Agenda Item 4B AMAP WG32/4B/5-Rev 1

Kiruna/Giron, Sweden 25-27 September 2018

AMAP work on marine microplastics and litter

Presented by AMAP Secretariat

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Background

The document presents a plan for an AMAP project on marine microplastics and litter. The plan has been developed on the background of concern raised at global (CBD, UNEP, etc.) and at regional (Arctic Council Ministerial, EU, OSPAR, Nordic Council) level. The topic is believed to be a priority under the coming Iceland chairmanship of the Arctic Council. Background is also recent projects by AMAP, CAFF and PAME:

- Chemicals of Emerging Arctic Concern (AMAP, 2016)[1]
- PAME Desktop Study on Marine Litter including Microplastics in the Arctic (PAME, 2017-19). The study recommends that a *regional action plan* on marine litter in the Arctic is developed and that the plan should be accompanied by a *monitoring program*. The latest draft version of the desktop study was circulated to AMAP HoDs 17th July. More information about the project is found at the PAME web site[2]
- CAFF's Arctic Migratory Birds Initiative (AMBI) includes objectives relating to marine plastic under Objective 2, Action 1 in the Circumpolar Flyway. This includes work to better understand the effects of plastics pollution on Arctic seabirds and seaducks.

A wish has been raised to seek advice and/or cooperation from CAFF and PAME on this project. The CAFF and PAME secretariats and chairmanships have been informed about this wish, and this document will be sent to the secretariats.

As the document describes, The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention) has developed and is developing monitoring guidelines within these areas. There are certain areas with regards to scope and expertise where there is an overlap between AMAP and OSPAR.

[1] https://www.amap.no/documents/doc/amap-assessment-2016-chemicals-of-emerging-arctic-concern/1624
[2] https://pame.is/index.php/projects/arctic-marine-pollution/marine-litter-workshop

Requests to WG

1. The document presents a plan for a project on marine microplastics and litter. The WG is invited to consider if the plan would be included in the 2019-21 AMAP WG work plan. The WG may alternatively decide that the plan should be further updated.
2. If the WG decides to include this project in the 2019-21 work plan, then the WG is invited to discuss the organization of cooperation with CAFF and PAME.
3. If the WG decides to include this project in the 2019-21 work plan, then the WG is invited to discuss cooperation with OSPAR on this project.

Please note that this is an update to an earlier version. The WG is invited in particular to note the changes to the Terms of Reference of the expert group.

AMAP project: Marine microplastics and litter

1. Background

1.1 Global perspective

Plastic pollution is recognized as a major environmental contaminant. Plastic and other forms of litter are being recognized as a threat to ecosystems and biota, and there initiatives aimed to address sources, threats and mitigation strategies. Specifically, microplastics (< 5mm as defined by the UNEP; UNEP 2016) are persistent and known to break down from macroplastic particles (>5 mm in size) to smaller plastic particles through exposure to ultraviolet (UV) light and physical abrasion, but total degradation is slow (Gewert et al., 2015). Most of the plastic material floating in the world's oceans is microplastic debris (<5 mm) (Cózar et al., 2014; Law et al., 2014b). Plastics are released directly into the environment during industrial activities such as commercial fishing, aquaculture, use of plastic abrasives, and spillage of plastic pellets. Additionally, plastic litter from household applications such as washing of plastic microfiber clothes and use of personal care products containing microplastics can be released to the environment via municipal wastewater. Leakage from landfill is also likely an important source of plastics and litter, especially in the Arctic where landfills most often are placed directly on the shoreline and municipal wastewater is discharged directly without treatment to the sea.

Marine plastics affect marine organisms in several interlinked ways. Plastics and other litter can pose a physical challenge in the environment through mechanical interactions such as entanglement, and/or hindering limb movements (Laist, 1987). Biota may also ingest plastic or litter which can cause internal physical damage via ulcers or punctures of the gastro-intestinal system. Additionally, ingested plastics can lead to an increased exposure to contaminants and this pose a potential toxicological effects from harmful chemicals (Koelmans et al., 2014).

Concerns are growing about the risk of how microscopic particles of plastic waste transferring toxins into biota, including potential trophic transfer of both plastics and the associated contaminants throughout the food chain. In addition, the use of chemical additives in plastic may be hazardous to human health and is gaining increased attention. In general, however, the effects of microplastics in the marine environment are difficult to quantify.

Microplastics are addressed in the environmental cooperation at global (CBD, UNEP, etc.) and regional (EU, OSPAR, Nordic Council) level. The "Working Group on Marine litter plastics and microplastics and its POPs and EDC components: challenges and measures to tackle the issue" (led by UNEP) discussed (among other things) the potential impacts of marine plastics on marine biodiversity and human health (November 2016).

1.2 Arctic perspective

It has been shown that Arctic sea ice from remote locations contains concentrations of microplastics that are several orders of magnitude higher than those that have been previously reported in highly contaminated surface waters (Obbard et al. 2014). High amount of ultrafine (1µm to 1mm) and microplastic plastic (1mm to 5mm) in sea ice has been found in the Fram Strait (Peeken et al., 2018).

Marine litter floating in surface waters provides an artificial substrate/habitat, potentially accumulating persistent organic pollutants that are then accessible to marine life (Hirai et al., 2011; Tanaka, 2013; Trevail et al., 2015; Herzke et al., 2016; Cozar et al. 2017).

Despite the significant increase in available data on marine plastic debris globally, including the Arctic, status reports are limited by unclear definitions of microplastics and thus a lack of standardization in methodology and reporting consistency. For some size classes methodology exists via OSPAR, including macro and microplastics via beach litter and ingested plastics in seabirds (the northern fulmar). For microplastics in water and sediment there are at present no harmonised measurements, monitoring methods or environmental indicators

The OSPAR methodology has been applied within the Arctic by several groups working directly with the team from the Netherlands that supports OSPAR in the North Sea. This includes examining work in Canada (Provencher et al. 2009; Poon et al. 2017), Norway (Trevail et al. 2015), Iceland (Kuhn and van Franeker 2012) and the Kingdom of Denmark (van Franeker et al. 2011). While these studies use the same methods, and provide some data, these efforts have been opportunistic, and represent single studies that are not part of national monitoring frameworks.

How the extreme environmental conditions of the Arctic might affect plastic transport and degradation processes is not yet known. Emerging knowledge from lower latitudes may not be transferable to the Arctic environment, so studies specific to Arctic conditions are needed.

The Norwegian Polar Institute report *The State of Marine Microplastic Pollution in the Arctic* (Trevail et al. 2015) has (among other) these recommendations:

- Quantification of ocean surface plastic concentrations in the Arctic would benefit our global understanding of the magnitude of plastic pollution and could explore the sixth gyre hypothesis suggested in Van Sebille et al. (2012).
- Further study of microplastics in Arctic sea ice can confirm methods in Obbard et al. (2014) and would improve our awareness of the plastic legacy that awaits release into the Arctic Ocean with sea ice melt.
- Continued study of plastic ingestion by Arctic biota, particularly northern fulmars, will provide valuable monitoring of plastic litter in the region.
- Further understanding of the chemical consequences of plastic litter will develop the understanding not only about the potential effects for Arctic biota, but also the possible consequences for human health via consumption of contaminated seafood.
- Efforts to continuously improve microplastic quantification and uniform classification will benefit future studies.

The Norwegian Polar Institute report *Plastic in the European Arctic* (Hallanger and Gabrielsen 2018 has (among other) a lists of knowledge gaps that should be addressed within the areas *Environment, Size of plastic, Biota,* and *Methods.*

1.3 Arctic Council perspective

The Nordic ministerial declaration on reducing the environmental impacts of plastics states that the Nordic countries aspire to be driving forces in efforts to promote a sustainable approach to the production, use, waste management and recycling of plastics, and has taken the decision to launch a programme to follow up this issue.

The declaration from the Arctic Council Ministerial (2017) note *(…) growing concerns relating to the increasing levels of microplastics in the Arctic and potential effects on ecosystems and human health*.

1.3.1 Chemicals of Emerging Arctic Concern (AMAP, 2016)

The section on *Marine plastics and microplastics* summarises current information on plastic debris on the marine surface, in the water column, and at the seafloor. It also summarises information about microplastics and notes that an important matrix for microplastics in polar regions is sea ice.

It describes ingestion of plastic litter by zooplankton, fish, seabirds and mammals, noting that the consequences of plastic ingestion for health and fitness parameters such as growth, survival, performance and reproduction are largely unknown.

The section describes how plastic litter on beaches in the Arctic (Norway, Svalbard) has been part of OSPAR's monitoring programme since 2011, but that only qualitative data have been made available[3]. Additionally, this monitoring has not been evaluated since the selection of beaches is based on exposure to sea currents, and the regularity and analysis of plastic found on the beaches is lacking.

The section concludes that despite the increase in available data on marine plastic debris globally, including the Arctic, and that recent work has outlined standardized methods for seabirds (Provencher et al. 2017) that for many other compartments (i.e. water, sediments) status reports are limited by a lack of standardization in methodology and reporting consistency. This makes it difficult to draw general conclusions about temporal and spatial trends. Harmonized methodology is required for sampling, identifying and quantifying plastic items across the full size range. How Arctic conditions influence plastic transport, sedimentation and breakdown is not well known.

The section lists a series of research topics that will improve understanding of marine plastic pollution and effects in the Arctic include. It includes: the identification and quantification of sources of marine plastic pollution in the Arctic; the occurrence, characteristics and distribution of marine plastic in the Arctic marine, freshwater and terrestrial ecosystems; the identification of hot-spots and local sources; the role of Arctic conditions on the fate and transport of marine plastic in water, ice and air; the potential changes in plastic distribution and transport to and within the Arctic under climate change; the impact of plastic pollution on Arctic food webs; and the remediation and avoidance of plastic pollution in the Arctic.

1.3.2 PAME Desktop Study on Marine Litter including Microplastics in the Arctic (PAME, 2017-19)

[3] It should be noted that this monitoring has not been evaluated since the selection of beaches is not good with regard to exposure to sea currents and also the regularity and analysis of plastic found on the beaches is lacking.

The PAME project is conducting a desktop study on marine litter in the Arctic region with the aim to provide the current status on this issue. Based on the outcome of the desktop study the project will explore the possibility of developing an outline for a framework of an Arctic regional action plan on marine litter.

The desktop study describes the governance framework, including international instruments (UNCLOS, MARPOL, etc.). It also summarises existing literature on a) sources and drivers, b) pathways and distribution, and c) interactions with biota and impacts (biological, ecological and socioeconomic).

In the response and monitoring section, the study notes that monitoring of marine plastic pollution is crucial for assessing the effectiveness of measures implemented. It also notes that OSPAR (Convention for the Protection of the Marine Environment of the North-East Atlantic) currently assesses beach and seabed litter, and plastic particles in fulmar stomachs. The Norwegian and Greenland Seas and the western part of the Barents Sea is part of the OSPAR convention area.

The study recommends that a *regional action plan* on marine litter in the Arctic is developed and that the plan should be accompanied by a *monitoring program*:

- Establish an advisory group on monitoring with the Arctic Council working groups working on this topic and seek guidance, as relevant, from Regional Sea Conventions (e.g. OSPAR that is an Arctic Council Observer), that already have monitoring programs in place. Such an advisory group should develop a Terms of Reference for their work and could consider the following:
    - Such a monitoring program should reflect microplastics impacts on ecosystem health
    - It is important to standardize monitoring methods to improve comparability and determine trends.
    - Consider the development of new parameters for monitoring of plastic in the sea, sea ice and sediments.
    - Developing parameters for collection of data (e.g. OSPAR)
    - Coordinate monitoring of marine litter with other programs to assess effectiveness of mitigation measures.
- Other monitoring and information gathering included issues such as:
    - Planning for the collection of operational data linked to production
    - Developing a Threat map for sensitive species
    - Making recommendations to the Arctic Riverine (Arctic Great Rivers Observatory) project on marine litter from rivers.

2. Project description: Marine microplastics and litter

The purpose of the project is to prepare a strategy for an Arctic monitoring and assessment of microplastics and litter in the Arctic marine environment. The monitoring programme should include standardized sampling and analytical methods, and it should focus on levels, trends and effects. The assessment process should use standardized methods.

The project will establish an *AMAP Expert Group on marine microplastics and litter* and arrange one or more expert workshops to provide an overview of existing knowledge and to design and give advice on what an Arctic monitoring programme needs to cover to secure the necessary information that can quantify and document levels, trends and effects of microplastics and litter in the Arctic marine environment.

The expert group should formulate recommendations to the AMAP WG on these topics and identify those areas where new research and development is necessary from an Arctic perspective.

These topics are addressed in many fora, and the work should be built on information already existing in other marine programmes like HELCOM, OSPAR, ICES, and OECD. It should in particular be noted that monitoring data for plastic litter on beaches in Europe have been collected under the OSPAR Convention since 2001. Since 2011 the OSPAR monitoring program has been implemented for waters of the Arctic region in the area covered under the convention encompassing the Norwegian and Greenland Seas and the western part of the Barents Sea. OSPAR currently has guidelines for beach litter[4], seabed litter[5] and plastic particles in fulmar stomachs[6]. OSPAR is currently developing the indicator *micro litter in subtidal and offshore sediments*.

[4] CEMP Guidelines for monitoring marine litter washed ashore and/or deposited on coastlines (beach litter) (OSPAR): https://www.ospar.org/documents?d=37514
[5] CEMP Guidelines on Litter on the Seafloor (OSPAR): https://www.ospar.org/documents?d=37515
[6] CEMP Guidelines for Monitoring and Assessment of plastic particles in stomachs of fulmars in the North Sea area (OSPAR): https://www.ospar.org/documents?d=35083

2.1 Terms of reference

Current knowledge gaps about plastics and litter in the Arctic marine environment include:

- The prevalence of plastics and litter (all size classes, including nano-, ultrafine-, micro-, and macro-) in marine sediments, seawater, sea-ice and biota (in addition to birds) in the Arctic
- Plastics particles (all sizes) are transported to the Arctic by sea and air currents from the south
- Most plastic particles found in the Arctic come from the southern, highly populated areas. There are few local sources. However, it is known that nanoplastics are coming from local sources due to lack of sewage treatment in most local communities.
- The amount of microplastics ingested by animals is increasing and may be a threat to some species in the Arctic.
- There is a lack of harmonized methods for monitoring of plastics and litter in the Arctic Environment.
- There is a lack of knowledge with regard to the health effects of plastic ingestion in Arctic animals and humans.
- The number of species getting entangled in plastic is increasing in the Arctic marine environment, but the species and populations affected by this remain unknown.

The gaps to be filled in order to establish an Arctic monitoring and assessment programme include:

Monitoring

1) Better methods and harmonization for monitoring of plastic pollution in the Arctic environment (in sea water, in sediments, in sea-ice) is needed. Some methods exist for seabirds, which should be expanded and formalized for the Arctic, but could also be expanded to include potentially fish and bivalves.

   There are few standardized monitoring processes, and it could be the niche for AMAP to lead the process that can develop methods that can be adopted in other locales. Canada is for example currently considering methods that can be implemented locally in the Arctic, as well as expanded to a national approach. OSPAR guidelines are candidates, but they have not been evaluated under Arctic conditions; they could be a model, but will have to be modified. As an example birds collections are done via beached bird collections on beaches in the North Sea; this is not possible in the Arctic in many locations. Outcome: Recommendations on agreed methodology (in a cooperation with mainly OSPAR and PAME)

Assessment

2) Information about the sources of plastics and litter pollution in the Arctic; this is relevant for regulation, but also because most sources of microplastics is litter. One methodology is the so-called 'brand audit'. Outcome: 1) A review of the methodologies used to determine sources. 2) Recommendations on the methodologies that can be used for cities
3) Information about the chemical composition of the plastic pollution in the Arctic, and how this relates to different groups of chemical contaminants. Spectrometry methods can be used to determine plastic types, like polypropylene or other forms. It should answer questions like *What are the polymers that are dominant in the Arctic? And, address what are the chemical*

contaminants associated with the predominant polymer types found in the Arctic? Outcome: Overview of methods for the assessment of polymer types in all compartments. A literature review as part of an assessment. (This can also inform actions under ACAP).

4) Develop methodologies for answering questions like *Are there Arctic biological breakdown degradation issues?* Experts would be able to inform the assessment process. Outcome: A literature review as part of an assessment. The AMAP working group on biological effects has been looking at this and would be able to help. Information about the effects of metabolites would be included in this section.
5) Information about accumulation. For many single species, mercury for instance, this is known; it is not known for plastics. Should answer questions like *Is plastic accumulated in the Arctic food chain*? Outcome: A literature review as part of an assessment. Aim to address how different size classes of plastics may bioconcentrate, bioaccumulate and biomagnify.
6) Information about biological effects in order to answer questions like *Are there biological effects of exposure of plastics for Arctic biota and food webs?* Micro- and nanoplastics would have different biological effects (physical, metabolic, toxicological, etc.). Outcome: A literature review as part of an assessment.
7) Information about human health effects in order to answer questions like *What are the human health effects of plastic pollution in the Arctic? Is intake through air a major source?* This could be different for micro- and nanoplastics. Outcome: A literature review as part of an assessment. This would greatly build on the AMAP Human Health working group.
8) The existence of relevant standardized assessment processes order to understand if they are applicable to the Arctic marine environment.

The project should formulate recommendations to the AMAP WG on these topics and identify those areas where new research and development is necessary from an Arctic perspective.