

Project information

Keywords

marine plastic

Project title

Microplastics in arctic marine food chains; biological uptake pathways and socio-economic consequences

Year

2016

Project leader

Dorte Herzke; Claudia Halsband

Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)

Håkøybotn: 69.67°N 18.79°E Adventsfjord: 78°14'N 015°38'Ø

Participants

Dr. Claudia Halsband, (APN)

Dr. Dorte Herzke, NILU

Dr. Jan H. Sundet, IMR

Dr. Jan Ove Bustnes, NINA

Dr. Kevin V. Thomas, NIVA

Dr. Eirik Mikkelsen, NORUT

Dr. Geir W. Gabrielsen, NPI

Dr. Paul E. Renaud, UNIS

SALT (Kriss Rokkan Iversen)

Flagship

Hazardous Substances

Summary of Results

Plastic pollution in the Norwegian Arctic is worse than expected, 87.5% of northern fulmars examined had ingested plastic (Trevail et al. 2015), and this may result in some contaminant uptake into tissues and physical damages. An average of 15 plastic pieces were found and 23 % of the birds exceeded the EcoQO for plastic ingestion in fulmars.

In 2012, 8 fulmars and in 2013, 76 fulmars were unintentionally caught as by-catch on long-lines off the coast of Northern Norway and delivered to the Norwegian Institute of Nature Research. Liver and muscle samples were collected together with plastic particles found in the stomach of each individual. Plastic particles were found in every bird collected in 2012, ranging from 1 to 27 pieces (0.002 - 0.725 g). In 2013, 72% of the collected birds contained ingested plastic. The EcoQO for birds from northern Norway was 38%. Both plastic pieces as well as threads were found in the stomachs. Liver, muscle and plastic pieces were analysed for persistent organic pollutants in selected individuals (2012: n=8; 2013: n=30). Birds with a high, medium and no load of ingested plastic were selected for comparison. Beached plastic litter was investigated in a similar way, including DART-MS-TOF experiments to identify the type of plastic. For the 2012 samples, liver and muscle tissue concentrations of sumPCB, sumPesticide and sumDDT correlated well with r^2 ranging between 0.48 and 0.78. Plastic concentrations of POPs correlated with the respective muscle and liver samples too, with muscle correlating better than liver tissue for PCBs and DDTs, reflecting long-term exposure (sumPCB in muscle: $r^2 = 0.4$, in liver $r^2 = 0.25$; sumDDT in muscle: $r^2 = 0.81$, in liver $r^2 = 0.20$). Pesticides however, showed the opposite, with sumPest in muscle: $r^2 = 0.19$, in liver $r^2 = 0.31$, indicating a fresh exposure.

A pilot study on storm petrels was conducted at Hornøya, eastern Finnmark, in September 2016. Storm petrels are known to ingest microplastic, and the aim was to check whether birds in this region contained plastic items. Three stomach content samples were secured, and will be checked in the coming months.

Implementation of suitable sampling methods for microplastics pollution began in autumn 2014 with a view to start assessing the extent of the problem in the vicinity of Tromsø (an area with increasing human population), and in coastal systems of Svalbard (little local human impact). Water and zooplankton samples were taken locally in Balsfjorden and Håkøybotn, as well as Adventfjorden (Svalbard) in summer 2015 and along western Spitsbergen in September/October 2014 and 2015 based on a method by Lusher et al. (2014). Additional sediment, effluent and biota samples were collected in summer 2015. Microscopic analysis of microplastics on filters from water samples began in autumn 2015 but was discontinued due to contamination issues. Similar issues were observed for sediment samples, causing a higher uncertainty in the results and an increased limit of detection. However, effluent samples from Longyearbyen as well as blue mussel stomach samples showed a clearly elevated content of microplastic, mostly fibers. It was decided to postpone in situ microplastics water analyses until standard protocols become available from the EU JPI-Oceans program BASEMAN, where NILU and NPI are partners. A protocol for a proteinase digest has been published (Cole et al. 2014), enabling efficient removal of chitin exoskeletons from planktonic crustaceans, which often dominate net samples of 60 to 500 µm mesh size. We also published a report to the Sysselman on the findings of the sediment project (Svalbard miljøvernfond, RIS-prosjekt nr. 10495, 2016). Additionally, we participated in the assessment of existing indicators for pollution by marine plastic by the Norwegian EPA (Miljødirektoratet, 2016) as well as publish a report on plastic related pollutants in fulmars (Ask, et al., 2016)

In MIME the experimental results showed ingestion of microplastics from tooth pastes in blue mussels (NIVA). Similarly, species-specific ingestion of microplastics was investigated in a MSc thesis conducted at Akvaplan-niva. Both studies showed that biofouling increases the ingestion of microplastics, regardless of food conditions or microplastics concentrations.

The project has been contributing to a PhD thesis (Inger Lise Nerland, UiO/NIVA) and a MSc thesis (Renske Vroom, U Wageningen, NL/Akvaplan-niva).

A review paper on socio-economic effects of microplastics in the marine environment will use expert opinions on the certainties and knowledge gaps of current research, collected during the workshop in May. The current knowledge is very limited, and the paper includes a discussion of possible effects and methods to investigate them given future availability of relevant data, focusing on the seafood industry, human health and cultural ecosystem services. The paper proposes a research agenda and also discusses policy approaches given the current poor level of knowledge about socio-economic effects of marine microplastics.

In total, 10 applications for further research funding were submitted by consortium members in 2014-16: PArC (NordForsk Arctic Center of Excellence), 3x JPI-Oceans program on ecological aspects of microplastics (2 funded), ArcPlast (NFR MarinForsk), 2x Svalbard Miljøvernfond (funded), 2x EU TRAMPOLINE and PEACE (NWO, NL, pending). These have paved the way for continued collaborative research on plastic as an emerging contaminant in the Arctic, resulting in several new applications to Fram Centre Flagships (Miljøgifter and MIKON) in 2016 and the Svalbard Miljøvernfond.

Master and PhD-students involved in the project

3 master students

For the Management

Several members of the consortium attended national and international workshops relating to marine litter. Here, contacts were established and fostered with relevant stakeholders within governmental authorities, industry and the science community. Research results, methodological challenges and needs for future research and legislation were discussed.

- marine plastic pollution in the Arctic is very abundant but sources and fate are poorly understood
- Marine organisms are exposed to marine plastic in the Arctic posing a variety of harm

Could results from the project be subject for any commercial utilization
No