Are the presence of Eastern Oysters in the Hudson River causing a flux of microplastics from the water column to the sediment?

Abstract

Microplastics, usually defined as plastic particles smaller than 5mm in size, have become a growing concern in marine environments. While there is extensive research regarding the concentrations of microplastics in the water column, (Cole et al. 2011), little to no research has been done to understand how much is entering the benthic environment. Bivalves could be an important component, acting as a mechanism for the transfer of microplastics from the water column to the benthos. If bivalves are filtering the plastic particles through the water, then they could be depositing the microplastics into the sediment as feces and pseudofeces. This work will provide a better understanding of filter feeders' contributions to the benthic flux of microplastics. We will suspend 3 groups of 3 cages with 3 sediment traps suspended to the bottom of each cage from Pier 26 off of the Hudson River in Manhattan, New York. Pier 26 is located at the most downstream section of the river, close to where the river deposits into the Atlantic Ocean. The first group of three cages will contain 25 live oysters. The second will have 25 empty oyster shells, where we will attempt to understand if microplastic concentrations are affected by the communities that surround oysters. The last group of cages will remain empty to act as a control. All 9 cages were suspended 8 feet below the water surface.

We plan to examine the microplastic samples after sieving, wet peroxide oxidation, and density separation. Due to the small sizes of the plastic particles that will be ingested by the oysters, the plastics will be analyzed through the Nile Red staining method to allow enumeration of microplastics that are smaller than 300 microns. We will then test for differences in microplastic accumulation in the sediment traps using a one-way ANOVA test. Based on the average rate that oysters filter water (30 Liters per day) and on the average concentration of microplastics in a downstream river 17.93 no. m^{-3} (McCormick et al., 2014), we expect to find about 605.5 microplastic particles per cage after two weeks of the oysters being suspended in the river. If we find that there are higher microplastic concentrations in the group with live oysters than the other two, then it is possible that the oysters are affecting the microplastic concentration in the sediment through their filter feeding. If so, future studies could be done to determine whether microplastics are entering the benthic food web.

Experimental Design:

We plan to set out 3 groups of 3 rectangular 20"x 6" cage bottoms. We will have 1 experimental group and 2 control groups. All 9 cages will be suspended from Pier 26 at the Hudson River 8 feet below the surface of the water. All cages will have 3 sediment traps attached to the bottom, each with a 6" diameter. Sediment traps will be constructed by attaching a tin funnel to a small mason jar, then attached to cages with wire. The first group of cages will contain 25 live oysters, the second will contain 25 empty oyster shells, and the third will be completely empty. These groups will help us determine if the concentrations of microplastics in the sediment are affected by the oyster's filter feeding. The first group (experimental) will catch oyster feces and pseudofeces which will be examined for microplastics. The second group (control) will help us determine how the communities that live around oysters and oyster shells affect how many

microplastics enter the sediment. The last group will (control) will increase our understanding of the microplastic concentration in sediment that is not due to oyster's or the communities that live around them. The oysters will be deployed for one week before the sediment traps are attached, to allow the oysters to become acclimated to their environment. After one week, the sediment traps will be attached to the cages and the cages will be deployed at Pier 26 for another two weeks. After two weeks, the samples will be examined using the Nile Red Staining method. This method will allow us to examine microplastics that are smaller than 300 microns, which we speculate will be the size of the majority of microplastic particles ingested by oysters. Because oysters filter about 100 Liters of water per day, if there are 17.3 microplastics per cubic meter in the Hudson River, we determined that we should find about 605.5 microplastics per cage after 14 days. We will analyze our results using a one-way ANOVA test. If the results are significantly different, it is possible that the oysters' filter feeding is acting as a mechanism to transfer microplastic particles from the water column to the sediment.