



Assessing Human Impact on Tidal Wetland Diversity in NYC

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Introduction

Salt marshes support a diverse community of birds, fish, and invertebrate species. They provide a safe nursery for aquatic species, prevent shoreline erosion, and serve as a buffer zone during storms to prevent flooding¹. They also help filter pollutants, which is especially crucial in large cities that lack permeable surfaces and with their dense populations produce an enormous amount of polluted runoff.

The diversity of fish and birds found in a marsh reflects the marsh's overall health. Our project surveyed four anthropogenic factors, specifically water, air, noise, and litter pollution. We studied marshland birds and fish and measured these four abiotic factors in four different New York City wetlands: Udall's Cove, Pelham Bay Cove, Hutchinson River, and Spring Creek. The significance of this project is to truly understand how human factors are affecting the marsh and to raise awareness so that we may try to preserve and protect urban marshes.

Research Question/Hypothesis



Research Question: Is there a difference in anthropogenic effects across NYC wetlands?

Hypothesis: We hypothesized that more urbanized wetlands would have greater anthropogenic effects, and that these would negatively affect fish and bird diversity.

Methods

Litter Quadrats

- Quadrats of one square meter were thrown randomly thirty times
- Number of pieces of trash within each quadrat was counted
- Latitude and longitude of each quadrat was recorded



Noise Levels & Particulate Matter

- An Airbeam measured temperature, humidity, particulate matter, and sound levels
- Average noise level and particulate matter measurements were used in analyzing our data

Point Count

- Two people stood back to back and observed birds within a 50 meter radius for 10 minutes, upon arriving and then upon leaving

Water Quality

- A refractometer was used to determine salinity
- Lamotte kits were used to measure carbon dioxide, phosphates, and nitrates
- Probes measured dissolved oxygen, pH, and temperature
- Turbidity was measured with a secchi disk



Seining & Fish Trap

- A seine net and fish trap were used to assess marine species composition at each site (Pelham Bay Cove was not included)
- Fish and crabs were measured, photographed, and recorded



Results



Location	Salinity (g/kg)	pH	CO2 (ppm)	Nitrates (ppm)	DO (mg/L)	Turbidity (ft)	Phosphates (ppm)
Udall's Cove	17.33	7.37	4.33	0.13	10.67	1.2	0.17
Pelham Bay Cove	26.33	7.5	9.67	0.1	3.22	3.25	0.2
Hutchinson	22.73	7.47	10.33	0.13	7.6	1.33	0.23
Spring Creek	20.67	7.83	3.13	0.1	7.62	1.4	0.2

Table 1: Summary of Average Water Quality Measurements
This table summarizes the average values for water quality at each site.

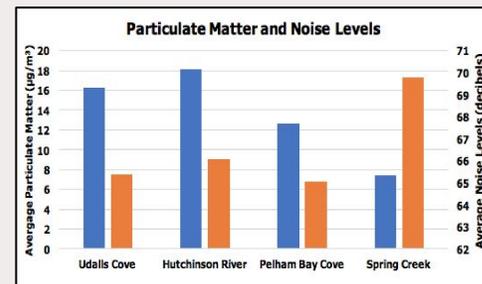


Figure 2: Average Particulate Matter and Noise Levels
Mean values for average particulate matter and noise level were taken for each site.

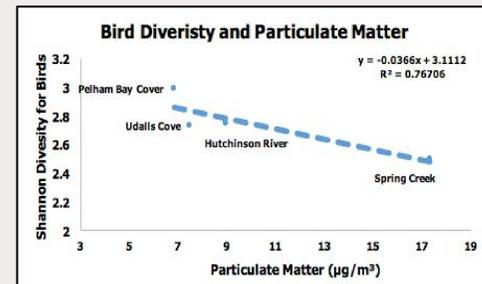


Figure 4: Relationship of Bird Diversity to Particulate Matter
A negative trendline suggests that as particulate matter increased, bird diversity decreased. Shannon Diversity Index values were used.

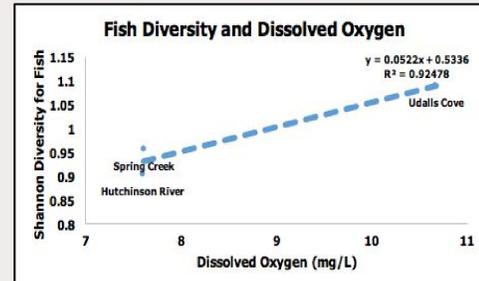


Figure 1: Relationship of Fish Diversity to Dissolved Oxygen
The positive trendline indicates that increasing diversity is related to increasing dissolved oxygen. Shannon Diversity Index values were used to assess biodiversity at each site. The graph has an r value of 0.9617.

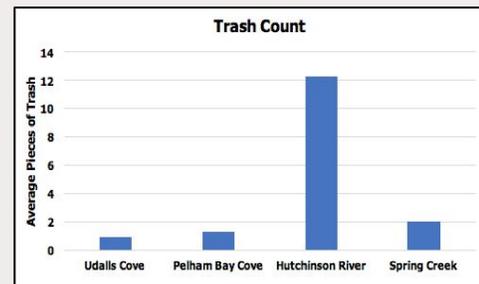


Figure 3: Average Trash Count Across Sites
Mean trash count values were compared across the four sites.

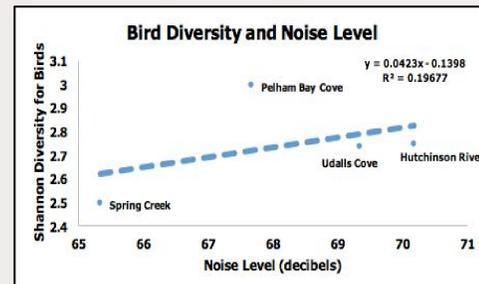


Figure 5: Relationship of Bird Diversity to Noise Levels
A positive trend is shown between noise level and bird diversity, though the trend is weak, with an r value of 0.4366.



Alewife Shad (Spring Creek)



Blue Crab on Ribbed Mussel



Winter Flounder (Udall's Cove)



Red-winged Blackbird⁶

Discussion

Fish Diversity

An analysis using the Shannon-Wiener Diversity Index suggested a relationship between fish diversity and dissolved oxygen levels. Our graph of fish diversity and dissolved oxygen (Figure 1) had a fairly strong trend, with a Pearson's r value of 0.9617 and thus a strong positive association between fish diversity and dissolved oxygen values. Lower dissolved oxygen levels are associated with greater water pollution and decreased fish diversity; our hypothesis that increased pollution would correspond to decreased diversity was supported³.

Values for fish diversity and dissolved oxygen were both markedly high at Udalls Cove, in Queens (Table 1), seemingly the most pristine of the four sites. Notably, Udalls has drinking water leaking into it from a pipe that runs through the marsh. Udalls also had the lowest average value for pieces of trash, perhaps because it's the furthest from a major roadway (Figure 3).

Bird Diversity

Bird diversity was compared to two anthropogenic factors: noise pollution and air pollution. A graph of bird diversity to particulate matter (Figure 4) supported our original hypothesis; less bird diversity was observed at sites with higher values for average particulate matter. There was a moderately strong trend; this graph had a Pearson's r value of -0.8758. Previous studies have suggested that high levels of particulate matter can be detrimental to bird health⁴. The site with the lowest value for bird diversity had planes flying closely overhead.

A graph of the relationship between noise level and bird diversity (Figure 5) did not support our hypothesis. The graph for bird diversity against average noise levels suggested that bird diversity increased with increasing noise levels, though this graph has a Pearson's r value of only 0.4366. Several factors may account for this. Noise levels were measured using a wearable device; our data may have been skewed by our own discussions during our research. Alternatively, prior research has suggested that some urban bird species can persist in areas with high noise levels by altering their behavior; given that our research was conducted in sites with high levels of urbanization, some of the bird species we observed may have this ability⁵.

Future Research



Great Egret⁶

Future work could be done to further explore the role of air pollution in bird composition, and noise levels could be more accurately obtained if measured over shorter periods of time, with the Airbeam placed some distance away. Future studies in soil could focus on researching the microbiota to get a more accurate understanding of the health of each wetland.

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