October 08, 2018

Earth & Space

Seal poo unravels the microplastic journey through marine food webs

by **Sarah Nelms**[1] | PhD student

[1]: Plymouth Marine Laboratory, University of Exeter, Exeter, UK

This Break was edited by Reinier Prosee, *Scientific Editor* - TheScienceBreaker

ABSTRACT

Investigating microplastic trophic transfer in marine top predators

Image credits: Pixabay – CC0

Plastic pollution is now one of the most widespread and significant threats facing our oceans. Microplastics (pieces less than 5 mm in size), in particular, have been in the spotlight for a number of reasons. Firstly, there's so many of them! Microplastics come from a variety of sources and once in the sea, can be broken down into smaller and smaller pieces, meaning they increase in number. Secondly, they can look (and smell) like food for marine animals. This, coupled with their small size, means they can be eaten by a whole range of species, from microscopic zooplankton – tiny creatures at the base of the food chain – to huge seawater-sieving whales and anything in between. To make matters worse, there are not one but two ways that microplastics may be ingested. Aside from eating them directly, carnivores may also be exposed to 'trophic transfer'. This is where prey containing microplastics are eaten by predators, and the plastic moves up the food web.

Until now, trophic transfer has only been observed in animals near the bottom of the food chain, such as crabs, during laboratory experiments. We wanted to know whether it occurs in those at the top of the food chain, and to what extent. Top predators are often considered indicators of marine ecosystem health because studying them can help us understand changes in the wider environment. In addition, humans are also top predators because we eat fish and other seafood, which means we too may be exposed to microplastic ingestion. Researching microplastics in marine top predators will help us understand any possible implications for our own health.

We analysed scats (poo) from four captive grey seals fed on wild-caught fish and digestive tracts (guts) of some of the fish. There are several reasons why we chose to use captive seals; wild seals often haul-out to rest on beaches and in caves which are difficult, and often dangerous, to access. The seals in this study live in a sanctuary so their scats are easy to collect. Related to this, captive seals are used to humans whereas wild seals can be very sensitive to disturbance. From a science perspective, captive seals are a more robust way of investigating trophic transfer because their environment is controlled. While wild seals may be exposed to marine litter, we know that captive seals are not. Because we could eliminate the possibility that the seals in our study were eating plastic directly we could be sure that any microplastics found in their scats came via their diet.

To look for microplastics, sub-samples of scat and the content of whole fish digestive tracts were filtered and inspected under a microscope and any potential microplastics photographed, measured and their appearance (colour and shape) recorded. Understanding plastic type, or *polymer*, can help us determine where the microplastics might have come from. To do this, we used fourier-transform infrared spectroscopy (FT-IR) which uses infrared radiation to produce a spectrum, almost like a 'molecular fingerprint'. This can then be compared to a database of spectra from known polymer types and matched to the most similar one.

Contamination control is extremely important in any microplastics study because these little pieces of plastic are everywhere, even in the air we breathe. Fibres are particularly widespread because many synthetic textiles, like our clothes, shed plastic particles when we move. We were extremely strict during our study so we could be sure that the microplastics we found came from the samples and not us!

We found that a third of fish and half of scat sub-samples contained between one and four individual microplastics. Ethylene propylene, a type of synthetic rubber which has many uses, including hoses, tubing and roofing membranes, was commonly found in both fish and scats. Other polymers, such as polyethylene, neoprene and polypropylene, were also prevalent. Blue, black and red were the most frequently found colours, a result which corresponds to findings from other studies on microplastics in the general marine environment.

We didn't find any evidence of contamination in our study set up so we could attribute the presence of microplastics in seal scats to trophic transfer from the fish.

Our study is the first to show that trophic transfer is an indirect, yet potentially major, route of microplastic ingestion for marine top predators. The next steps are to investigate the extent of microplastic ingestion in wild marine mammals and assess whether they cause any impacts on animal health. This will help us understand whether there are any risks for humans too.