Case Study Exploration of Marine Biodiversity as a Function of Microplastics Pollution

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Abstract

Microplastics (particles ≤5mm), a prevalent form of debris in oceanic and freshwater bodies may contain chemical compounds which, when ingested, convey dangerous chemicals up the food chain. Our naturalistic survey assessed whether microplastics pollution may be associated with the marine invertebrate biodiversity of Long Beach. Twenty-one samples were collected. DNA was extracted using the silica method and amplified by PCR. Three species of sand crab were identified of which two were not indigenous to Long Beach (*Emerita analoga and Emerita portoricensis*). Additionally, two crane flies were identified as *Tipula oleracea,* native to Europe. Our findings suggest that Long Beach hosts an ecosystem with a geographically diverse spread of species. Further testing will verify the species, establish a microplastics count, and compare microplastics count by location.

Introduction

Masura, Baker, Foster, and Arthur (2015): microplastics are the most prevalent form of aquatic debris. 5mm or smaller, they enter the environment via runoff and proceed to break down into minute particles through mechanical, biological, and oxidative degradation. Ingested by marine life, these particles have a high chance of traveling up the marine food chain.

Magadini, D. L., Louw, R. S., Perez-Perez, Y., Sarker, R. T., Torrez, T., & Goes, J. I. (2018): bottom feeders like clams and mussels had hundreds of counts of plastics while mummichog fish samples had ingested hundreds of counts of plastic fibers.

Laws targeting microplastics pollution: Suffolk County passed a 2016 law charging customers for plastic bags. No known laws exist for Nassau County nor from New York City or New Jersey, the closest areas to the Long Island South Shore in the tri-state region.

Research goals: assess whether microplastics pollution may be associated with the marine invertebrate biodiversity of the Long Island's South Shore.

H1: Microplastics counts will increase as we sample westward along Long Beach.
H2: Microplastics counts will be inversely related to biodiversity.
H3: Marine biodiversity will decrease as we sample westward along Long Beach.

Materials & Methods

We constructed a core sample collector following the directions outlined by Tufts University. This allowed us to collect two cores from the site for analysis. We also used the head of a pool skimmer with a sturdy frame and fine mesh. This allowed sand to pass through the mesh leaving behind bits of broken shells and the collected specimens. As each wave receded, we placed an edge of the skimmer in the top inch or so of the sand. The receding wave washed through the mesh and collected some sand, shells and specimens. Lastly, we used mesh-lined pans to dredge the sand at the swash zone, 2-3 inches deep, and then sifted through the sand for specimens.

We used the silica method for isolating DNA from our samples after which we used PCR for amplification and electrophoresis for analysis and quality control. Results were analyzed were trimmed and matched using the DNA Subway.

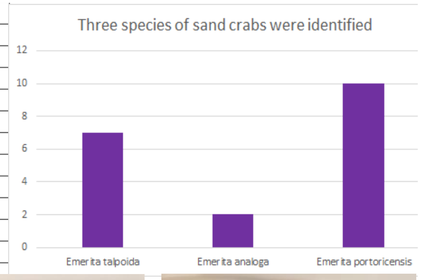
Results

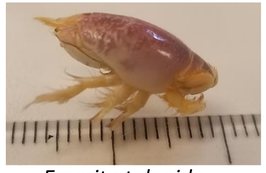
We identified 3 species of mole crab: *Emerita talpoida* (native to the American East Coast), *Emerita portoricensis (*Puerto Rico), and *Emerita analoga* (American West Coast). Additionally, we identified one species of crane flies (*Tipula oleracea).* This organism originates from Europe and was brought over as an invasive species.

Tables & Figures

DNA Subway BLASTN Results by Sample

PJM-001	*Emerita talpoida*	PJM-002	*Emerita analoga*
PJM-003	*Emerita talpoida*	PJM-004	*Tipula oleracea*
PJM-005	*Emerita talpoida*	PJM-006	*Tipula oleracea*
PJM-007	*Emerita analoga*	PJM-008	*Emerita talpoida*
PJM-009	*Emerita talpoida*	PJM-010	*Emerita talpoida*
PJM-011	*Emerita portoricensis*	PJM-012	*Emerita portoricensis*
PJM-013	*Emerita portoricensis*	PJM-014	*Emerita talpoida*
PJM-015	*Emerita portoricensis*	PJM-016	*Emerita portoricensis*
PJM-017	*Emerita portoricensis*	PJM-018	*Emerita portoricensis*
PJM-019	*Emerita portoricensis*	PJM-020	*Emerita portoricensis*
PJM-021	*Emerita portoricensis*		

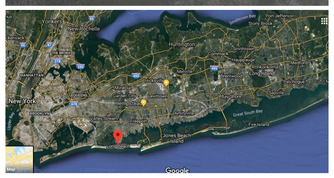




Emerita talpoida

Emerita portoricensis

Emerita analoga



Discussion

Two species were non-native to Long Beach: *Emerita portoricensis* (Puerto Rico) and *Emerita analoga* (American west coast). How did these crabs arrive? (1) We will examine whether the different species are consistently represented at all future collection points. (2) A future study could identify shipping routes and assess whether the populations of non-native crabs change as a function of proximity to shipping routes.

Crane flies originate from Europe and are an invasive species.

We intend to make this a multi-year effort, sampling more locations along Long Beach and testing for biodiversity and microplastics counts across locations. We will continue our research at Columbia University by counting the microplastics in each sample. Results may shed light on the increase in microplastics pollution up the food chain. These microplastics may contain toxins and may also absorb toxins found in polluted waters such as PCBs. Human consumption of seafood may lead to microplastics in the body.

References

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