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All guts, no glory: ingested microplastics in marine mammals

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ABSTRACT

Microplastics (pieces less than 5 mm in size) have now been discovered in a wide range of aquatic habitats, from deep sea sediments to seemingly pristine tropical beaches. Their small size and omnipresence mean that microplastics can be eaten by animals at the base of the food chain as well as larger animals.

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Microplastics (pieces less than 5 mm in size) have now been discovered in a wide range of aquatic habitats, from deep sea sediments to seemingly pristine tropical beaches. Their small size and omnipresence mean that microplastics can be eaten by animals at the base of the food chain as well as larger animals. For our study, we were particularly interested in marine mammals for several reasons. Firstly, they're diverse. Marine mammals come in all shapes and sizes with different methods of foraging and communicating. Secondly, generally, they are long-lived which allows us to observe how they respond to alterations in their environment. Lastly, many species are top predators so studying them can help us understand whether the ecosystem they live in is healthy because they react to changes lower down the food chain. This is particularly important because the ocean is so vast and challenging to study. Marine mammals can ingest microplastics through two main pathways - direct ingestion can occur as a result of accidentally consuming microplastics that are present in seawater during prey capture. The indirect route of microplastic ingestion happens when prey containing microplastics are consumed by predators. This is known as trophic transfer.. Our previous study using captive grey seals demonstrated this process but it was clear we needed to better understand the extent to which wild marine mammals ingest microplastics.

To do so, we examined the digestive tracts (guts) of 50 marine mammals from 10 different species (Atlantic white-sided dolphin, bottlenose dolphin, common dolphin, grey seal, harbour porpoise, harbour seal, pygmy sperm whale, Risso's dolphin, striped dolphin and white-beaked dolphin) that stranded around the British coast. The first step was for qualified marine mammal pathologists to carry out post-mortem examinations of the stranded animals to try and determine the cause of death, as well as record useful information such age-class, sex, and length. Then the whole digestive tract was removed so that we could extract the gut content. Aside from just wanting to know how many microplastics are in marine mammal digestive tracts, we also wanted to investigate whether they get stuck or simply pass through, and if they do get stuck, where? Seals are like us in that they only have one stomach but cetaceans (whales and dolphins) have a slightly more complicated set-up with three stomach compartments. So we separated the stomach(s) and intestines and analysed the contents of each section.

We found that every animal contained at least one microplastic particle (mean = 5.5 particles per animal) with a maximum of 12. We were surprised that this number was not higher, especially as approximately 11–30% of fish are estimated to contain microplastics. Given that most of the species we examined predate on fish, a greater number of microplastic could perhaps be expected in their digestive tracts. There are at least four possible explanations for the observed low abundances of microplastics. Firstly, microplastics are egested along with other dietary waste, such as fish bones, otoliths, and squid beaks, as shown by their presence in seal scats and the intestines of both cetaceans and seals. Secondly, the levels of microplastics in fish and other prey species may have been overestimated due to poor contamination control in some studies. Thirdly, it is possible, that very small microplastics (nanoplastics) can pass through the gut wall and enter bloodstream, though this is yet to be demonstrated. Lastly, the number of microplastics detected in this study possibly represents a proportion of what is present within the marine mammal guts at the time of death as some may have been lost during the extraction process.

The majority of particles detected in our study were synthetic fibres measuring approximately 2 mm in length, which corresponds with observations of environmental microplastics as well as those found in other studies on cetaceans, turtles, and fish. Similarly, blue and black, the most common colours detected in the marine mammal digestive tracts, frequently dominate the composition of particles ingested by turtles, fish and zooplankton. In terms of polymer, the most common type was Nylon followed by polyethylene terephthalate (PET) and polyester. Many everyday objects are made from these polymers. For example, Nylon and polyester are frequently used in our clothes and other textiles, ropes and fishing line, and PET is widely used for plastic bottles and food packaging.

When we investigated factors that may affect microplastic burden (taxon, age-class, sex, length, cause of death), we found a slight but statistically significant relationship between the number of microplastics and cause of death - animals presenting infectious diseases contained slightly higher mean microplastics abundances than those which died from trauma and other causes of mortality. This result should be treated with caution, however, as it is not yet possible to draw firm conclusions on its biological significance. More research is required to better understand the potential chronic effects of microplastic exposure on marine mammal health.