Marine Litter and Microplastics in the Canadian Arctic: State of literature and approach

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Outline

- Driver for momentum: global and Canadian outlook of the issue

- Overview of relevant Canadian literature
  - Accumulation
  - Sources
  - Pathways

- Monitoring and response: Canadian approach and activities

Plastic waste and marine litter: a global issue

- More than 150 million tonnes of plastics are in the ocean
  - 8 million tonnes of plastic waste enters the ocean from land every year
- Impairs water quality, sea-life, habitat, and potentially human health
  - >600 marine species affected; 15% are endangered
  - Source of contaminants
  - Vector for bioaccumulation (toxins, chemicals, heavy metals) and trophic transfer
- Significant wasted material value and embedded energy (GHGs)
  - USD 80-120 B/year in plastic packaging material value lost to the economy
  - 6% of global oil consumption (20% by 2050)
- > $13 billion/year damage to marine ecosystems

Marine litter and plastics in Canada

- Marine litter and microplastics are found on all three coasts and in freshwater systems, including the Great Lakes
  - In sea ice, surface waters, water column, sediment, aquatic life and on shorelines.

- In 2010, contributed about 8,000 tonnes of plastic waste into oceans from land.
  - <0.1% of global contribution (collectively Arctic Council members contributed ~1.2%)
  - Without any action this could almost double by 2025

- 80% of plastics are recyclable but national plastics recycling rate <11%
  - Domestic use mostly packaging (39%) and construction (33%)

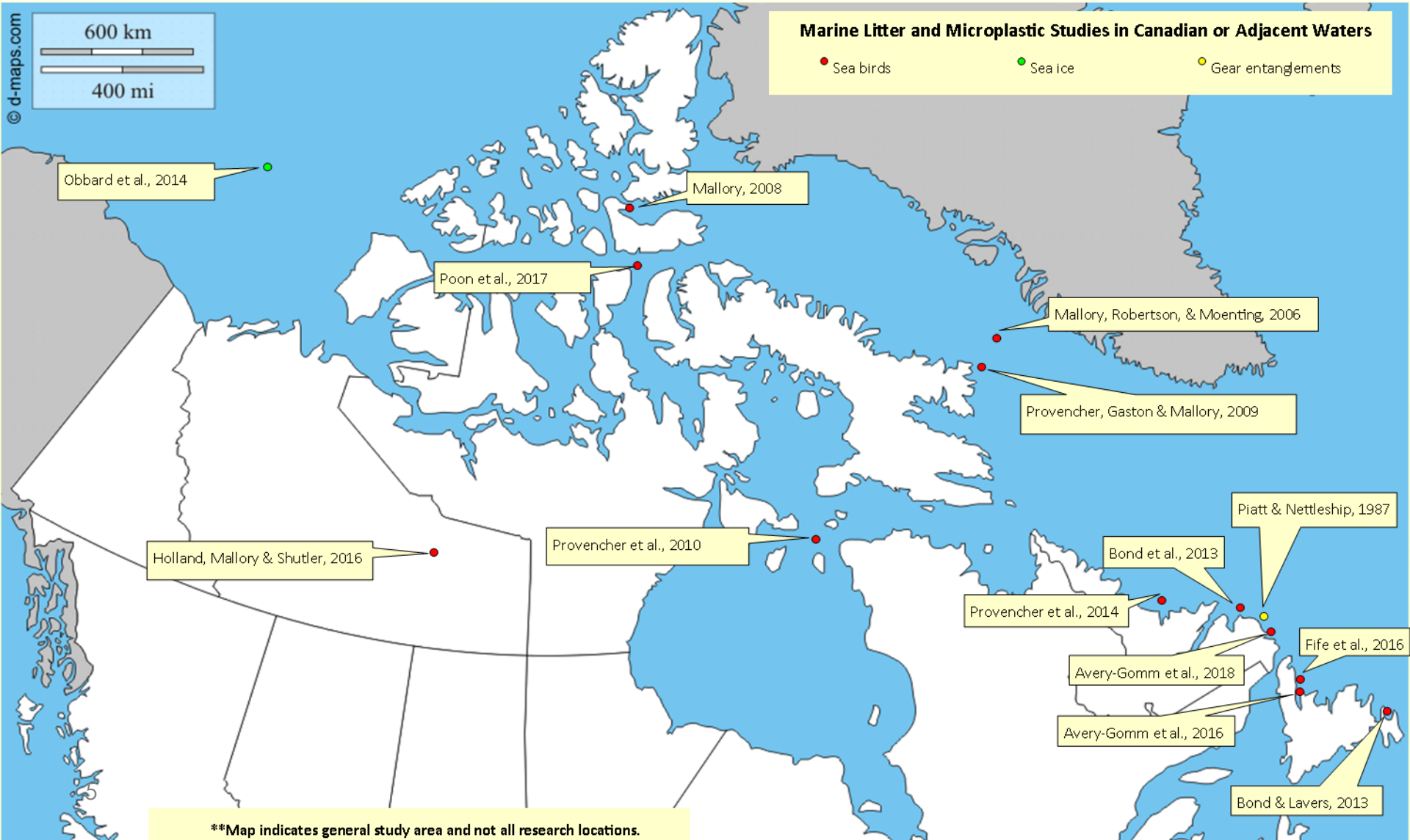
Macrodebris UN Environment

Microbeads pixabay.com

Pellets © Dave Crawford

Fragments 5 Gyres

Canadian marine litter and microplastics literature

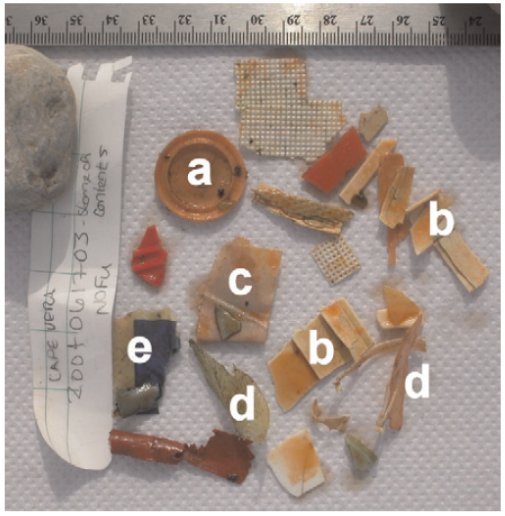


Accumulation in Canada's north

- Polar sea ice is becoming a major sink for microplastic contamination (Obbard, 2014)
  - 38-234 plastic particles per cubic metre are captured in sea ice
  - At current sea ice melt rates, over 1 trillion pieces of plastics will enter the environment by 2025
  - Found fragments and fibres

- Plastics are ingested by seabirds across Canada
  - Ingestion varies by foraging type with surface feeders ingesting more than divers (Poon et al., 2017)
  - Majority of microplastics ingested are fragments (Avery-Gomm et al., 2018; Poon et al., 2017)

- Seabirds, mostly fulmars, are also caught in longline fisheries
  - About 500 seabirds entangled in fishing line every year in the Davis Strait (Mallory et al., 2006)



Plastic fragments from the proventriculus of one fulmar, with identifiable pieces from: (a) bottle cap liner, (b) plastic containers, (c) adhesive bandage, (d) heavy tape, (e) snack food wrapper. (Moore, 2008)

Sources of marine litter

- Seabird ingested plastics are primarily user plastics (i.e. those used in commercial goods) rather than industrial plastics (i.e. pellets)
  - 89% user plastics and 9% industrial found in Canadian high arctic seabirds
  - 58% of these user plastics were fragments (Poon et al., 2017)

- User goods are commonly collected on shorelines across Canada, including in the three northern territories
  - Most frequently collected items : cigarette butts; food wrappers; plastic bottles, caps, bags, cups and plates (Great Canadian Shoreline Cleanup, 2015)

Factors and pathways to Arctic waters

- 66% of Canada's coastline is in the Arctic with over 36,000 islands
  - Remote and largely inaccessible
  - Marine waters covered by sea ice half the year
  - Three northern territories home to ~119,000 people, over 50% of which identify as Indigenous

- Debris enters the Arctic through: waste or fishing gear discarded by ships; blown into the water from ports; from communities and inadequate waste systems (e.g. coastal dumps); or can be carried through ocean and wind currents from around the world.

Spotlight: Northern Fulmar

- Present on all 3 of Canada's ocean coastlines
  - Found to ingest plastics across Canada
  - Lower ingestion rates in the Arctic than other areas in Canada
  - Most widely studied species for plastic ingestion

- Opportunistic sampling shows > 80% of northern fulmars in Arctic Canada have ingested plastics, mostly fragments (Poon et al., 2017)
  - Surface foragers have a high frequency of occurrence to ingest plastics, indicating there may be higher levels of microplastics on surface waters

- North Sea Ecological Quality Objective (EcoQO) set:
  ≤ 10% of fulmars having 0.1g or more of plastic in stomach
  - Plastics ingestion in seabirds in Arctic Canada (2002-2008) was 14% (Provencher et al., 2017)
  - 34% of fulmars exceeding the EcoQO in the Labrador Sea (Avery-Gomm et al., 2018)

Monitoring

- Standardized monitoring methods are needed to improve comparability and determine trends
  - Provencher et al. (2017) proposed a standard method for plastic ingestion monitoring
- Further research is also needed on all compartments and the socio-economic and environmental impacts

Analytical Methods

PAPER

View Article Online

Quantifying ingested debris in marine megafauna: a review and recommendations for standardization†

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Plastic pollution has become one of the largest environmental challenges we currently face. The United Nations Environment Program (UNEP) has listed it as a critical problem, comparable to climate change, demonstrating both the scale and degree of the environmental problem. Mortalities due to entanglement in plastic fishing nets and bags have been reported for marine mammals, turtles and seabirds, and to date over 690 marine species have been reported to ingest plastics. The body of literature documenting plastic ingestion by marine megafauna (i.e. seabirds, turtles, fish and marine mammals) has grown rapidly over the last decade, and it is expected to continue grow as researchers explore the ecological impacts of marine pollution. Unfortunately, a cohesive approach by the scientific community to quantify plastic ingestion by wildlife is lacking, which is now hindering spatial and temporal comparisons between and among species/organisms. Here, we discuss and propose standardized techniques, approaches and metrics for reporting debris ingestion that are applicable to most large marine vertebrates. As a case study, we examine how the use of standardized methods to report ingested debris in Northern Fulmars (Fulmarus glacialis) has enabled long term and spatial trends in plastic pollution to be studied. Lastly, we outline standardized metric recommendations for reporting ingested plastics in marine megafauna, with the aim to harmonize the data that are available to facilitate large-scale comparisons and meta-analyses of plastic accumulation in a variety of taxa. If standardized methods are adopted, future plastic ingestion research will be better able to inform questions related to the impacts of plastics across taxonomic, ecosystem and spatial scales.

1 Introduction

Since the invention of plastic in the early twentieth century, it has been polluting the marine environment. Plastic pollution has become one of the largest environmental challenges we currently face. The United Nations Environment Program (UNEP) has listed it as a critical problem, comparable to climate change, demonstrating both the scale and degree of the environmental problem.[1,2] Marine plastic pollution occurs from the Arctic to the Antarctic, with several areas of significant concentrations in regions where ocean currents converge in gyres.[3] Plastic pollution has also been documented in freshwater ecosystems,[4] illustrating that few aquatic ecosystems are unaffected. Importantly, plastic pollution impacts wildlife through both entanglement and ingestion. Mortalities due to entanglement in plastic fishing nets and bags have been reported for marine mammals, turtles and seabirds (hereafter referred to as marine megafauna),[5–7] and to date over 690 marine species have been reported to ingest

Over the last few decades, as the environments has increased documenting plastic there have been methods however

Canadian Arctic research underway

- The Federal Northern Contaminants Program engages Northerners and scientists to research long-range contaminants in the Arctic
- Microplastics identified as emerging contaminant of concern, current projects:
  - Microplastics in Canadian Arctic snow, sediment, water and zooplankton
  - Plastics as vector for chemical contaminants in Arctic seabirds
  - Microplastics in Beaufort Sea beluga whale food web

Canadian Arctic research underway

Additional research underway by the Government of Canada, academia and NGOs:

- Sea birds as concentrators of plastics through excrement around colonies
- Microplastics distribution, exposure, ingestion and effects
- Microplastics in sediments and intertidal zones across Canada
- Develop and evaluate approaches for biological monitoring, citizen science trawls, shoreline sampling
- Citizen science through the Great Canadian Shoreline Cleanup

Canada's domestic approach

- The Government of Canada, provinces and territories, in consultation with civil society, industry and others, are developing an approach to keep plastics within the economy and out of landfills and the environment.
- Pursuing solutions along the plastics lifecycle:
  1. Sustainable design and production
  2. Collection and management
  3. Sustainable lifestyle and education
  4. Research and innovation
  5. Action on the ground
- Launched the Canadian Dialogue on Plastic Waste
  - Seeking Canadians views and suggestions to move toward zero plastic waste and reduce marine litter and inform the approach
  - Online portal: www.placespeak.com/moving-toward-zero-plastic-waste

Legislation

Over 10 federal Acts and associated regulations are related to marine litter and microplastics (e.g. Disposal at Sea regulations pursuant to the Canadian Environmental Protection Act; Microbeads in toiletries regulations).

Subnational: extended producer responsibility programs, bans or fees on products

Research and Innovation

Conduct research on monitoring methods and the sources, distribution, and impacts of marine litter and microplastics in the aquatic environment and biota.

Technology development programs (e.g. Sustainable Development Technology Canada, National Research Council)

RESPONSES IN CANADA: COMPLEMENTARY ACTIONS

Actions & Engagement

Waste collection and recycling programming; pilot projects (e.g. Commission for Environmental Cooperation project); technical guidance and best practices (e.g. 2017 Solid Waste Management for Northern and Remote Communities), and engagement with stakeholders (e.g. Great Canadian Shoreline Cleanup).

Funding

Funding programs are in place to support:

- research (e.g. Northern Contaminants Program),
- action like cleanup and education (e.g. EcoAction Community Funding Program),
- infrastructure (e.g. Green Municipal Fund, Clean Water and Wastewater Fund, First Nations Waste Management Initiative).

Canada's G7 Presidency

- Oceans health, resiliency and addressing plastic pollution are a priority under Canada's G7 Presidency in 2018.

- Building on existing G7 commitments on marine litter and resource efficiency.
  - G7 Action Plan to Combat Marine Litter (2015)
  - Toyama Framework on Material Cycles (2016)
  - G7 Bologna Roadmap (2017)

- Advocating for a G7 commitment to take action on plastics throughout their lifecycle and reduce marine litter through a G7 Plastics Charter.

Questions

- Any questions or comments?

- For more information, please contact:

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