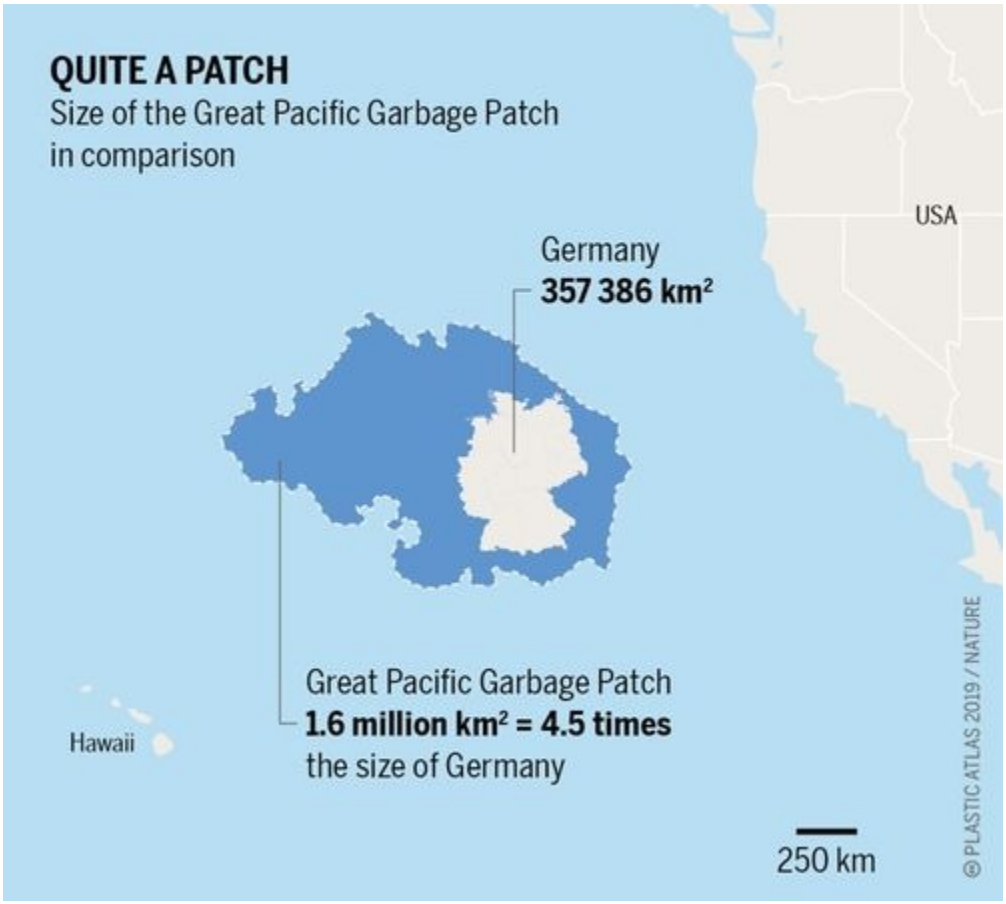
Freeing the Ocean of Plastic, One Step at a Time

by Caitlyn Meagher



This map of the Great Pacific Garbage Patch shows it is 4.5x larger than the size of Germany
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Certain problems in the world may seem like huge, unresolvable challenges. However, individuals and teams can tackle even the largest issues by developing and testing solutions one step at a time. Boyan Slat, a Dutch inventor and entrepreneur, knows this firsthand. He was scuba diving in Greece when he noticed large amounts of plastic around him. He started researching ocean pollution for a school project and became very interested in figuring out how to remove plastic from the ocean. Slat eventually founded Ocean Cleanup, a nonprofit organization that tests and develops systems to remove ocean plastic. He and his team developed solutions by going through specific steps repeatedly.

The first step to developing a solution to this large problem was research. Slat needed to understand the plastic problem. First, he decided to map out where most of the plastic accumulates in the ocean. There are five main areas where ocean currents concentrate plastic. The largest area is called the Great Pacific Garbage Patch, which is about halfway between Hawaii and California. Before Slat's research, no one had done an in-depth analysis about how much plastic there was in these areas. The Ocean Cleanup sponsored 30 boats to travel to these areas to map the pollution. Slat's team also flew an airplane over these areas to take scans of the ocean's surface. This was the first aerial

survey of the Pacific Garbage Patch. Through this research, they determined there were over 80,000 tons of plastic there as of 2020. During this research phase, Slat also realized that the plastic in these areas continues to accumulate. Over the years, these plastics break down into smaller and smaller pieces, eventually becoming microplastics. Microplastics are pieces of plastic that are about the size of a sesame seed or smaller, and they are even more difficult to remove from the ocean.

After carrying out this research, Slat created a list of concerns regarding plastic removal. Then, Slat and his team began a long learning and testing process. First, they started sampling the plastic using a trawl, a fishing net that is pulled through the water by boat. They realized the holes in a regular trawl let a lot of smaller plastic items escape. To capture microplastics, they needed to develop a trawl 15 times finer. They also needed to figure out to what depth the ocean should be cleaned. To do this, the Ocean Cleanup developed a "Multi-Level Trawl," which stacked 10 trawls on top of one another to reach a depth of 5 meters. They measured how the plastic entered this large net. Using this research tool, they discovered that almost all of the plastic floats in the few meters below the ocean's surface.

After this learning and testing process, they brainstormed with professors and engineers all around the world about how to create systems that would capture and remove plastic most efficiently. Then, Slat and his team created scale models to test their many ideas. Scale models are much cheaper to use than full-size models because they are much smaller. They also provide engineers with the opportunity to test many different design variations quickly to see what works best and what new problems arise. Slat and his team used large pools to simulate the ocean and its currents. They performed many experiments in these pools using their scale models of different potential cleanup systems.

Throughout this testing process, they faced design challenges. One of the difficulties they came across was anchoring their system to the seabed. If they followed this approach, their system would have to be able to withstand strong ocean currents and storms without breaking or detaching from the ocean floor. They continued to brainstorm and finally had a breakthrough, inspired by one of their organization's core principles-"We work with nature." As they continued to research, they realized that ocean currents move faster at the surface and slower at deeper levels. So, in keeping with their principle of working *with* nature, they decided that boats could be used to slowly pull the system and allow it to drift with the ocean currents. As long as their system was drifting slower than the plastic, it would still capture plastic. As Slat says, "to capture plastic, act like the plastic." This breakthrough meant engineers did not have to develop ways for their system to withstand large ocean storms. It also meant that the system did not need to be fixed in one direction, but could be free to orient itself to where the plastic is coming from. The engineers built scale models to test this new approach. They found that the moving system captured much more plastic than the fixed system!

After figuring out the best approach using scale models, the Ocean Cleanup began working on scaling up their project to work in real oceans. They had a successful fundraising campaign to build these systems and employ people to man the boats where the plastic is deposited. Their first system deployed in the Great Pacific Garbage Patch failed to capture a lot of plastic. Part of it also broke. But engineers took this failure as an opportunity. They brought the system back to shore to figure out what went wrong. They realized the boats needed to pull the system at a higher speed to capture plastic. By testing different designs and materials, engineers developed a stronger, more efficient system. This second system was a much greater success!

The Ocean Cleanup vessel removes tons of plastic waste from the ocean.
Martime Museum of San Diego, Flickr, CC BY 2.0

Today, Ocean Cleanup's system consists of a massive U-shaped barrier made of a large fishing net that extends 3 meters down into the ocean. It has flotation devices along the top to help keep its U-shape. The barrier is connected to a vessel at each end. The two vessels move across the surface of the ocean at a very slow speed. As they move, plastic hits the barrier and slowly flows into the middle of the net. In the middle of the net, there is a "retention zone." Once this part of the net is full of plastic, it is detached from the rest of the system and brought on board the boats. There, the plastic is dumped. Then, the middle part of the net is put back in place and the cleanup continues. Once the boats are full of plastic, they travel back to shore for recycling. Then, this process begins again.

Now that the technology has been proven, the organization's next goals focus on making larger and more efficient systems. Slat's team continues to identify any problems and adjust the newest systems accordingly. For example, animals sometimes get trapped in the trawl, even though most are able to escape under the net. Engineers are continuing to work on that problem to make sure this system has as few drawbacks as possible.

The Ocean Cleanup's goal is to have removed 90% of floating ocean plastic by 2040. As of 2023, the organization has removed over 440,000 pounds of plastic from the Great Pacific Garbage Patch. They have also deployed systems in rivers to work on removing pollution in those waterways. Although there is still a long way to go, progress is being made. The Ocean Cleanup team does not shy away from continuously improving their designs for greater efficiency and impact. Developing solutions to huge problems takes time, testing, and teamwork.

Do you want to be a part of the solution? Become a "Citizen Scientist" at the Ocean Cleanup's website. People all over the world can help identify pollution hotspots and add to the organization's research efforts to know the locations of plastic accumulation. It takes a lot of people to solve the world's biggest problems!