Comparative Analysis of Microplastics Consumed by White Perch in Two Locations Along The Hudson River, USA

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ABSTRACT

Microplastics are a diverse and harmful emerging contaminant in freshwater systems. The more these pollutants are presented in aquatic ecosystems, the more available they become for uptake. The aim of this study was to compare particulates consumed by a fish species captured from two locations along the Hudson River, USA that vary in anthropogenic inputs . A total of 43 White Perch samples were collected from South Coxsackie, NY and South Poughkeepsie. Results show that in areas estimated to have higher concentrations of microfibers, there were more occurrences of microfibers in the fish tissue. The increasing number of anthropogenic particles consumed by aquatic species prompts urgent reform in the way humans use and dispose of plastics and calls for more sustainable practices.

INTRODUCTION

Microplastics

- Rivers serve as a major pathway for plastic transport[1]
- Plastic is susceptible to degradation and weathering[2]
- Pieces of plastic 5mm and under are known as microplastics and are classified as primary (created small) and secondary (large and become small over time)
- Characterized by shape, size, weight, and polymer type
- Mason *et al*. (2016) observed 17 WWTP facilities and concluded that 4 million microplastics/facility/day and between 3-23 billion (average 13 billion) microplastic particles are being released into US waterways/day via municipal wastewater.[3]

Fig. 1. 17, G., & Blogger, G. (2020, June 17). Sustainability science Capstone Workshop INVESTIGATES microplastics in the Hudson River. Retrieved February 03, 2021, from https://blogs.ei.columbia.edu/2020/06/17/sustainability-science-capstone-workshop/

Effects on fish

- Ingested plastic can have adverse effects on fish such as injury or blockage[2]
- Microplastics can act as vectors for the transfer of persistent organic pollutants (POPs) to marine organisms[4]
- Microplastics are bioavailable to white perch

Fig. 2. White perch (Morone Americana

Location

- Perch are resident throughout the 243 km tidal portion of the Hudson River, often in brackish water
- Locations where perch reside differ in population density, industry and land use patterns

HYPOTHESIS

Higher microplastic contamination will be measured in White Perch sampled in Poughkeepsie than in South Coxsackie.

METHODOLOGY

Sample collection

- The Hudson River does not have a north to south linear flow. As such, sample locations were selected that had previously been deemed to have relatively high (South Poughkeepsie) and low (South Coxsackie) microfiber abundance[5]
- White perch (n=43), 33 from Poughkeepsie and 10 from S. Coxsackie were obtained from the New York Department of Environmental Conservation (DEC) by net between 9//2/20 and 10/29/20.

Site description

- The Town of Poughkeepsie is approximately 31.3 square miles. It is an urban town with a population of 30,515 and 2 large scale WWTPs
- The town of Coxsackie is 36.9 square miles with a population of 8,485 and 1 WWTP

Sample Processing

- Methodology for processing samples followed the NOAA recommended wet peroxide oxidation[6]

Data Analysis

- Using a dissection microscope, each sample was characterized to type, color, and size.
- Average particle abundance among the two locations was calculated and compared

Fig.3. Wet peroxide oxidation

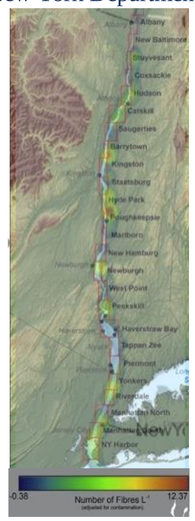

Fig.4 Scaled Map of locations along the river known to have an abundance of fibers

RESULTS

- Plastic found in 35 (81%) of 43 fish.
- Of the 129 size-separated samples, 56 samples (43%) contained particulate.

Type	Fragment	Fibers	Film	Bead	Foam	Total
# of particles	59 (50%)	57 (49%)	1 (1%)	0 (0%)	0 (0%)	117

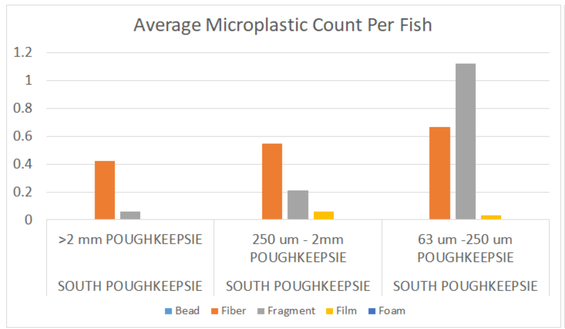

Fig. 5. Size-specific average particulate abundance for Poughkeepsie

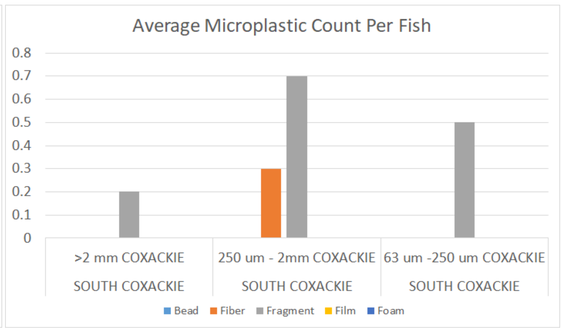

Fig.. 6. Size-specific average particulate abundance for Coxsackie

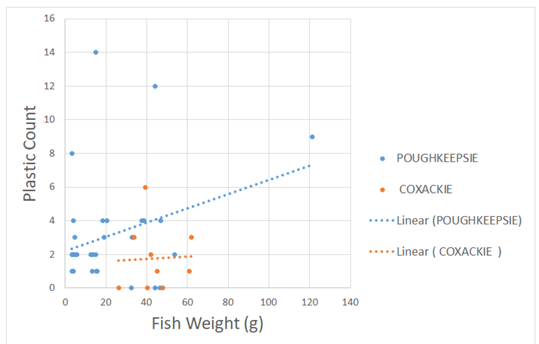

Fig. 7. Particulate abundance as a function of fish weight (g) Poughkeepsie: r2=0.0987, Coxsackie: r2=0.0017

CONCLUSIONS

- Poughkeepsie contained 2.3 times more microfibers than those sampled from Coxsackie
- Similar correlations to background river contamination
- The more bioavailable an element is in the environment, the more likely it is to be accessible for uptake by a consumer
- Many aquatic species are at risk of uptake and calls for regulations that will reduce the danger that the pollutants pose on aquatic ecosystems
- The results are consistent with expectations

DISCUSSION

Plastic Sources

- Fewer sources for contamination in Coxsackie
- Bigger fish in Poughkeepsie may be consuming more plastics
- WWTPs represent a likely pathway for microplastics to enter the aquatic environment
  - Poughkeepsie has 2 times the number of WWTPs and fish-ingested fibers

Plastic Types

- Frequency of fragments was not significantly different across the two locations
- Higher microfiber contamination was measured in White Perch sampled in Poughkeepsie than in South Coxsackie.

Potential Future Research

- Source of fiber vs fragments
- Impact of fish migration on plastic ingestion.

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