

Welcome to the plastisphere; Marine ecology

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A new world in the making

What is pollution to some is opportunity to others

SINCE 2008 geologists have been mulling over the idea of the Anthropocene, a proposed new epoch in the history of the Earth that would encompass the years in which people have had profound effects on the planet's workings. Most often, discussion of the Anthropocene revolves around how atmospheric chemistry has changed since the beginning of the industrial revolution. Sometimes the effects of new terrestrial ecosystems, in the form of fields, pastures and plantations, are also considered. To date, though, how the Anthropocene has created new ecosystems in the oceans as well as on land has not been much examined.

Such ecosystems are, nevertheless, emerging--as Tracy Mincer of the Woods Hole Oceanographic Institution, in Massachusetts, and Linda Amaral-Zettler of the Marine Biological Laboratory, also in Woods Hole, describe in *Environmental Science and Technology*. The malign effect of floating plastic debris on seabirds, turtles and other sea creatures is well known. But, as Dr Mincer and Dr Amaral-Zettler have discovered, plastic debris also provides a new habitat for organisms small enough to take advantage of it.

The two researchers collected pieces of plastic from various sites in the North Atlantic. They then examined each using DNA analysis, and also an electron microscope, to see what was living on it. Lots of things were. Altogether, they discovered about 50 species of single-celled plant, animal and bacterial life. Each bit of debris was, in effect, a tiny ecosystem.

As with many ecosystems, the bottom of the food chain was occupied by things that photosynthesise. These included unicellular algae called diatoms and dinoflagellates, and photosynthetic bacteria known as cyanobacteria. Usually, such creatures swim freely in the ocean. They therefore have to work hard to stay near the surface, where light for photosynthesis is abundant. By hitching a ride on a piece of floating plastic, they can stay near the surface without effort.

Where plants abound, herbivores will not be far behind. These, Dr Mincer and Dr Amaral-Zettler found in the form of dinoflagellates, some of which like to snack on smaller creatures to supplement their photosynthesis. They also found predators on the herbivores, in the form of ciliates (a type of protozoan) and predator bacteria, which feed on other bacteria. Except for top predators--the type that themselves prey on predators--the two researchers thus discovered a classic web of food chains of the sort familiar from ecology text books. And they also, and perhaps most pertinently from the human point of view, found evidence for one other part of such a food web: the decomposers.

Plastics are energy-rich substances, which is why many of them burn so readily. Any organism that could unlock and use that energy would do well in the Anthropocene. Terrestrial bacteria and fungi which can manage this trick are already familiar to experts in the field. Dr Mincer and Dr Amaral-Zettler found evidence of them on their marine plastic, too.

They noticed many of their pieces of debris sported surface pits around two microns across. Such pits are about the size of a bacterial cell. Closer examination showed that some of these pits did, indeed, contain bacteria, and that in several cases these bacteria were dividing and thus, by the perverse arithmetic of biological terminology, multiplying. Though the two researchers have not yet proved the bugs in the pits are actually eating the plastic, that hypothesis seems a good bet. And if they are, it suggests plastic pollution in the ocean may not hang around as long as has often been feared.

Less encouragingly, Dr Mincer and Dr Amaral-Zettler also found cholera-like bacteria in their tiny floating ecosystems. Both fish and seabirds act as vectors for cholera (the former bring it into human settlements when caught by fishermen, the latter when resting ashore or nesting), so anywhere that such creatures might pick up cholera bugs is something worth keeping an eye on.

The researchers paint an intriguing picture of the adaptability of nature, and provide another piece of the jigsaw that is the Anthropocene. Conservationists intent on preserving charismatic megafauna have reason to lament the spread of plastics through the ocean. But those interested in smaller critters have been given a whole, new sphere--the plastisphere--to study.

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