Economic Inequality and Biotic Diversity in NYC Wetlands

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Research Question

Does economic inequality in urban wetland areas relate to biotic diversity?

Introduction

Today, 54% of the world's population lives in urban areas, a proportion that is expected to increase to 66% by 2050[1]. The negative social costs of urbanization are evident in the high levels of resource use demanded by a growing population, the high levels of waste that megacities generate, and the impoverished conditions that people live in on the outskirts of major cities[2]. Therefore, we took a profound interest on the relationship between socioeconomic disparity and the quality of wetland habitats around New York City.

Hypothesis 1 We hypothesized that areas with higher economic status would associate with healthier wetlands with higher levels of biodiversity, specifically with greater bird diversity and the presence of pollution-sensitive macroinvertebrates.

Hypothesis 2 We hypothesized that there would be an inverse relationship between income and the amount of litter found.

Methods

Bird Diversity

For surveying bird diversity, we used a point count method of observation. One researcher was designated as the observer, who used a pair of binoculars to survey the area for birds. A second researcher recorded the species and number of individuals that the observer saw in the area. This process was duplicated once in the morning and once in the afternoon for ten minute intervals.

Fig. 1-- Project TRUE members Jake and Cedric observing birds at Willow Lake.

Litter Data

We observed each site for litter (any garbage/refuse not in a trash can) and recorded each piece of litter observed at the wetland site as a member of 1 of 3 categories:

1.Non-recyclable (includes, but not exclusive): napkins, tissues, paper towels, wax paper wrapping paper, cardboard lined with plastic, waxed cardboard, motor oil cans, cardboard/metal containers, paint cans, light bulbs, mirror glass, window glass, ceramic, crystal, plastic baggies, plastic tableware, styrofoam containers

2. Recyclable: anything considered recyclable in New York City[3]

3. Biodegradable: any litter that can be broken down naturally by the ecosystem (ex. food, newspaper)

Economic Data

We performed a meta-data analysis of median income of NYC online (from the US Census[4]) and recorded data for the areas immediately surrounding the wetland sites we surveyed.

Macroinvertebrates

We swept a dip net three times (once near the top, once through the middle, and once near the aquatic floor) within 5 meters of wetland shore site.

Then, we observed the contents of the net and, if possible, photographed each individual macroinvertebrate using a handheld microscope. We then identified the organisms to lowest taxonomic group possible by observing their external characteristics.

Fig. 2-- Project TRUE members Cedric, Sarah and Henry surveying the Ramble for macroinvertebrates.

Results

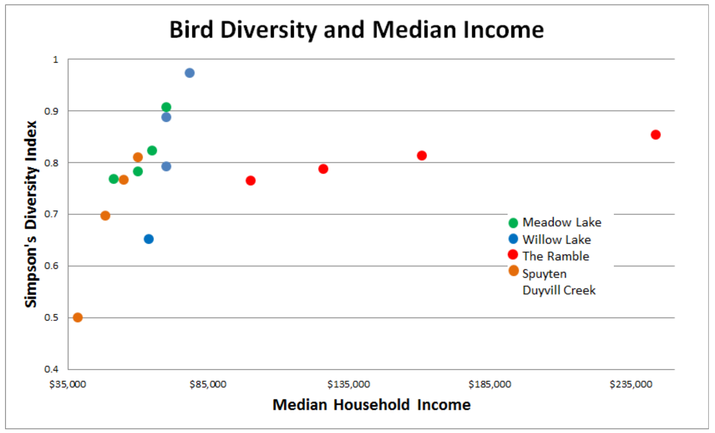

Fig. 3--Graph shows the relationship between Simpson's Diversity Index[5] and median household income of the four sites. s a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species.*

Pollution Tolerant

COMMON NAME	POLLUTION TOLERANCE (1-10 Scale)*	WETLAND SITE(S) OBSERVED	NUMBER OBSERVED
Leech	10	The Ramble	3
Aquatic Worm	9	Meadow Lake	12
		Willow Lake	20
		The Ramble	37
		Spuyten Duyvil Creek	120
Polychaete Worm	9	Spuyten Duyvil Creek	2

Somewhat Pollution Tolerant

COMMON NAME	POLLUTION TOLERANCE (1-10 Scale)*	WETLAND SITE(S) OBSERVED	NUMBER OBSERVED
Lunged Snail	6-8	Meadow Lake	3
		Willow Lake	5
Common Snail	6-8	Willow Lake	5
Pouch Snail	6-8	The Ramble	2
Blackfly	6	Meadow Lake	2
Midgefly	6	Meadow Lake	3
		The Ramble	4
		Spuyten Duyvil Creek	4

*pollution tolerance is graded on a 1-10 scale[6] --1 being the lowest pollution tolerant (very sensitive) and 10 being the highest pollution tolerant (very resistant)-- the presence of more pollution sensitive organisms may indicate lower levels of pollution.

Somewhat Pollution Sensitive

COMMON NAME	POLLUTION TOLERANCE (1-10 Scale)*	Wetland Site(s) Observed	NUMBER OBSERVED
Scud	4	Meadow Lake	1
		Willow Lake	4
		Spuyten Duyvil Creek	1
Cranefly	3	Meadow Lake	1
Caddisfly	3	The Ramble	1

Fig. 4-- These tables identify, group and number the various amounts of organisms found at the four sites. Macroinvertebrates are essential in determining wetland quality due to their varied resistance to pollution.

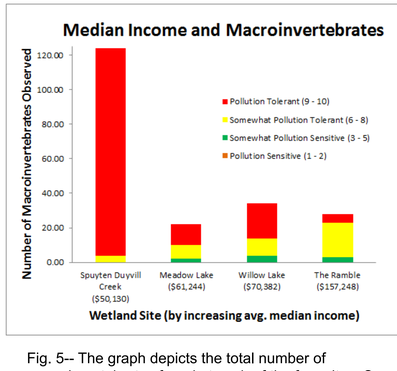

Fig. 5-- The graph depicts the total number of macroinvertebrates found at each of the four sites. Spuyten Duyvil Creek had the largest number of macroinvertebrates observed.

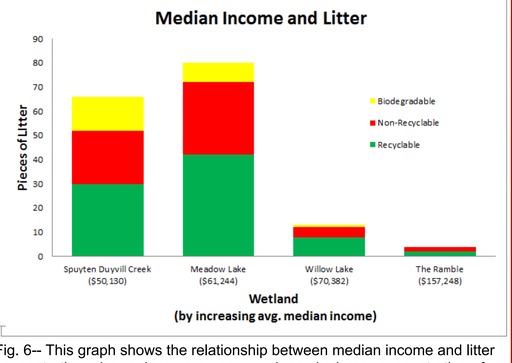

Fig. 6-- This graph shows the relationship between median income and litter concentrations. Lower income areas experienced a larger concentration of litter

Conclusion/Discussion

Economic Inequality and Biotic Diversity

When considering our hypothesis, we can conclude that economic inequality does relate to biotic diversity in the areas that we surveyed. This is evident through the observation of Figure 4., which generally displays an upward trend with regards to median household income and bird diversity. We cannot say with certainty whether the data shows significant correlation, but we can conclude that there is definitely a connection between the economic status of the area and the diversity of that wetland.

Macroinvertebrates

As previously stated (Figure 5 notes), macroinvertebrates are key indicators of wetland quality due to their varied tolerance to pollution. Based on the collections at the four sites, Meadow Lake and the Ramble were found to contain organisms with a tolerance grade of 3. Organisms with a grade of 3 were the least pollution tolerant organisms found at any of the four sites. Moreover, we can speculate that Meadow Lake's and the Ramble's respective waters contained the lowest concentrations of pollution out of the four sites we observed. Spuyten Duyvil Creek had the greatest abundance of organisms, but the majority were pollution tolerant (9-10).

Litter

Figure 9 indicates that more garbage was found in the two lower income regions (Spuyten Duyvil Creek and Meadow Lake) and less garbage was found in the higher income regions (the Ramble and Willow Lake). We would like to further explore this topic and hypothesize further that wetlands surrounded by lower income neighborhoods tend to have more trash due to the fact that people in lower income areas have other more immediately pressing concerns (food, taxes, mortgages, etc.) than maintaining an aesthetic and healthy wetland.

Future Directions

We need to help protect our earth and biodiversity before it is too late. We also need to start discussions about how economic inequality should not effect something that every human deserves the right to. The higher income families should not have all of the benefits and access to a greener healthier life, while the lower income families receive a lesser version.

You can help protect our earth by: supporting green infrastructure and recycling. These are just a couple of the many ways you can help. The possibilities are endless when you put your mind to it.

SPREAD THE WORD.
START A MOVEMENT.
SAVE PLANET EARTH.
STAND FOR YOUR RIGHTS.

References

[4] WNYC (2008-2012) *Median Income Across the US*

[3] Clarke, M. J., & Maantay, J. A. (2006). Optimizing recycling in all of New York City's neighborhoods: Using GIS to develop the REAP index for improved recycling education, awareness, and participation. *Resources, conservation and recycling*, *46*(2), 128-148.

[6] U.S. Environmental Protection Agency (1989) *Rapid Bioassessment Protocols for Use in Streams and Rivers, Benthic Macroinvertebrates and Fish* retrieved from:

[5] Offwell Woodland & Wildlife Trust (1998-2000) *Simpson's Diversity Index*

[1, 2] Marzluff, J., Bowman, R., & Donnelly, R. (Eds.). (2012). *Avian ecology and conservation in an urbanizing world*. Springer Science & Business Media.