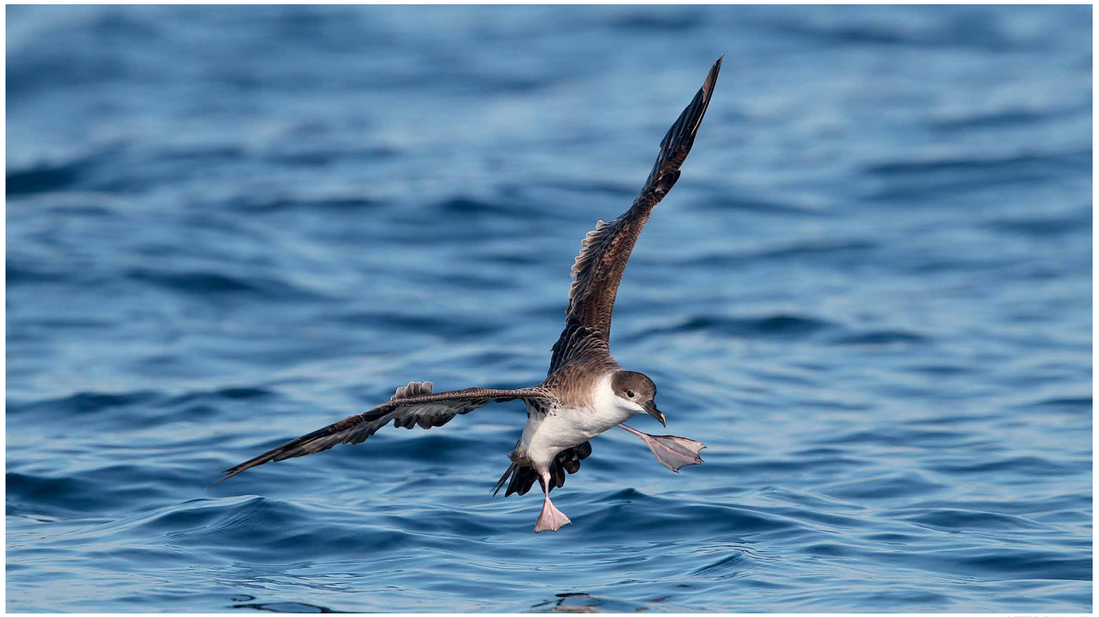
# TOXIC OVERLOAD You are what you eat



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Many marine organisms ingest plastic litter at sea, either directly through indiscriminate foraging behaviour or indirectly through contaminated prey. Plastic has been recorded in the stomachs of about half of all the world's seabird species and, given the ubiquitous nature of microfibres in the world's oceans, it is likely that all species have been exposed to some ingested plastic.

So what? Seabirds often consume indigestible items, which they either regurgitate or excrete. The seabirds such as petrels and phalaropes that accumulate large plastic loads in their stomachs seldom regurgitate pellets and only excrete very small items. Yet these species evolved in an environment where they often eat pumice, seeds and other natural debris floating at sea. Like ingested plastics, pumice and seeds (and indigestible prey remains such as squid beaks) are gradually worn down in the stomach and excreted. So is eating plastic a problem?

Ingested plastic is thought to have three main impacts on seabirds. Firstly, it might block or damage the digestive tract, leading to injury or death. Blockage is a significant issue for turtles, but there are only a few records of seabirds with their guts obstructed by ingested plastic items – many fewer than are entangled in marine litter. In terms of internal injury, seabirds often swallow sharp objects such as spiny fish and crustaceans. Gull regurgitations frequently contain pieces of glass and metal, which are more likely to injure than plastic.

Over the past few decades I have dissected thousands of seabirds killed on longlines and have found numerous albatrosses and petrels containing old fish hooks from previous, less lethal interactions with fishing vessels. In some instances the hooks have penetrated the stomach wall, creating a large cyst, without killing the bird. We even had one Tristan Albatross incubating its egg with an old tuna fish hook protruding from its neck. Clearly this is not ideal, but it shows that most seabirds probably survive ingesting the odd sharp-edged piece of plastic.

Secondly, seabirds that accumulate large amounts of plastic in their stomach might eat less either through a false sense of satiation or simply as a result of having a reduced effective stomach volume. Experiments on chickens and turtles have found slower growth rates for individuals fed large loads of plastic pellets. However, even among species where a high proportion of individuals contain some ingested plastic, only a few individuals tend to contain enough plastic for this to be a significant issue.

That leaves the transfer of toxic compounds from ingested plastics as arguably the most worrying threat from plastic ingestion. Plastics are largely biologically inert, but many plastic items contain additives to give them specific properties and some of these additives can impact birds. Added to this, some compounds adhere to plastics drifting at sea, including long-lasting 'legacy' pollutants such as DDT, DDE and PCBs, which have long been banned under the Stockholm Convention.

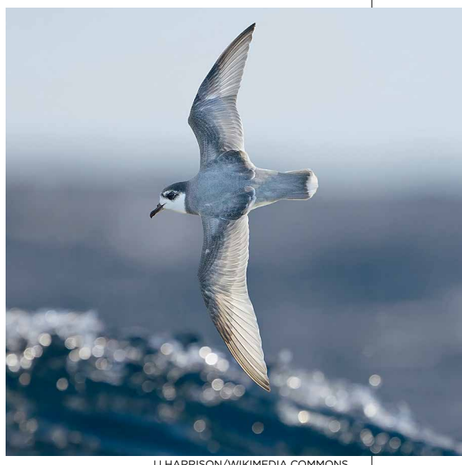
We know that such compounds can be transferred to birds if plastics remain in their stomach for a long period, but the extent of the problem is poorly understood. A recent study led by Rei Yamashita (2021, *Environmental Monitoring and Contaminants Research* 1: 97–112) reports the occurrence of various man-made chemicals in the preen gland oil of 32 seabird species sampled from around the world. The compounds of interest are fat soluble and so preen gland oil provides a convenient, non-destructive way to sample these compounds in seabirds.

Legacy pollutants were found in almost all species, but their concentrations were greater in seabirds that fed on fish and squid rather than crustaceans. This indicates that most PCBs, DDT and DDE probably derive from seabird prey, with bio-magnification as one progresses up the food chain. By comparison, plastic-specific additives such as UV stabilisers and flame retardants were not correlated with the concentrations of legacy pollutants. Rather, they were found most commonly in birds known to regularly ingest plastic fragments.

UV stabilisers were found in 20 of the 32 species sampled, including albatrosses, petrels, frigatebirds, tropicbirds, boobies, cormorants, gulls and auks. By comparison, flame retardants, which are added to a smaller subset of plastic items, were only detected in 11 species. Among the species sampled around southern Africa, two stood out for having very high concentrations of benzotriazole-type UV stabilisers.

Great Shearwaters sampled at their breeding colony on Gough Island had the highest concentration of any species sampled. Yamashita and colleagues suggest that concentrations exceeding 1000 nanograms/gram (ng/g) indicate significant exposure to plastic-related compounds, and the Great Shearwaters sampled contained four to seven times this value. They are trans-equatorial migrants that spend the non-breeding season in the North Atlantic, where they might pick up a lot of their ingested plastic.

above *All the plastic ingested by a Great Shearwater found dead on Inaccessible Island in 2018.*



JJ HARRISON/WIKIMEDIA COMMONS

right *Although Blue Petrels are largely confined to the Southern Ocean, they still eat large amounts of plastic – and contain high levels of UV stabilisers.*

However, the Blue Petrel is a Southern Ocean species that seldom ventures north of the Roaring Forties. Despite these waters having the lowest concentrations of floating plastics on earth, more than 80 per cent of Blue Petrels typically contain ingested plastic. And all three birds sampled on Marion Island contained more than 1000 ng/g of the UV stabiliser UV-238. This provides compelling evidence that plastic is responsible for the long-distance transport of UV-238, which is a requirement to get this persistent pollutant listed under the Stockholm Convention.

The impacts of UV stabilisers on birds are not known, but other plastic-related compounds such as phthalates and brominated flame retardants are endocrine disrupters that can affect thyroid functioning as well as reduce fertility. The study provides further evidence for the need to reduce the amount of waste plastic entering the sea. It also shows that we cannot focus only on plastic packaging, because the additives found in seabirds come from plastics used in consumer products that are designed to last much longer than packaging.

**PETER RYAN**

above *Great Shearwaters from Gough Island contained the highest levels of UV stabilisers among 32 species of seabirds sampled.*