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Marine Biology

Using Stable Isotope Signatures to Identify Possible Anthropogenic Nutrient Sources

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Geukensia demissa, commonly referred to as ribbed mussels, are sessile, filter-feeding marine bivalves. Filter feeders such as these allow water in through their incurrent siphon, a tube-like structure, and then filtered by ctenidia. The mussels feed on what is left over after the filtering process, particulate organic matter (POM). As water filters through their internal structures, nitrogen and carbon become fixed in their tissues. Because *G. demissa* are sessile animals, the nitrogen and carbon collected in their tissues can be indicative of the environment in which they were found. Increases in anthropogenic sources of nitrogen have been linked to an increase in occurrences of eutrophication, which can have negative impacts on the environment, such as promotion of growth of harmful bacteria (Paerl 1997). The average δ15N levels for unimpacted groundwater range from -1.5 to 4.5% (McClelland et al. 1998). When affected by human waste these levels can reach 10-20% (Bannon 2008). Increased isotopic levels can be indications of source material that have the potential to cause harmful effects, making it important to monitor these parameters and be aware of the anthropogenic sources in an area. The goal of this study was to test ribbed mussel tissue and water samples for elevated δ15N and δ13C values through stable isotope analysis, and compare these results to literature values, as well as look for variations in results due to seasonality.

Ribbed mussel and water samples were collected from five locations along the Connecticut coast; Sandy Point Bird Sanctuary (SP), Morris Creek at Lighthouse Point Park (MC), Quinnipiac Meadows Nature Preserve (QM), Clinton Town Beach (C) and a salt marsh located on Grand Avenue (GA). The mussels were frozen for easy tissue extraction then dried until there was no excess water. 300mL of each water sample were filtered via vacuum filtration, then dried until only particulate matter remained. The samples were brought to the Yale Analytical and Stable Isotope Center, where they were frozen with liquid nitrogen and ground into a powder using a mortar and pestle. To test for δ^{15}N and δ^{13}C levels, a Costech 4010 Elemental Analyzer paired to a Thermo Delta Plus Advantage Isotope Ratio Mass Spectrometer containing the samples were run overnight. PAST software was used to run statistical analyses.

While the sites showed a small range in δ15N isotope rations, there was a broader range of δ13C ratios. Despite the small range in both δ15N and δ13C, individual samples from each site displayed scattered results with small areas of clustering, similar to the results obtained from same sites during the winter months (Stohm 2019). All samples produced δ15N levels between 10.4% and 12% indicating that there are anthropogenic sources affecting these areas. The

average levels at Sandy Point were less than the expected values regarding waters in the vicinity of wastewater treatment plants. This could be because the output pipe for the facility released the waste further into the body of water than the area from which the samples were gathered. Morris Creek produced the greatest δ15N levels of any location. This could be because this site was in close proximity to multiple sources with potential for anthropogenic waste, as opposed to other sites which were located to fewer potential sources. The results of the δ15N and δ13C levels in the particulate matter from all sites except Quinnipiac Meadows were inconclusive. This was most likely due to the high percentage of salts that made up the final PM sample.

Literature Cited

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