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Responding to the emerging threat of microplastics in the Southern Ocean

Submitted by ASOC and COLTO



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Responding to the emerging threat of microplastics in the Southern Ocean

Submitted by ASOC and COLTO¹

Abstract

Emerging research into microplastic pollution in the Southern Ocean has detected microplastics in several different regions of the Antarctic. Microplastics could have negative effects on the ecosystem, particularly when ingested by krill or fish species. In this paper, ASOC and COLTO summarize existing research findings and describe some methods for reducing microplastic pollution via the filtration of laundry water. ASOC and COLTO further recommend that:

- All operating vessels and research stations consider ways to limit potential sources of microplastics and microfibers discharged through grey or laundry water. New technologies have already been successfully adopted on some fishing vessels to reduce the amount of microplastic fibers entering the ocean.
- CCAMLR Members and Observers, as well as SC-CAMLR, note the formation of the SCAR Action Group and look for opportunities to participate in microplastics research.
- Research and monitoring plans for marine protected areas (MPAs) adopted by CCAMLR should include microplastic pollution as an area requiring further research.

Introduction

The impact of microplastic pollution across the world's oceans has received significant attention in the media from scientists, environmental organisations, community groups, businesses and governments. Although remote from many major sources of plastic pollution, the Antarctic is unfortunately not free from this problem. In this paper, ASOC and COLTO provide a short summary of current research on Southern Ocean microplastics, present some options for mitigation of local sources, and discuss possible next steps to help address the problem.

Summary of current microplastics research occurring in the Southern Ocean

Little is known about microplastics - small plastic pieces less than five millimeters long - in the Antarctic region, including the scale of microplastic pollution and their potential ecosystem effects (Waller et al. 2017). In previous decades, publications from the scientific community focused mostly on marine debris on remote beaches or that posed harm to marine mammals (Sul et al. 2011).

Studies have found microplastics in intertidal sediment in Subarea 48.3 (Barnes et al. 2009), near stations south of the Polar Front (Cózar et al. 2014), in deep-sea sediment in the Weddell Sea (Van Cauwenberghe et al. 2013), and from towed neuston nets in the Southern Ocean (Eriksen et al. 2014).

Researchers are attempting to determine a baseline for microplastics in the Antarctic region and have conducted sampling in several locations. The concentration of microplastics in each example below is attributed to human activities. Some key findings thus far are:

- In the Ross Sea region, samples taken near the sewage treatment plant at Mario Zucchelli Station contained more microplastic fragments than those taken further offshore (Cincinelli et al. 2017).

¹ Lead authors Hannah Hayes and Claire Christian with contributions from Rhys Arangio, Chris Johnson, Ricardo Roura and David Santillo. The authors thank IAATO, Rachael Miller and Blair Jollimore for providing additional information.

- Sampling from Terra Nova Bay – encompassing an area up to 10 km from Mario Zucchelli Base – confirmed Cincinelli’s analysis that the number of plastic particles in sediment decreased the further the samples were from the station (Munari et al. 2017).
- Rothera Research Station (Reed et al. 2018) and the South Shetland Islands (Waller et al. 2017) also showed an increased concentration of microplastics near scientific stations.

In 2009 Grondahl et al. reported that 52% of the 71 research stations in Antarctica did not have conventional wastewater treatment systems. It is unclear what impact this may have on the release of microplastics into the marine environment.

Fishing vessels have also begun participating in research, and COLTO Member Talley’s Group Ltd. has undertaken plankton tows in 88.1 and 88.2. The materials will be analysed for evidence of microplastics in the Ross Sea.

Microplastic fragments found in the Southern Ocean

Microplastics from scientific stations are not the only concern. A recent Greenpeace expedition discovered microplastic fragments from single-use plastic in the Southern Ocean (2018). Japanese scientists also collected samples at five stations in the Southern Ocean with a neuston net. Their results exhibited that higher latitudes – south of 60°S – had more microplastic particles, while mid-latitudes had significantly fewer (Isobe et al. 2017). Surprisingly, the estimated number of particles per square kilometer for Antarctic sampling sites was similar to that found in the North Pacific closer to inhabited areas (Isobe et al. 2017). Since some of the particles appear to have come from outside the Antarctic, the researchers theorize that the Antarctic Circumpolar Current and other ocean fronts may prevent them from leaving Antarctic waters (Isobe et al. 2017).

The degradation of macroplastics into microplastics (Barnes 2010), waste from human activity, or the transportation of marine debris by the ocean currents might keep the plastic in the Antarctic environment indefinitely. Despite recent research, there is not a comprehensive understanding of the distribution or impact of microplastics in the Antarctic region (Waller 2017).

Microplastics in the marine food web

Microplastics also pose a danger to the marine ecosystem, particularly to marine animals who may mistake the substance as food or may ingest them while feeding. Filter feeders, such as krill, are vulnerable to plastic ingestion; this can lead to adverse effects since they are the prey for predators and might transfer the microplastic up the food chain.

Waller noted that the highest concentration of Antarctic krill is near the Drake Passage and the Scotia Sea, a high traffic area for tourism, fishing (2017) and research ships associated with National Antarctic programs. If plastic pollution increases because of human activity in the region, then the krill population might be negatively impacted.

Recent studies by Australian scientists observed that krill cannot differentiate between algae and microbeads and are likely to ingest some of those present in areas where they are feeding (Dawson et al. 2018). Krill, therefore, ingest microplastics and break them down into nanoplastics, which are then expelled back into the environment (Dawson et al. 2018). While microplastics are a physical particle and may cause biological problems by blocking gut or respiratory structures, or introducing harmful chemicals, nanoparticles may cause additional harm in that they can cross biological barriers and increase an organism’s absorption of toxic substances (Dawson 2018).

While a krill can clear microplastics from its gut in less than five days (Dawson et al. 2018), other marine organisms may not have that ability. Two microplastic items were recovered from the gastrointestinal tract of a single Antarctic toothfish (*Dissostichus mawsoni*) in a study of plastic

ingestion in fish in the Southern Hemisphere (Cannon et al. 2016). These authors note the challenges of making comparisons with other species in other regions due to differences in classifying microplastic fibers and fragments. They suggest that implementing consistent sampling protocols could improve the ability to draw conclusions about the impact of plastic ingestion on fish (Cannon et al. 2016).

Mitigation of microplastic pollution

ASOC and COLTO encourage all those operating vessels or research stations to consider ways to mitigate potential sources of microplastics. MARPOL Annex V already prohibits the discharge of plastic garbage, which can contribute to microplastic pollution through photodegradation, abrasion and biologically accelerated fragmentation. Similarly Article 5 (1), Annex IV of the Protocol on Environmental Protection to the Antarctic Treaty prohibits "...the disposal into the sea of all plastics, including but not limited to synthetic ropes, synthetic fishing nets, and plastic garbage bags". CM 26-01 also regulates the use of plastic packaging bands on board fishing vessels.

Laundry water is another major source of microplastics from those operating vessels or stations in the Southern Ocean and therefore should be a primary target for additional mitigation. Since many clothing items are made from synthetic polymers, water used to launder these items is likely to contain fibers from these garments. Fleece fabric shed significantly more fibers than other knits. PET (polyethylene terephthalate) fleece sheds an estimated 110,000 fibers per garment and wash (Carney Almroth et al. 2018).

There are several methods for collecting these fibers, which are summarized in Annex 1.

Some COLTO member companies are already exploring ways to mitigate their contribution to microplastics sources. For example, some toothfish vessels, such as those operated by Argos Froyanes Ltd, are fitted with the Lint LUV-R washing machine discharge filter. This option was chosen because it does not require action for each individual load of laundry, as do the others. The filters are collecting lint and Argos Froyanes Ltd is collecting water samples before and after the filters were installed to analyse for plastic content, and is willing to share the results with CCAMLR when they are available.

During the 2018 fishing season in Subarea 48.3, all toothfish vessels, who are also all members of COLTO, fitted the Lint LUV-R filters (for further information see CCAMLR-XXXVII/BG/15). COLTO is aiming to have all members install the LUV-R filters to their vessels during 2019. ASOC and COLTO encourage other ship operators who decide to implement any one of the measures mentioned in Annex 1 to collect water samples or collect accumulated fibers so that they can be further analysed.

The International Association of Antarctica Tour Operators (IAATO) is also working with its members to reduce plastic pollution, in collaboration with its sister in the Arctic, the Association of Arctic Expedition Cruise Operators (AECO). This includes:

- Participating in research to understand the scale of the issue in the polar regions;
- Tasking working groups to develop programmes and guidelines that will help members reduce and eliminate plastics across the industry;
- Encouraging visitors to reduce their use of plastics through Antarctic Ambassador programmes and pre-departure information;
- Raising awareness by supporting campaigns such as the UN Clean Seas campaign.

Next steps and recommendations

Microplastic pollution is one of several emerging threats facing Southern Ocean ecosystems that require complex global solutions. Since there are no viable methods for large-scale removal of microplastic particles from the ocean and particles may remain in the environment for centuries, the application of

the precautionary approach is critical. While the full impact of widespread microplastics pollution is not yet fully understood, including with respect to ingestion by marine species, toxicity associated with microplastics and nanoplastics is a major concern. However, it would seem that is relatively easy to mitigate some ongoing sources of this problem, particularly in regards to waste management and the unwanted disposal of lint in laundry water originating from Antarctic ships and research stations

In response to this emerging issue, SCAR is forming an Action Group led by Dr. Cath Waller from the University of Hull (UK) with the participation of many Antarctic scientists from a range of disciplines. The group will work to assess the scale of the problem by using standardized sampling methods, and has encouraged from a wide variety of stakeholders including groups like COLTO and IAATO that may be able to undertake sampling. ASOC and COLTO therefore encourage CCAMLR Members and others working in the Antarctic region – whether fishing vessels, ships or stations run by national operators, or tourist vessels – to explore ways to contribute to this research. COLTO is aiming to have all members install the LUV-R filters on their vessels during 2019. ASOC, COLTO and IAATO will continue to work with the SCAR action group to increase participation in microplastics research by all vessels and ensure that their research is aligned with SCAR's agreed research methods and the most critical research needs.

ASOC and COLTO therefore recommend:

- That all vessels and research stations operating in the Antarctic consider using filtration technologies such as the ones described in Appendix 1 to reduce the amount of microplastic particles entering the Antarctic marine environment through grey or laundry water.
- That CCAMLR Members and Observers, as well as SC-CAMLR, note the formation of the SCAR Action Group and look for opportunities to participate in microplastics research.
- That the issue of microplastics is included in research and management plans for marine protected areas adopted by CCAMLR.

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Annex 1: Current options for removing microplastic fibers from laundry water

Product	Method of Operation and Cost	Additional details	Website
Lint LUV-R	Attaches to washing machine discharge hose and filters leaving washing machine. \$140 USD per filtration system.	Requires installation. Once installed, works automatically. Does not require filter cleaning after every load. May not work on all vessels but has already been installed on some fishing vessels. Catches over 80% of fibers (manufacturer-provided statistics based on a study done by university students). Filter more complicated to clean and may need to be cleaned frequently depending on volume of laundry. Manufacturer offers 5-year replacement guarantee on the filter housing and a lifetime guarantee on the filter screen.	https://environmentalenhancements.com/index.html
Guppyfriend	Bag for clothing that collects loose microfibers. Fibers collect in the seam of the bag and are removed manually. 29.75 Euros per bag.	No installation required and simple fiber removal process. Stops 86% of fibers (manufacturer statistics). May prevent fibers from being released from clothing and prolong their life. Only holds a few garments so many would be needed for larger capacity washers. May prevent full cleaning of garment.	http://guppyfriend.com/en/
Cora Ball	This is a ball with multiple loops that catch loose microfibers during the wash cycle. Collected fibers are removed manually from the loops. Multiple balls recommended for full coverage or large washers. \$29.99 USD per ball, discounts potentially available for large orders.	Does not require installation and fiber removal process is simple. Each ball can collect approximately 35% of the fibers released (manufacturer-provided statistics). Multiple balls recommended to achieve maximum fiber removal. Cora Ball manufacturers willing to accept collected fibers from Antarctic vessels and will analyse effectiveness. Requires user to add to each load.	https://coraball.com/