# Arctic Marine Plastic Pollution - Lectures and discussion meetings on the marine plastic -

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### Abstract

Increasing concentrations of macro- and micro-plastics have been found in Arctic waters and sea ice, but the impacts of plastics pollution on Arctic environments and species has not yet been widely studied. A study group on the marine plastic pollution in the Arctic started in April 2021 under the program of Hokkaido University Arctic Research Center. In this study, six lectures and discussion meetings were held on the arctic environment, marine ecosystems, ecosystem simulation, etc.

Key words: arctic, marine plastic, environment

#### 1. Introduction

While the Arctic ecosystem is already stressed by the effects of the climate crisis, another threat is emerging: plastics. Plastic pollution has become an environmental issue of the highest concern world-wide, and the plastic pollution tide is also rising in the Arctic. The total volume of plastic waste that has flowed into the sea to date is approximately 150 to 400 million tons, and an estimated 8 million metric tons of plastic enters the ocean worldwide every year, though only 1% of it has been accounted for. This raises the question, where is all the plastic in the ocean?<sup>1</sup>

Plastic litter is found in even the most remote locations in the world, and the Arctic is no exception. Currents, streams, waves and wind carry marine litter across the seas, while solid waste and wastewater from Arctic communities, and larger communities up-river, contribute to the problem. Plastic debris is found on Arctic beaches, in the water column, in sea ice, sediments and even in the bodies of Arctic birds and mammals.

Microplastics have been found in the seas of the Arctic and Antarctic, including surface waters and deep-sea and shallow sediments. These tiny particles and plastic fibres have been shown to negatively impact a variety of marine species (*Fig. 1*).

How much is in the Arctic is unknown, but one recent study found plastic particles in all but one of 97

seawater samples, and sea ice is known to contain extremely high levels of microplastics.<sup>2</sup>)



Fig. 1 Seal became tangled in a fishing net.<sup>3)</sup>

#### 2. International Movement

# 2.1 International Symposium on Plastics in the Arctic<sup>2)</sup>

The Government of Iceland in collaboration with the Nordic Council of Ministers hosted the International Symposium on Plastics in the Arctic and Sub-Arctic Region on March 2-4 and 8-9, 2021. The symposium was organized in co-operation with 11 international partners that address marine pollution in various ways. Iceland had chosen the Arctic marine environment as one of four priority areas of work for its chairmanship and addressing plastic marine litter, and in particular pollution in the Arctic, became a high priority issue in the work programme of the Arctic Council.

KEY FINDINGS of the Symposium:

- The Arctic marine environment is affected by plastic pollution,
- Much marine litter is carried to the Arctic, but some of the litter that washes up on beaches enters the water in the region,
- Waste management and wastewater treatment in the Arctic come with significant challenges,
- Abandoned, lost and discarded fishing gear is a major component of plastic litter in the Arctic, and wildlife risks getting entangled in it,
- Microplastics arriving from other regions on currents accumulate in the Arctic,
- Arctic species have been found with plastics in their stomachs,
- Plastic litter can transport non-native species to the Arctic.

## 2.2 A Global Symposium on Plastics in the Arctic<sup>3)</sup>

In October of 2019, the Belfer Center's Arctic Initiative and the Wilson Center's Polar Institute cohosted a workshop with the Icelandic Chairmanship of the Arctic Council at Harvard Kennedy School entitled, Policy and Action on Plastic in the Arctic Ocean. This event convened over 60 global thought leaders, diverse stakeholders, and subject matter experts to begin developing a framework for tackling Arctic marine plastic pollution as part of the Icelandic Chairmanship's ambitious agenda.

### 2.3 Where does the plastic come from?

Plastic debris of all sizes comes from sea-based activities, land-based activities, riverine deposition, and through atmospheric transport (*Figs. 2* and 3).

*i) Sea-based activities*: particularly commercial fishing, generate large quantities of plastic debris in the Arctic marine environment, especially ghost gear (lost or discarded fishing gear). Other known sea-based sources include aquaculture, shipping, the oil and gas sectors, and ocean transport of debris from outside the Arctic.

*ii)* Land-based sources: debris come from tourism, extractive industries, inadequate water treatment plants (particularly microplastics), lack of treatment plants, and poor landfill management. There has also been documentation of atmospheric deposition of small particles across vast distances.

*iii) Significant inputs*: plastic debris enter the Kara and Laptev Seas, which demonstrate the role of rivers as pathways for litter, currently estimated to be about 2 million tons each year.



# Fig. 2 Arctic marine litter entry and dispersion pathways<sup>4</sup>)



Fig. 3 Litter items with readable embossed text or labels collected from a beach of the Hinlopen Strait, Svalbard Archipelago<sup>4</sup>): A close inspection of litter beached on Svalbard showed that the majority of litter items with identifiable imprints originated from Norway and Russia (41%), other European countries (43%), or other sources including Canada, USA, Brazil, Argentina (9%). Still, it is important to bear in mind that the identification of the country of production of an object does not mean that the actors involved in the release are also from the same country as the object could have been internationally traded. Similarly, and also very important, the country of production of an object does not indicate where the object has been released, as it could have been transported for long distances before being released in the environment.

### 3. The Study Group Activities

We held six lectures and discussion meetings on the Arctic marine environment (*Table 1*) and conducted a field survey in Makuhari Beach, Chiba (*Fig. 4*).

# Table 1 Lectures and discussion meetings- Invited speakers -

2021.6.18	
西尾伸也 日本大学生産工学部土木工学科	
「海岸に漂着したマイクロプラスチックの実態調査	
2021.7.30	
小森谷友絵 日本大学生産工学部環境安全工学科	ŀ
「ラテックス凝集反応による CRP タンパク質の測定	
「セシウムの除去を目的としたファインバブルを用い	いた
海洋汚泥分解」、	
岩崎慎介 (国研)寒地土木研究所寒冷沿岸域チー	-4
「海洋漂流物の輸送過程」	
2021.9.27	
<b>豊島淳子</b> 笹川平和財団海洋政策研究所	
「2020年に実施された北極海海洋プラスチック調	査」
矢吹裕伯 国立極地研究所国際北極環境研究セン	ター
「日本の北極プロジェクトとデータマネージメント」	
2021.11.2	
朴 昊澤 JAMSTEC 北極環境変動総合研究センタ	-
「北極海の海氷減少と気温上昇に及ぼす暖かい液	可川
水の影響」	
2021.12.6	
田島木綿子 国立科学博物館脊椎動物研究グルー	・プ
「ストランディング鯨類からわかる海洋環境の今」	
2022.2.25	
伊勢武史 京都大学フィールド科学教育研究センタ	<u> </u>
「生態系のコンピューターシミュレーションと海洋ブ	ラス
「生態系のコンヒューターシミュレーションと毎年ノ	·



Fig. 4 Field survey on plastic in Makuhari Beach, Chiba, November 9, 2021.

#### 4. Conclusion

While the Arctic ecosystem is already stressed by the effects of the climate crisis, another threat is emerging: plastics. Plastic debris is found on Arctic beaches, in the water column, in sea ice, sediments and even in the bodies of Arctic birds and mammals. Development of protocols and standardization of data to measure trends that is conducive to data sharing through international cooperation is an urgent task.

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#### References

- "Policy and Action on Plastic in the Arctic Ocean," October 2019 Workshop Summary & Recommendations, The Arctic Initiative, The Polar Institute.
- 2) United Nation in Western Europe webpage, accessed in Jan. 2022, https://unric.org/en/plastic-is-hurting-the-arctic/
- 3) The Belfer Center for Science and International Affairs, Harvard Kennedy School webpage, accessed in Jan. 2022, https://www.belfercenter.org/publication/global-symposiumplastics-arctic
- "Desktop Study on Marine Litter including Microplastics in the Arctic," Protection of the Arctic Marine Environment PAME, Arctic Council, 7 May 2019.

#### **Summary in Japanese** 和文要約

## 北極海海洋プラスチック問題研究集会

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近年の北極域研究は、北極海の海洋プラスチック問題 を提起している。北極海に流入するプラスチックは、内陸 からの流入、大気による運搬、漁業や海運および資源開 発からの投棄などが挙げられている。海氷に取り込まれ た形で蓄積されたプラスチックが海氷の融解と共に北極 海全体に流出する恐れがあることから、国際的な研究体 制の確立とデータ収集の標準化が求められている。本研 究集会では、文献から北極海のプラスチック問題の現状 を調べるとともに、海洋プラスチック問題の現状と課題を議論した。

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