

'Microplastic Hot Spots' Are Tainting Deep-Sea Ecosystems

Scientists found 2 million microplastic particles in a square meter of sediment, as currents drag debris into seafloor versions of the Great Pacific Garbage Patch.

[Matt Simon](#) 04.30.2020 02:00 PM

Photograph: Juan Carlos Munoz/Getty Images

Off the coasts of Corsica and Sardinia in the Mediterranean Sea swirls an omnipresent yet vanishingly small menace: microplastics. By this point, it comes as no surprise to scientists that they would find the tiny bits of plastic in seafloor sediments—last year [researchers found them](#) in samples off the coast of Southern California. But in the Mediterranean, the sheer concentration of them is astounding: [Writing today](#) in the journal *Science*, researchers report finding 1.9 million microplastic particles in a single square meter of seafloor sediment only 5 centimeters thick.

They also surveyed local ocean currents and seafloor topography to show how microplastic is accumulating in “hot spots,” creating Mediterranean deep-sea equivalents of the Great Pacific Garbage Patch—and it’s safe to assume it’s happening elsewhere around the world. These are the same currents that transport the oxygen and nutrients that support bustling ecosystems. That means these ecosystems are now corrupted with microplastic, which itself may be toxic for the species that sift through the sediment. Even worse, microplastics are known to accumulate additional toxins, plus viruses and bacteria, as they float around the ocean. This could be problematic for baby fish in particular, which researchers have found can [mistake microplastic particles for prey](#).

Whether or not consuming microplastics will affect individual fish and their offspring is something that scientists are just beginning to explore. "Is this toxicity something that modifies the way that this particular species or individual functions, and that actually causes a problem in the population in the next generation?" asks University of Strathclyde microplastic researcher Deonie Allen, who wasn't involved in this work. "That's really new."

The field of microplastic research is young, so scientists are still refining their methods for collecting samples and counting the particles. They have to figure out, for example, how fine their filters should be, which will influence the size of the particles they're able to catch. Even the term "microplastic" is still being debated—the National Oceanic and Atmospheric Administration here in the US considers them to be particles under [5 millimeters long](#), though the European authors of this new paper opt for 1 millimeter instead.

Regardless, a microplastic particle comes in two main varieties: fibers and fragments. Fibers tend to come from clothing made from synthetic fabrics, which shed the wiry bits in the wash. These make their way into the sea via wastewater. Fragments come from the breakdown of plastic packaging, as the stuff floats around the ocean baking in the sun.

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Both varieties make their way into ocean currents and eventually into microplastic hot spots. To get an idea of how sediment is moved around and deposited at the bottom of the sea, think of how water moves through a river. When the river bends, the water flow loses energy toward its outer edge. This is how you get a sandbank: When the water slows, it drops the sediment it's carrying. "Whereas the water within the actual river course keeps its energy, and it keeps that sediment in suspension," says University of Manchester earth scientist Ian Kane, lead author on the new study.

Courtesy of Ian Kane

Similarly, at the bottom of the ocean (the team used samples from up to a kilometer deep), complex topography like underwater valleys will channel ocean currents like rivers, and accelerate them. Here, the water is moving so fast it's keeping sediment in suspension, just as it would in the middle of a swiftly-flowing river. But wherever the currents are slow, the sediment falls out of suspension, creating what are essentially underwater sand dunes, sometimes many kilometers in length.

Microplastics abide by the same physics: The study found their concentrations were a lot lower in samples taken from channels where currents are stronger than in areas where currents are slower and the plastic bits can fall out and settle on the seafloor. This creates the hot spots. And, unfortunately, these also happen to be biodiversity hot spots, because the same currents have also deposited nutrients there.

Here bottom-dwelling critters (benthic organisms like sea cucumbers, which gobble up sediment and filter out the edible bits) could well be consuming the tiny plastics—coated in biofilm, which may be carrying viruses and bacteria—in addition to the actual food carried in by the current. The precise effects these particles have on such animals is still being studied. But there are troubling signs that microplastics are affecting some species' behavior: [Recent research has shown](#) that hermit crabs exposed to the stuff struggle to select new shells.

And researchers are concerned that the particles will work their way up the food chain, as smaller creatures like bivalves and baby fish eat the microplastics before themselves becoming prey to something even larger. "They're being eaten by bigger and bigger and bigger creatures," says Kane. "Of course, they're eventually eaten by things that we eat. So the next time you're eating a nice tuna steak, you might be eating decades-old microplastics contaminated with all kinds of toxins."

Microplastics are showing up in many benthic species, particularly filter-feeders like mussels. "And some of them can even take that microplastic from their gut tissue into their muscle tissue," says the Scripps Institution of Oceanography's Jennifer Brandon, who studies microplastics but wasn't involved with this research. That might not matter when we humans eat a mussel, since we eat the whole thing. "That *does* matter if fish and other animals are doing that, too, because we only eat their muscle tissue," she says, because the plastic could be moving through the lining of their guts and concentrating in those edible bits.

Alternatively, maybe even if a fish eats a piece of microplastic and it passes right through its system, the microplastic still leaves some toxic traces behind. "Did the chemicals from that plastic leach into their tissues that we're going to eat?" Brandon asks. "That is very, very understudied."

It still might be too early to assume microplastic is toxic for bottom-dwelling species, says University of Michigan eco-toxicologist Allen Burton, who studies microplastics but wasn't involved in this new work—although he notes that the situation doesn't look like it's about to get any better. "I think with the predictions that plastic production is going to continue to go up and up and up, that these numbers of fibers and fragments are just going to increase in these areas where they tend to accumulate," he says. "So it could be that we reach that threshold at some point, where it actually is causing adverse impacts on the benthic organisms. I doubt it is at this point."

The discovery of these underwater hot spots is a breakthrough in decoding the mystery of the missing ocean trash: The plastic we can see floating out in the ocean accounts for perhaps 1 percent of the mass that *should* be out there, given rates of pollution. It's increasingly clear from this study and others that much of this trash isn't truly missing, it's just been ground down into miniscule bits and transported by ocean currents.

Nowadays in microplastics research, scientists aren't just quantifying how

many particles they're finding in a given environment, but investigating what those particles look like. Kane and his colleagues found that their samples contained anywhere between 70 percent and 100 percent fibers, and the rest were fragments. Their question now is: How do these different kinds of microplastics move differently through the sea?

Researchers have already shown that, on land, fibers tend to travel farther in the wind than fragments. "We know fundamentally that the density of the different types of plastics will have an impact on how this moves," says Deonie Allen, of the University of Strathclyde. She was part of a team of researchers who last year found that microplastics were blowing from European cities [onto remote mountaintops](#). "We also know that the particle size is going to have a different impact on how this moves," she adds. But microplastic researchers haven't yet done extensive experimentation in the lab replicating how different kinds of plastic might move through air and water. Fibers have been shown to blow [all the way to the pristine Arctic](#), but how does their shape and weight determine how they travel in the sea?

The researchers finding so many fibers in the Mediterranean is a huge clue as to the source of this microplastic pollution: your clothes. Each laundry cycle might shed 100,000 synthetic fibers from stretchy socks or polyester sweatshirts, [researchers have previously found](#). That water flows to wastewater treatment facilities, which catch some of the fibers, but not all. A single city might still eject hundreds of billions of microfibers a year into the sea.



You might expect, then, that with this study in the Mediterranean, the researchers would have found more microplastics in sediment samples closer to the coast, given all the rivers carrying plastics from land to the sea. But nope, that's not where the microplastics were clustered—they're drifting into deeper waters. "And in fact, the concentration *increased* away from the coast," says Kane. "It looks like plastics are making their way down these canyons to the seafloor, and then they're being picked up by the ocean

circulation and redistributed."

This work, says University of Strathclyde microplastic researcher Steve Allen (he's Deonie Allen's spouse, and also wasn't involved in the study), advances the scientific understanding both of where all the plastic is in the seas, and how it's moving. But it also complicates matters, because clearly microplastics are traveling far and wide. "What's really interesting, is that if we *do* find where it is, it looks like it's not going to be there the next time we look," he says. "So that's going to make it really hard to track numbers and work out the severity."

Still, the more scientists learn about the microplastic menace, the better action we can take to stop it from spreading. At a bare minimum, manufacturers of clothes washers could add filters to keep synthetic fibers from entering wastewater, and treatment plants could backstop that with their own filters. The integrity of Earth's ecosystems, deep sea or otherwise, depends on it.

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