COINAtlantic
COASTAL AND OCEAN INFORMATION NETWORK

Microplastics Research in the Saint John Harbour Executive Summary

This Executive Summary presents key takeaways from the growing body of research into plastic contamination in the Saint John Harbour (SJH), New Brunswick [1], and provides an overview of the results of surface water, subtidal, and intertidal microplastic sampling conducted by ACAP Saint John and University of New Brunswick researcher, Krista Beardy, in the SJH during the 2018 field season.

Plastics are the most common form of marine debris [2]. Their fragmentation– driven by exposure to UV radiation and physical abrasion– results in the formation of microplastics [3]. As an emerging field, much is still unknown about the impacts of microplastics, yet plastics are known to adsorb persistent organic pollutants (POPs) found throughout the marine environment [4]. When accidentally ingested, microplastics containing POPs are potentially dangerous to marine species due to the risk of biomagnification in marine food chain [5].

Microplastics are defined as plastic particles smaller than 5 millimeters, and take different forms depending on their source material. While authoritative descriptions of these forms have yet to be established, a compilation of sources suggest the following classifications [6]:

- Microbeads; resembling spherical, pellets
- Microfilms; thin, low density, flexible; common sources are consumer and industrial packaging and plastic bags
- Microfibers/threads; common sources are rope, clothing, fishing gear
- Foam; common source is polystyrene
- Micro-fragments; broken pieces, solid

Primary microplastics are deliberately manufactured as small pellets, beads and fragments, while secondary microplastics are resultant from the breakdown of larger plastics [7]. Terrestrial systems, such as surface waters, freshwater systems, wastewater treatment facilities, along with wind, transport plastics and microplastics into marine environments [8].

The Saint John River flows 673 kilometers through the traditional territory of the Maliseet People, including parts of New Brunswick, Quebec and Maine, and has a watershed spanning 55,000 square kilometres [9]. This massive watershed has been identified as a "Canadian Heritage Rivers System" and drains into the Bay of Fundy (BoF), which contains Ecologically or Biologically Significant Areas (EBSAs) [10]. The area yields significant economic contributions for the Maritimes Scotia Fundy Region, with fisheries valued at $3.4 billion CAD in 2017 [11]. A 2020 study has shown that the mean density of marine debris in the BoF was 137 pieces per square kilometer, with 51% comprising plastics [12]. The ecological and economic value of this watershed coupled with the signitritficant presence of plastic marine debris makes the SJH a prime location for sampling microplastics, to assess their pervasiveness, and support increased understanding of their impacts on the health of this system [13].

To further build on the microplastics research in the SJH, surface water, subtidal, and intertidal microplastics sampling were conducted during the 2018 field season. This work was funded by Environment and Climate Change Canada's Atlantic Ecosystems Initiative (AEI) and Fisheries and Oceans Canada's Ocean Protection Plan (OPP). The AEI Funding Program is aimed at improving the water quality, health, productivity and long-term sustainability of ecosystems in Atlantic Canada using ecosystem-based approaches. The Coastal Environmental Baseline Program, operating through OPP, is developing a baseline monitoring program for the SJH which includes monitoring protocols, strategies, and environmental indicators to measure impacts of human activities within this industrialized port.

In 2018, surface waters of the inner and outer SJH were sampled for microplastics by ACAP Saint John using a Low-Tech Aquatic Debris Instrument (LADI) trawl designed following protocol from the Civic Laboratory for Environmental Action Research (CLEAR) at Memorial University [14]. The greatest proportion of plastic found at each site (53 – 64%) were considered micro at < 5 mm. Microplastics were further subdivided into macro plastics if measuring > 25 mm, and meso if between 5 – 25 mm. Results showed that the most common type of plastic across the SJH was microfibers, with the inner harbour samples showing microfibers (78%), foam (8%), and equal amounts of threads, fragments, and named items (5% each), followed by film (2%). No microbeads or pellets were counted at either site. In the outer harbour, the most common type of microplastic was microfibers (48%) followed by threads (21%), fragments (19%), film (7%), and foam (5%). Densities of microplastics were lower in the inner harbour than outer, with 18,482 particles/km2 and 23,731 particles/km2, respectively.

In 2018, subtidal and intertidal sediments were sampled for microplastics at predetermined locations in the inner and outer SJH by Krista Beardy, in association with the University of New Brunswick [15]. A vessel-suspended benthic grab was used for subtidal sampling, and glass and metal collection devices were used for intertidal sampling. Intertidal microplastics were processed at a University of New Brunswick lab using same method as above. Sample locations and results of the subtidal and intertidal microplastics can be found on COINAtlantic's Saint John Harbour Environmental Data Map, featuring other ecological, physical, and chemical data from the SJH. In total, 679 microplastics were discovered over this study, categorized as four key forms: fibres, fragments, flakes and spheres. Fibres were by far the most common (83%) form of microplastic observed in sediment samples while spheres (0.6%) were the least common form. Fragments comprised 12.70% and film comprised 3.5%. The inner harbour sites showed similar amounts to the outer harbour sites with approximately 235 particles per kg of sediment and 248 particles per kg of sediment respectively.

These microplastic studies contribute to refining methods for detecting microplastics, improved understanding of microplastic impacts on the environment, and contribute to informing management strategies in the Saint John River and harbour. Other research contributing to increased understanding of the extent of microplastic presence in the harbour include a sediment study conducted by Forsythe (2016) and a sediment/bivalve study conducted by Beardy (Unpublished) that show microplastics in all bivalves tested from the BoF, and in all sediment samples from the SJH, ranging from 80 – 1,000 pieces of plastic per 2 kg sample. Additional AEI research includes a project mapping the spatial distribution of microplastics across the watershed, and a study of microplastic content in freshwater mussels and sediments, assisted by the Canadian Forces School of Military Engineering Army Dive Centre and the 5th Canadian Division Support Group Environmental Services Branch [16].

Given that commercial and industrial use of plastic remains high, it is vital to continue to monitor microplastics in the SJH and seek to understand the impacts. At present, a number of institutes and organizations are working on this issue including ACAP Saint John, Mount Saint Vincent University, and the Huntsman Marine Science Centre, with additional research in the Atlantic region by Coastal Action Foundation, University of New Brunswick, ACAP Humber Arm, and Memorial University of Newfoundland’s CLEAR Lab. A Microplastics Working Group was recently established through the Clean Foundation’s Ocean Summit, with the overall goal to work through community-based action to prevent the accumulation of microplastics in ecosystems across the region and toward other solutions [17]. Specific actions of the Working Group include the development of a data repository for microplastic work in Atlantic Canada, engaging communities in microplastic data collection on the use of standardized methods, as well as coordinating efforts around public engagement and education on microplastics.

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2. Goodman et al. 2020
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4. Karbalaei, Hanachi, Walker & Cole 2018
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12. Goodman et al. 2020
13. Reinhart & Power 2018
14. Coyle et al. 2016; Reinhart & Power, 2018
15. Beardy, unpublished
16. Environment and Climate Change Canada 2018a; ECCC 2018b; Mount Allison University 2019; National Defence 2019
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