STATE OF THE UPPER NEW YORK BAY:

IS THE WATER QUALITY OF LOWER MANHATTAN AND GOVERNORS ISLAND SUFFICIENT TO SUSTAIN MARINE RESTORATION EFFORTS?

Mauricio Gonzalez, Violeta Gonzalez, Tahirah Abdo, Averille Ramos, Ameena Peters, Anthony Fernandez, & the NYHS HARBOR SEALs Team
The Urban Assembly New York Harbor School, NYC, 2014

RATIONALE.

Since the Clean Water Act was passed in 1973 the quality of water of the Hudson River has improved. This has led to the reporting of an increase in counts of various estuarine organisms (New York-New Jersey Harbor & Estuary Program, 2012). However, keystone species such as the Atlantic oyster (*Crassostrea viriginica*) and eel grass (*Zostera marina*) have not returned in significant abundance to take the ecosystem to a higher steady state. Due to the complexity of requirements of these keystone species (Twilley *et. al.*, 1985), it is difficult to plan for the best geographical localities in which to invest restoration efforts. In order to further improve these efforts and ecosystem services around the estuary, site specific water quality monitoring is now required (USACE, 2010).

SCIENTIFIC PROBLEMS.

•What is the water quality (*i.e.* pH, dissolved oxygen, temperature, salinity, nutrients, enterococcus bacteria, and currents) of four stations off of Governors Island and Lower Manhattan?
•Is the water quality in the sites being sampled sufficient to sustain keystone species such as the Atlantic Oyster and Eel grass?
•What are the tidal dynamics of the area between Lower Manhattan and Governors Island?
•Can community stakeholders, particularly high school students, successfully participate in a rigorous citizen science monitoring program and use their experiences to help bridge the gap between high school and college?

METHODS.

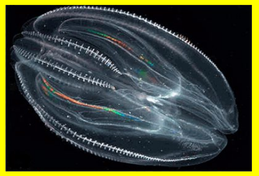
We sampled water quality (*i.e.* pH, dissolved oxygen, temperature, salinity, nutrients, enterococcus bacteria, and currents) of four stations off of Governors Island and Lower Manhattan. On year one (01) pH was determined using a calibrated Hanna Combo Sensor and verified using Aquacheck colorimetric test strips; dissolved oxygen was determined using the Lamotte Azide modified Winkler Method; temperature was determined using a calibrated thermometer and verified with the Hanna Combo sensor; salinity was measured using a calibrated refractometer by Vital Sine; nutrients were determined using Aquacheck colorimetric test strips; and enterococcus levels were determined using IDEXX Enterolert. On year two (02) all the above applied except for the following: dissolved oxygen, temperature, salinity, and nutrients were determined using Yellow Spring Instruments (YSI) meters (YSI ProPlus and YSI 9500 Photometer). The data was graphed using Microsoft Excel and was analyzed against tolerance levels for Striped Bass which has stricter survival requirements than the Atlantic oyster and eel grass. This helped to determine the viability of restoration efforts.

STUDY LOCALITY.

FIGURE 01. Sampling Stations, Lower Manhattan & Governors Island

MARINE LIFE


Eastern Oyster (*Crassostrea virginica*)


Sea Walnut (*Mnemiopsis leidyi*)


Slipper Snail (*Credpidula fornicate*)


Asian Shore Crab (*Hemigrapsus sanguinaeus*)


Barnacle (*Semibalanus balanoides*)

Solitary Sea Squirt (*Mogula manhattensis*)


Colonial Sea Squirt (*Botryllus schloseri*)


Searobin (*Prionotus evolans*)


Eel Grass (*Zostera marina*)


Sea Lettuce (*Ulva lactuca*)


Cormorant (*Phalacrocorax carbo*)


Harbor Seal (*Phoca vitulina*)

PRELIMINARY RESULTS

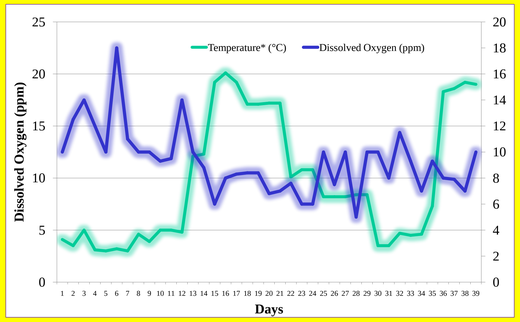


FIGURE 02. Dissolved Oxygen (ppm) vs. Temperature (C) in the Upper New York Bay

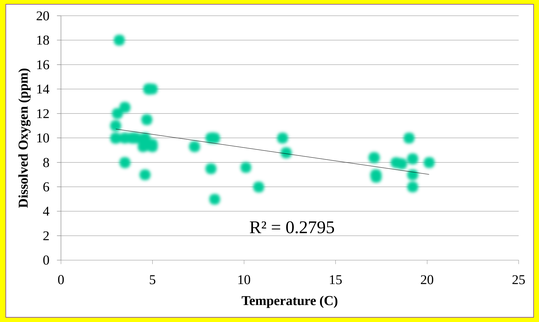


FIGURE 03. Dissolved Oxygen (ppm) vs. Temperature (C) in the Upper New York Bay

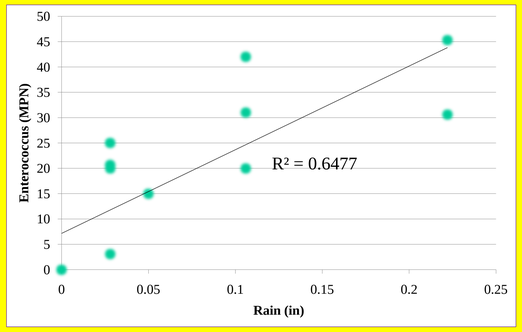


FIGURE 04. Enterococcus (MPN) vs. Rain (in) Avg. Over Previous 5 days

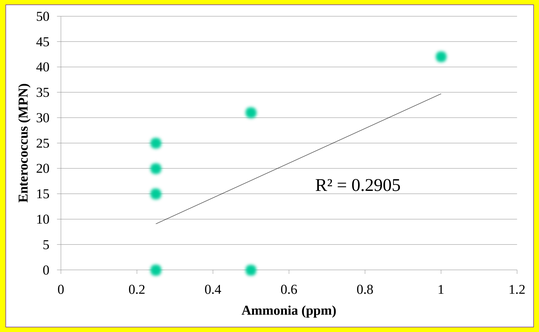


FIGURE 05. Enterococcus (MPN) vs. Ammonia (ppm) Concentration

Table 01. WATER QUALITY AVERAGES & TOLERANCE LEVELS

Water Quality Parameter	Tolerance	Average Value
Temperature	< 29 C	10.1 C
Dissolved Oxygen	4 – 10 ppm	9.3 ppm
pH	6 – 8	7.6
Rain	< 0.10 in	0.06 in
Enterococcus	< 35 MPN	18 MPN
Ammonia	< 0.25 ppm	0.67 ppm
Nitrate	< 40 ppm	7.8 ppm

PRELIMINARY ANALYSIS

According to the data from Fig. 01, the temperature of the Upper NY Bay follows a noticeable pattern with the seasons. During the first winter of data collection the water temperature at 1m depth reaches a low of 3.0 C only to climb to 20.1 C in September. The average temperature throughout the study was 10.1 C, well below the upper limit of the tolerance level (see Table 01). There is a weak correlation between water temperature and dissolved oxygen (r^2 = 0.28). This could be due to human error as the volunteers struggled to follow the Winkler method correctly.

There was a strong correlation between rain events and enterococcus readings (r2 = 0.65). However, there was a weak correlation between enterococcus and ammonia levels. It would be expected that when it rains, sewage released from CSOs contain both enterococcus and ammonia. It may be that because sampling was never coordinated with rain events, enterococcus and ammonia signals were being registered at different points of sampling from these events such that the two never overlap but peak at different times after the CSO discharge.

According to Table 01. the average of all parameters were within tolerance levels except for ammonia. Taking the water quality parameters as a whole, it appears as though the Upper NY Bay is within tolerance level for striped bass which has strict growing requirements. Therefore it can be tentatively affirmed that it is safe for restoration efforts for other important organisms such as the Eastern Oyster and Eel Grass.

CONCLUSIONS

•The water quality in the sites being sampled is sufficient to sustain keystone species such as the Atlantic Oyster and Eel grass.
•We don't address the tidal dynamics of the area between Lower Manhattan and Governors Island in this preliminary analysis.
•Through this project, community stakeholders, particularly high school students, are successfully participating in a rigorous citizen science monitoring program which will help them bridge the gap between high school and college.

VOLUNTEER with us at
www.harborseals.org!