Life in plastic, it's not fantastic: A sensory ecology approach to plastic ingestion

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Albatrosses (Diomedeidae), gannets (Sulidae), and shags (Phalacrocoracidae) all have different feeding strategies. Albatrosses are surface feeders, while gannets plunge dive and shags pursue their prey. Since feeding behaviour often relies on an animal's sensory ecology, we hypothesised that birds with different feeding behaviours would show different investments in their sensory systems. To gain an insight into the sensory ecology of my study bird families, I started my Master's by measuring different sensory organs and processing centres as well as body morphometrics of albatrosses, gannets and shags. The results suggested that albatrosses had the largest olfactory ratios (the size of the olfactory bulb compared to the cerebrum; a likely indicator for how well and animal can smell), followed by shags and then gannets. I also found that the relative eyeball volume of albatrosses and gannets were significantly greater than those of shags.

Since our study birds did indeed show different sensory investments, we then hypothesised that these differences in sensory ecology would result in different vulnerabilities to plastic ingestion. Therefore, we dissected the gastrointestinal tract of various albatross, gannet, and shag species in search of ingested plastic. Out of 125 specimens across 19 species, we only found three pieces of ingested plastic. Following our dissection conundrum, we wondered whether our methods were restricting us from finding plastic that had been ingested but had not remained within the seabird carcass.

To follow up our dissection study, we collected guano from the nesting sites of one species each of albatross, gannet and shag to represent our study families. Following their analysis under a microscope, we found that pied shags/kāruhiruhi ingested the most plastics per gram followed by Australasian gannets/takapu, and then northern royal albatrosses/toroa. However, because our study birds primarily fed on prey larger than 5mm (the size of microplastics), it is unlikely that these ingested plastics were selected by the birds, rather they were incidental occurrences.

After confirming that our study species are in fact vulnerable to plastic ingestion, we explored the possibility of plastics acting as a sensory trap by appearing attractive to seabirds through colours or smells. We set up a year-long experiment in Viaduct Harbour where we deployed different coloured plastic bottlecaps and balloons, and measured changes in colour and smell every month. By modelling the colours of the bottlecaps into seabird vision systems we were able to see that longer wavelengths such as red, orange, or yellow were better differentiated by seabirds, perhaps suggesting a sensory bias for such colours. We were also able to differentiate the compounds in the odours emitted by marine biota that colonised our plastics in the ocean. We found dimethyl sulphide, a feeding infochemical that is used by various marine animals to locate food. Dimethyl sulphide has briefly been researched as a compound emitted by biofouled plastic. However, we were also able to identify another compound that has not previously been studied in a plastic ingestion context; methional is a fishy-smelling compound emitted by several marine animals such as some pelagic fish species.

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