NEWS

The Dirt on Ocean Garbage Patches

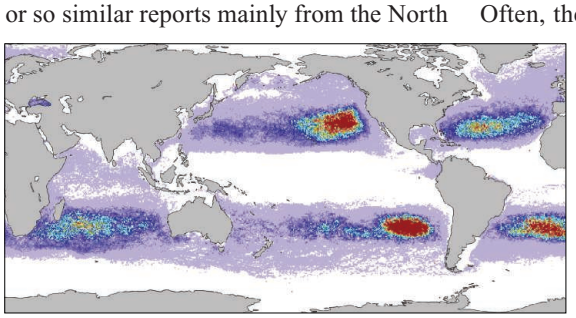
Their biological impact is uncertain and their makeup, misunderstood

Catch of the day. Plastic bits in the ocean (*top*) and collected from plankton tows in the Great Pacific Garbage Patch.

CHANCES ARE YOU'VE HEARD OF THE GREAT Pacific Garbage Patch. It is, according to countless press and TV reports, a "trash vortex," "the world's largest rubbish dump," and a "vast mass of floating debris" midway between Hawaii and California. According to Charles Moore, a sailor-turned-scientist who discovered the patch in 1997 and has been interviewed on *The Oprah Show*, the *Late Show with David Letterman,* and *Good Morning America*, it is a plastic soup twice the size of Texas.

Although many media stories conjure up a chunky soup of bottles and tires, it is mostly an unstrained consommé of small bits of floating plastic. And the patch Moore found isn't the only one. A similar accumulation of plastic particles—which include weathered fishing line, Styrofoam, wrappers, and raw resin pellets—has shown up in the North Atlantic Ocean. But the potential harm to marine life is far from clear. "We just don't know the importance," says biological oceanographer James Leichter of the Scripps Institution of Oceanography in San Diego, California, who points out that "there's a lot more water than plastic."

Accumulating tiny plastic debris was first discovered in 1972, when researchers at the Woods Hole Oceanographic Institution in Massachusetts found plastic particles up to 0.5 centimeters in diameter in their surface plankton nets in the North Atlantic's Sargasso Sea (*Science*, 17 March 1972, p. 1240). Since then, there have been a dozen or so similar reports mainly from the North Atlantic and the North Pacific.



Trash traps. A modeler has predicted the spots (red, yellow) within five gyres where oceanic debris will wind up.

It was Moore who brought the problem to public attention. In 1997, he sailed from Hawaii to Long Beach, California, across a notoriously calm area, where for a solid week he spotted at least one bottle or piece of plastic every hour, he says. Moore went back with some scientists and a plankton tow net. In a 2001 paper in *Marine Pollution Bulletin*, they reported the highest average plastic count on record in the Pacific—334,271 pieces per square kilometer—and a startling 6:1 ratio of plastic to zooplankton by weight. They worried that the plastic was exposing animals to toxins, pointing to a Japanese study showing that polypropylene pellets can suck up pollutants from seawater.

Independent Seattle oceanographer Curtis Ebbesmeyer, known for using spilled shipments of shoes and rubber ducks to study ocean currents, suggested that Moore had found a "garbage patch" within the North Pacific subtropical gyre—one of several major ocean gyres, or large, wind-driven, circular current systems with a quiet center.

While scientists commend Moore's efforts to raise public awareness of marine pollution, some question the 6:1 ratio he came up with. Doubts have also been raised about the patch's size.

Nevertheless, there's clearly a lot of plastic out there. When graduate students from Scripps spent 19 days in the same area last summer sampling sea life, they snagged plastic on every one of 126 plankton tows. Often, the half-liter jar of residue strained from a single 0.5-kilometer tow contained so many plastic chips that the jar "looked like a snow globe," says graduate student Miriam Goldstein, who led the trip. "That is not normal."

Similar findings have come from off the U.S. East Coast. Last winter, the Sea Education Association (SEA), a nonprofit in Falmouth, Massachusetts, that takes students on sailing research trips, reported high—but consistent year-to-year—microplastic counts over a 1450-kilometer transect in the western North Atlantic Ocean that SEA has been sampling for 22 years. Oceanographic modeler Nikolei Maximenko of the University of Hawaii, Manoa, had predicted this patch's location; he has pinpointed other likely patches in the Indian Ocean, South Pacific, and South Atlantic.

Whether the plastic is damaging marine ecosystems is, however, an open question. In the past, researchers have mostly focused on larger threats: abandoned fishing nets that trap turtles and seals; plastic bags that block the digestive tracts of turtles; and the toothbrushes and bottle caps that seabirds mistake for food, sometimes starving as a result or dying from a blockage. But toxin-laden microplastics may add another risk to marine life. Benthic worms, mussels, krill, sea cucumbers, and birds will ingest tiny plastic particles, according to various studies, some by marine ecologist Richard Thompson of the University of Plymouth in the United Kingdom. "There's quite a lot of signals out there that we need to be concerned," says Thompson. But nobody has yet confirmed that significant amounts of chemicals wind up in animals' tissues.

Nor does anyone know where all this plastic ultimately goes. Does it simply get too small to trap with a net? Does it sink to the sediments? Wash onto shore? (Large numbers of microplastics have been found on a Hawaii beach.) One worrisome find from the Scripps trip: a hatchetfish, a midwater dweller, with a plastic chip in its stomach. "It's going somewhere," says SEA oceanographer Kara Lavender Law. She and others would like to find out where. **–JOCELYN KAISER**

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