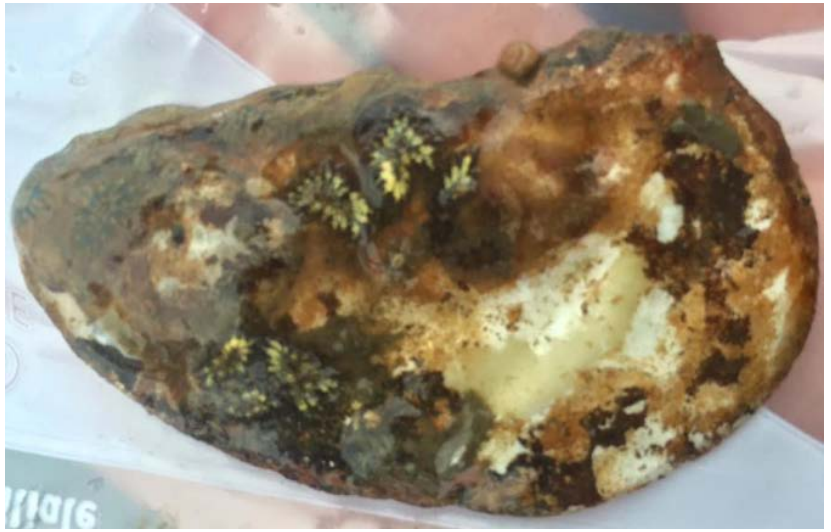




As sites moved South-> phytoplankton concentrations increase.

Benthos





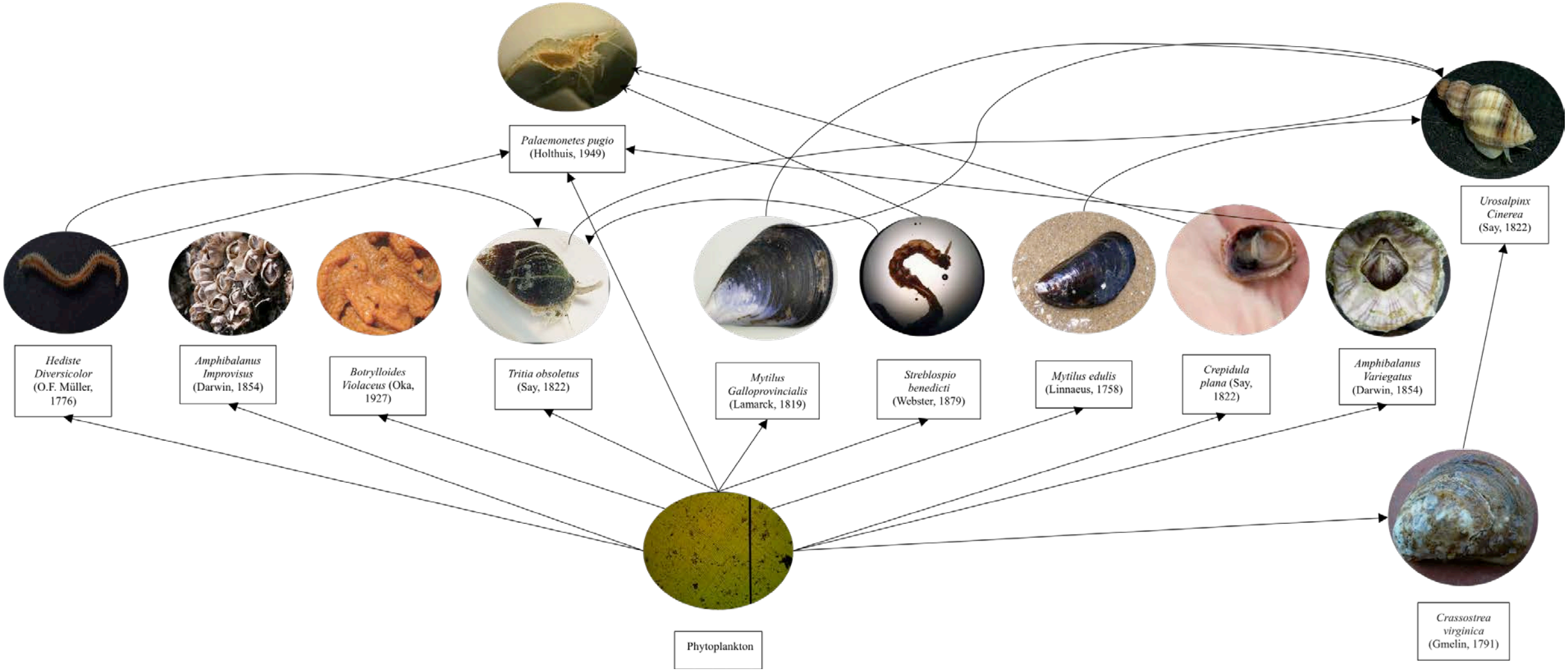
As sites moved South-> benthic density decreases.

Biodiversity

Site 1 (116th St)		Site 2 (111th St)		Site 3 (103rd St)		Site 4 (GI Oyster Reef)	
Genus	**Specific epithet**	**Genus**	**Specific epithet**	**Genus**	**Specific epithet**	**Genus**	**Specific epithet**
Hediste	diversicolor	Hediste	diversicolor	Tritia	obsoleta	Hediste	diversicolor
Tritia	Obsoleta	Tritia	obsoleta	-	-	Mytilus	galloprovincialis
-	-	Crepidula	plana	- -	- -	Mytilus	edulis
- -	- -	Streblospio	benedicti	- -	-	Amphibalanus	variegatus
-	-	Urosalpinx	cinerea	-	- -	Amphibalanus	improvisus
- -	-	-	-	-	-	Botrylloides	violaceus

The most commonly found organism was *Hediste diversicolor*, a native species to New York. The second most commonly found organism was *Tritia obsoleta*, an invasive species. It is speculated that Site 2 had the most organism species found of the three sites because of the spatial complexity seen at the site.

Food Web


Palaemonetes pugio (Holthuis, 1949)
Urosalpinx Cinerea (Say, 1822)
Hediste Diversicolor (O.F. Müller, 1776)
Amphibalanus Improvisus (Darwin, 1854)
Botrylloides Violaceus (Oka, 1927)
Tritia obsoletus (Say, 1822)
Mytilus Galloprovincialis (Lamarck, 1819)
Streblospio benedicti (Webster, 1879)
Mytilus edulis (Linnaeus, 1758)
Crepidula plana (Say, 1822)
Amphibalanus Variegatus (Darwin, 1854)
Phytoplankton
Crassostrea virginica (Gmelin, 1791)

Result Patterns/Discussion

- Southern sites, decrease benthic density & increase avg. phytoplankton
- Site 3 and 4 = little sediment vs. Site 1 and 2, decrease benthic density
- Increase nitrates = increase filamentous phytoplankton
- pH increased moving south (Increase pH = increases toxicity, Oram, n.d.)
- The pH trend in our study reflected the decreasing trend seen in benthic data.
- Ammonia (0-0.4ppm) not healthy (EPA limit 0.02 ppm in fresh/marine)
  - toxic to marine invertebrates (Alken Murray Corp.)
  - Sources of ammonia-> storm water runoff and CSO outlets

HYPOTHESIS SUPPORTED

Next Steps: Our Future Waterfront

Living shoreline would:

- decrease runoff
- lowers ammonia levels in river
- inviting habitats/ideal water quality for organisms
- increase biodiversity
- increase benthic density
- phytoplankton as base of food web
- public access and interaction
- filter CSO emissions
- Stabilize/restore ecosystem

Source: Mathews Nielsen Landscape Architects

Future Research: Phase 02.

- Determining what kinds of construction materials are best for organisms to grow on, in order to begin the restoration process.

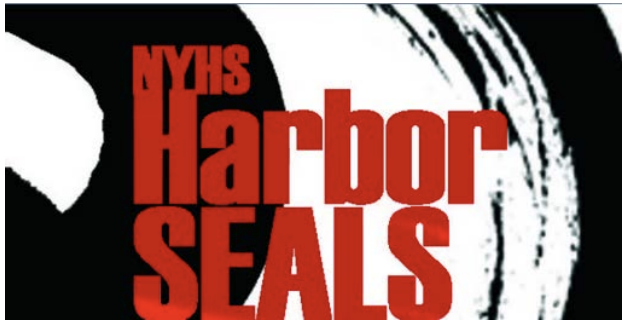
We Would Like To Acknowledge All Members Of Our Collaborative Team

CIVITAS Citizens

The New York Urban Assembly Harbor School

The Harbor SEALS

The New York Harbor Foundation



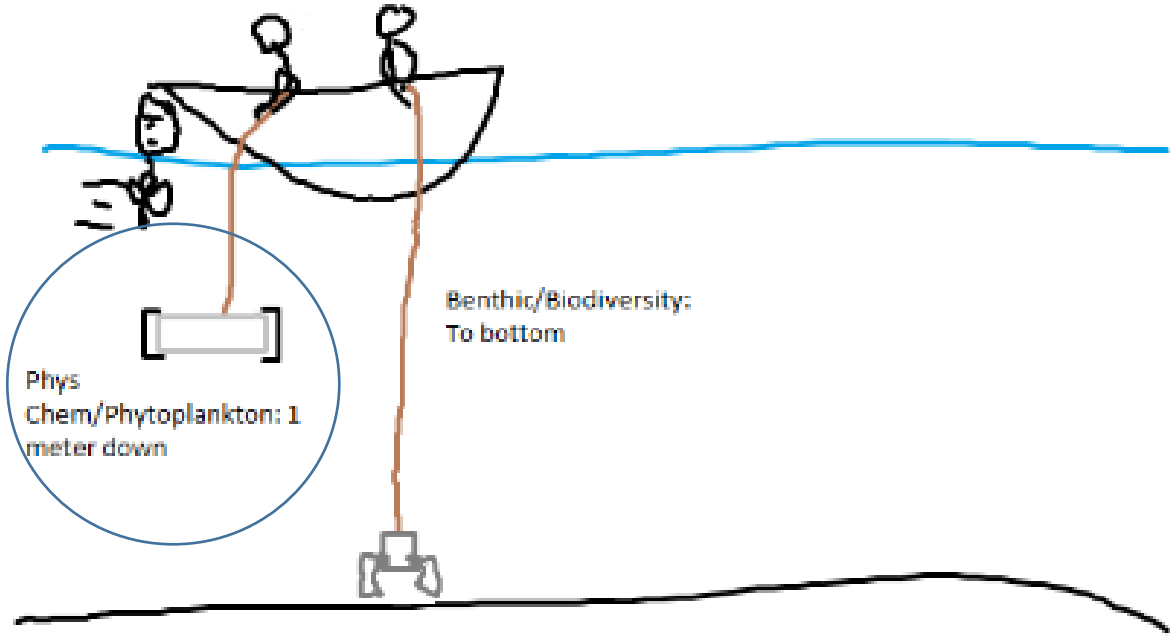
THANK YOU!

EXTRA SLIDES BELOW DESCRIBING METHODS

Physical Chemistry Collection Methods

(*From Gonzalez and Sommers, 2015)*

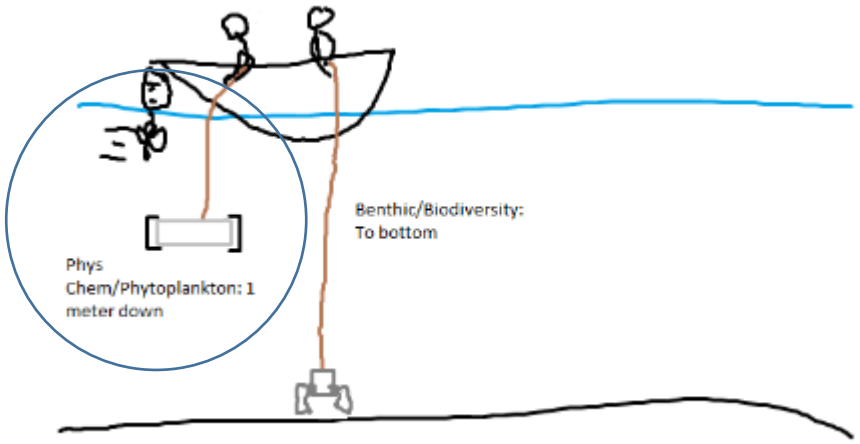
1. Collect water sample (~80 mL at 1m below surface using Beta Bottle; 2 collections per site).
2. Measure physical chemical parameters using YSi Proplus or Aquacheck test strips.
3. Record measurements on data sheet (the mean of each parameter – excluding pH- was used to compare large amounts of data using a single value for each category.)



Phytoplankton Collection Methods

(From Suthers and Rissik, 2009)

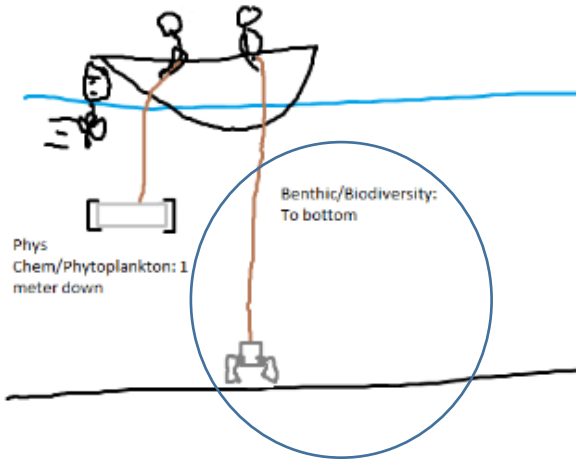
1. Collect water sample (100 mL at 1 m below surface using Beta Bottle; 2 collections per site).
2. Transfer sample to 100 mL graduated cylinder and let sample settle.
3. Remove 90 mL of the remaining 10 mL, 1 mL is placed onto a Sedgwick- Rafter counting cell. Individual plankton are counted by grid.



Benthic and Biodiversity Collection Methods

(Standard Collection Methods)

1. Collect sediment sample (Ekman Grab Collection ~6- 10m; 2 collections per site).
2. Measure the mass of the sample with a scale.
3. Sieve (500 um) the sediment and record what organisms are revealed.



Data Precision

Parameter	Precision	Parameter	Precision	Parameter	Precision
Salinity (YSI Pro Plus, 600 OMS)	± 0.1 ppt	Salinity (Refractometer)	± 1.0 ppt	Benthic Phylum Density	± 5 organisms per 0.04 m^2
Temperature (YSI Pro Plus, 600 OMS, Hanna Combo)	± 0.1 °C	Temperature (Thermometer)	± 1.0 °C	Unicellular Phytoplankton Concentration	± 10 cells per mL
Dissolved Oxygen (YSI Pro Plus, 600 OMS)	± 0.5 ppm	Dissolved Oxygen (Mod. Winkler)	± 1.0 ppm	Colonial Phytoplankton Concentration	± 15 cells per mL
pH (YSI Pro Plus, Hanna Combo)	± 0.1 units	pH (Test strips)	± 0.6 ppm	Filamentous Phytoplankton Concentration	± 25 cells per mL
Ammonia (YSI 9500)	± 0.25 ppm	Ammonia (Test strips)	± 0.5 ppm		
Phosphate (YSI 9500)	± 0.25 ppm	Phosphate (Test strips)	± 1.0 ppm		
Nitrate (YSI 9500)	± 0.25 ppm	Nitrate (Test strips)	± 1.0 ppm		
Nitrite (YSI 9500)	± 0.25 ppm	Nitrite (Test strips)	± 1.0 ppm		
Silicates (YSI 9500)	± 0.25 ppm	Silicates (Test strips)	± 1.0 ppm		