REVIEW OF PLASTIC POLLUTION POLICIES

Review of plastic pollution policies of Arctic countries in relation to seabirds

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**ABSTRACT**

Marine plastic is a ubiquitous environmental problem that can have an impact on a variety of marine biota, such as seabirds, making it an important concern for scientists and policymakers. Although research on plastic ingestion by seabirds is increasing, few studies have examined policies and long-term monitoring programs to reduce marine plastic in the Arctic. This paper provides a review of international, national, and regional policies and long-term monitoring programs that address marine plastic in relation to seabirds in the Arctic countries: Canada, the Kingdom of Denmark (Greenland and the Faroe Islands), Finland, Iceland, Norway, the Russian Federation, Sweden, and the United States of America. Results show that a broad range of international, national, regional, and local policies address marine debris, specifically through waste management and the prevention of pollution from ships. However, few policies directly address seabirds and other marine biota. Further, policies are implemented inconsistently across regions, making it difficult to enforce and monitor the efficacy of these policies given the long-range transport of plastic pollution globally. To reduce marine plastic pollution in the Arctic environment, pan-Arctic and international collaboration is needed to implement standardized policies and long-term monitoring programs for marine plastic in the Arctic and worldwide.

**CONTEXT**

This report is part of an initiative by the Conservation of Arctic Flora and Fauna (CAFF) Working Group of the Arctic Council to better understand the effects of plastic pollution in the ocean on Arctic seabirds. Developed via CAFF's Arctic Migratory Birds Initiative (AMBI), in collaboration with the Circumpolar Seabird Expert Group (CBird), this report provides a review of the policies of Arctic countries that address marine plastic related to Arctic-breeding seabirds. Additional components of this work include a review of literature related to the vulnerability of Arctic breeding seabirds to plastic pollution including ingestion and entanglement in the Arctic, and the development of a pan-Arctic framework for monitoring plastic pollution in seabirds in the Arctic. This work contributes to the implementation of the Regional Action Plan on Marine Litter being developed by the Arctic Council via the Protection of the Arctic Marine Environment (PAME) Working Group.
1. INTRODUCTION

Plastic pollution in the marine environment has been reported as a problem for nearly half a century. It is now recognized as a serious threat to our marine ecosystems, including the remote Arctic (Carpenter and Smith 1972; Colton et al. 1974; Harper and Fowler 1987). Marine plastic can enter the Arctic through local sources such as communities, landfills, shipping, tourism and fisheries (UNEP 2016; Hallanger and Gabrielsen 2018; Falk-Andersson and Strietman 2019; Halsband and Herzke, 2019; PAME 2019), but also from southern areas via transport by ocean currents, wind, or biota (Van Sebille et al. 2012; Cózar et al. 2017; Halsband and Herzke 2019). As a result of these multiple vectors plastics have been reported within arctic beaches, snow, surface, sub-surface and seafloor samples and in sea ice (Bergmann and Klages, 2012; Obbard et al. 2014; Lusher et al. 2015; Bergmann 2016; Cózar et al. 2017; Kanhai et al. 2018; Peeken et al. 2018; Bergmann et al. 2019; PAME 2019; Blinovskaya et al. 2020; Kanhai et al. 2020). Recently, microplastics have been found in amphipods (Gammarus setosus; Iannilli et al. 2019), blue mussels (Mytilus edulis; Sundet et al. 2016, Bråte et al. 2020), red king crabs (Paralithodes camtschaticus; Fuhrmann et al. 2016), and fish (Morgana et al. 2018), but plastics have been found in Arctic seabirds since the 1960s (Day 1980; Harper and Fowler 1987; PAME 2019; Baak et al. 2020).

Plastic pollution can have deleterious impacts on marine biota in a variety of ways, depending on consumer species and the shape, size and type of plastic (Werner et al. 2016), but the most documented impacts are from ingestion and entanglement. However, there are more studies on plastic ingestion in seabirds reported in the literature (Wilcox et al. 2015 (SI Table 1); review by Baak et al. 2020), than compared to studies on plastic entanglement in seabirds (Kühn et al. 2015; Ryan 2018). Marine mammals, seabirds, turtles and fish can become entangled in fishing gear, rope and plastic bags (Laist 1987, 1997; Walker and Taylor 1996; Provencher et al. 2017). If not directly causing mortality, marine plastic pollution may affect the fitness of individual organisms by compromising their ability to capture and digest food, reproduce, migrate and/or escape from predators (CBD 2012; Galloway et al. 2017). As plastics break down in the ocean, they become available to a broader range of marine organisms. Ingestion of microplastics can result in physical damage such as obstruction or internal abrasions (Wright et al. 2013). Further, when ingested, chemicals used in plastic production can be incorporated in the tissues of the animals (Tanaka et al. 2013, 2020; Rochman et al. 2014). In addition to physical effects, marine plastics can transfer chemicals to the marine environment or act as vectors for species, such as bryozoans, barnacles, polychaete worms, hydroids and molluscs (Barnes 2002; Hermabessiere 2017).

Seabirds play an important role in marine ecosystems and are thus important indicators of ecosystem health (Mallory et al. 2010; van Franeker et al. 2011) but are also culturally important for Indigenous peoples of the Arctic (Mosbech et al. 2018). Many Arctic seabird species are in decline (Paleczny et al. 2015; Goyert et al. 2018) due to threats such as overfishing of food sources, bycatch from fisheries, climate change and pollution (Sullivan et al. 2006; Croxall et al. 2012), and plastic pollution may exacerbate this decline (Mallory et al. 2006). As plastic pollution continues to increase in the Arctic, seabirds and other marine biota will be at an increased risk of ingestion and entanglement (Kühn et al. 2015; Wilcox et al. 2015; Kühn and van Franeker 2020), thus monitoring the prevalence of this pervasive environmental contaminant will be of increasing importance. Indeed, the Protection of the Arctic Marine Environment (PAME) is currently developing a Regional Action Plan on Marine litter that will address both sea and land-based activities, with a focus on Arctic-specific marine litter sources and pathways (PAME 2020). However, many countries lack the policy and monitoring programs to enable and enforce the prevention, reduction and monitoring of marine plastic pollution.

The legal framework that is applicable to marine plastic pollution is complex and consists of international, national, regional and local policies which cover ocean- and land-based sources of marine plastic. Several review documents already exist for policies that directly or indirectly can be applied to mitigate the impact of marine plastic (Kershaw et al. 2013; Pettipas et al. 2016; Xanthos and Walker 2017; PAME 2019; Eriksen et al. 2020), however, none are specific to the Arctic. The United Nations Environment Programme (UNEP) recommended that current international and regional frameworks on marine plastic pollution be reviewed to identify gaps for policy improvement (UNEP 2016). Further, the Arctic Migratory Birds Initiative (AMBI) 2019-2023 workplan highlights the need for a review of policies within Arctic countries that address marine plastic to recommend future research and policy development in the region (CAFF 2019). The implementation of policy and long-term monitoring programs for marine plastic pollution in the Arctic region will facilitate our understanding of the impacts of plastic ingestion on Arctic species and allow us to compare plastic ingestion and entanglement across species, regions and time.

We reviewed policies and long-term monitoring programs that address marine plastics in the eight Arctic Council countries: Canada, the Kingdom of Denmark (Greenland and the Faroe Islands), Finland, Iceland, Norway, the Russian Federation (hereafter Russia), Sweden and the United States of America (US). We outline international, national, regional and local policies on plastic pollution in the Arctic marine environment, identify gaps in these policies in relation to the Arctic and Arctic seabirds, and suggest actions for future policy development in the Arctic.
2. METHODOLOGY

The Arctic was defined following the Conservation of Arctic Flora and Fauna (CAFF) definition (Irons et al. 2015), which includes Greenland, the Faroe Islands, Iceland, Norway, Finland, Sweden, Russia, and the US, as well as the major seas in the Arctic: the Barents, Beaufort, Bering, Chukchi, East Siberian, Greenland, Kara, Norwegian, Labrador and Laptev seas (Fig. 1; ECCC et al. 2008). Representatives from the governments of each country were contacted to request information on plastic pollution policies. To explore additional information, we used the Google Scholar search engine to retrieve records available up to March 2020. Search terms used were: “policy”; “legislation”; “monitoring”; “plastic”; “Greenland” (or Iceland or Norway or Finland or Sweden or Russia or Canada or the United States). Additionally, government and non-profit organization websites for each Arctic country were searched using the search terms above, and representatives from these organizations were contacted directly for information regarding plastic pollution policy. Finally, all country representatives of the CAFF Circumpolar Seabird Expert Group (CBird) were consulted to add any additional policies or programs for marine plastic pollution in the Arctic countries. Policy tools reviewed include a mix of legislative instruments (Acts, Regulations, Legal frameworks, Laws and By-laws), hereafter “policies”. Results that describe international, national, regional and local policies or long-term monitoring programs relating to marine plastic pollution in the Arctic were included. We recognize that littering, in general, is prohibited in all regions in this review, we aim to capture policies that relate more to plastic pollution specifically, and not littering generally. Results on how seabirds are addressed in these policies/legislations are summarized and discussed.

3. INTERNATIONAL PLASTIC POLLUTION POLICY

The prevention of plastic pollution entering the marine environment is a topic of priority across the globe. Indeed, Goal 14 of the 2030 agenda for Sustainable Development is to “conserve and sustainably use the oceans, seas and marine resources”, and calls for actions that prevent and significantly reduce marine pollution of all kinds by 2025 (UN 2017). Consequently, there are a range of legally binding and non-binding international conventions that directly or indirectly address marine debris (e.g. BRS Conventions 2019; Kershaw et al. 2013; PAME 2019). One of the first global treaties to protect the marine environment from human activities was The London Convention (Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972) that came into force in 1975. This convention was followed by The International Convention for the Prevention of Pollution from Ships (MARPOL), the United Nations Convention on the Law of the Sea (UNCLOS) and The Basel Convention (Table S1), which together have formed the foundation of international regulations to reduce this environmental pollutant.

The protection of specific marine environments through regional regulations plays an important role in the concretisation of international regulatory frameworks. One of United Nations Environment Programme’s (UNEP) most significant achievements is The Regional Seas Programme (launched in 1974), which, in cooperation with regional organizers, has implemented activities related to the prevention and reduction of marine debris that have been consolidated by legal frameworks, such as the regional sea conventions like the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR; Table S1). A list of international conventions with relevance to the Arctic that address the reduction of marine debris are presented in Table S1 and signatory Arctic Countries are presented in Table 1.

Non-governmental organizations (NGOs) also play an important role in creating awareness of marine debris. One example is the International Coastal Cleanup (ICC), from the US-based NGO, Ocean Conservancy, to remove marine debris from coastlines and to collect data on the amount and types of marine debris removed (Ocean Conservancy 2020). Another global initiative that aims to reducing plastic waste production and consumption is the Greenpeace Call for a Plastic-Free Future (Greenpeace 2020) based on Zero Waste Standards & Policies (ZWIA 2014). For example, in Russia, this initiative has resulted in many leading commercial networks considerably reducing the use of disposable plastic bags (Greenpeace 2018).
4. PLASTIC POLLUTION POLICY IN THE EUROPEAN ARCTIC

European Arctic countries consist of the Kingdom of Denmark (Greenland and the Faroe Islands), Finland, Iceland, northern parts of Norway, Sweden and part of Russia (see detailed information regarding Russia below). Finland and Sweden are members of the European Union (EU) whereas Greenland, the Faroe Islands, Iceland, Norway and Russia are not (European Union 2020). Treaties ratified by the Kingdom of Denmark are automatically extended to Greenland and the Faroe Islands unless the ratification is accompanied by a declaration or other statement that the treaty does not extend to these regions. However, since Greenland and the Faroe Islands are both self-governing Arctic regions within the Kingdom of Denmark, they are considered separately for the remainder of this review. Iceland and Norway are part of the European Economic Area (EEA) and are thus also obliged to both follow and report on some of the objectives covered by EU Directives (EFTA 2020), for example, the Waste Framework Directive (Table S2).

4.1. EUROPEAN UNION POLICIES

In September 2019, more than 100 European companies and organisations signed the Declaration on European Circular Plastics Alliance (EC 2019), committing to using 10 million tonnes of recycled plastic in new products by 2025. This commitment to addressing plastic pollution is reflected in a wide range of European Union policies focused on marine debris in terms of its sources and impacts (EC SWD 2012; Kershaw et al. 2013; EC SWD 2018). The first EU legislative instrument related to the protection of marine biodiversity was the Marine Strategy Framework Directive (MSFD; Table S2). Several other EU initiatives have also been adopted in recent years including the European Strategy for Plastics in a Circular Economy (EC SWD 2018), which aims to transform the design, production, use and recycling of plastic products in the EU and the Single-Use Plastics Directive (effective from July 2021), banning the use of certain single-use plastic products (Table S2). Further, in April 2019 the ministers of environment and climate of the Nordic countries approved a Nordic Declaration, which calls for a global agreement to more effectively and comprehensively address marine plastic litter and microplastics (Nordic Co-operation 2019).

A list of legally binding instruments in the EU that relate to the prevention and control of marine debris is presented in Table S2.
4.2. GREENLAND

4.2.1. Legal frameworks and strategies
The Government of Greenland (Naalakkersuisut) is responsible for marine areas within three nautical miles of the coastline, which includes all inland seas, such as fjords and bays. The Danish Government is responsible for the marine environment from the three nautical mile border up to 200 nautical miles from the baseline (i.e. the Exclusive Economic Zone). Greenland has entered into various international agreements to minimize plastic pollution in the marine environment (Table 1). In addition, Greenland has implemented national policies and regulations to combat marine pollution and waste management issues (Table S3).

The Ministry of Nature and Environment is working on an action plan to reduce the consumption of plastic and to clean up abandoned or lost fishing gear throughout Greenland. The draft of the Naalakkersuisut’s action plan for reducing the consumption of plastic “Less plastic in nature” has been sent for consultation (Government of Greenland 2020). In 2018, the Inatsisartut (Parliament of Greenland) established an Environmental Fund (Miljøfonden), to improve plastic recycling and fisheries waste management programs which in 2019, one million Danish Kroner was allocated to address plastic pollution and another one million Danish Kroner was allocated to clean up abandoned or lost fishing gear (Government of Greenland 2019).

In Greenland, municipalities are responsible for waste management. Thus, together with the Government of Greenland, municipalities are working on optimizing solutions for incineration, disposal, sorting and recycling of waste. Plastic waste management (i.e. sorting and recycling) is a relatively new focus in Greenland and action plans are currently in preparation (Poulsen 2020).

4.2.2. Long-term monitoring programs
There are few long-term monitoring programs for marine plastic pollution in Greenland. Yearly surveys on several beaches were initiated in 2016 as part of the Danish financed SUMAG-project and at least until 2021 with the aim of determining baselines and starting trend analyses on the amount, accumulation and sources of plastic (Strand et al. 2018). The monitoring data has also been uploaded to the OSPAR database for beach litter monitoring data. There are no established long-term monitoring programs for plastic ingestion by seabirds in Greenland, but fulmar stomachs have been examined twice in 2016 and 2017 according to the OSPAR monitoring guideline (Strand 2018) and these studies will be repeated in the near future. In addition, intact stomach samples from northern fulmars collected in West Greenland in year 2000 and stored in the Arctic tissue bank at Aarhus University have also been examined for comparison. Plastic ingestion has also been examined opportunistically in thick-billed murres (Uria lomvia), common eider (Somateria mollissima borealis), king eider (S. spectabilis) and little auks (Alle alle; Falk and Durinck 1993; Pedersen and Falk 2001; Provencher et al. 2014; Amélineau et al. 2016).

4.3. THE FAROE ISLANDS

4.3.1. Legal frameworks and strategies
The Faroe Islands is a self-governing region within the Kingdom of Denmark and thus legislates and governs independently in a wide range of areas, such as the conservation and management of living marine resources and the protection of the environment. The Faroe Islands have entered into various international agreements to minimize plastic pollution of the marine environment (Table S2). Additionally, the Faroe Islands also have a set of national laws and regulations to combat marine debris and waste management issues (Table S3). General waste management is determined by municipalities, and the Ministry of the Environment has made proposals to reduce plastic pollution, but otherwise, waste management facilities have their own systems for recycling plastic (Poulsen 2020).

4.3.2. Long-term monitoring programs
There is currently no long-term monitoring of marine plastic pollution in the Faroe Islands, nor is there long-term monitoring for plastic pollution in seabirds. However, plastic ingestion by seabirds has been examined in northern fulmars (Fulmarus glacialis; van Franeker...
2012; van Franeker and Save the North Sea (SNS) Fulmar Study Group 2013; Trevail et al. 2014) and their main predator, the great skua (*Stercorarius skua*; Hammer et al. 2016). In addition, a recent study assessed whether the use of opportunistic sampling of northern fulmar fledglings hunted as a traditionally food resource, could be a potential monitoring strategy in the Faroe Islands. The study indicated that plastic ingestion by northern fulmar fledglings was at a similar rate as adults, suggesting that parents do indeed regurgitate plastic as a food source for chicks (Ask et al. 2020). Further, in the OSPAR monitoring database, there are beach litter data from a single beach in the Faroe Islands, surveyed in 2002-2006.

### 4.4. ICELAND

#### 4.4.1. Legal frameworks and strategies

Iceland is not an EU Member, but as an EEA member, has implemented several EU regulations related to waste management (Table S2). Additionally, Iceland has national policies and regulations to combat plastic and waste management issues (Table S3). For example, it is prohibited by law to abandon fishing gear lost at sea (Act No. 57/1996). Further, fishing gear is among the materials included in Act No. 162/2002 (on processing fees) that encourages reuse and recycling. A draft for a national action plan on plastic pollution was presented to Parliament in 2019, which contains proposals for the prevention, sorting and recycling of plastic (Poulsen 2020).

#### 4.4.2. Long-term monitoring programs

Iceland has been monitoring marine debris on beaches according to the OSPAR monitoring guidelines since 2016 (OSPAR 2010) and in fulmar stomachs since 2018 (Snæþórsson 2018, 2019). Before this, plastics in fulmar stomachs were opportunistically sampled, also following the OSPAR monitoring guidelines (e.g. Kuhn and van Franeker 2012). In 2018, a project on the extent of microplastic pollution in mussels in selected locations was initiated to lay a foundation for similar research on microplastic in the marine ecosystems of Iceland (Halldórsson and Guls 2018). Further, in the OSPAR monitoring database there are beach litter data from six shoreline locations in Iceland surveyed since 2016.

### 4.5. NORWAY

#### 4.5.1. Legal frameworks and strategies

Norway is not an EU Member, but as an EEA member, has implemented several EU regulations related to waste management (Table S2). Additionally, Norway has national policies and regulations to address plastic and waste management issues (Table S3). Norwegian laws and regulations are generally designed to prevent littering by addressing waste management in various industries (Table S2, S3). Norway is a contracting party of the OSPAR Convention and is thus obliged to take the necessary measures to protect the North-East Atlantic marine environment (Table S1). Norway is also using an integrated marine management regime to achieve good environmental status, for all its sea areas (the Barents Sea, the Norwegian Sea and the North Sea and Skagerrak). The goals for marine debris differ slightly in the three marine areas, however the overall objectives are similar, with plans to avoid the negative impacts on the environment from marine debris.

#### 4.5.2. Long-term monitoring programs

Norway has been mapping marine debris in seabeds since 2005 under the MAREANO programme (Mareano 2020) and monitoring and reporting marine debris on beaches since 2011 following the OSPAR guidelines. Since 2010, the Norwegian-Russian ecosystem survey in the Barents Sea has surveyed marine plastic from bycatch and trawls. In 2019, the joint Russian-Norwegian Environmental Commission (2019) established a project on marine litter and microplastics. The aim of the project is to exchange knowledge on the occurrence and effects of marine litter and microplastics in the Barents Sea, including effects on seabirds. The project will also exchange relevant information on regulations and measures to reduce and prevent plastic pollution. For seabirds, the Norwegian authorities have been monitoring plastic pollution in northern fulmar stomachs in the North Sea area in the framework of OSPAR since 2002 (Dehnhard et al. 2019a). Northern fulmars from Northern Norway are investigated in the same manner, but not obtained regularly. Possibilities for a regular, non-invasive monitoring of plastic ingestion by seabirds
in mainland Norway and Svalbard have been discussed at a workshop in 2019 (Dehnhard et al. 2019b) but such a monitoring has not been implemented to this date. Further, systematic monitoring of presence/absence and type of plastic integrated in seabird nests has been conducted during the 2019 breeding season at several colonies in mainland Norway and Svalbard for multiple seabird species, including the Atlantic puffin (*Fratercula arctica*), European shag (*Phalacrocorax aristotelis*), black-legged kittiwake, herring gull (*Larus argentatus*), great-black backed gull (*L. marinus*) and common eider (*Somateria mollissima*; N. Dehnhard; pers. comm.).

### 4.6. FINLAND

#### 4.6.1. Legal frameworks and strategies

Finland is a member of the EU, thus regulations and decisions automatically become binding on the date they enter into force and EU directives must be incorporated into their national legislation. Legally-binding instruments relating to the prevention of litter entering the ocean in the EU are listed in Table S2. Finland's marine coastline borders the Baltic Sea, and since Finland is a contracting party in the Convention on the Protection of the Marine Environment of the Baltic Sea Area – also known as the Helsinki Convention – originally signed in 1974, Finland implements the regional action plans and the other requirements of the Baltic Marine Environment Protection Commission (HELCOM), including the necessary measures to protect the marine environment as agreed on in the Regional Action Plan on Marine Litter (HELCOM 2015; Table 1; Table S1). Further, Finland is a contracting party of the OSPAR Convention (Table S1).

#### 4.6.2. Long-term monitoring programs

Finland does not have coastline bordering the Arctic Ocean, thus analysis of long-term monitoring programs has not been conducted for this region. In the Baltic Sea, the national monitoring program of Finland implements the requirements of the EU Marine Strategy Framework Directive.

### 4.7. SWEDEN

#### 4.7.1. Legal frameworks and strategies

Sweden is a member of the EU, thus regulations and decisions automatically become binding on the date they enter into force and EU directives must be incorporated into their national legislation. Legally-binding instruments relating to the prevention of litter entering the ocean in the EU are listed in Table S2. The Swedish Baltic Sea coastline extends from the northernmost part of the Bothnian Bay to the Skagerrak coastline and thus is not part of the CAFF region. However, Sweden is a part of HELCOM (Table 1; Table S1) and is thus working to protect the marine environment of the Baltic Sea from pollution. Further, Sweden is a contracting party of the OSPAR Convention and is thus obliged to take the necessary measures to protect the North-East Atlantic marine environment (Table S1).

#### 4.7.2. Long-term monitoring programs

Sweden does not have coastline bordering the Arctic Ocean, thus analysis of long-term monitoring programs has not been conducted for this region. In the Baltic Sea, the national monitoring program of Sweden implements the requirements of the EU Marine Strategy Framework Directive.

### 4.8. RUSSIA

#### 4.8.1. Legal frameworks and strategies

Russia does not specifically address marine plastic pollution in federal policy or legislation. However, marine debris is an integral part of waste management legislation, and there are various policies that regulate the production and consumption of consumer and industrial waste from both land- and ship-based sources. For example, the main federal legislation that addresses waste management is the law “On production and consumption of wastes” (1998), which primarily addresses land-based sources of waste (see Table S3). Further, because Russia is a party to the MARPOL convention, regulations under Annex V were implemented as a law (MNRE 2019). Following MARPOL, the Fishery Fleet Instructions on Preventing Pollution from Ships (1994), which focuses on preventing pollution from fishing vessels, and the Compulsory Regulations on Sea Ports (2007), which addresses the prevention of pollution from ships (Table S2), were developed to combat marine pollution, including plastic pollution. Finally, the impacts of marine plastic pollution were recently added to the agenda of the Ministry of Natural Resources and Ecology within the frame of the working program of the Joint Russian-Norwegian environmental commission, thus marine plastic pollution policy in Russia is expected to increase.

Regionally, Russia is a party to conventions such as HELCOM (Baltic Sea), the Framework Convention on the Protection of the Black Sea Against Pollution (Bukharest Convention 1992) and the Framework Convention for the Protection of the Marine Environment of the Caspian Sea (Tehran Convention 2003). Further, the Administration of seaports, under the instruction of the State Marine Pollution Control, Salvage and Rescue Administration, developed the Shipboard Waste Management Plans that specify waste management policy for each port (Table S3). These plans include waste collection and disposal but do not directly address plastic pollution. Additionally, the National Ecology Project (NEP 2018), led by the Ministry of Natural Resources and Environment (MNRE), plans to implement waste management programs to reduce the production and consumption of waste in Russia. The MNRE is working to improve waste management in 15 Specially Protected Areas (SPAs; one of which is
in the Russian Arctic), where solid waste (including plastic) collection systems and education programs will be implemented (MNRE 2018). This project is expected to expand to all SPAs in the future.

4.8.2. Long-term monitoring programs

To date, there are currently no long-term monitoring programs for marine plastic pollution in the Russian Arctic. However, there are several regional studies that monitor marine plastic pollution. For example, the State Oceanographic Institute of Roshydromet, as part of the GEF/UNDP-EMBLAS international project on the Black Sea (EMBLAS project 2020), monitors plastic pollution in the marine environment (EC 2013). Moreover, as part of HELCOM (HELCOM 2015) and the UNEP NOWPAP Regional Marine Litter Action Plan (NOWPAP 2011), marine plastic pollution is surveyed in the Baltic Sea and Far East seas, respectively. The longest series are available for the Russian part of the Sea of Japan, where marine debris has been monitored since 1998 (microplastics since 2014), primarily as a research initiative of the Far Eastern Federal University using the framework of ICC and NOWPAP. A Marine litter database is established and a microplastics database is developing (i.e. Okhotkina et al. 2020). In past years, collaboration has extended to the Arctic region (Blinovskaya and Gavrilo 2020; Blinovskaya et al. 2020). As mentioned above in the Norwegian section on long-term monitoring, in 2019, the joint Russian-Norwegian Environmental Commission (2019) established a project on marine litter and microplastics. The project will also exchange relevant information on regulations and measures to reduce and prevent plastic pollution. Finally, Russia and Norway are working together to assess marine plastic pollution in the Barents Sea and Kara Sea (see section 4.5.2).

There are currently no long-term monitoring programs for plastic ingestion by seabirds in Russia. However, research on plastic pollution ingestion by seabirds in the Russian Arctic is increasing (Weslawski et al. 1994; Golovnyuk et al. 2019; Zelenskaya 2019; Solovyeva et al. 2020). In November 2019, the “Plastic pollution & seabirds in the Russian Arctic: State of knowledge, information exchange, possibilities for collaboration” workshop, organized under CAFF and AMBI, was the first workshop focusing on the impacts of marine plastic on seabirds and is thus an area of development for Russia.

European Shags in their breeding colony. Photograph: Nina Dehnhard
5. PLASTIC POLLUTION POLICY IN THE NORTH AMERICAN ARCTIC

5.1. CANADA

5.1.1. Legal frameworks and strategies
At the national level, the Government of Canada has established over 10 federal Acts that govern marine debris, which enable the Canadian government to set regulations and guidelines to reduce, prevent, and research marine debris. These policies largely address marine debris by prohibiting the deposition of waste in the marine environment, but also address land-based sources and lost or discarded fishing gear (see Table S3). At the national level, the only ban on plastic pollution that currently exists is the Microbeads in Toiletries Regulations (2017), which prohibits the manufacturing and distribution of cosmetics that contain microbeads. However, the Canadian government recently announced that single-use plastics (e.g. plastic bags, straws, and other single-use plastics deemed “harmful” to the environment, although the list of items has not been finalised) will be banned across Canada as early as 2021 (Government of Canada 2020). However, as a result of concerns over safety during the COVID-19 pandemic, some plastic bag bans in other regions of Canada (e.g. Newfoundland) are being delayed (Silvia et al. 2020). Further, after calls from scientists and other groups (Rochman et al. 2013), the Canadian government is set to list plastics as a toxic substance under the Canadian Environmental Protection Act (Government of Canada 2019a), which will allow the government to regulate certain plastic products under this Act (Blaze Baum 2020). In anticipation of this, the Canadian government released a science assessment on plastic pollution in 2020 (ECCC 2020).

To address marine debris in the Canadian Arctic, Canada has established the federal Arctic Waters Pollution Prevention Act (Government of Canada 2019b), which prohibits the deposition of waste in Arctic waters (or land where waste may enter Arctic waters), which includes Canada’s three Arctic territories (Nunavut, Northwest Territories and Yukon). These territories also have policies that govern solid waste and other contaminants at the regional level, where the deposition of waste into marine waters without a permit is prohibited in all three territories (see Table S3).

In terms of seabirds, there is no Canadian legislation that directly addresses marine plastic pollution in relation to seabirds. The Migratory Birds Convention Act (Government of Canada 2017) prohibits the deposition of a substance into waters that is harmful to migratory birds, and though seabirds are migratory, and plastics can be harmful to seabirds (Kühn et al. 2015), this legislation does not directly protect seabirds from plastic pollution. In addition to legislation on marine plastics, there are also nation-wide strategies in place to combat this environmental problem. For example, Canada created the Ocean Plastics Charter (ECCC 2018) to commit G7 countries to take action on plastic pollution. This charter outlines various targets, including the goal to recover 100% of all plastics by 2040. Additionally, the charter calls for other nations to implement these objectives, and of the Arctic countries, the European Union (Greenland, Faroe Islands, Finland and Sweden) and Norway have signed the charter (at the time of this study). In line with the Ocean Plastics Charter, the Canadian Council of Ministers of the Environment (CCME) developed the Canada-wide Strategy on Zero Plastic Waste, which outlines Canada’s goal of zero plastic waste and a circular economy: to keep plastics in the economy and out of the environment (CCME 2018). The CCME, in collaboration with organizations and stakeholders, developed the Canada-wide Action Plan on Zero Plastic Waste (CCME 2019), which aims to reduce the negative environmental impacts of plastic pollution through pollution prevention (reduction) and improved recovery (increased recycling rates) (Walker and Xanthos 2018). Though not legally-binding, this action plan encourages government, industry and citizens to collaborate on this issue, and progress will be reported regularly. Phase two of this action plan (due to be released in 2020) will focus on preventing plastic pollution in the ocean and other waters. Finally, the Government of Canada created the Canada Plastics Science Agenda (CaPSA), which highlights priority science areas required to address the issue of plastic pollution in Canada (ECCC 2019). Under theme one, CaPSA identifies the need for harmonized and standardized methodology for data collection to ensure data is comparable across species and areas, and also indicates the need to identify sources and pathways of plastics in the environment. In theme two, CaPSA identifies the need to assess the effect of plastic on human health, wildlife and the environment.

5.1.2. Long-term monitoring programs
The prevalence of plastic ingestion by seabirds in the Canadian Arctic has been relatively well-studied (Mallory et al. 2006, 2008; Provencher et al. 2009, 2010, 2014; Poon et al. 2017; Avery-Gomm et al. 2018). However, there remains no coordinated monitoring programs for plastic ingestion and entanglement by seabirds despite calls for national monitoring programs (Provencher et al. 2015) and recommended standardized methods (van Franeker et al. 2011; Provencher et al. 2017, 2019).
5.2. UNITED STATES

5.2.1. Legal frameworks and strategies
The US Environmental Protection Agency (EPA) is responsible for regulating waste management in the US and setting standards for strategies and implementation of waste management practices. The US has a variety of national policies that address marine debris, such as the Marine Debris Research, Prevention and Reduction Act (2006), the Maritime Pollution Prevention Act (2008) and the Save Our Seas Act (2018; see Table S3 for complete list). These Acts enable research, monitoring, reduction and prevention of marine debris. At the national level, the only ban on plastic pollution that currently exists is the Microbead Free Waters Act (2015), which prohibits the manufacturing and distribution of cosmetics that contain microbeads (United States Congress 2015). Following recommendations from the EPA, each state has the authority to introduce its own rules and regulations for waste management. At a local level, Alaska (the only US state in the Arctic), has various municipal bans on plastic bags, and a state-wide legislation pending (Baglaws.com), but no other legislation that specifically addresses plastic pollution.

5.2.2. Long-term monitoring programs
Seabirds have been examined for plastics in Alaska since the late 1970’s (Day 1980; Robards et al. 1995; Vlietstra and Parga 2002; Bond et al. 2010; Yamashita et al. 2011; Tanaka et al. 2013), but there are no coordinated long-term monitoring programs for plastic ingestion and entanglement by seabirds in this region. However, the US has citizen science monitoring programs, such as the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Monitoring Program (MDP) and the Coastal Observation and Seabird Survey Team (COASST) that monitor marine plastic pollution on beaches. The NOAA MDP monitors the amount and type of marine debris in coastal areas in North America (including locations in Alaska) and uses these data to track the progress of marine debris prevention initiatives in these regions (NOAA 2020). Similarly, COASST engages citizen scientists in monthly surveys of marine debris and beached birds in coastal areas, with recent efforts in Alaska (COASST 2020).

Elsewhere in the US, there are established plastic pollution monitoring programs such as San Francisco Bay Microplastics Project (5 Gyres Institute 2020) that collect data on sources and pathways of microplastics in the region and uses these data to make policy recommendations in the area (Box and Cummins 2019). Though these projects are not based in the Arctic, they could be used as a guideline to develop similar monitoring programs in Alaska.
6. DISCUSSION

Marine plastic is an increasing global issue that can impact a variety of marine biota (Laist 1987, 1997; Provencher et al. 2017; Hallanger and Gabrielsen 2018), making it an important concern for scientists and policymakers worldwide. To address this environmental problem, various policies and programs have been implemented to prevent, reduce and monitor plastic in the marine environment. In the Arctic, there is a broad range of international, national, regional and local policies and legislation that include marine debris, addressing both its sources and impacts in this region (see Table S1, S2, S3). This includes a range of policy tools that largely address waste management and pollution from ships, but not the conservation of seabirds and other wildlife.

Importantly, policies on plastic pollution vary widely across Arctic countries. Among the Arctic countries, Greenland, the Faroe Islands, Finland, Iceland, Norway and Sweden have signed the OSPAR Convention, but Norway and Iceland are the only countries that have implemented the plastic pollution OSPAR seabird monitoring component. While other Arctic countries have applied the protocol opportunistically (e.g. Canada; Poon et al. 2017), these studies are not a part of a coordinated national policy or long-term monitoring programs. Though these opportunistic studies contribute to our understanding of plastic ingestion by Arctic seabirds, they cannot be used to assess temporal trends of plastic pollution in Arctic ecosystems due to small sample sizes, lack of repeat sampling at the same site, and large intervals between sampling periods (Poon et al. 2017; Baak et al. 2020). Further, a lack of standardized methods makes it difficult to compare impacts across seabird individuals and populations. This reinforces the need for long-term monitoring programs on plastic ingestion by seabirds in the Arctic to both track trends in plastic pollution and the potential effects on seabird populations. Further, the development of a shared database (e.g. the International Council for the Exploration of the Sea’s Marine Environment database used by OSPAR, HELCOM, and other expert groups) for securing long-term monitoring data with proper quality control and assurance procedures would be needed for improving pan-Arctic assessments.

Long-term monitoring programs are imperative to determine the efficacy of policy through temporal changes in marine plastic pollution. For example, the effectiveness of reducing single-use plastic bags varies, ranging from 33 – 96% depending on the policy (Schnurr et al. 2018). Xanthos and Walker (2017) noted that because policy announcement occurs months or years before implementation, monitoring of marine plastic can be conducted pre- and post-implementation to determine if these policies are positively impacting marine ecosystems. For example, after MARPOL was enacted to reduce pollution from ships, the proportion of industrial pellets in seabirds from the South Atlantic and Indian Oceans decreased, suggesting that these policies are beneficial (Ryan 2008). Similarly, through OSPAR, van Franeker and the Save the North Sea (SNS) Fulmar Study Group (2013) determined that the number and mass of industrial plastics are decreasing in fulmars since the 1980s when monitoring started. However, despite declines in industrial pellets, seabirds are vulnerable to ingesting other types of marine plastic, such as hard plastic fragments, soft plastic packaging, balloons and foamed plastics like polystyrene (Ryan 2008; Kühn and van Franeker 2012; Roman et al 2019), and in the North Sea, the ingestion of user plastics has increased or remained stable over time (van Franeker et al. 2011). Though there are currently few policies that address marine plastic in seabirds, any policy that effectively prevents, reduces or removes plastic in the marine environment will subsequently reduce plastic in Arctic seabirds.

Importantly, policies on plastic pollution vary widely across Arctic countries. Given that plastic pollution is subject to long-range transport, this inconsistency across the region is likely to reduce efficacy of actions to reduce plastic pollution and to monitor changes over time. Therefore, in order for policies to be more effective, pan-Arctic coordination is required so that similar programs can be implemented in a coordinated manner. This
cooperation could be facilitated at a regional level (i.e. the Arctic Council), or at the international level in a forum in which many of the Arctic countries are already engaged (i.e. UNEP).

Plastic pollution has negative impacts on Arctic biota, which are already vulnerable to a variety of environmental threats (i.e. climate change, habitat destruction, chemical pollutants). Given that northern fulmars have been effectively used in the North Sea to track trends in plastic pollution, future policies should not only include actions to reduce plastic pollution in the environment but ensure that an environmental indicator, such as seabirds, be included in policy development as a monitoring tool. The OSPAR protocol has been implemented in the Arctic (Iceland, with ad hoc sampling that uses the protocol in Canada, Greenland and the Faroe Islands). While many regions of the Arctic are not a part of the OSPAR area, a similar protocol could be adopted at the pan-Arctic level to harmonize with ongoing OSPAR efforts.

Importantly, while many policies do not include seabirds, many of the policies that were reviewed can benefit seabird populations. For example, several countries have policies that address abandoned, lost and discarded fishing gear. In Iceland, there is a fee associated with the purchase of fishing gear (Act No. 162/2002) that is waived when this gear is recycled, and now the fishing industry recycles up to 90% of disused gear (Clean Nordic Oceans 2019). While plastic pollution from fishing efforts may not directly relate to plastic ingestion in seabirds, reports from other regions have demonstrated that seabirds can be particularly vulnerable to lost, discarded or abandoned fishing nets (i.e. ghost nets; Huin and Croxall 1996; NOAA 2015; Hallanger and Gabrielsen 2018) through entanglement (Ryan 2018). While there is very little information on how Arctic-breeding seabirds are affected by ghost nets and other abandoned, lost or discarded fishing gear, it is likely that these negatively affect seabirds in the Arctic through either ingestion or entanglement, and that any actions to reduce this type of plastic pollution will benefit seabird populations.

Approximately eighty percent of marine plastic pollution comes from land-based sources (Jambeck et al. 2015; Falk-Andersson and Strietman 2019). Though human and industrial activities are lower in the Arctic compared to southern areas (UNEP 2016, 2018), wind and ocean currents transport this debris from these areas to the Arctic (Cózar et al. 2017). This highlights the need for both pan-Arctic and international collaboration to implement and enforce marine plastic policies and programs. We recognize that plastic waste management can be difficult to implement in developing countries, thus it is good practice for developed countries to include provisions to developing nations in marine plastics policy. For example, Canada is providing CAD $100 million to help developing countries reduce plastic waste in oceans and coastal areas (Government of Canada 2020). Similarly, Norway has provided approximately USD $200 million on The Norwegian Development Program to Combat Marine Litter and Microplastics, to help prevent and reduce the extent of marine litter from large sources in developing countries in the period 2019–2022 (Government of Norway 2018).

7. CONCLUSIONS

Though many Arctic countries have marine plastic policies in place, few directly address plastic ingestion monitoring for seabirds, despite the increasing levels of plastic in seabirds across the Arctic (Provencher et al. 2009; Kühn et al. 2015; Kühn and van Franeker 2019). Importantly, though not directly addressing seabirds, policies on prevention, reduction and removal of plastic in the marine environment can also help reduce plastic impacts on seabirds. Marine plastic should be addressed by all levels of government. However, marine plastic policy and programs in the Arctic are implemented inconsistently across regions, and until the completion of the Arctic Council Regional Action Plan on Marine Litter, there is no pan-Arctic framework to address marine plastic pollution. Further, there is a lack of enforcement and follow-up monitoring, making it difficult to determine effectiveness of these policies. To curb this environmental contaminant, pan-Arctic and international collaboration are needed to implement consistent policies and programs. Additionally, international standardized research and monitoring programs for marine plastic are required to inform these decisions and facilitate comparisons across regions.

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MNRE 2019. Guidelines for the application of the provisions of the International Convention MARPOL 73/78. Saint-Petersburg, Russian Maritime Shipping Register. 106 p. [In Russian].


Table 1. List of Arctic countries that have signed international policy frameworks to reduce marine plastic pollution, where AM = Associate Member.

<table>
<thead>
<tr>
<th>INTERNATIONAL FRAMEWORK</th>
<th>CANADA</th>
<th>FAROE ISLANDS</th>
<th>GREENLAND</th>
<th>FINLAND</th>
<th>ICELAND</th>
<th>NORWAY</th>
<th>RUSSIA</th>
<th>SWEDEN</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Convention for the Prevention of Pollution from Ships (MARPOL)</td>
<td>X</td>
<td>AM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Helsinki Commission (HELCOM)</td>
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<td>X</td>
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</tr>
<tr>
<td>Global Convention on the Conservation of Migratory Species of Wild Animals (Bonn/CMS)</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<td>X</td>
</tr>
<tr>
<td>Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Convention on Biological Diversity (CBD)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>United Nations Fish Stocks Agreement (UNFSA)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Honolulu Strategy</td>
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<td>X</td>
<td>X</td>
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<tr>
<td>The 2030 Agenda for Sustainable Development – Sustainable Development Goals (SDGs)</td>
<td>X</td>
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<tr>
<td>Food and Agriculture Organization of the United Nations (FAO) Voluntary Guidelines on the Marking of Fishing Gear</td>
<td>X</td>
<td>AM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>International Maritime Organization (IMO) Action Plan to Address Marine Plastic Litter from Ships</td>
<td>X</td>
<td>AM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</table>

*Non-ratified.
Figure 1. Map of the circumpolar Arctic as defined by CAFF (Irons et al. 2015), including the major Arctic seas (ECCC et al. 2008) and an outline of the Arctic circle at 66°33’ N.
**SUPPLEMENTARY MATERIAL**

Table S1. List of international policy frameworks to reduce marine plastic pollution. Information adapted from Annex I and II (Kershaw et al. 2013) and Plastic PEWG (2020).

<table>
<thead>
<tr>
<th>INTERNATIONAL FRAMEWORK</th>
<th>YEAR ENTERED INTO FORCE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London Convention) and its 1996 Protocol (London Protocol)</td>
<td>1975/2006</td>
<td>The London Convention and London Protocol were some of the first global conventions to protect the marine environment from human activities. Under the London Protocol there is a general prohibition on the dumping of any waste or other matter at sea, including plastics. The objectives of the London Convention and London Protocol are to promote the effective control of all sources of marine pollution and to encourage countries to take effective measures to prevent pollution of the marine environment caused by dumping at sea.</td>
</tr>
<tr>
<td>Helsinki Commission (HELCOM)</td>
<td>1980</td>
<td>The Helsinki Commission (HELCOM) is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (including Kattegat) (the Helsinki Convention). In 2015 HELCOM released a new marine debris action plan with the aims to achieve a significant reduction of marine litter by 2025 and to prevent harm to the coastal and marine environment.</td>
</tr>
<tr>
<td>Global Convention on the Conservation of Migratory Species of Wild Animals (Bonn/CMS)</td>
<td>1980</td>
<td>The Convention on the Conservation of Migratory Species of Wild Animals (CMS) applies to migratory species, but in recent years has put more emphasis on marine debris. The Parties have adopted two resolutions (res.10.4 in 2011 and res.11.30 in 2014) that encourage or recommend specific measures for Parties to address knowledge gaps relating to the impacts of debris on marine species, implement best practices on commercial vessels, and organize awareness campaigns.</td>
</tr>
<tr>
<td>International Convention for the Prevention of Pollution from Ships (MARPOL)</td>
<td>1983/1988</td>
<td>MARPOL is the main international convention aimed at preventing and minimizing pollution of the marine environment from ships – both accidental pollution and that from routine operations. It was signed in 1973, but not until 1988 was Annex V, the prevention of pollution by garbage from ships, introduced. Annex V was revised in 2011 (enacted in 2013). Annex V prohibits the discharge of all garbage into the sea, unless permitted under specific circumstances. A legally binding ban on the discarding of plastic waste from ships anywhere into the ocean applies to the 174 member states of the International Maritime Organization, which accounts for almost 100% of the world’s shipping tonnage.</td>
</tr>
<tr>
<td>Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention)</td>
<td>1992</td>
<td>The Basel Convention provides maybe the most comprehensive approach to the issue of marine plastics and microplastics globally, because the provisions of the Convention, with respect to waste minimization, the environmentally sound management of wastes generated, and the transboundary movement, apply to plastic waste. In 2019, Governments amended the Basel Convention to include plastic waste in a legally-binding framework which will make global trade in plastic waste more transparent and better regulated, whilst also ensuring that plastic waste management is safer for both human health and the environment. A new Partnership on Plastic Waste was also established to mobilize business, government, academic and civil society resources, and incorporate interests and expertise to assist in implementing the new measures (BRS Conventions 2019).</td>
</tr>
<tr>
<td>INTERNATIONAL FRAMEWORK</td>
<td>YEAR ENTERED INTO FORCE</td>
<td>DESCRIPTION</td>
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<tr>
<td>Convention on Biological Diversity (CBD)</td>
<td>1993/2016</td>
<td>The CBD does not directly address pollution of the marine environment since it principally applies to the conservation of biological diversity. However, it has adopted a resolution (CBD/COP/DEC/XIII/10) in 2016 to address impacts of marine debris and anthropogenic underwater noise on marine and coastal biodiversity. The decision also has specific priority actions related to microplastics.</td>
</tr>
<tr>
<td>United Nations Convention of the Law of the Sea (UNCLOS)</td>
<td>1994</td>
<td>UNCLOS is the only global instrument that imposes a legally binding obligation upon States for the prevention, reduction and control of land-based sources of pollution (article 207). States are required to adopt laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources, taking into account internationally agreed rules, standards and recommended practices and procedures.</td>
</tr>
<tr>
<td>The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)</td>
<td>1998</td>
<td>The OSPAR Convention (1992) is the legal instrument guiding international cooperation for the protection of the marine environment of the North-East Atlantic. The 15 contracting parties and the European Commission are under a general obligation to “take the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected”. It supports direct measures of the reduction of marine debris through initiatives such as “Fishing for Litter”. As indicators of environmental quality, plastics in the stomachs of northern fulmars (Fulmarus glacialis) and on beaches are assessed and monitored.</td>
</tr>
<tr>
<td>United Nations Fish Stocks Agreement (UNFSA)</td>
<td>2001</td>
<td>The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (United Nations Fish Stocks Agreement/UNFSA) is mainly concerned with the conservation and management of straddling fish stocks and highly migratory fish stocks, but it also includes obligations for States to minimize pollution, waste, disposal, and bycatch by lost or abandoned gear (article 5(f)). In addition, in the Article 18 (3d), it is requested to mark fishing vessels and fishing gear for identification in accordance with uniform and internationally recognizable vessel and gear marking systems, such as the Food and Agriculture Organization of the United Nations Standard Specifications for the Marking and Identification of Fishing Vessels.</td>
</tr>
</tbody>
</table>
| Honolulu Strategy                                            | 2011                   | The Honolulu Strategy published by the United Nations Environment Programme (UNEP) and the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program, is a global framework for prevention and management of marine debris. The strategy has three main goals:  
  • Goal A: Reduce amount and impact of land-based sources of marine debris introduced into the marine environment  
  • Goal B: Reduce amount and impact of sea-based sources of marine debris including solid waste, lost cargo, abandoned, lost or otherwise discarded fishing gear, and abandoned vessels introduced into the sea  
  • Goal C: Reduce amount and impact of accumulated marine debris on shorelines, in benthic habitats, and in pelagic waters. |
<table>
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<tr>
<th>INTERNATIONAL FRAMEWORK</th>
<th>YEAR ENTERED INTO FORCE</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>The 2030 Agenda for Sustainable Development - Sustainable Development Goals (SDGs)</td>
<td>2015</td>
<td>Resolution 70/11 and the UN Agenda 2030 for Sustainable Development was adopted in 2015 by the United Nations General Assembly with 17 SDGs, including SDG 14 to conserve and sustainably use the oceans, seas and marine resources. Each SDG includes targets and under the 10 targets for the implementation of SDG 14 (“Life below water”), target 14.1 specifically aims to prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris.</td>
</tr>
<tr>
<td>Food and Agriculture Organization of the United Nations (FAO) Voluntary Guidelines on the Marking of Fishing Gear</td>
<td>2016/2019</td>
<td>The FAO guidelines (first drafted in 2016) consider the issue of marine debris and microplastics from the perspectives of i) reducing marine litter that originates from the fishing industry, in particular abandoned, lost or otherwise discarded fishing gear (ALDFG); ii) assessing the ecological impact of microplastics on fisheries resources and aquaculture products; and; iv) assessing food safety risks from marine litter, in particular microplastics, on human health. In 2018, the Committee on Fisheries (COFI33), endorsed FAO’s Voluntary Guidelines for the Marking of Fishing Gear (VGMFG) 3 that includes a framework for undertaking risk assessment to identify the appropriateness or otherwise of implementing a system for marking fishing gear as well as provisions related to associated measures such as retrieval of lost gear, reporting of ALDFG and disposal of end-of-life gear. The VGMFGs are an important tool in preventing and reducing ALDFG and ghost fishing, and in combating illegal, unreported and unregulated fishing. The VGMFG compliments FAO’s Code of Conduct for Responsible Fisheries.</td>
</tr>
<tr>
<td>International Maritime Organization (IMO) Action Plan to Address Marine Plastic Litter from Ships</td>
<td>2018</td>
<td>In addition to the legally-binding instruments, IMO’s Marine Environment Protection Committee (MEPC) recently adopted (on 26 October 2018) the Action Plan to Address Marine Plastic Litter from Ships (Resolution MEPC.310(73)), to find a global solution for preventing marine plastic debris entering the oceans through ship-based activities. IMO Member States agreed that actions are to be completed by 2025, which applies to all ships including fishing vessels. The action plan also seeks to address possible gaps in MARPOL, such as waste from dredging. Further discussions are continuing within MEPC to advance on the implementation of the Action Plan.</td>
</tr>
</tbody>
</table>
Table S2. Legally binding instruments relating to the prevention of debris entering the ocean in the European Union (EU). Directives applicable to members of the European Economic Area are marked with an asterisk (*Act under scrutiny by EEA/EFTA, **Incorporated into the EEA Agreement and in force, EFTA 2020). Information adapted from Kershaw et al. (2013), the European Commission (European Commission 2020) and EFTA (2020).

<table>
<thead>
<tr>
<th>EU FRAMEWORK</th>
<th>YEAR</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>Urban Waste Water Treatment Directive (91/271/EEC**)</td>
<td>1991</td>
<td>Requires secondary treatment for sewerage discharges serving cities with a population over 10000 in coastal areas and 2000 in estuarine areas. Urban waste water discharge is one of the main sources of marine litter. Sewage-related debris includes sanitary towels, tampons and plastic cotton wool bud sticks. Storm water overflows may be a significant source of debris and are not included.</td>
</tr>
<tr>
<td>Habitats Directive (92/43/EEC)</td>
<td>1992</td>
<td>Aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It forms the cornerstone of Europe’s nature conservation policy with the Birds Directive and establishes the EU wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments.</td>
</tr>
<tr>
<td>Packaging and Packaging Waste Directive (2018/852*, 2015/720**, 94/62/EC**)</td>
<td>1994</td>
<td>Gives a range of requirements to reduce the impact of packaging, light-weight plastic carrier bags and packaging waste on the environment. Directive contains provisions on the prevention of packaging waste, on the re-use of packaging and on the recovery and recycling of packaging waste. Requires Member States to ensure that preventative measures are implemented (e.g. by national programs, extended producer responsibility programs); to develop packaging re-use systems for the reduction of the impact of packaging and packaging waste on the environment; and to introduce systems for the return and/or collection of used packaging. Directive 2018/852 amends directive 94/62/EC and contains updated measures designed to prevent the production of packaging waste, and promote the reuse, recycling and other forms of recovering of packaging waste, instead of its final disposal, thus contributing to the transition towards a circular economy.</td>
</tr>
<tr>
<td>Landfill Directive (2018/850*, 99/31/EC)</td>
<td>1999</td>
<td>Aims to reduce impacts of landfills on the environment, including the pollution of surface water. Establishes technical requirements for the operation of landfills, taking into account factors such as the proximity of water bodies and coastal waters and the location of landfill sites such that wind-blown materials are minimized.</td>
</tr>
<tr>
<td>End-of Life Vehicle Directive (2018/849*, 2000/53/EC**)</td>
<td>2000</td>
<td>This Directive lays down measures which aim, as a first priority, at the prevention of waste from vehicles and, in addition, at the reuse, recycling and other forms of recovery of end-of life vehicles and their components so as to reduce the disposal of waste, as well as at the improvement in the environmental performance of all of the economic operators involved in the life cycle of vehicles and especially the operators directly involved in the treatment of end-of life vehicles.</td>
</tr>
<tr>
<td>List of Wastes (2000/532/EC**)</td>
<td>2000</td>
<td>Provides a framework for the collection of statistics on plastic waste streams. Distinguishing between pre-consumer and post-consumer plastic waste is important.</td>
</tr>
<tr>
<td>Port Reception Facilities Directive (2019/883*, 2010/65/ EU**, 2000/59/EC**)</td>
<td>2000</td>
<td>Directive (EU) 2019/883 amends Directive 2010/65/EU and repeals Directive 2000/59/EC. This Directive aims to protect the marine environment by reducing discharges of waste from ships, and to improve efficiency of maritime operations in ports, by seeking to ensure that more waste is delivered on shore, in particular garbage, including waste from the fishing sector such as derelict fishing gear. It also aims to contribute to the Circular Economy, by improving the adequacy of waste reception facilities, in particular as regards their environmental operation.</td>
</tr>
<tr>
<td>EU FRAMEWORK</td>
<td>YEAR</td>
<td>DESCRIPTION</td>
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<tr>
<td>------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Bathing Water Quality Directive (2006/7/EC).</td>
<td>2006</td>
<td>Requirement to monitor bathing waters every year and prepare a description of bathing waters and potential impacts and threats to water quality, both as information for citizens and as a management tool for the responsible authorities.</td>
</tr>
<tr>
<td>European Union Regulation of 18 December 2006 (1907/2006**).</td>
<td>2006</td>
<td>European Chemicals Agency Database. Regulates the production and use of chemical substances (i.e. everything made of atoms), and their potential impacts on both human health and the environment.</td>
</tr>
<tr>
<td>Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)</td>
<td>2006</td>
<td>REACH aims to lower levels of pollution and increase safety levels in relation to the use of hazardous chemicals. Recycled plastics are affected as it requires recyclers to provide information on the types of chemicals included in recycled plastics. Requires producers to register chemicals in the.</td>
</tr>
<tr>
<td>Regulation on shipment of waste (EC No. 1013/2006**).</td>
<td>2006</td>
<td>This Regulation aims to prevent the illegal shipment of waste. Under Article 59, checks can be carried out on waste shipments or on related recovery or disposal.</td>
</tr>
<tr>
<td>Waste Framework Directive (2008/98/EC**, 2006/12/EC).</td>
<td>2006</td>
<td>Sets out essential conditions for all waste management and concerns all waste, thus influencing marine litter. Prohibits the abandonment, rejection and uncontrolled elimination of waste; promotes the prevention, recycling and transformation of waste; introduces a procedure for defining end-of-waste (EoW) criteria to enable a waste stream to cease being defined as waste. As of June 2015 legislative changes concerning the list of waste and hazardousness properties have been made (replacing annex III; Commission Regulation (EU) No 1357/2014)</td>
</tr>
<tr>
<td>Assessment and management of flood risks (2007/60/EQ).</td>
<td>2007</td>
<td>This Directive requires Member States to assess if all watercourses and coastlines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk.</td>
</tr>
<tr>
<td>Marine Strategy Framework Directive (MSFD) (2008/56/EC).</td>
<td>2008</td>
<td>The MSFD was the first EU legal instrument to address explicitly marine litter and to protect more effectively the marine environment across Europe. The MSFD aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. It is currently the most important European Legislation concerning marine litter. Member States were required to develop Marine Strategies which serve as Action Plans and which apply an ecosystem-based approach to the management of human activities, including marine litter. The MSFD provides the overarching framework for earlier directives, including the Habitats Directive (92/43/EC), the Birds Directive (2009/147/EC), the Water Framework Directive (2000/60/EC).</td>
</tr>
<tr>
<td>Birds Directive (2009/147/EC).</td>
<td>2009</td>
<td>Aims to protect all wild bird species naturally occurring in the EU and prevent declining populations due to pollution, loss of habitats and unsustainable use.</td>
</tr>
</tbody>
</table>

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**Note:** The Asterisks (*, **) indicate the specific version of the directive.
<table>
<thead>
<tr>
<th>EU FRAMEWORK</th>
<th>YEAR</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>Ecodesign Directive (Directive 2009/125/EC**)</td>
<td>2009</td>
<td>To reduce energy use for energy-using and energy-related products, and enforcing other environmental considerations (materials use, water use, polluting emissions, waste issues and recyclability)</td>
</tr>
<tr>
<td>Ship-source Pollution Directive (2009/123/EC**)</td>
<td>2009</td>
<td>The Ship-source Pollution Directive transposes into EU legislation the standards introduced by MARPOL 73/78 relating to the prohibition of polluting discharges into the sea and specifies the sanctions to be imposed.</td>
</tr>
<tr>
<td>Industrial Emissions Directive (IED) (2010/75/EU**)</td>
<td>2010</td>
<td>This Directive is the main EU instrument regulating pollutant emissions from industrial installations and commits member states to control and reduce the impact of industrial emissions on the environment.</td>
</tr>
<tr>
<td>Plastic materials and articles intended to come into contact with food directive (Commission Regulation (EU) No 10/2011**)</td>
<td>2011</td>
<td>Establishes a list of monomers and other substances, such as additives, that are permitted for use in the manufacture of food packaging.</td>
</tr>
<tr>
<td>Restriction of Hazardous Substances Directive (2011/65/ EU**)</td>
<td>2011</td>
<td>This Directive lays down rules on the restriction of the use of hazardous substances in electrical and electronic equipment (EEE) with a view to contributing to the protection of human health and the environment, including the environmentally sound recovery and disposal of waste EEE</td>
</tr>
<tr>
<td>Waste Electrical and Electronic Equipment Directive (WEEE) (2018/849*, 2012/19/EU**)</td>
<td>2012</td>
<td>The objective of the Directive is to promote re-use, recycling and other forms of recovery of waste electrical and electronic equipment (WEEE) in order to reduce the quantity of such waste to be disposed and to improve the environmental performance of the economic operators involved in the treatment of WEEE. The WEEE Directive sets criteria for the collection, treatment and recovery of waste electrical and electronic equipment.</td>
</tr>
<tr>
<td>Common Fisheries Policy EU no 1380/2013</td>
<td>2013</td>
<td>Aims to achieve a thriving and sustainable European fishing industry.</td>
</tr>
<tr>
<td>Single-use plastics directive (2019/904*)</td>
<td>2019</td>
<td>In June 2019 the European Parliament and Council adopted the Single-Use Plastics Directive, (EU) 2019/904, on the reduction of the impact of certain plastic products on the environment. As from July 2021 the Single-Use Plastics Directive bans the use of certain single-use plastic products, which are considered as the most found as marine litter, such as cutlery (forks, knives, spoons, chopsticks), plates, straws, beverage stirrers, certain food and beverage containers, as well as cups made of expanded polystyrene and products made from oxo-degradable plastics.</td>
</tr>
</tbody>
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Table S3. List of national and regional policy frameworks to reduce marine plastic pollution in the eight Arctic countries.

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<tr>
<th>COUNTRY</th>
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<th>NAME</th>
<th>YEAR</th>
<th>DESCRIPTION</th>
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</table>
| Canada        | National  | Arctic Waters Pollution Prevention Act (AWPPA) (R.S., 1985, c. A-12)  | 1985 | • Aims to prevent pollution in Canadian Arctic waters  
• Prohibits the deposition of waste of any type in Arctic waters or on land in the Canadian Arctic where waste may enter Arctic waters  
• Describes the offences and punishments if AWPPA is not followed (e.g. a person or ship guilty of an offence can be fined up to $5,000 or $100,000, respectively) |
|               |           | Canada Water Act                                                     | 1985 | • Governs the water resources in Canada, which includes regulating the development, utilization and conservation of these resources  
• Prohibits the deposition of waste of any type, where waste is defined as “any substance that, if added to any water, would degrade”  
• Prohibits the deposition of waste of any type, where waste is defined as “any substance that, if added to any water, would degrade or alter or form part of a process of degradation or alteration of the quality of that water to an extent that is detrimental to their use by man or by any animal, fish or plant that is useful to man”  
• Provides authority to the government to establish committees that can recommend development plans, conservation programs, policies and priorities for research surrounding water resources and waste treatment in water resources |
|               |           | Fisheries Act                                                        | 1985 | • Allows the Canadian government to set objectives, guidelines and rules to reduce prevent pollution, similar to CEPA  
• Section 25 of the Act states that “any person who places or sets any fishing gear or apparatus in any water, along any beach or within any fishery shall remove it when the gear or apparatus is not being tended and prior to the commencement of a close time”  
• Section 36 of this Act prohibits the deposit of deleterious substances into waters frequented by fish, where deleterious substances are defined as “any substance that, if added to any water, would degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water” |
|               |           | Migratory Birds Convention Act                                       | 1994 | • Section 5.1 (1) of this Act prohibits the deposition of a substance that is harmful to migratory birds in waters or areas where the substance may enter such waters |
|               |           | Oceans Act                                                           | 1996 | • Allows for the Canadian government to establish marine protected areas (MPAs). For example, in the Arctic, the Tuvaijuittuq MPA in Nunavut or the Anguniaqvia niqiyuam and Tarium Niryutait MPAs in the Northwest Territories  
• Allows the government to develop national strategies for the management of marine ecosystems and marine environmental quality guidelines  
• Allows the Department of Fisheries and Oceans Canada to conduct research to further the understanding of Canada’s oceans |
<table>
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<th>COUNTRY</th>
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</table>
|         |       | Canadian Code of Conduct for Responsible Fishing Operations | 1998 | - Includes guidelines for commercial fishing operations in Canadian waters that concern marine debris to inform new fisheries management policies and practices  
- Recommends that fish harvesters use sustainable waste management practices in harvesting operations  
- Recommends that fishing practices should minimize the risk of gear loss and in the event of gear loss, it should be reported and every reasonable solution to retrieve it should be attempted |
|         |       | Canadian Environmental Protection Act (CEPA) | 1999 | - Aims to prevent pollution and protect the environment  
- Allows the government to set objectives, guidelines and rules to reduce and prevent marine pollution, defined in the Act as “the introduction by humans, directly or indirectly, of substances or energy into the sea that results, or is likely to result, in: (a) hazards to human health; (b) harm to living resources or marine ecosystems; (c) damage to amenities; (d) interference with other legitimate uses of the sea”  
- Part 7, Division 3 of CEPA states that the disposal of waste and other matter into the ocean from ships, aircraft or other structures is prohibited, when the structure is within Canada and when Canadian ships are in international waters, unless a permit is issued by Environment and Climate Change Canada. Disposal of certain substances (e.g. dredged material, fish waste, ships) may be permitted by the government for disposal at sea if the permit applicant has considered other waste disposal options (e.g. recycling) and these are not practical, and if the disposal is determined to cause no significant adverse effect. For example, ships may be permitted for disposal at sea if all floating debris (e.g. plastic) has been removed (CEPA Schedule 5)  
- Schedule 6 of CEPA outlines the permit process, which includes information on timing, disposal and monitoring requirements. This section helps Canada meet its obligations under the London Convention and London Protocol (see Table S1) |
|         |       | Canadian Shipping Act | 2001 | - Aims to protect the marine environment, specifically from damage due to navigation and shipping activities  
- Prohibits the discharge of pollutants into Canadian waters or Canada’s Exclusive Economic Zone, where pollutant is defined as “a substance that, if added to any waters, would degrade or alter or form part of a process of degradation or alteration of the quality of the waters to an extent that is detrimental to their use by humans or by an animal or a plant that is useful to humans”. This definition does not directly protect animals and plants in the marine environment, but only those that if harmed, will not be useful to humans  
- Discharge of pollutants is only permitted if authorized by the Canadian Shipping Act or CEPA |
|         |       | Disposal at Sea Regulations (SOR/2001-275) | 2001 | - Regulation under CEPA 1999  
- Governs the assessment of substance concentrations and biological responses of disposed waste, as well as the eligibility requirements for permit renewals |
<p>|         |       | National Marine Conservation Areas Act | 2002 | - Prohibits disposal of substances in National Marine Conservation Areas unless permitted by this Act or CEPA |</p>
<table>
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</table>
|         |       | Disposal at Sea Permit Application Regulations (SOR/2014-177) | 2014 | • Regulation under CEPA 1999  
  • Provides the application forms for disposal at sea permits |
|         |       | Microbeads in Toiletries Regulations (SOR/2016-150) | 2016 | • Regulation under CEPA 1999  
  • Prohibits the manufacturing, importing and sale of toiletries (non-prescription drugs and natural health products) that contain microbeads, where microbeads are defined (under Schedule 1) as “plastic microbeads that are ≤ 5 mm in size” |
|         |       | Arctic Waters Pollution Prevention Regulations (C.R.C., c. 354) | 2017 | • Regulation under AWPPA  
  • Regulates the deposit of domestic and industrial waste on land and in water in the Arctic region |
| Regional |       | Consolidation of Environmental Protection Act | 1998/2011 | • Territories: Nunavut and Northwest Territories  
  • Prohibits the discharge of contaminants into the environment, where contaminant is defined as “any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment, (a) endangers the health, safety or welfare of persons, (b) interferes or is likely to interfere with normal enjoyment of life or property, (c) endangers the health of animal life, or (d) causes or is likely to cause damage to plant life or to property”  
  • Allows the government to make regulations on maximum concentrations of contaminants in the environment and the discharge, transport, use, recycling or disposal of contaminants  
  • Allows the government and the Chief Environmental Protection Officer of these territories to implement methods to prevent the discharge of contaminants into the environment |
|         |       | Environment Act | 2002 | • Province: Yukon  
  • Part 7 of this Act outlines waste management and prohibits the disposal of solid waste unless at a waste disposal facility, where solid waste is defined as “refuse, ashes, garbage, domestic waste, compost or any other waste prescribed by regulation whether or not the waste has any commercial value or is capable of being used for a useful purpose”  
  • Part 7 section 98 gives the federal government the authority to require the Yukon government to submit a waste management plan for the territory  
  • Part 7 section 101 prohibits a person to abandon or discard litter unless at a waste disposal ground, a municipal waste system or with a permit, where litter is defined as “any rubbish, refuse, garbage, paper, packaging, containers, bottles, cans, manure, human or animal excrement, sewage, the whole or part of an animal carcass, the whole or part of a vehicle or piece of machinery, construction material, or demolition waste that is abandoned or discarded and anything prescribed by regulation”  
  • Part 8 section 108 gives the government the authority to establish a recycling fund to finance projects to reduce, reuse and recycle waste  
  • Part 8 section 110 allows the government to ban the sale or use of products or packages that will “cause a significant impairment of the natural environment that cannot otherwise be prevented or mitigated” |
<table>
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<th>COUNTRY</th>
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<th>NAME</th>
<th>YEAR</th>
<th>DESCRIPTION</th>
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</thead>
</table>
| Nunavut       |          | Nunavut Waters and Nunavut Surface Rights Tribunal Act    | 2002 | • Province: Nunavut  
• Prohibits the deposit of waste in Nunavut water or any place where if deposited the waste may enter Nunavut waters, where waste is defined as “any substance that, by itself or in combination with other substances found in water, would have the effect of altering the quality of any water to which the substance is added to an extent that is detrimental to its use by people or by any animal, fish or plant” |
|               |          | Waste Reduction and Recovery Act                          | 2003 | • Province: Northwest Territories  
• Allows the government of the Northwest Territories to establish programs to for waste management (waste recovery, reduction and recycling)  
• Establishes an Environment Fund to support waste management programs and enforce recovery |
|               |          | Waters Act (s. 24)                                       | 2014 | • Province: Northwest Territories  
• Prohibits the deposit of waste in water management areas or areas that the waste deposited may enter water management areas in the Northwest Territories, where waste is defined as “a substance that, if added to water, would degrade or alter or form part of a process of degradation or alteration of the quality of the water to an extent that is detrimental to its use by people or by an animal, fish or plant …” and water management areas are defined by the government, usually consisting of river basins or other geographical areas  
• Outlines when a licence is or is not required for the deposit of waste in Northwest Territories waters  
• Outlines fines associated with the illegal deposition of waste in Northwest Territories waters |
| Faroe Islands | National | Marine Environment Act                                    | 2005 | • Promote recycling and mitigate waste disposal issues  
• Prohibits dumping at sea and sets detailed technical requirements for ships and limits their access to discharges of oil, chemicals, sewage and waste |
|               |          | Environmental Protection Act                              | 2007 | • Prevention of pollution of air, water and soil  
• Prevent pollution by waste and promote recycling  
• Promote recycling and mitigate waste disposal issues |
| Greenland     | National | Environmental Act                                         | 2011 | • Applies to land as well as land-based marine pollution. No direct reference to plastic pollution  
• Prevent and combat pollution of air, water, ice, mountain and soil  
• Protecting the health of the population  
• Provide the basis for planning and action against pollution  
• Restrict the use and waste of resources  
• Promote recycling and mitigate waste disposal issues |
|               |          | Marine Environment Act                                    | 2017 | • Aims to prevent and limit pollution and other effects on nature and the environment, in particular the marine environment, from activities that can endanger human health, harm the living resources and life at sea and on land, or disrupt the rightful exploitation of the sea  
• Prohibits dumping at sea and sets detailed technical requirements for ships and limits their access to discharges of oil, chemicals, sewage and waste |
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</thead>
<tbody>
<tr>
<td>Finland</td>
<td>National</td>
<td>EU policies and legislations relating to the prevention of marine debris and waste management</td>
<td></td>
<td>• See Table S2</td>
</tr>
<tr>
<td>Iceland</td>
<td>National</td>
<td>EEA policies and legislations relating to the prevention of marine debris and waste management</td>
<td></td>
<td>• See Table S2</td>
</tr>
<tr>
<td>Iceland</td>
<td>National</td>
<td>Act No. 57/1996 on access to marine commodities</td>
<td>1996</td>
<td>• This act forbid to abandon lost gear at sea. The loss of gear must be reported to the authorities and vessels will be held financially accountable for the retrieval of the gear.</td>
</tr>
<tr>
<td>Iceland</td>
<td>National</td>
<td>The Nature Conservation Act no. 44/1999</td>
<td>1999</td>
<td>• The purpose of this Act is to direct the interaction of man with his environment so that it harm neither the biosphere nor the geosphere, nor pollute the air, sea or water.</td>
</tr>
<tr>
<td>Iceland</td>
<td>National</td>
<td>Act No. 162/2002 on processing fees</td>
<td>2002</td>
<td>• The aim of this Act is to encourage reuse and recycling of waste for the purpose of reducing the amount of waste that goes to final disposal and ensure proper disposal of hazardous waste. Fishing gear is amongst the materials covered under this act.</td>
</tr>
<tr>
<td>Iceland</td>
<td>National</td>
<td>Act No. 33/2004 on marine and coastal antipollution measures</td>
<td>2004</td>
<td>• Aims to protect the ocean and beaches against pollution and activities that could jeopardize human health, damage the ocean’s living resources and disturb its biosphere, damage the environment or prevent the lawful utilisation of the ocean and beaches. • The act applies to any kind of activity related to business operations, projects, ships and aircraft in Iceland on land, in the air and within Iceland’s pollution jurisdiction • The act also applies to Icelandic ships outside Iceland’s pollution jurisdiction insofar as Iceland has obliged itself under international agreements.</td>
</tr>
<tr>
<td>Norway</td>
<td>National</td>
<td>EEA policies and legislations relating to the prevention of marine debris and waste management</td>
<td></td>
<td>• See Table S2•</td>
</tr>
<tr>
<td>Norway</td>
<td>National</td>
<td>Act on Protection against Pollution and on Waste (Pollution Control Act) (LOV-1981-03-13-6, Forurensningsloven)</td>
<td>1981</td>
<td>• Protect the environment from pollution and to reduce existing pollution • Reduce the amount of waste and promote better treatment of waste</td>
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|         |       | The Aquaculture Act (LOV-2005-06-17-79, Akvakulturloven) | 2005 | • The purpose of this Act is to promote the profitability and competitiveness of the aquaculture industry within the framework of a sustainable development and contribute to the creation of value on the coast.  
• Aquaculture activities require a license from the County Council according to the AA. Conditions: ‘Environmental responsible’, not contravening adopted land use plans, approved by the competent authorities of a number of sectoral laws (e.g. Food Act, Animal Welfare Act, Pollution Control Act, Water Resources Act, Harbour Act).  
• Certain articles concerning the Aquaculture Act, such as environmental monitoring has been amended (No. 74 of 2013). |
|         |       | The Regulations of aquaculture activities | | • The regulations are based on the Aquaculture Act and provide supplementary provisions to the law. They include additional requirements for aquaculture facilities in order to promote profitability within the framework of sustainable development. The regulations stipulate that in the event of permanent termination of operations at a site, a complete clean up, including removal of installtions above and below water, shall be ensured. According to the regulations a complete clean up must be completed no later than 6 months after termination (§ 17). |
|         |       | The Regulations of permits for aquaculture of species other than salmon, trout and rainbow trout | | • The regulations are based on the Aquaculture Act and provide supplementary provisions to the law. They stipulate special requirements for applications to establish aquaculture facilities for species other than salmon, trout and rainbow trout. Applications for a permit for aquaculture of mussels and aquatic plants must contain documentation that ensures financial security for the company, such as a deposit, in the case of termination of operations at the aquaculture facilities. The financial security aims to ensure that facilities are removed from the sea upon termination. |
|         |       | Ship safety and Security Act (No. 9 of 2007) | 2007 | • The purpose of this Act is safeguard life, health, property and the environment by facilitating a high level of ship safety and safety management, including preventing pollution from ships, ensuring a fully satisfactory working environment and safe working conditions on board ships as well as appropriate public supervision of ships.  
• Pollution of the external environment by the discharge or dumping from ships, or by the incineration of harmful substances, or pollution in any other way in connection with the operation of the ship is prohibited, unless otherwise decided by law or regulation laid down pursuant to law. |
|         |       | Marine Resources Act (LOV-2008-06-06-37, Havressurslova) | 2008 | • Under this act fishermen are required to search for lost fishing gear and report losses to the Norwegian Coast Guard if gear is not retrieved  
• The law aims to ensure a sustainable and economically profitable management of wild living marine resources. In order to achieve this, the law includes regulations on harvesting, but also regulations on fishing activities that shall ensure a healthy marine ecosystem. As such, the law stipulates the duty to search for lost gear and report such events (§ 17 and related regulations) and it prohibits anyone from dumping, or unnecessarily leaving, objects in the sea (§ 28). |
<p>|         |       | The Regulations of fishing activities in the sea | | • The regulations are based on the Marine Resources Act and provide supplementary provisions to the law. They include additional requirements for fishing activities. The regulations stipulate the duty to supervise and control active nets, tines and rusk (§ 28), report fixed gear and fishing lines (§ 30) and report unretrieved lost gear (§ 78). |</p>
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<tr>
<td></td>
<td></td>
<td>Natural Diversity Act (LOV-2009-06-19-100, Naturmangfoldloven)</td>
<td>2009</td>
<td>• To preserve nature’s biological, landscape and geological diversity through sustainable use and protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regulations on environmental safety for ships and mobile offshore units (No. 488 of 2012)</td>
<td>2012</td>
<td>• The regulations comprise rules on environmental safety for ships and mobile facilities, including waste handling obligations. It contains rules that are based on the international rules on waste from ships found in MARPOL Appendix V (§ 11). It is also stated that the captain of the ship shall ensure that waste and cargo residues are delivered at waste handling facilities in port (§ 16). The Ministry of Climate and Environment and the Ministry of Trade, Industry and Fisheries are responsible for enforcement of the regulations.</td>
</tr>
<tr>
<td>Russia</td>
<td>National</td>
<td>Polluted Harbour Waters Cleanup Operation Rules</td>
<td>1990</td>
<td>• Regulates cleaning of polluted water in seaport areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fishery Fleet Instructions on Preventing Pollution from Ships</td>
<td>1994</td>
<td>• Prevents marine pollution from fishing vessels</td>
</tr>
</tbody>
</table>
|         |        | On Inland Sea Waters, Territorial Sea, and Adjacent Zone of the Russian Federation Law | 1998 | • Establishes the status and legal regime of inland sea waters, the territorial sea and the adjacent zone of the Russian Federation. Defines the procedure for the protection and preservation of the marine environment and natural resources.  
• Article 37 states prohibits the deposit of waste and other materials (with the exception of landfills recovered during dredging), and the discharge of pollutants, in inland sea waters and in the territorial sea.                                                                 |
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<tr>
<th>COUNTRY</th>
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|         |       | Environmental Protection Law | 2001 | • Law that mandates the instruments of environmental policy and calls for a balanced solution for environmental, social and economic problems  
• Article 51 addresses production and consumption of waste to meet requirements of environmental protection. Waste (including plastics) from production and consumption must be collected, used, transported, stored and disposed in a way that is safe for the environment  
• Chapter V establishes general provisions on environmental standard-setting and allowable environmental impacts to ensure the preservation of a favourable environment and environmental safety. In particular, it states that these settings should include the production and consumption of waste generation standards and limits for their disposal |
|         |       | Water Code of the Russian Federation | 2006 | • Article 56 formulates the requirements for the protection of water bodies against pollution and wastes  
• Prohibits the discharge of production and consumption waste into water bodies  
• The enforcement against violations of water legislation (including pollution of water bodies during industrial activities) has intensified in the current version as of 2006. |
|         |       | Strategy on the development of industry for the processing, utilization and neutralization of production and consumption waste for the period until 2030 | 2018 | • Aimed at the formation and future development of industries allowing implementation of the 3R (reduce, reuse, recycle) principle of waste management  
• Sets up targets for increasing reuse and recycling of polymer fraction of the solid wastes |
| Regional |       | On Seaports in the Russian Federation | 2007 | • Addresses the management of garbage from ships  
• The compulsory regulations under this law develops specific rules regulating solid waste management for each of the sea ports  
• Since January 2019, the definition of waste that are prohibited for deposition includes polyethylene, polypropylene, polyacrylates, polyethylene terephthalate, polystyrene, and other polymers |
|         |       | Regulations for Navigation and mooring in the seaports of the Russian Federation and on the approaches to them | 2017 | • Developed in accordance with Federal Law On Seaports in the Russian Federation (2007)  
• Prohibits the deposition of any kind of waste in port areas  
• States that all wastes should be delivered to special port facilities |
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<tbody>
<tr>
<td>Sweden</td>
<td>National</td>
<td>EU policies and legislations relating to the prevention of marine debris</td>
<td></td>
<td>• See Table S2</td>
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<tr>
<td>United States</td>
<td>National</td>
<td>Clean Water Act (1972); formerly: Federal Water Pollution Control Act of 1948</td>
<td>1948</td>
<td>• Prohibits the discharge of pollutants from a point source into navigable waters unless a permit is obtained • Enables the Environmental Protection Agency (EPA) to implement pollution control programs. For example, the EPA has used funding from this Act to implement litter fencing at landfills in Alaska • Requires each state to establish a Total Maximum Daily Loads (TMDL) for pollutants for specific waterways as a tool to reduce the movement of pollutants (including plastic) into US waters.</td>
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<td>Resource Conservation and Recovery Act</td>
<td>1976</td>
<td>• Provides authority to the Environmental Protection Agency to control the generation, transportation, treatment, storage, and disposal of hazardous and non-hazardous solid waste, where solid waste is defined as: “any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.” • Includes guidelines for the storage and collection of residential, commercial and institutional solid waste, guidelines for the development and implementation of solid waste management, and criteria for municipal solid waste landfills</td>
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<td>Maritime Pollution Prevention Act (2008), formerly: Marine Plastic Pollution Research and Control Act (1987); and Act to Prevent Pollution from Ships (1980)</td>
<td>1980/1987/2008</td>
<td>• Implements Annex V and VI of the MARPOL Protocol (see Table S1) • Prohibits the violation of the MARPOL Protocol and outlines penalties for such violations and enables the US Coast Guard to enforce this Act • Supports the development of practices and technologies for solid waste management and waste reduction on ships • Prohibits the discharge of plastic and floating garbage • Establishes a plastic pollution public education program where the public must be educated (by NOAA and the Environmental Protection Agency) regarding: “(A) the harmful effects of plastic pollution; (B) the need to reduce such pollution; (C) the need to recycle plastic materials; (D) the need to reduce the quantity of plastic debris in the marine environment; and (E) the requirements under this Act and the Act to Prevent Pollution from Ships (33 U.S.C. 1901 et seq.)”</td>
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|         |       | Marine Debris Research, Prevention, and Reduction Act | 2006 | - Established to identify sources of, reduce and prevent marine debris in the United States
- Section 3 of this Act establishes a Marine Debris Prevention and Removal Program within the National Oceanic and Atmospheric Administration (NOAA). This program requires NOAA to identify, map, remove and prevent marine debris in the waters of the United States. Further, it focuses on reducing and preventing the loss of fishing gear and requires NOAA to engage in outreach and education to waste management industries and marine-dependent industries (e.g. fishing industries) on sources and threats of marine debris as well as methods to reduce and prevent marine debris
- Section 4 of this Act orders the Commandant of the Coast Guard to enforce the Act to Prevent Pollution from Ships (1973; see below) to reduce pollution from ships (e.g. disposal of plastics and waste into the sea) and to implement a plan to improve waste management on vessels
- Section 5 of this Act amends the Marine Plastic Pollution Research and Control Act (1987, see below) to establish an Interagency Marine Debris Coordinating Committee to coordinate a program for marine debris research in cooperation with industries, non-governmental organizations, universities, and other states and nations. This section requires that the government is updated every two years on the status of marine debris
- Section 6 of this Act orders NOAA and the Interagency Marine Debris Coordinating Committee to have open-source data available to researchers to use to improve marine debris identification and monitoring
- Marine debris is not defined in this Act |
|         |       | Microbead Free Waters Act | 2015 | - Prohibits the manufacturing, packaging, and distribution of rinse-off cosmetics (including toothpaste) that contain plastic microbeads, where microbeads are defined as “any solid plastic particle that is less than five millimeters in size and is intended to be used to exfoliate or cleanse the human body or any part thereof” |
|         |       | Save Our Seas Act | 2018 | - Increases government response to marine debris and reduce sources of land-based marine debris in the United States
- Provides funding to NOAA to respond to severe marine debris events
- Amends the Marine Debris Act (1952; now Marine Debris Research, Prevention, and Reduction Act; see above) to reinstate the funding for the NOAA marine debris monitoring program through 2022 |
|         |       | Save Our Seas Act 2.0: Enhancing the Domestic Marine Debris Response Act (Bill S.1982) | 2018 | - Bill (Passed in Senate, not yet an Act)
- Increases waste management and recycling infrastructure
- Increases international cooperation
- Provides further opportunities for funding (e.g. grant programs, trust funds) |