Ariel Smith, Coastal and Marine Team Lead with the LADI Trawl Sampling in the LaHave River

ATLANTIC CANADA MICROPLASTIC RESEARCH PROJECT

Surface Water Results Summary (2018)

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Clean Annapolis River Project

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Background

Microplastics, categorized as particles less than 5 mm in size, have been found in rivers, lakes, and oceans, including shoreline sediment, sea ice, and arctic environments. Due to the boom of plastic production since the 1950's, Jambeck et al. (2015) estimate that between 4.8 and 12.7 metric tons (MT) of plastic has found its way to the ocean, roughly 80% coming from land-based sources. Larger plastics easily degrade into microplastics via sun, wind, and wave exposure, making particles difficult to detect and impossible to cleanup. Microplastics can have both physical and chemical impacts to aquatic life, with research showing that plastics have been ingested by species such as zooplankton, bivalves, fish, and whales (Jambeck et al., 2015). Implications for species health correlate to potential impacts on human health and economic systems, due to our dependence on freshwater and marine environments. Plastics have also been detected in tap water and bottled drinking water, posing additional questions regarding the risks microplastics can have on human health (WHO, 2019). Current research has been focused on these questions, delving deeper into the issue of short-term and long-term effects of microplastics on wildlife and human health.

In Atlantic Canada, minimal data has been collected on microplastics in aquatic and marine environments, with no studies focusing on the issue from a regional context. Coastal Action's *Atlantic Canada Microplastic Research Project* was developed to fill this research gap, by creating a baseline understanding of the issue with a regional lens. This research will contribute to solution initiatives around plastic pollution, focusing efforts on reduction and prevention strategies.

Project Overview

The purpose of the Atlantic Canada Microplastic Research Project (2017-2020) is to determine the quantity and type of microplastics in 3 near-shore communities of Atlantic Canada: LaHave River Estuary, Annapolis Basin and Bay of Islands (Fig. 1). The data will be used to inform solutions around plastic pollution in the region. The project is funded by Environment and Climate Change Canada's Atlantic Ecosystem Initiative and is in partnership with Clean Annapolis River Project (CARP), ACAP Humber Arm, and Dr. Max Liboiron at the Civic Laboratory for Environmental Action Research (CLEAR) out of Memorial University of Newfoundland (MUN). Dr. Max Liboiron is the chief academic advisor on the 3-year project, assisting with project development, methods and protocol, and sampling design. The project included sampling both surface water and beach sediment at all three study locations. The surface water trawling equipment was built using CLEAR's low-aquatic debris instrument (LADI) design. This document contains the results from the 2018 surface water samples and Fourier transform infrared (FTIR) spectroscopy, conducted by Surface Science Western at the University of Western Ontario (Surface Science Western, 2020). Sediment data results for 2018 and hot-spot data from 2019 will be available in 2020.

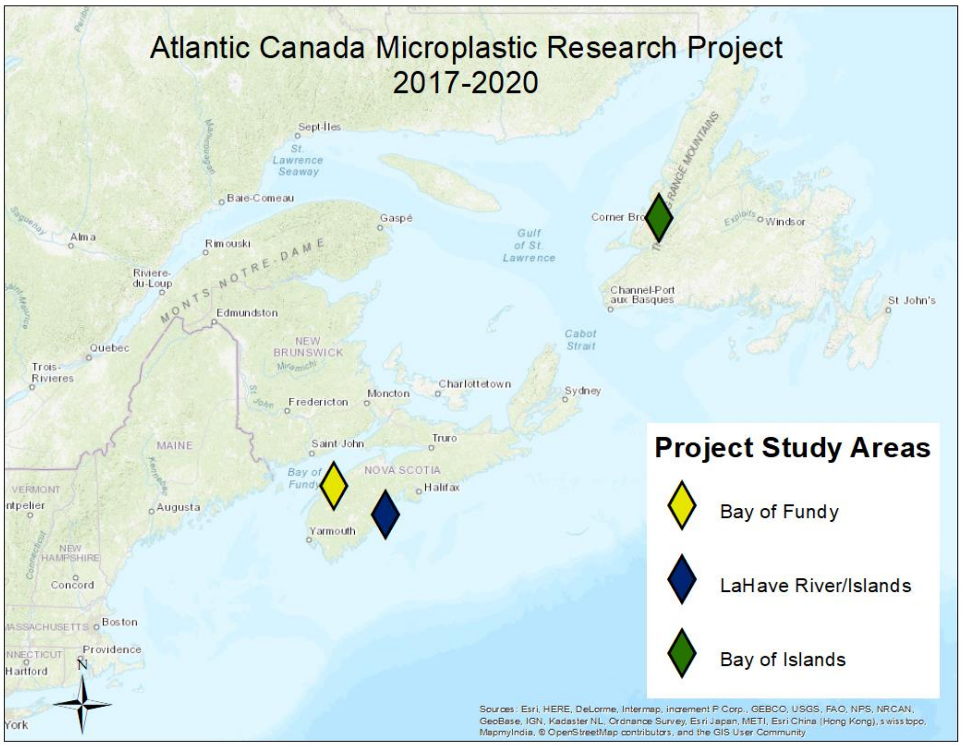

Figure 1. Three near-shore study locations were sampled as part of the project: LaHave River and Islands (Coastal Action), the Bay of Fundy, NS (CARP), the Bay of Islands, NL (ACAP-Humber Arm).

Surface Water Results (2018)

All Locations

Plastics found in the samples are categorized into 8 types (Table 1) and are classified into 3 size groups: macro (>25 mm), meso (5-25 mm), and micro (<5 mm) (Table 2). All surface water samples were collected between June and September 2018.

Table 1. Terminology used to describe types of plastic found in samples and used in analysis.

Terminology	Definition
Microfibers	Microfibers are thinner and kinked compared to threads - usually from synthetic fabrics
Threads	Threads are thick filaments, such as fishing line
Fragments	Hard plastic fragments, though they can be flexible
Foam	Such as Styrofoam - bounces back to the touch, has air pockets
Film	Sheet plastics, such as plastic bags. However, not synonymous with plastic bags
Microbeads	Small spheres from cosmetics
Pellets	Industrial pre-production pellets, or nurdles
Named item (Macro)	If an item is large in size (macro plastic) and can be identified, i.e. cigarette butt, which is technically many hundreds of thousands of microfibers
Total plastics	Total number of plastics in a trawl sample

Table 2. Total plastics found in surface water at sampled sites in Lunenburg (5 sites, sampled June through August 2018 by Coastal Action), Bay of Fundy (6 sites, sampled June through August 2018 by CARP) and in Newfoundland (8 sites, sampled July 2018 by ACAP Humber Arm). Analysis completed by CLEAR. Size classifications for plastics are macro (>25 mm), meso (5-25 mm), and micro (<5 mm).

Location	Site	Macro	Meso	Micro	Total Plastics
LaHave, NS	1 – Green Bay, LaHave	0	2	13	15
	2 – Mouth of River, LaHave	4	3	15	22
	3 – Hartling Bay, LaHave	1	6	20	27
	4 – LaHave River	2	7	16	24
	5 – Lunenburg	0	0	11	12
	Total	7	18	75	100
Bay of Fundy, NS	1 – Above Causeway	1	7	17	25
	2 – Bear River	2	8	8	18
	3 – Below Causeway	1	1	4	6
	4 – Digby	1	4	2	7
	5 – Goat Island	0	7	12	19
	6 – Victoria Beach	3	8	35	46
	Total	8	35	78	121
Bay of Islands, NL	1 – Corner Brook	13	6	31	53
	2 – Mont Moria / Curling	0	0	3	3
	3 – Summerside	5	17	31	53
	4 – Gillams / Meadows	2	4	7	13
	5 – Frenchman's Cove	0	0	4	4
	6 – Benoit's Cove	3	9	38	50
	7 – York Harbour	0	1	6	7
	8 – Lark Harbour	0	3	1	4
	Total	23	40	121	187

At the LaHave location, the Hartling Bay surface water samples had the most plastic. The LaHave River and the Mouth of the River had similar amounts of plastic, slightly less than Hartling Bay which is in the LaHave watershed (Table 2; Fig. 2). In the Bay of Fundy, the Victoria Beach surface water samples had the most plastic, with other sites containing approximately 50% less than the

Victoria Beach amount (Table 2; Fig. 2). In the Bay of Islands, Corner Brook and Summerside surface water samples had the most plastic, and Benoit's Cove had similar results. All other sampled sites had much less plastic (Table 2; Fig. 2). For sizing, microplastic composed the largest proportion of total plastics in all sampled areas (Fig. 2).

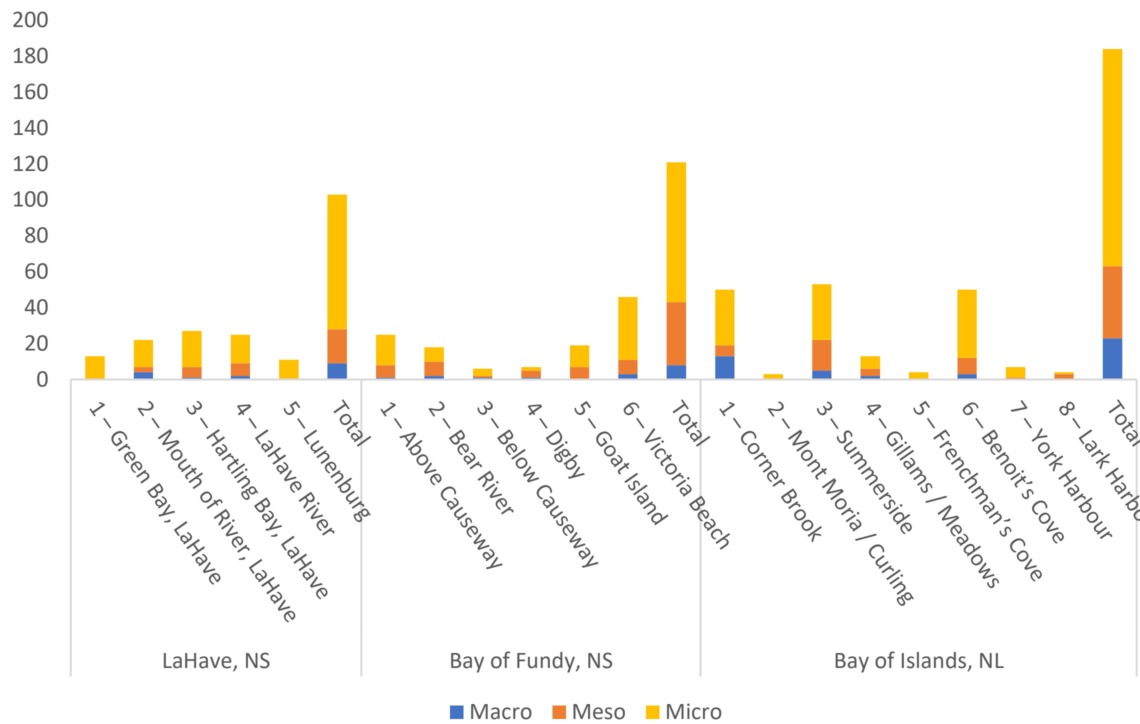

Figure 2. Graph showing total plastics found in surface water at sampled sites in Lunenburg (5 sites, sampled in June through August 2018 by Coastal Action), Bay of Fundy (6 sites, sampled in June through August 2018 by CARP) and in Newfoundland (8 sites, sampled in July 2018 by ACAP Humber Arm). Analysis completed by CLEAR Laboratory. Size classifications for plastics are macro (>25 mm), meso (5-25 mm), and micro (<5 mm).

Important Note: *These sums do not account for the volume of water sampled and are therefore not directly comparable. A comparable density measure will include the total area per trawl divided by the surface area sampled.*

At all three locations, plastic fragments (42%) and threads (30%) were the most common types of plastics found among the samples, followed by foam (10%) and film (8%) (Fig. 3).

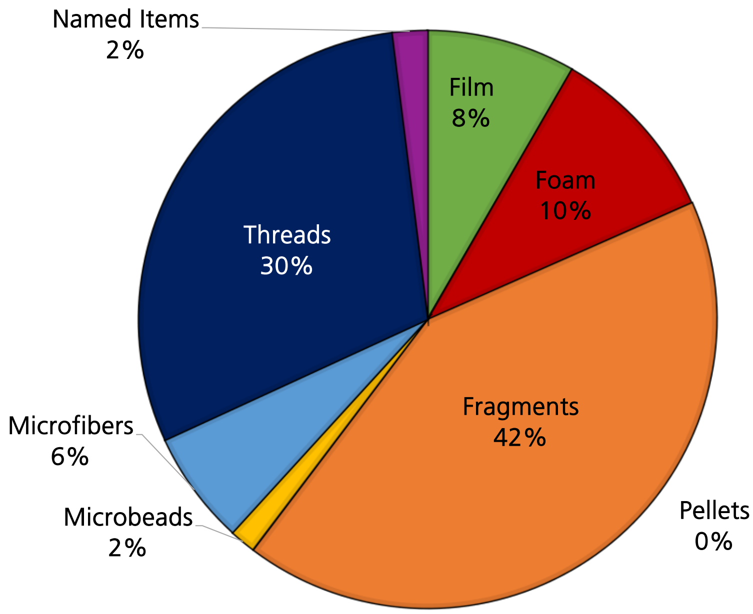

Figure 3. Proportion of plastic types found across all three locations (sampled June to September 2018); LaHave/Lunenburg (5 sites, sampled by Coastal Action), Bay of Fundy (6 sites, sampled by CARP) and in Newfoundland (8 sites by ACAP Humber Arm). Analysis completed by CLEAR Laboratory. No pellets were found in the samples.

FTIR Findings

FTIR uses optical spectroscopy to determine the chemical composition of the materials found in a sample, by assessing the bonding of each material. FTIR helps to identify potential sources and impacts of microplastics found (Table 3). To determine composition effectively, bonds need to be present in greater than 3-5% for classification (SSW, 2020). Samples are then compared against known common plastics and fibers. Particles that did not match known plastics and fibers were classified as uncommon commercial plastics. If the particle was consistent with known materials it was identified to the greatest degree possible.

Table 3. Types of chemical bonds identified with FTIR for all samples and their likely source.

Chemical Bond	Definition & Likely Sources
ABS	Acrylonitrile-butadiene-styrene; Common thermoplastic used to make light, rigid, molded products such as pipe, automotive body parts, wheel covers, enclosures, protective head gear, etc. (McKeen, 2019).
Alkyd	Type of polyester resin used as a coating binder, from baking enamel to a clear wood finish (Campbell, 2001); Likely a paint.
Calcium Carbonate ($CaCO_3$)	Common plastics filler used with several thermoplastics (like PVC floor tiles) and with thermosets (like polyesters in sheet molding compounds). $CaCO_3$ is abundantly available in nature as limestone, chalkboard, or marble (Mallick, 2000).
Cellulosic	Encompasses plant materials, polysaccharides, oligosaccharides, cotton, rayon and derivatives of these, often occurring in combination; Likely a biofilm (combination of cells and secrete polysaccharides; SSW, 2020).
EPDM	Ethylene propylene diene terpolymer; Elastomer in many automotive applications that is anti-corrosive and heat resistant (Choudhury et al., 2008).
HC	Hydrocarbon, made exclusively from carbon and hydrogen; Dominant in crude oil, processed petroleum hydrocarbons (gasoline, diesel, kerosene, fuel oil, and lubricating oil), coal tar, creosote, dyestuff, and pyrolysis waste products (Abrajano et al., 2007).
Inorganic	Materials that are uncommon commercial plastics and are not natural substances (Oxford Dictionary, n.d.).
Metal carboxylate	Formed by combining metals with carboylic acid; Used in lubricants, paints and waterproofing materials (Lincy et al., 2012).
N'N'-Methylenediacrylamide	White substance used in cleaning products and food packaging (packaging, paper plates, cutlery, and small appliances, personal care products. Products are related to fracking and natural gas (National Library of Medicine, n.d.).
PET	Polyethylene terephthalate polyester; Thermoplastic polymer resin of the polyester family, used in food and drink containers (very common in plastic waste bottles), electronic components, and fibers in clothes. Recycled PET bottles are used to make fleece garments, as well as plastic bottles (Crawford & Quinn, 2016).
Phthalate	Used to soften plastics and increase flexibility, and as solvents in household products; Found in self-care products, constructions and renovation products, fabrics and textiles, electrical items and electronics, children's toys, printing inks, automotive and pest control products, and some food packaging materials (Health Canada, 2019).
Polyacrylonitrile	Synthetic resin in the acrylic family that is a hard thermoplastic; Commonly used as a substitute for wool in clothing and furniture (Encyclopedia Britannica, 2014).

Polyamide	Encompass both proteinaceous materials and plastics commonly referred to as nylon (SSW, 2020).
Polyethylene	Most popular plastic used worldwide produced from ethylene gas; The resins are tailored for specific applications such as packaging films, rigid containers, drums, and pipes based on density and melt index (Patel, 2016).
Polypropylene	Thermoplastic polymer used in a wide variety of applications, including textile fibers, fishing rope and nets, packaging and labeling, plastic parts and reusable containers of various types, laboratory equipment, automotive components, etc. (Qin, 2016).
Polystyrene	Synthetic styrene polymer resin that is hard, stiff, and transparent. Used widely in the food-service industry as rigid trays and containers, disposable eating utensils, and foamed cups, plates, and bowls (Encyclopedia Britannica, 2018).
Polyurethane / Polyester	Tough elastic polymer used as adhesives, coatings, sealants, rigid and flexible foams, and textile fibers (like polyester). Also used in biomaterial applications such as artificial pacemaker lead insulation, catheters, vascular grafts, heart assist balloon pumps, artificial heart bladders, and wound dressings (Heath & Cooper, 2013).
Polyvinylacetate	Synthetic vinyl acetate polymer resin used as the film-forming ingredient in water-based (latex) paints, and is used in adhesives (Encyclopedia Britannica, 2020).
PVC	Polyvinyl chloride; Synthetic vinyl chloride polymer resin, second most popular plastic by consumption; Used in an enormous range of domestic and industrial products, from raincoats and shower curtains to window frames and indoor plumbing. It is a lightweight and rigid plastic in its pure form and is also manufactured in a flexible “plasticized” form (Encyclopedia Britannica, 2019).
Rubber	Highly elastic material made by chemically treating and toughening natural rubber or created synthetically; used in the manufacture of erasers, electrical insulation, elastic bands, crepe soles, toys, water hoses, tires, and many other products (Dictionary.com, n.d.).
Silicate	Natural mineral made of silicon-oxygen compounds that are widely distributed throughout the solar system (Encyclopedia Britannica, 2018).
Silicone	Diverse class of fluids, resins, or elastomers based on polymerized siloxanes, composed of silicon and oxygen atoms. Silicone is inert, water and oxidation resistant, and stable at all temperatures, being used for range of commercial applications, from lubricating greases to electrical-wire insulation and biomedical implants (Encyclopedia Britannica, 2020).
Talc	Naturally occurring mineral that is used in self-care products, food, paint, paper, plastics, ceramics and prescription drugs (Health Canada, 2019)

FTIR analysis found over 20 different chemical bonds present across samples from all sites (Fig. 4). Polypropylene accounted for nearly a quarter (22%) of all particles found across all three locations. The high percentage of polypropylene may be attributed to the high presence of fishing activity in Atlantic Canada, which uses rope and netting made of polypropylene (Goodman et al., 2019). However, pinpointing exact sources of the particles is challenging due to the multiple uses of polypropylene in many commercial and industrial products (Qin, 2016). Polyethylene (14%), cellulosic particles (14%), and uncommon commercial plastics (10%) were also prominent, followed by polystyrene (8%). The project's findings show that polyethylene is among the dominant chemical present, which is in line with research showing that polyethylene is the most common commercial plastic by use and volume (Patel, 2016).

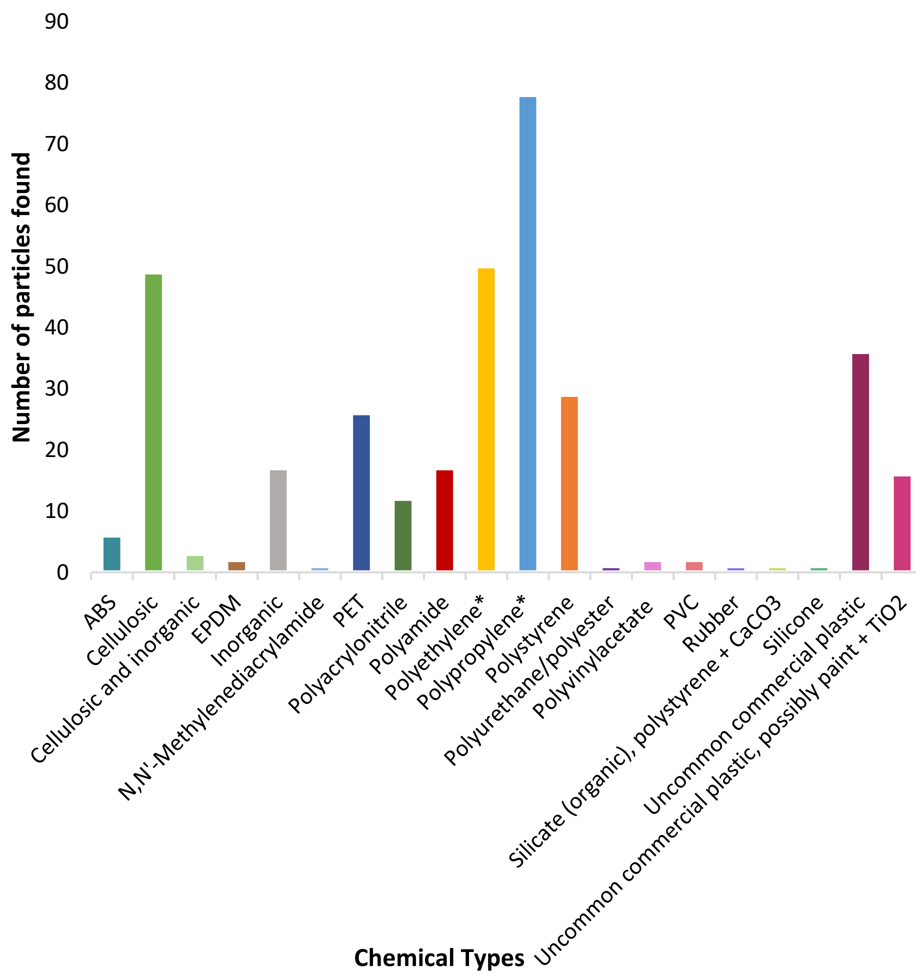

Figure 4. Graphical representation of the number of particles per chemical bond identified through FTIR analysis across all sites. FTIR Analysis was completed by Surface Science Western out of the University of Western Ontario in January and February of 2020. The asterixis indicate that mixes containing that chemical have been amalgamated for representation.

LaHave River Estuary, Nova Scotia

Sampling by Coastal Action

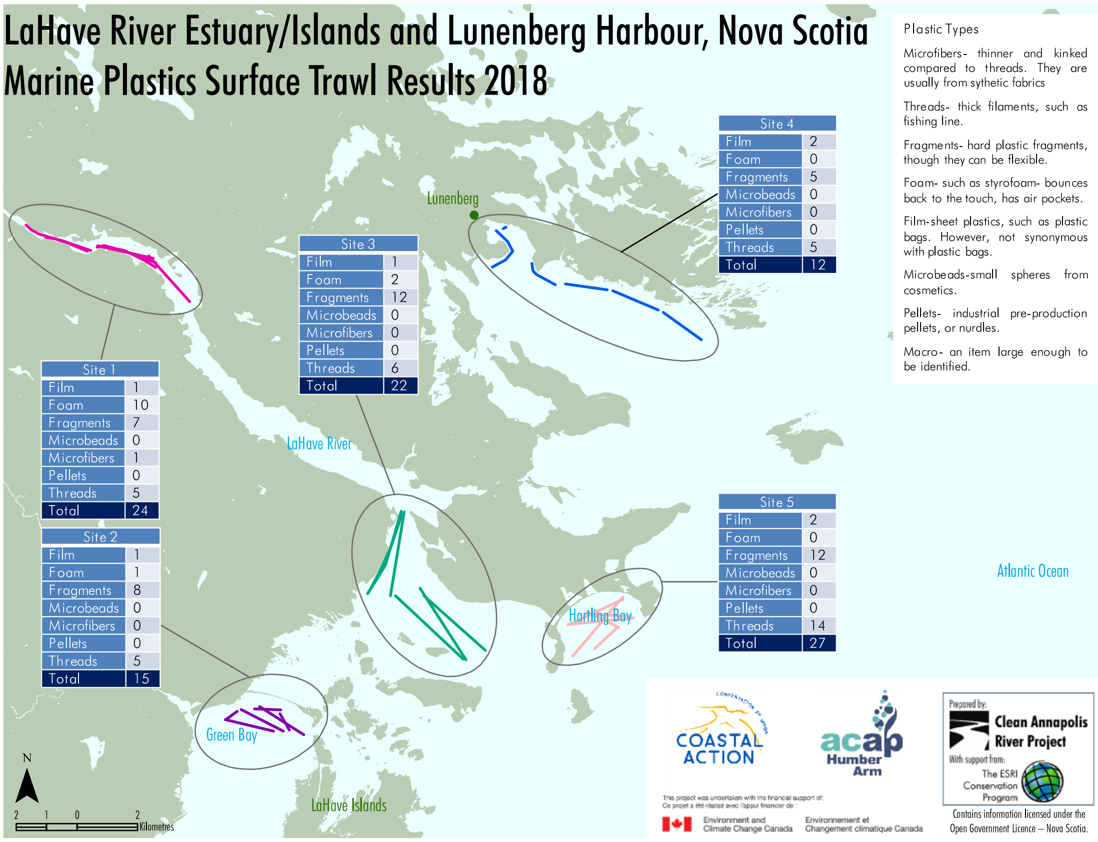

Figure 5. Map of surface water sampling sites in LaHave River Estuary/Islands and Lunenburg taken in August 2018 by Coastal Action.

Surface water sampling in LaHave River Estuary, LaHave Islands, and Lunenburg Harbour took place at 5 sites (Fig. 5). All sites had plastic film, fragments, and thread present in the samples (Table 5). The LaHave River (site 1) samples had the greatest amount of foam in comparison to surface waters at other sampled sites (Table 5), composing 71% of all foam found. Hartling Bay (site 5) surface water samples had the greatest amount of threads in comparison to other samples (Table 5), composing 38% of all threads found. Plastic fragments (44%) and threads (34%) made up most of the total plastics found in the LaHave Estuary surface water samples (Fig. 6).

Table 4. Breakdown of plastic type found in surface water at each site in Lunenburg, summarized by category. Samples were collected by Coastal Action in June through August of 2018, analysis completed by CLEAR Laboratory.

Site	Film	Foam	Fragments	Microbeads	Microfibers	Pellets	Threads	Named Items	Total Plastics
1 – Green Bay, LaHave	1	1	8	0	0	0	5	0	15
2 – Mouth of River, LaHave	1	3	12	0	0	0	6	0	22
3 – Hartling Bay, LaHave	2	0	12	0	0	0	13	0	27
4 – LaHave River	1	10	7	0	1	0	5	0	24
5 – Lunenburg	2	0	5	0	0	0	5	0	12
Total	7	14	44	0	1	0	34	0	100

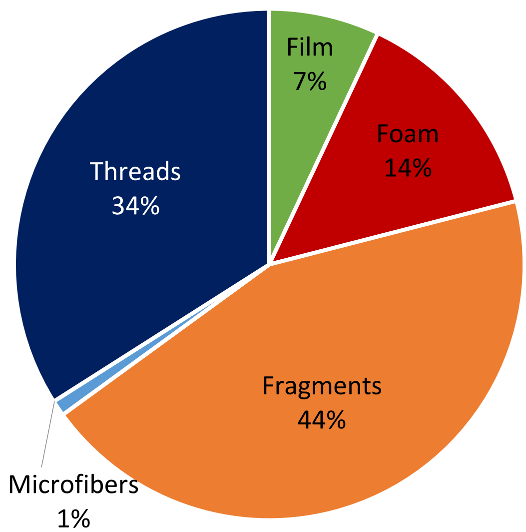

Figure 6. Proportion of plastics found in all surface water samples in LaHave/Lunenburg: film 7%, foam 14%, fragment 44%, microbeads 0%, microfibers 1% and threads 34%. Samples were collected by Coastal Action in June through August of 2018, analysis completed by CLEAR Laboratory.

FTIR Findings

Polypropylene (16%) and polyethene (16%) made up the largest portion of plastics found in the LaHave/Lunenburg area, followed by polystyrene (13%) and cellulosic bonds (11%; Fig. 7). Uncommon commercial plastics (11%) were mainly composed of alkyds and talc, which are likely from paint (Fig. 8).

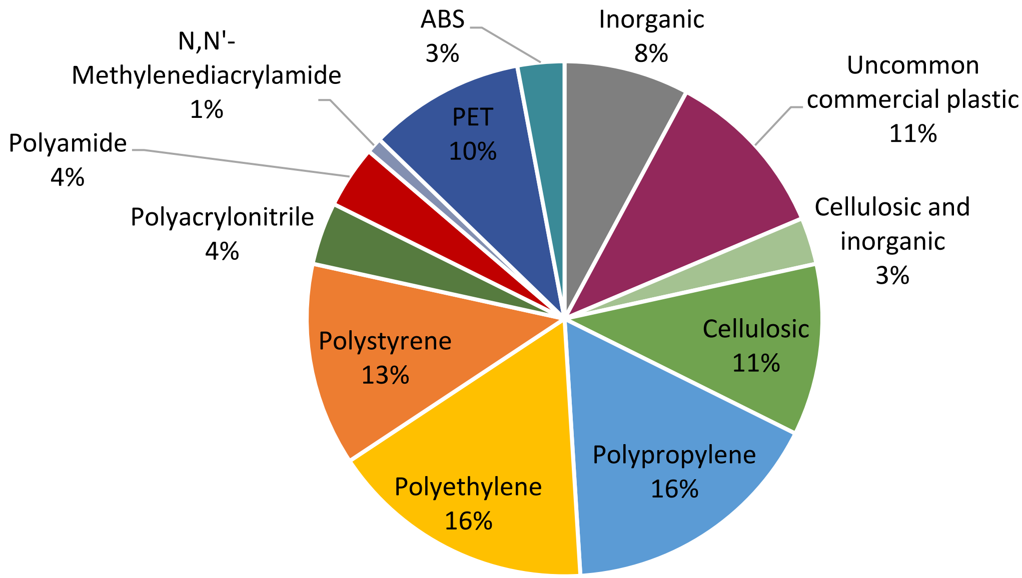

Figure 7. Proportions of chemicals found in all surface water samples at the LaHave/Lunenburg sites. Samples were collected by Coastal Action and FTIR analysis completed by Surface Science Western. Chemical composition of uncommon commercial plastic found in LaHave River Estuary, LaHave Islands, Lunenburg have been expanded upon in Figure 8.

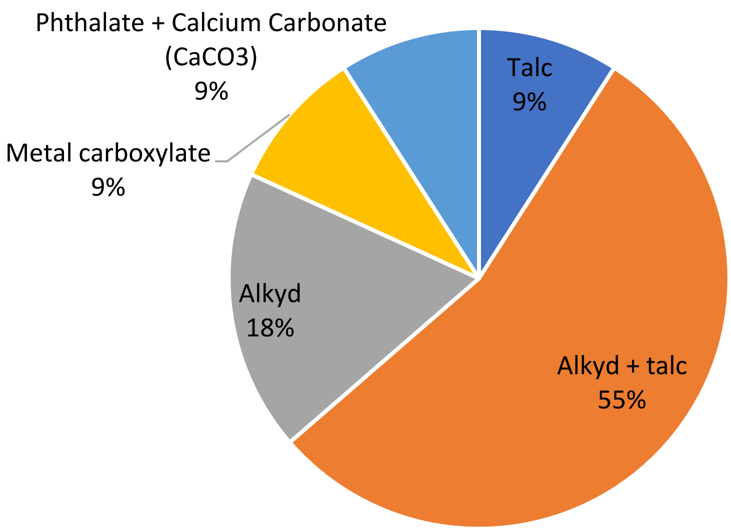

Figure 8. Chemical compositions of uncommon commercial plastics found in LaHave/Lunenburg samples. Analysis completed by Surface Science Western.

Across all sites in the LaHave/Lunenburg area, plastic fragments were composed of a mix of chemicals, but were mainly polyethylene, uncommon commercial plastics, and cellulose. Threads were found at all sites and were composed of mixed materials but were primarily polypropylene.

Film plastic made of polyethylene was found in the mouth of the LaHave River (site 3), Hartling Bay (site 5) and in Lunenburg Harbour (site 4). Foam and white foam-like particles were identified as polystyrene and found in samples from the LaHave River and the mouth of LaHave River (site 1 and 3).

Hartling Bay had the most microplastics among the sites sampled in the LaHave Estuary and had the greatest variety of chemical compositions. The combined outflow from the LaHave River mixing with inflow from the ocean tides likely creates strong mixing of materials, along with nutrients from the estuary (NOAA, 2004; Fig. 5). The variety of chemical bonds in Hartling Bay may also be attributed to its geographic positioning as a catchment beach that is heavily influenced by sediment transport, allowing chemicals to become easily trapped in Hartling Bay (Park et al., 2019).

Annapolis Basin, Bay of Fundy, Nova Scotia

Sampling by Clean Annapolis River Project (CARP)

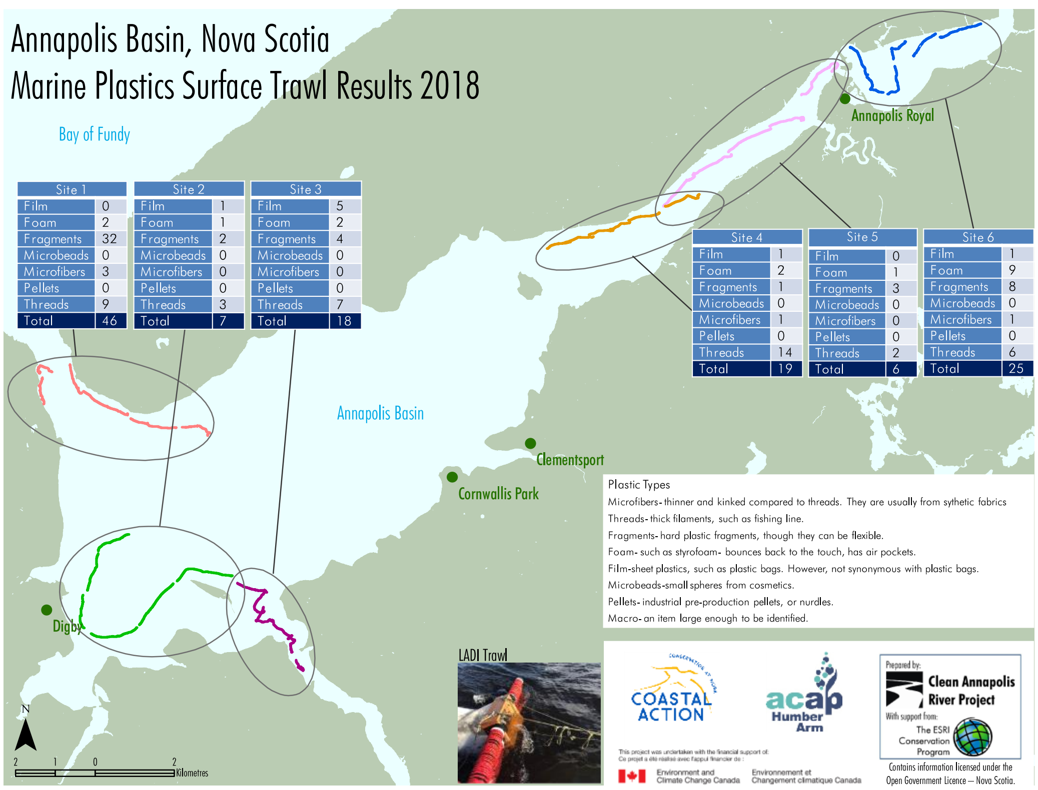

Figure 9. Map of surface water sampling sites in the Bay of Fundy taken in June through August 2018 by Clean Annapolis River Project (CARP).

Surface water sampling in the Annapolis Basin, Bay of Fundy, took place at 6 different sites (Fig. 9). All sites had plastic fragments and thread in their samples (Table 6). Victoria Beach (site 1) surface water samples had the greatest number of fragments in comparison to other sampled sites, composing 67% of all fragments found.

Table 5. Breakdown of plastic type found in surface water at each site in the Bay of Fundy, summarized by category. Samples were collected by CARP in June through August of 2018, analysis competed by CLEAR Laboratory.

Site	Film	Foam	Fragments	Microbeads	Microfibers	Pellets	Threads	Named Items	Total Plastics
1 – Above Causeway	1	9	8	0	1	0	6	0	25
2 – Bear River	5	2	4	0	0	0	7	0	18
3 – Below Causeway	0	0	1	3	0	0	2	0	6
4 – Digby	1	1	2	0	0	0	3	0	7
5 – Goat Island	1	2	1	0	1	0	14	0	19
6 – Victoria Beach	0	2	32	0	3	0	9	0	46
Total	8	16	48	3	5	0	41	0	121

Plastic fragments (40%) and threads (34%) made up most of the total plastics in Bay of Fundy surface water sites (Fig. 10).

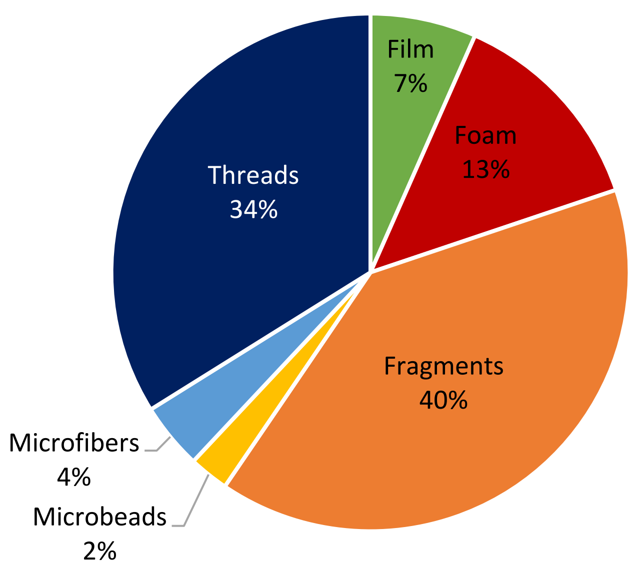

Figure 10. Proportion of plastics found in all surface water samples in the Bay of Fundy: film 7%, foam 13 %, fragment 40%, microbeads 2%, microfibers 4% and threads 34%. Samples were collected by CARP in June through August of 2018, analysis competed by CLEAR Laboratory.

FTIR Findings

Polypropylene (15%) and polyethylene (15%), were the dominant chemical bonds found in the Bay of Fundy samples, followed by uncommon commercial plastics (14%) and a mix of paint and titanium dioxide (TiO_2; 15%; Fig 11). When combining the mixed samples, polypropylene would remain dominant (17%) followed by polyethylene (16%).

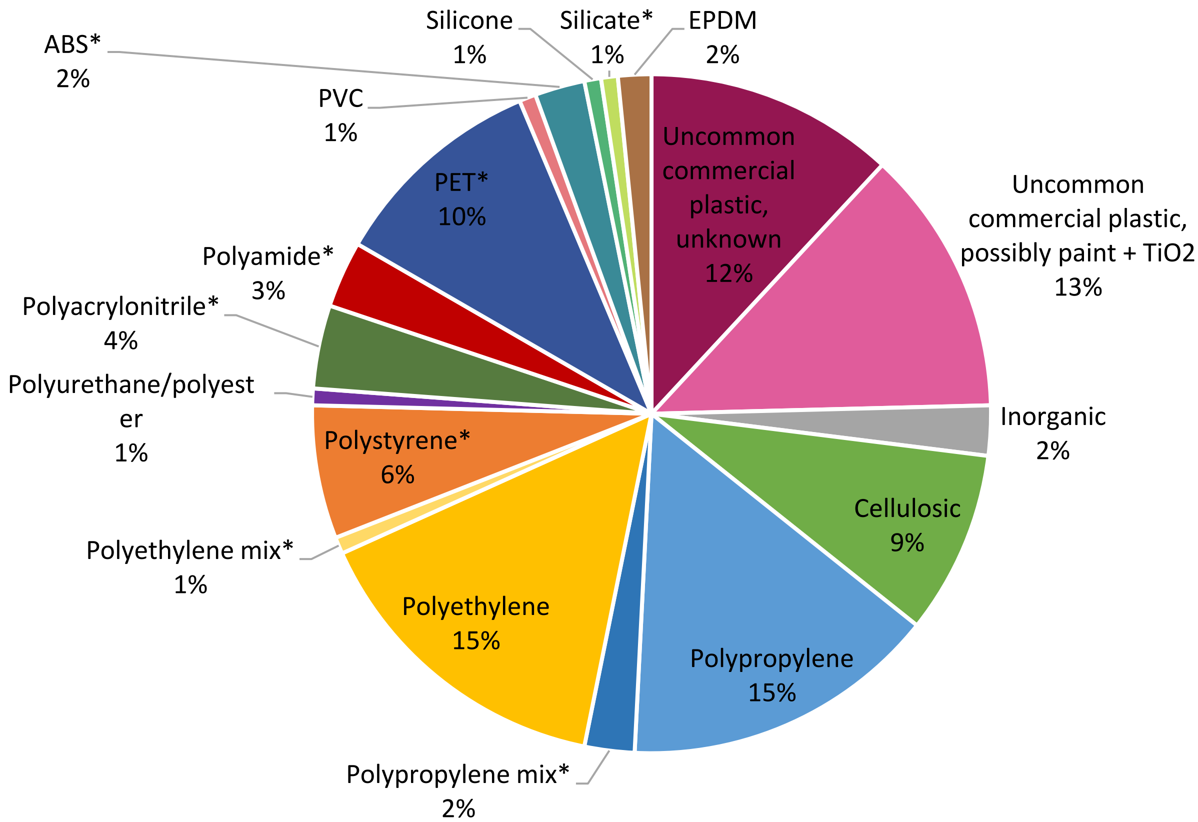

Figure 11. Proportions of chemicals found in all surface water samples in the Bay of Fundy. Samples were collected by CARP in June through August of 2018, and analysis completed by Surface Science Western. Asterixis next to primary chemicals denote that some samples had mixed materials. The polypropylene mixed samples contained polyamide, $CaCO_3$, and polyethylene bonds. The polyethylene mixed sample contained inorganics. One polystyrene mixed sample contained inorganic silicate, and another contained $CaCO_3$, talc and other contaminants. One polyacrylonitrile sample was mixed with cellulosic material. One polyamide sample contained cellulosic material, and another had $CaCO_3$. One PET sample contained polyamide, and another contained organic silicate. One ABS sample contained a polyamide bond. The silicate sample was organic and contained polystyrene and $CaCO_3$ bond.

Film particles found in samples above the Causeway (site 6), in Bear River (site 3) and around Goat Island (site 4) were all polyethylene bonds. Foam and white foam like fragments found in Bear River and in Digby (site 2) were all polystyrene. Threads and fragments found at all sites were composed of a mixture of different chemicals. Threads were primarily composed of polypropylene, polyethylene, polyacrylonitrile, polyamide and cellulose. However, the threads found around Goat Island contained no polypropylene, which differs from the rest of the project's findings. Fragments were primarily composed of uncommon commercial plastics, polypropylene, polyethylene, cellulose, PET, ABS, EPDM. Nearly all the fragments found at Victoria Beach were uncommon commercial plastics, and of those, half were possibly paint mixed with titanium dioxide (TiO_2).

Of all sites sampled in the Annapolis Basin, above the Causeway and Victoria Beach (site 1) had the greatest amount of plastics with a variety of chemical bonds. Causeways create hard barriers and are known to reduce waterflow, especially over tidal flats like in Annapolis Royal, and can lead to poor water quality with low diversity and disrupted biotic communities (Reimer et al., 2015). Reduced water flow from the Causeway has likely caused greater accumulation of microplastics in the area. Victoria Beach is located at the exit point of the Annapolis Basin to the Bay of Fundy, and experiences strong tidal movement due to its bottleneck shape that funnels large quantities of water with each tidal cycle (Fig. 9; Parrot et al., 2008). This area is known by fishers as 'The Dump' and benthic imagery has shown fishing gear, plastic and other marine debris items on the seafloor, identifying it as a 'hotspot' for marine debris based on accumulation patterns (Goodman et al., 2019; Goodman et al., 2020). The microplastic data from this project furthers the rationale for identifying Victoria Beach as a hotspot, as it had the most microplastics of all sites in the Annapolis Basin composed of mixed chemical compositions, which is likely attributed to its geographic location and oceanographic conditions as described.

Bay of Islands, Newfoundland

Sampling by ACAP Humber Arm

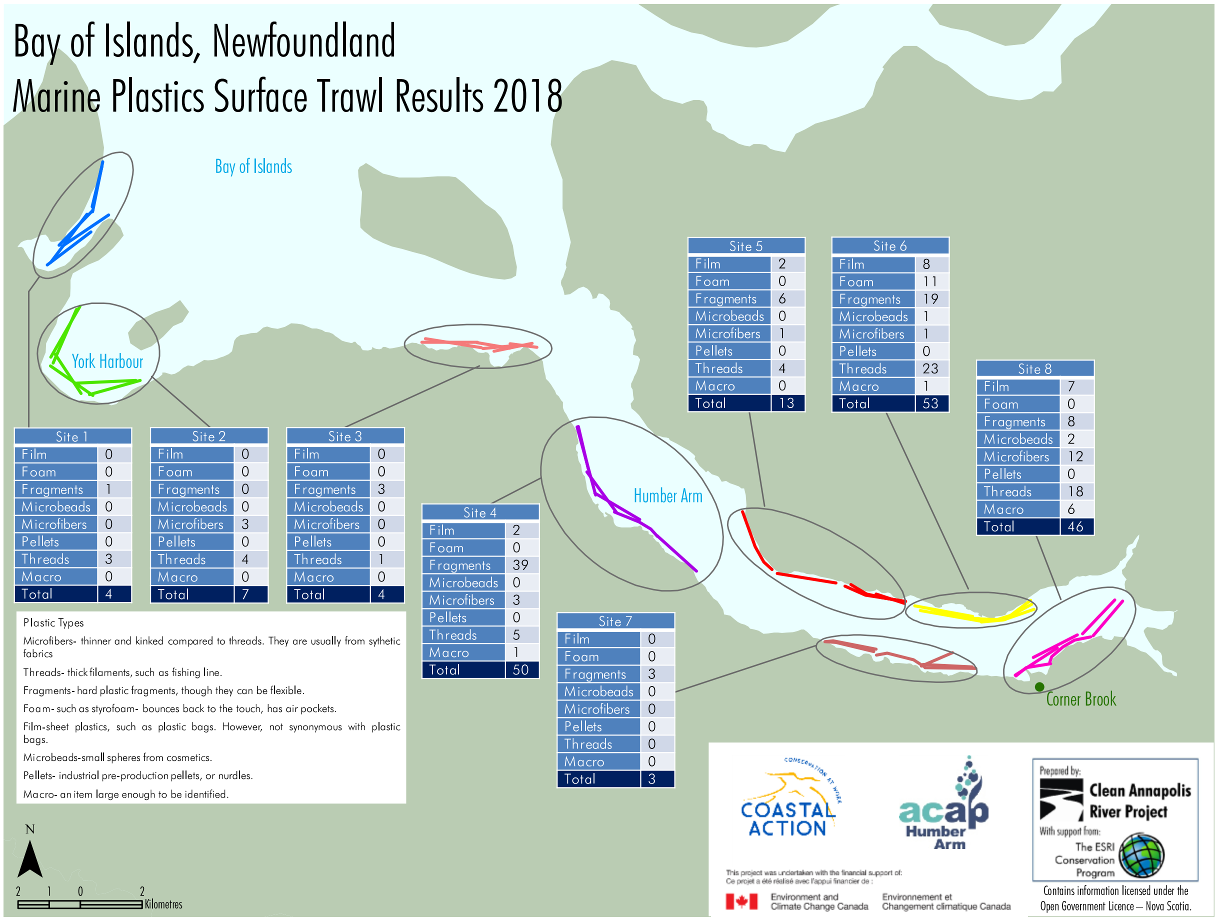

Figure 12. Map of surface water sampling sites in the Bay of Islands, Newfoundland, taken in July 2018 by ACAP Humber Arm.

Surface water sampling in the Bay of Islands, Newfoundland took place at 8 different sites (Fig. 12). All sites had plastic fragments and threads (Table 7), making up most of the total plastics found (42% and 25% respectively; Fig. 13). Benoit's Cove (site 4) surface water samples had the greatest number of fragments in comparison to other sampled sites, composing nearly half of all fragments found (49%). Summerside (site 6) surface water samples had the second most, composing a quarter of all fragments found (24%). Corner Brook (site 8) surface water samples had the greatest number of threads in comparison to other sampled sites, followed by Summerside samples.

Table 6. Breakdown of plastic type found in surface water at each site in Newfoundland, summarized by category. Named items in Corner Brook included fishing line, tape, synthetic cloth and garbage bag; in Summerside the item was a medical object; in Benoit's Cove the item was a condom. Samples were collected by ACAP Humber Arm in July 2018, analysis by CLEAR Laboratory.

Site	Film	Foam	Fragments	Microbeads	Microfibers	Pellets	Threads	Named Items	Total Plastics
1 – Corner Brook	7	0	8	2	12	0	18	6	53
2 – Mont Moria / Curling	0	0	3	0	0	0	0	0	3
3 – Summerside	8	11	19	1	1	0	12	1	53
4 – Gillams / Meadows	2	0	6	0	1	0	4	0	13
5 – Frenchman's Cove	0	0	3	0	0	0	1	0	4
6 – Benoit's Cove	2	0	39	0	3	0	5	1	50
7 – York Harbour	0	0	0	0	3	0	4	0	7
8 – Lark Harbour	0	0	1	0	0	0	3	0	4
Total	19	11	79	3	20	0	47	8	187

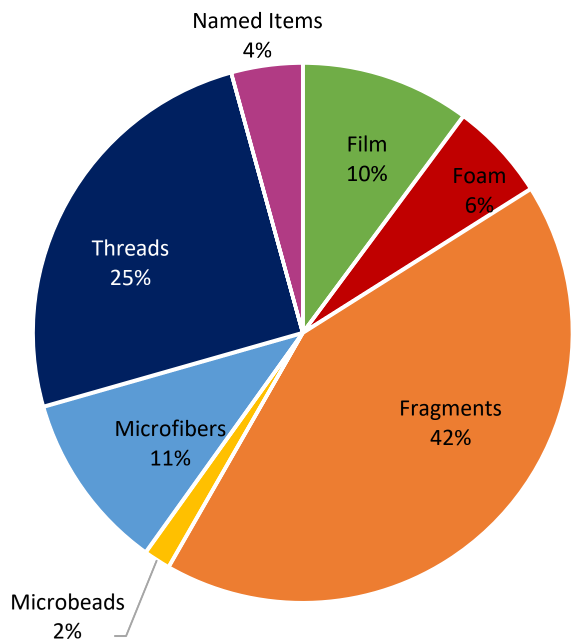

Figure 13. Proportions of plastics found in all surface water samples in Newfoundland: film 10%, foam 6%, fragment 42%, microbeads 2%, microfibers 11%, threads 25 % and named items (macro) 4%. Named items in Corner Brook included fishing line, tape, synthetic cloth and garbage bag; in Summerside the item was a medical object; in Benoit's Cove the item was a condom. Samples were collected by ACAP Humber Arm in July 2018, analysis by CLEAR Laboratory.

The sites located at the mouth of the Humber Arm had notably fewer microplastics than those closer to Corner Brook (Fig. 12). This difference may be attributed to stronger water circulation at the mouth of the Arm. The community presence at Corner Brook may also be responsible for greater release of microplastics into the marine environment farther upstream, combined with less flushing at the mouth of the Arm, leading to greater accumulation on microplastics in the area.

FTIR Findings

Polypropylene (30%) and cellulosic bonds (24%) were the most common among Newfoundland particles sampled (Fig. 14). When combining the mixed samples, polypropylene would increase slightly (34%) as would polyethylene (13%).

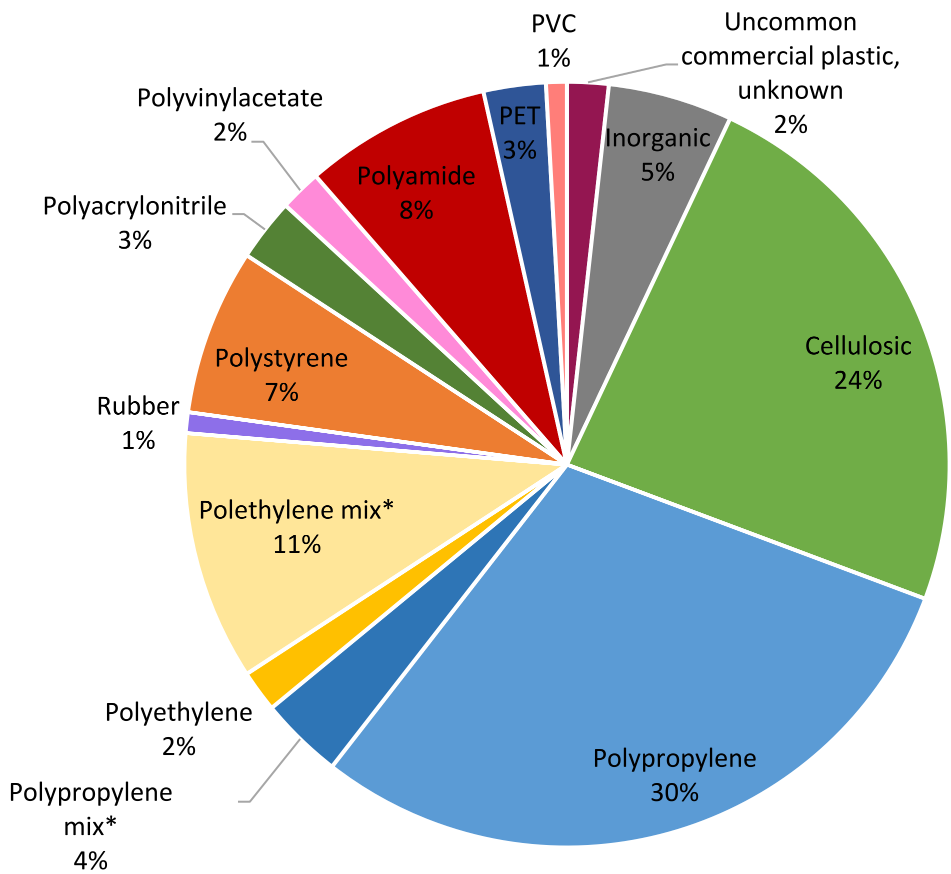

Figure 14. Proportions of chemical found in all surface water samples in Newfoundland. Samples were collected by ACAP Humber Arm in July 2018, and analysis completed by Surface Science Western. Asterixis next to primary chemicals denote that some samples had mixed materials. The polypropylene mix contained a sample with polyethylene or hydrocarbons and another with silicate, cellulose and polyamide. The polyethylene mix contained samples with cellulose, hydrocarbons, and ethylene vinyl acetate.

All sites sampled in Newfoundland contained fragments, except for York Harbour (site 2), which consisted of a mixture of chemicals, primarily composed of polyethylene, polypropylene and polyamides. Threads found were primarily composed of polypropylene but also contained uncommon commercial plastics, cellulose, polyamide, and polyacrylonitrile. All foam found in Newfoundland was composed of polystyrene. Fibers were composed of polyamides, PET, cellulose, polyacrylonitrile, polyethylene and polypropylene. The film particles were composed of polyethylene, polypropylene, PVC, rubber and cellulose, a mixture of chemicals varying from film found in the LaHave Estuary and Annapolis Basin.

Conclusion & Recommendations for Future Work

The *Atlantic Canada Microplastic Research Project* is a robust assessment of microplastics at three locations in Atlantic Canada, providing data on quantities, types, and potential sources. As the project is the first regional look at microplastics in Atlantic Canada, more data at additional sites across the four Atlantic provinces is needed in order to better understand microplastics in the region and provide effective comparability between sites.

Coastal Action will be continuing microplastic data collection in Atlantic Canada in order to fill this research gap as well as working with stakeholders to determine the most effective solutions for plastic prevention and reduction. Coastal Action recommends that in tandem with data collection at surface water and shoreline sites to determine quantity and type, research should be conducted on the impacts microplastics have on aquatic species found in Atlantic Canada. Assessing the impacts on species that are vital for the environmental and economic livelihood of the region will assist government, non-government organizations, and researchers in determining appropriate measures to plastic pollution for the local context.

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