

Sealing the D(eel)

Research on the Relations Between Eels, Macroinvertebrates and Microplastics

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INTRODUCTION

Urbanization is the shift of an environment from a rural to urbanized setting. These changes to the structure and composition of natural ecosystems force animals to adapt. For example, the construction of dams may prevent American eels (*Anguilla rostrata*) from traveling upstream from the Sargasso Sea to the Bronx River- where they stay to feed and mature. Similarly, the development of and excessive use of plastics has resulted in the introduction of plastic waste into aquatic ecosystems such as rivers, lakes, and ponds. Plastic does not biodegrade, but rather breakdowns into tiny pieces known as microplastics, which are remnants of plastic debris that are less than >5mm in length. While the Bronx River Alliance has studied the presence of plastic waste in the Bronx River, to our knowledge, no research has demonstrated the presence of microplastics. The presence of microplastic contamination in eels can be examined by looking at trophic levels in the food web of eels. In particular to American eels, bioaccumulation of microplastics can occur through the consumption of benthic macroinvertebrates. Benthic macroinvertebrates are small aquatic organisms that lack backbones and are visible to the naked eye (EPA). They serve as an indicator species for bodies of water such as rivers, ponds, and creeks. Studies have shown an accumulation of microplastics within benthic macroinvertebrates themselves. Eels and the food that they consume help us as humans to understand and be aware of the health of the Bronx River from an urban ecological standpoint. Through this research, we aimed to study microplastic pollution through the food chain.



Figure 1. Eel migratory pattern and life cycle.

Eels are the only catadromous species of fish in North America (US Fish and Wildlife). Catadromous means that the species is born in saltwater, matures in freshwater, and then returns to the ocean to reproduce and die.

METHODS

Eels: Eels were captured using traps made from frayed rope which mimics aquatic plants, such as kelp, that serves as a habitat for eels. We placed three mops at each of our three sites (Twin Dams, Bronx Lake, and 182nd st Dam) which were checked twice a week. In order to check for eels, the mops were placed into a bin of water and the contents were then strained through a mesh in a separate bucket. The eels were separated, measured in length, and life stage was determined before being released.



Figure 2. Eel Mop

Microplastics in water samples: Twice a week, we collected 100 ml water samples at our three sites (Twin Dams, Bronx Lake, and 182nd st Dam). The samples were strained into a glass container using a mesh cloth to remove any large debris. Next, the water sample was dyed with 2 mL of Nile Red dye and was run through a Buchner vacuum filter using glass fiber filter paper (Whatman grade 934-AH, 90mm diameter, 1.5 um pore). A UV light was used to illuminate the dried filter paper on a stereoscopic microscope. Particles and fibers on the paper that fluoresced as red, yellow, or orange were quantified.

Microplastics in macroinvertebrates: Macroinvertebrates were collected as bycatch after straining eel mops. Any macroinvertebrates found were collected into a petri dish and preserved in alcohol. The sample was then strained and separated by species. Each species group was put into their own respective 20 mL glass beaker and were immediately mashed using surgical steel tools such as forceps and scalpels. 20 mL of water and .5 mL of Nile Red Dye were added to the beaker. A UV light was shined into the beaker and any particles or fibers that fluoresced as red, yellow, or orange were quantified.

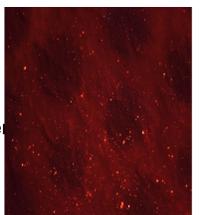


Figure 3. Microplastics fluorescing

How does water quality and the presence of microplastics affect abundance of eels in the Bronx River?

- What is the effect of dams on Eel distribution and size in the Bronx River?**
 - Hypothesis: Smaller eels will congregate at the shorter dams (182nd) in higher numbers whereas larger eels will be found more upstream but in less abundance.
- What species of benthic macroinvertebrates are found in the Bronx River?**
 - Hypothesis: Only species tolerant of pollution will be found in the Bronx River.
- Are microplastics present in the Bronx River?**
 - Hypothesis: There will be a presence of microplastics found throughout the Bronx River
- Do benthic macroinvertebrates in the Bronx River contain microplastics?**
 - Hypothesis: Benthic macroinvertebrates will contain microplastics.

RESULTS

Number of Eels collected by site

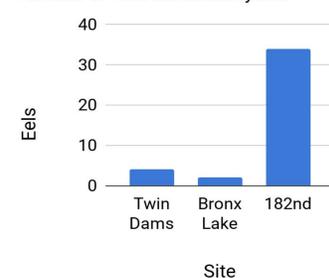


Figure 4 shows the amount of eels collected at each respective sites.

Average Eel Length By Site

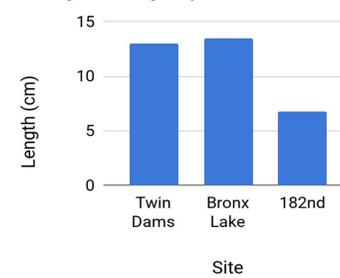


Figure 5 demonstrates average eel length in centimeters.

Interannual Eels Lengths

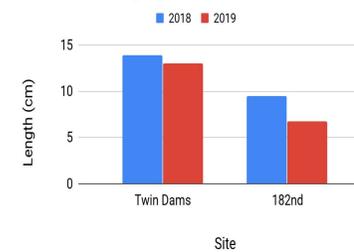


Figure 6 is a comparison of data collected in 2018 to data collected in 2019 of average eel length at Twin Dams and 182nd.

Table 1 demonstrates various species of benthic macroinvertebrates found in the Bronx River. Species are categorized based on tolerance to environmental parameters related to pollution.

Pollution Tolerance	Species Name	Picture	Twin dams	Bronx lake	182nd street
Tolerant	Aquatic Worms		X	-	-
	Snail (Left)		X	-	X
Moderately tolerant	Leech		-	X	-
	Midge		X	X	X
Fairly intolerant	Damselfly Nymph		-	-	X
	Scuds		X	X	X
	Clams		X	X	X
	Crayfish		X	-	X
Intolerant	Bettle larva		-	X	-
	Water- penny larvae		X	-	-
	Dobsonfly larva		X	X	X
	Snail (Right)		X	-	X

Average Microplastics in Bronx River

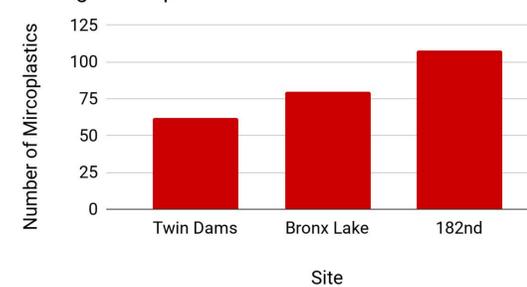


Figure 4 shows a quantitative measure of microplastics found in the Bronx River. The site, 182nd, had the highest average number of microplastics

Surface Analysis

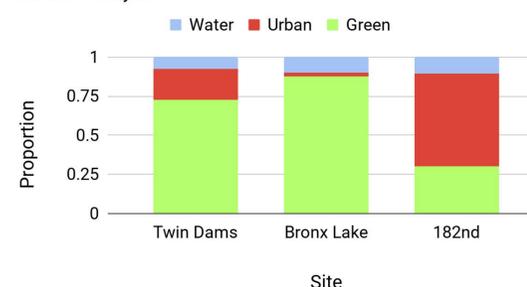


Figure 5 demonstrates the proportion of green, urban, and water space at each site.

DISCUSSION

Effect of dams on eel distribution and size in the Bronx River-

Our data revealed that there is a strong relationship between eel distribution and size below and above dams. There was a higher abundance of eels found at our southernmost site, 182nd St, which is below the first dam in the Bronx River. This is presented in Figure 3. However, the size of the eels were smaller than those found above the first dam. The abundance of eels decreased significantly above the dam whereas the actual size of eels increased. This shows an inverse relation between size and abundance of eels at each respective site. This data is supported by a similar study conducted by Project TRUE in 2018 seen in Figure 6. Our research suggests that this may be caused by the inability of smaller eels to access the river above the dam.

Species of benthic macroinvertebrates found in the Bronx River-

Our data did not support our hypothesis. Benthic macroinvertebrates of all 4 tolerance levels were found in the Bronx River. Species that are intolerant of pollution were found at all three sites. This indicates that the river is healthy despite plastic pollution. The most diverse selection of species were found at Twin Dams and the least diverse site was at Bronx Lake. The lack of species diversity at Bronx Lake can be attributed to the low current velocity at that location. Benthic macroinvertebrates prefer highly oxygenated and fast-flowing water as opposed to more stagnant bodies of water (Biological Monitoring). Sites with a high current velocity are found at Twin Dams and 182nd st.

Microplastics in the Bronx River- Our data revealed that there is a significant amount of plastic pollution throughout the Bronx River. All three sites demonstrated a presence of microplastics seen in water samples collected.

Benthic macroinvertebrates and microplastics- Our data supports our hypothesis that benthic macroinvertebrates in the Bronx River contain microplastics. Benthic macroinvertebrates from all three sites were tested positive for the presence of microplastics.

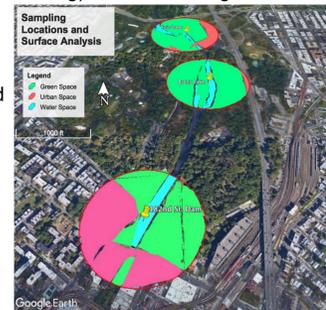


Figure 7. Map of three sites

CONCLUSIONS

Our research suggests that there is a connection between microplastics, benthic macroinvertebrates, and eels in the Bronx River. The connection being that microplastics have been found in benthic macroinvertebrates which are then consumed by eels. This suggests that microplastics may bioaccumulate in eels, which could cause negative effects on their growth and reproduction.

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