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How Big Is That Widening Gyre of Floating Plastic?

In the Pacific, Ocean Flows Sweep Litter Into a Flotilla That Could Be the Size of Quebec or Maybe the U.S. -- No One Knows

- By **CARL BIALIK**



A soup of plastic debris floats off the coast of California, a testament to humanity's reliance on plastic and the failure to dispose of it properly.

Just how big is this oceanic zone? Some say it is about the size of Quebec, or 600,000 square miles -- also described as twice the size of Texas. Others say this expanse of junk swept together by currents is the size of the U.S. -- 3.8 million square miles. Or, it could be twice that size.



Ari Patz

The debris floating in a large area of the Pacific Ocean usually isn't visible on the surface.

The Great Pacific Garbage Patch, as it has been called, has become a symbol of what some say is a looming crisis over trash. But this floating mass of plastic in the Pacific Ocean is hard to

measure, and few agree on how big it is or how much plastic it holds. That makes it difficult to determine what to do about it.

That hasn't stopped activists and the media from using only the biggest estimates of the patch's size to warn of an environmental catastrophe.

"We've found it really captures the public's imagination and its focus," says Eben Schwartz, marine-debris program manager for the California Coastal Commission, a state agency. However, "as hard as [environmental advocates] try to characterize it accurately, it is prone to mischaracterization."

The plastic-rich portion of the ocean is a product of swirling currents, known as the North Pacific Subtropical Gyre, that gather and concentrate debris. It captured public attention thanks to the efforts of Charles Moore, a woodworker-turned-sea captain who sailed through the zone in 1997 and was stunned to find plastic debris hundreds of miles from land. "That set off alarm bells and made me want to monitor it, made me want to quantify it, made me want to get a better handle on it," says Capt. Moore, a licensed merchant-marine officer. He dedicated the Algalita Marine Research Foundation that he had founded to studying this region of the ocean and publicizing its plastic problem.

The Numbers Guy Blog

- [Taking the Measure of Plastic Soup](#)

Researchers at the foundation have attempted to quantify the gyre by sailing deep into the Pacific and trawling for plastic and zooplankton using a contraption that resembles a manta ray. Sifting through the entire gyre for plastic would be impossible, so researchers survey a small sample.

But it is difficult to know how to extrapolate their findings to the entire region, or even what that region is. The borders of the gyre shift between seasons, and some scientists, such as Holly Bamford, director of the National Oceanic and Atmospheric Administration's marine-debris program, argue that the high-plastic area is confined to a relatively small part of the gyre.

"I admire Charles," says David Karl, an oceanographer at the University of Hawaii. But Capt. Moore's estimate of the size of the plastic patch -- up to twice the size of the U.S. -- strikes Prof. Karl as guesswork. "He doesn't know the edge" of the area.

Capt. Moore has relied on models of ocean currents from a retired NOAA scientist to help estimate the scope of the concentrated-plastic zone, with debris lurking, often in tiny, barely perceptible pieces, at or just below the surface. "I just did a very crude estimate, by getting a globe and placing my hand over the area defined by this current, and placing my hand over the continent of Africa" to see how the two compared, he says. "The condensed-soup part may be considerably less than the whole," he concedes, but he is frustrated by critics who play down the scope of the problem without doing any fieldwork.

Tara M. Clemente

Smaller pieces of debris show up in high concentrations.



Even as the debate over the plastic patch's size continues, some of the foundation's estimates have been reported as scientific certainty. For instance, a decade ago, researchers found that the ratio of plastic to zooplankton by mass was six to one. A more-recent visit turned up an increase in this ratio, to 46 to one, according to the foundation's Web site. But that is an average of the ratio at each testing site, which included some very high ratios, probably anomalies. A more comparable figure is eight to one, representing a more modest increase when results are aggregated across all testing sites.

In addition, comparing plastic and plankton weight might not be an ideal way to measure the problem, according to Angelicque White, a biological oceanographer at the University of Oregon who accompanied Prof. Karl on a recent voyage to the gyre. Dr. White points out that many plankton are too small for the nets, and might not have been included in the count. What's more, while the heaviest bits of plastic inflate the measure of the debris patch, those pieces pose less of an environmental threat, because they are too large for marine creatures to mistake for food.

Capt. Moore said that his scientific papers have made these distinctions clear. But news articles generally haven't. Dr. Bamford says inconsistent units of measurement of the plastic problem have impeded research. "We're trying to develop a standardized method," she says of NOAA, "so we can really get a handle on how this compares to various locations around the world." It's possible that consistent measurement will reveal that other parts of the ocean without a catchy name are just as plastic-rich, or more so.

Some misinformation comes from other environmental groups exaggerating the alarming research. Environmental advocate David Suzuki has written of a "massive, expanding island of plastic debris 30 meters [98 feet] deep and bigger than the province of Quebec." Asked whether the high-plastic region could really be called an island, Bill Wareham, senior marine conservation specialist with the David Suzuki Foundation, says, "It's not going to look like island in the context of, 'Gee, I can walk across that.' But it is a very high density of plastic." He adds, "David speaks in a way where he's framing the issue in a way people can understand it."

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Algalita Marine Research Foundation

Big entanglements can be found.



Other advocates object to such terminology. "The problem with superlative statements that this is somehow a huge floating mass of plastic is that they inevitably lead to desensitizing people when they learn the truth of it," says David Santillo, a senior scientist with Greenpeace.

Even if scientists and advocates could agree on numbers for the size and plastic concentration of the gyre, it is unclear what they would do with the information. Plastics can harm ocean birds and mammals who eat it, because they carry toxins, can pierce internal organs and can trick animals into thinking they are full. But hard numbers are tough to come by. "It's so hard to say a

bird died due to plastic in its stomach," says Dr. Bamford. "We have seen birds mature and live out their whole life, and necropsies show plastic in their stomach."

Though no one thinks any possible benefits of plastic outweigh risks, Prof. Karl did find some positive aspects of the patch -- a high concentration of microorganisms clinging to the debris. "The microorganisms are good for the ocean, because it turns out they're making oxygen," Prof. Karl says. "If plastics were otherwise neutral to the environment, then they'd be helping by harvesting more solar energy." Dr. Bamford says it is possible that a cleanup, even if it were feasible, would do more harm than good, by removing these organisms.

Capt. Moore says quantifying the plastic could provide a starting point for measuring the effectiveness of land-based efforts to choke the flow of plastic to ocean waters. "I would love to have a government agency form a concerted program to quantify the debris," he says. "It's a tragedy of the commons: Nobody owns the problem."

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