Mikroplast fra sjø til land?

Marine microplast goes terrestrial?

Report for project 19/42

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Innhold

Forord

Vi vil takke for tildelte midler fra Svalbards miljøvernfond i 2019, som vi fikk for å foreta en pilot-screening av mikroplast i jord/mose på Svalbard. Prosjektet ble startet fordi det er kjent at sjøfugl i arktis har i seg relativt høye forekomster av plast, og det kunne tenkes at mikroplast kunne komme i bakken under sjøfuglkolonier via avføring.

Feltarbeid ble gjennomført av Vegard Stürzinger, Stein Tore Pedersen, Jesper Mosbacher og Virve Ravolainen ved Norsk Polarinstitutt sommeren 2019. Prøver av mose/jord ble tatt fra fuglefjell og en tilsvarende fjellside uten sjøfuglkoloni. Jord/mose har tidligere kun i begrenset grad vært analysert for mikroplast, og prøvene måtte forberedes til plast-analysen med å utvikle teknikker som kunne skille ut mikroplast. Koronapandemien gjorde at analyse-delen ble kraftig forsinket, da tilgang til både personell og nytt utstyr som det var behov for i Tromsø ble endret. I 2022-23 kunne prøvene analyseres slik at screeningen kunne gjøres.

Vi rapporterer pilot-resultater fra et spennende tema, der de første funnene indikerer at mikroplast kan transporteres til landøkosystemet med sjøfugl som vektor.

Sammendrag

Sjøfugl bringer med seg store mengder næring fra det marine miljøet til landøkosystemet, men kan potensielt også fungere som vektor for forurensning og plast-partikler. Kartlegging av forekomst av plast-partikler er høyt prioritert av miljøforvaltningen i norske arktiske områder. Det finnes ingen tidligere informasjon eller kunnskap om hva slags konsentrasjon av plast fra det marine miljøet finnes fra kysten i arktisk. Vi foretok en pilot-screening av plastpartikler, delt i størrelser «makro» og «mikro»-plast i substratprøver hentet fra utvalgte fuglefjell og en lokalitet uten sjøfuglkoloni. Substratet består for det meste av mose men også noe organisk jord.

Resultatene fra Krykkjefjellet og Stuphallet i Kongsfjorden (fuglekoloni) og Dærten i Engelskbukta (uten sjøfuglkoloni) viser at det ble funnet kun 1 makroplast-partikkel men mange flere partikler i kategorien mikroplast. Det ble funnet polyetylen og polypropylen-partikler, der antallet varierte en god del mellom de ulike prøvene. Funn av mikroplast i bakken på Dærten indikerer at mikroplast kan finnes generelt i det øverste substrat-laget på Svalbard. Kilden til mikroplast kan ikke slås fast, men både vind, snø, bølger og menneskelig aktivitet er mulige vektorer for transport. Antallet mikroplastpartikler var høyere på fuglefjells-lokalitetene, enn på Dærten, noe som indikerer at sjøfugl kan fungere som vektor for transport av mikroplast fra det marine miljøet til landøkosystemet. Disse første pilot-resultatene viser behov for å undersøke nærmere geografisk spredning av plast-partikler i landøkosystemet, både lokalt innen fuglefjell (nærhet til koloni) og regionalt (variasjon mellom kolonier og andre lokaliteter, ulike arter sjøfugl i koloni).

Background

The coastal Arctic tundra is a hotspot for biodiversity and biological production. Significant amounts of marine nutrient input from sea birds contribute to the high production, but paradoxically, the sea birds can also act as vectors for contaminants and plastic particles (Foster et al., 2011). Sea birds ingest marine plastic through foraging and deposit it onto land through guano (Figure 1), which could result in relatively high levels of plastic transported from sea to land (Provencher et al., 2018). The plastic contamination that likely has accumulated in the soil-moss-column under bird cliffs can potentially spread into the terrestrial food web via reindeer and geese that feed on the slopes. A different route for plastic from the marine to the terrestrial environment is through consumption of kelp and seaweed by reindeer. Microplastic adheres to kelp and seaweed and is eaten together with these resources (Gutow et al., 2016), which is utilized by reindeer when winter rain caused by climate change blocks the foraging grounds (Hansen and Aanes 2012) and potentially transported with faeces on land. Before detailed studies on vectors and transport routes on land, we need basic knowledge about occurrence and distribution of plastic particles in the terrestrial ecosystem.

Relevance

Research on marine littering in the Arctic is important for the development of a common knowledge base on the global distribution of plastic. Especially is the occurrence of microplastic in the Arctic of high concern. This project will contribute to our understanding of how microplastic behaves in the Arctic environment and will provide first screening of the role of seabirds may play as vectors for marine microplastic to the terrestrial environment. Plastic litter of any sizes has been categorized as an environmental pollutant and screening/mapping of new Arctic contaminants have an **A** priority according to the environmental monitoring knowledge matrix given by the Governor of Svalbard, Norwegian Environment Agency, Directorate of Cultural Heritage and Norwegian Polar Institute (http://www.npolar.no/no/kunnskapsbehov).

Increased knowledge on the fate of microplastic in the marine and terrestrial environment is vital to proper monitoring and legislation on the global plastic litter and its impacts on Arctic key-species.

Aims

To investigate whether marine plastic occurs in the soil-moss column on the coast of Svalbard, and whether occurrence of plastic particles is different on sites with seabird colonies than site without seabird colony. This is valuable knowledge about a “new” contaminant source of which we have no data from the terrestrial environment on Svalbard.

Methods

In this pilot-project, we conduct the first analysis of the presence of microplastic in the terrestrial soil-vegetation system. We measured the number of plastic particles in soil/moss in the basal mountain slope at bird colonies on the west-coast of Spitsbergen. Due to the pioneering character of the project, plastic analysis were restricted to two bird colonies, Krykkjefjellet and Stuphallet, with a site at Dærten where there are no bird colonies. We analysed the samples for plastic in the macro and micro range (5 cm – 50 µm), using RAMAN spectrometry, to quantify the amounts and composition of the plastic particles.

Results

We divided the plastic in a larger (5 cm to 1 mm) and a smaller (1mm to 50 µm) fraction of particles.

In the larger fraction only one light blue polypropylene particle of 1 mm was found at Krykkjefjellet. For the smaller fraction a lot more particles were identified (Table 1, Figure 1).

Table 1: Overview of particles found at the different sites, the associated bird species, and the distance of the sampling site from the bird colonies N= number of particles per 5 g soil dry weight.

Site	Bird species	Distance to bird colony	PE - polyethylene	PP - polypropylene
Dærten	No colony	No colony	15 ± 12	5,5 ± 5
Stuphallet	Northern fulmars	Close	47,5 ± 0,7	1,5 ± 0,7
Krykkjefjellet	Kittiwakes	Close	0	0
		Medium	12 ± 0	0
		Far	69	1

For the smaller size fraction polyethylene (PE) and polypropylene (PP) particles was identified at the different sites. The highest number of particles was found at the bird colony “Krykkjefjellet”, followed by bird colony “Stuphallet”. Lowest number of particles was found at “Dærten”, the location without seabird colony.

There is in general a broad range of particles found at most sites showing large variance between replicates from the different sites. The highest number was found for polyethylene. At Krykkjefjellet we have samples from directly below the nesting birds, mid-slope and further away from the nesting birds but due to the pilot-character of the sampling the results cannot conclude on what proximity to the bird cliff mean for distribution of plastic particles in the soil-moss-substrate.

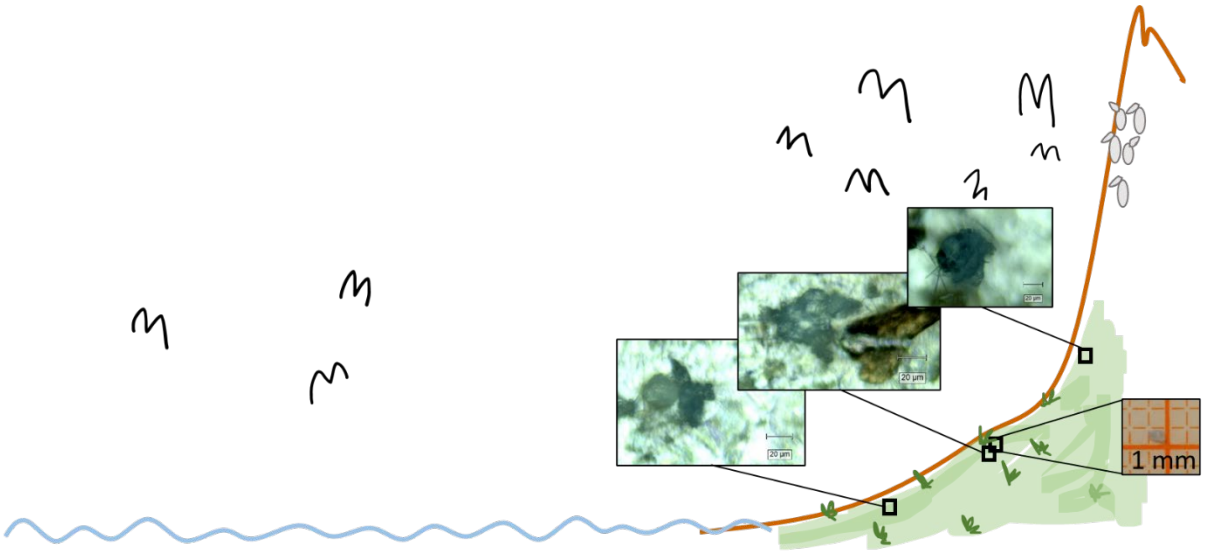

Figure 1: Conceptual model of the results from this study. Different small microplastic (scale 20 µm), and the one larger particle from the top substrate layer under bird cliffs.

Discussion

The presence of microplastic at Dærten indicate that there is a general presence of microplastic in the top vegetation layer at Svalbard. The source for this microplastic cannot be determined from this study, but it might have come through various ways such as transportation through air, wave and wind actions, and human activity both during summer and winter. This result also indicates that we can expect to find microplastic at any location at lower numbers of PE and PP. Future investigations of microplastic particles related to activity of sea birds can look to the pilot-numbers of background levels found at Dærten.

At the sea bird colony-locations Stuphallet and at Krykkefjellet we found higher numbers of PE particles than at Dærten, indicating that seabirds might act as vector for microplastic transfer from sea to the terrestrial environment. PE and PP are very common types of plastic it was expected to find these types of plastic . It was a little surprising that not other polymers were identified. PE has a high buoyancy and is amongst the polymers most often found in the stomach of sea birds, so we had expected this polymer to be found and dominating the soil sample.

At Stuphallet elevated particle numbers were observed close to the bird cliff, while at Krykkjefjellet these numbers were observed far from the cliff. This we find interesting, and we need to do more in-depth studies on the possible differences in plastic distribution depending on factors like the slope, the size of the bird populations, and species of birds residing in the different bird-cliffs.

Conclusion

This initial screening of soil/moss samples has shown that sea birds may act as vectors for plastic transfer to the terrestrial environment. Furthermore, we have documented presence of microplastic in the top 10-15 cm layer of the moss-soil-column in Svalbard.

References

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