Microplastics in the Great Marsh, MA: A small problem with big implications

University of New Hampshire
Coastal Habitat Restoration Team

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Introduction

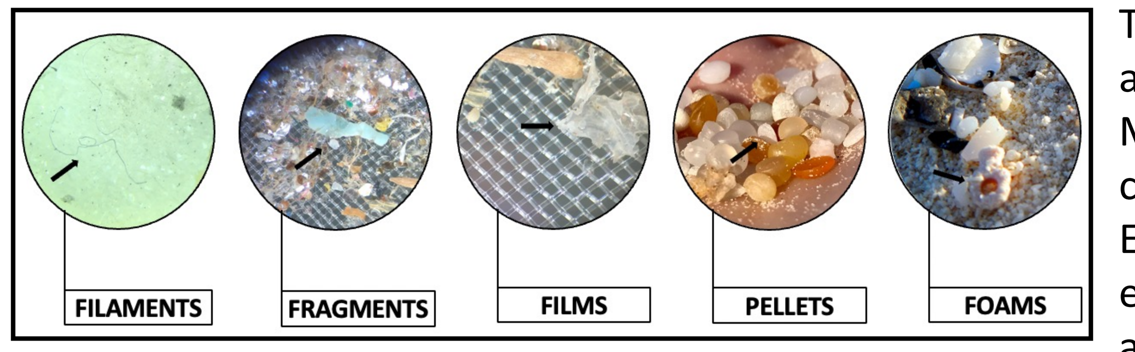


Figure 1: Five common types of microplastics: filaments, fragments, films, pellets, and foams. (Photo credit for last two images: NOAA, 2021)

The Great Marsh Estuary, spanning across the North Shore of Massachusetts, is the largest contiguous salt marsh in New England and provides critical ecosystems services at both local and regional scales. Situated between terrestrial and aquatic ecosystems, estuaries face high rates of contamination from land- based sources (Kennish 2002). Microplastics (Figure 1), defined as small plastic particles less than 5 mm in size, are one of these contaminants (Arthur et al. 2009). Their presence poses a threat to environmental and human health due to their accumulation in ecosystems, as well as their association with persistent, bioaccumulative, and toxic (PBT) chemicals (Rochman et al. 2013; Wright et al. 2013). To understand the presence of microplastics in the Great Marsh, a pilot study was conducted in October 2020.

Methodology

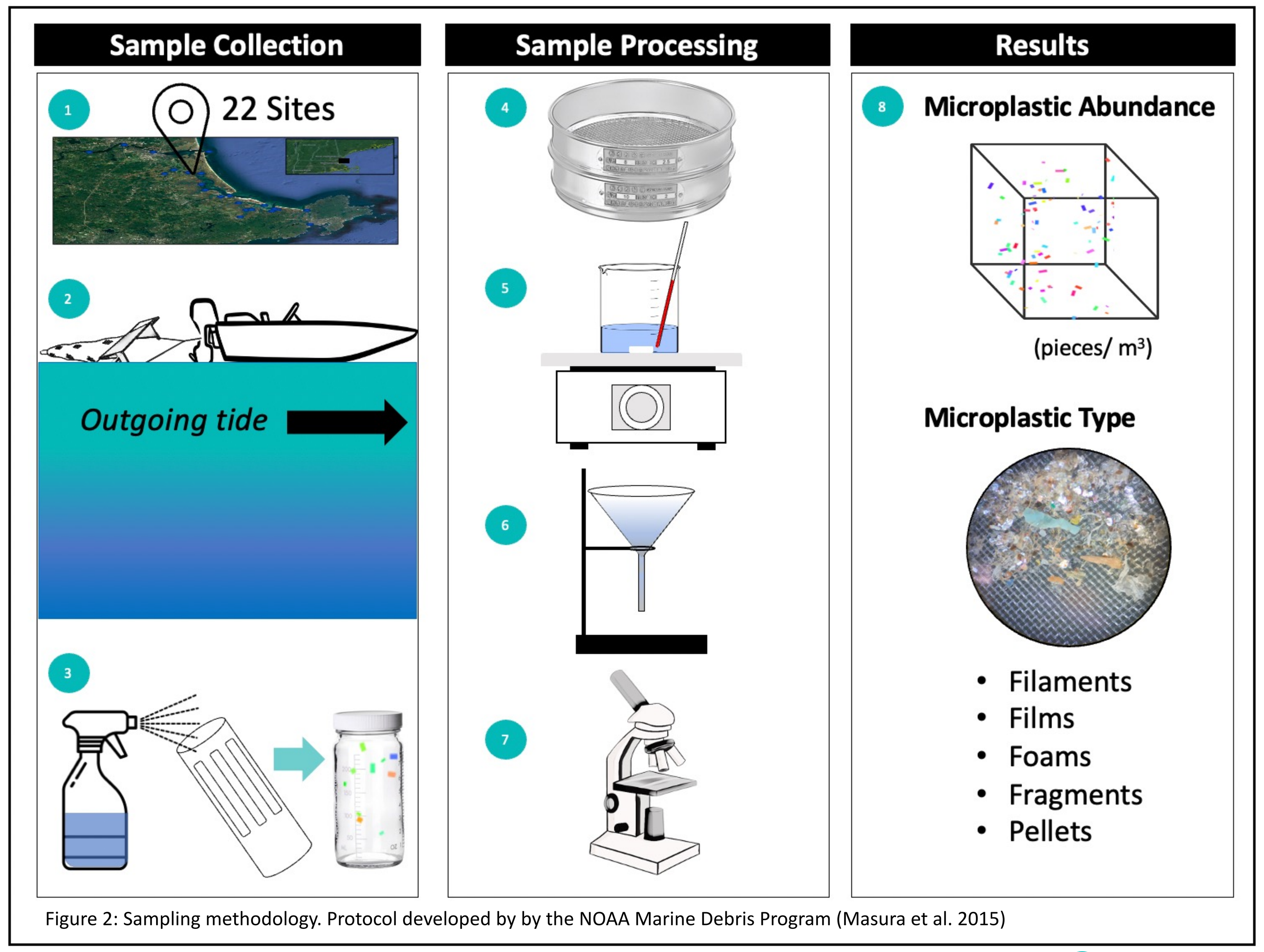


Figure 2: Sampling methodology. Protocol developed by by the NOAA Marine Debris Program (Masura et al. 2015)

1 Twenty-two locations were sampled in Great Marsh, MA in October 2020. 2 Surface water samples were collected using a 0.335 mm Manta Net with attached flow meter. 3 Collected material was backwashed into glass containers and stored at 4°C. 4 In lab, samples were wet sieved through two four-inch, 5.6-mm and 0.3-mm mesh sieves. Solids collected on the 0.3-mm sieve were retained and dried at 90 °C. 5 Wet peroxide oxidation was used to remove organic material from samples. 6 Samples were density separated using NaCl to isolate microplastics. 7 Floating solids were collected and microplastics removed under a dissecting scope at 40X magnification. Settled material was also scanned for microplastics. 8 All microplastics were removed, counted, sorted, and stored. Abundance (pieces/m3) and type were noted for each sample.

Results

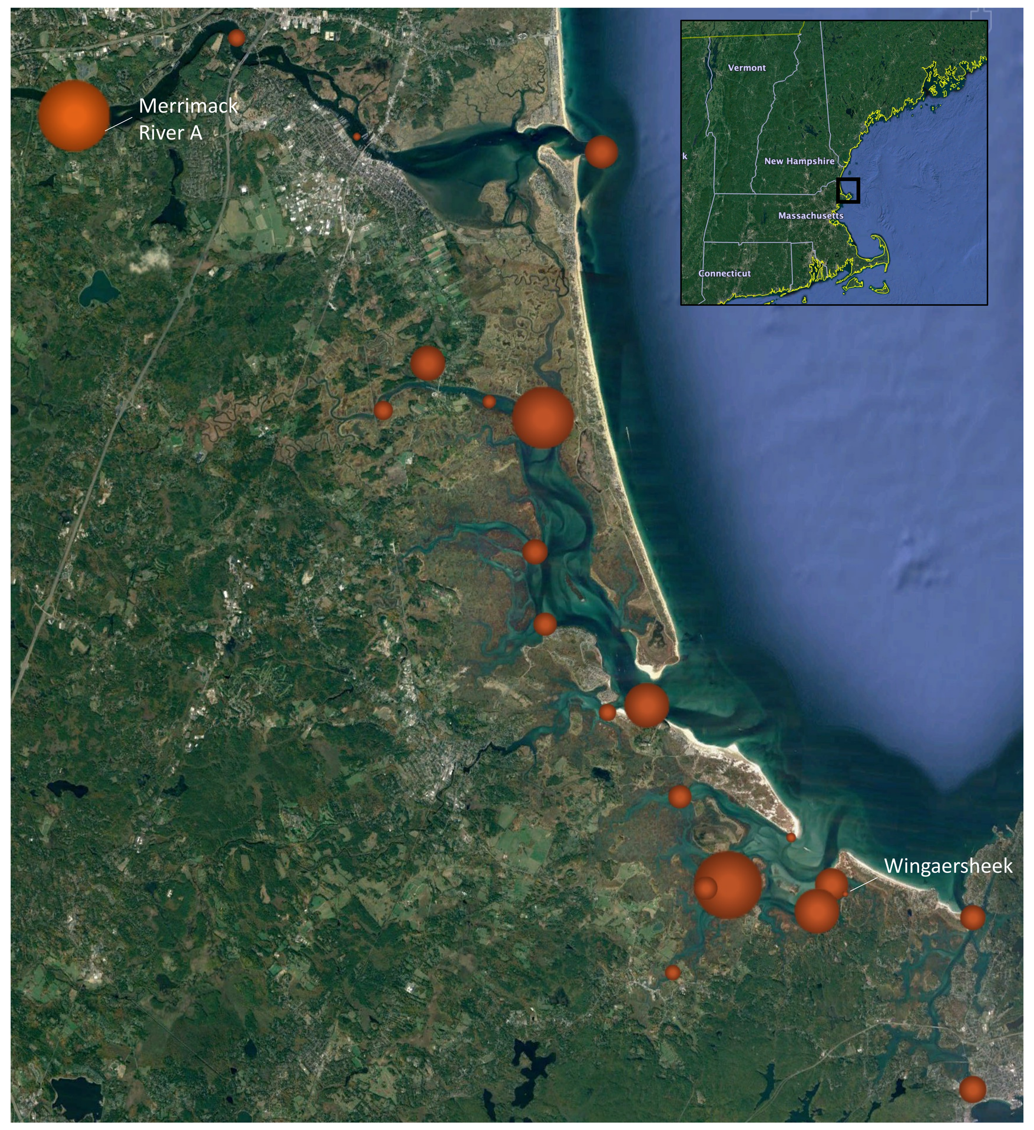


Figure 3: Sampling locations depicting microplastic volume (pieces/m³). Size of the marker indicates relative microplastic abundance.

- Microplastics were found in every sample collected (average= 1.522 ±0.205 pieces/m³). However, abundance varied spatially (Figure 3).
- The smallest number of microplastics were reported at Wingaersheek Harbor (0.315 pieces/m³) and the largest were reported at Merrimack River A (3.750 pieces/m³).
- While Merrimack River A was the most up-stream sampling location, and Wingaersheek was one of the most coastal, no relationship was found between distance up estuary and microplastic abundance (R^2=0.037, p>0.05).

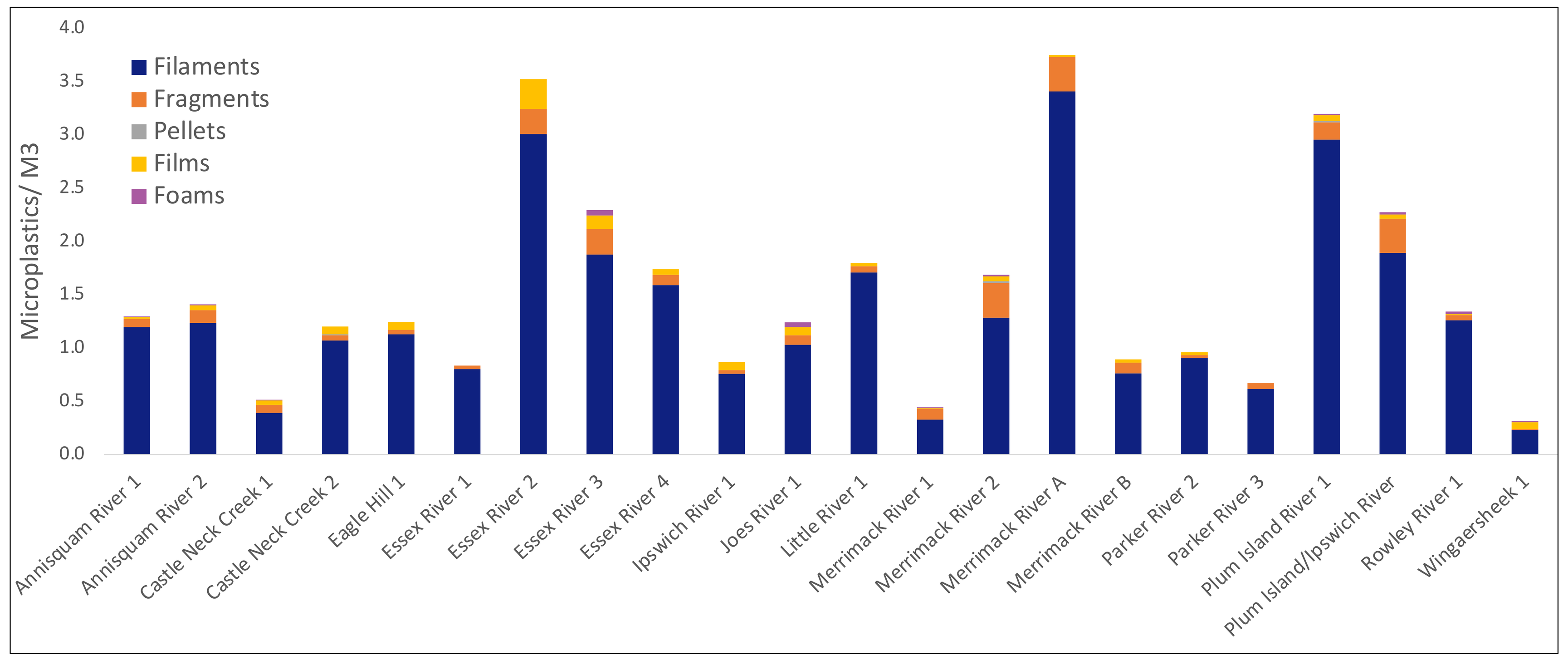


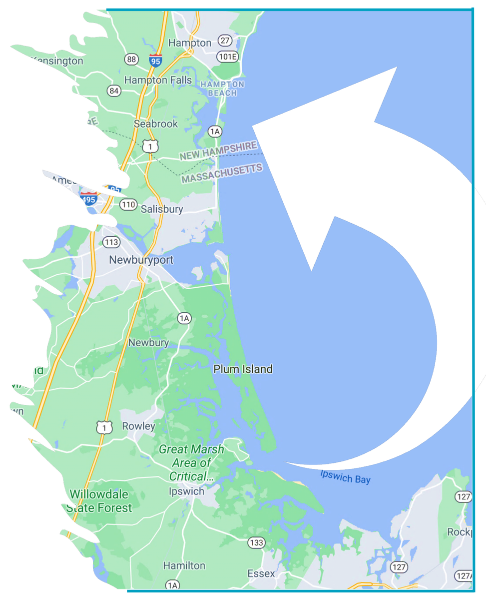
Figure 4: Microplastic concentration by location (pieces/ m³). Total volume is the sum of each contributing microplastic fraction (filament, fragment, pellet, films, and foam).

- Five different types of microplastics were found: filaments, fragments, pellets, films and foams (Figure 4).
- Filaments were the most abundant type found across all samples, ranging from 72.73-95.83%, followed by fragments, films, foams, and pellets.

Key Findings

- Microplastics are present within surface waters in the Great Marsh, MA.
- Average abundance of microplastics within the Great Marsh is consistent with other estuarine studies (Cohen et al. 2019; Yonkos et al. 2014).
- Abundance varied spatially, but did not correlate with distance up estuary.
- Five plastic types were found across samples, with filaments being the most common.

What's Next?



With a general knowledge of microplastic presence in the Great Marsh, we now seek to understand pathways of microplastic transport and drivers of movement in estuarine environments.

We will expand our study north to the Hampton-Seabrook Estuary. Here we will collect surface water samples during the summer of 2021. Microplastic abundance will be paired with environmental data, such as: tidal flow, salinity, temperature, precipitation, and proximity to point sources.

From this study, we hope to better understand microplastic import and transport in estuary systems to better inform local and regional management efforts.

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