

TIME FOR A SEA CHANGE

The vast amount of plastic littering our oceans isn't just bad news for marine life – it's making its way into the human food chain too. It's time to clean up our act.



Anyone sailing off the coast of LA will find more than a few plastic bottles in their path. A mishmash of shoes, packaging, fishing nets and other plastic debris has, via ocean currents, gathered between California and Hawaii, forming the world's largest collection of floating rubbish.

Three times the size of France, the Great Pacific Garbage Patch (GPGP) is vast and will only get bigger unless action is taken.

Cue Boyan Slat. Just 16 when he first studied the scale of pollution in our seas, the now 23-year-old is founder of The Ocean Cleanup, a non-profit organisation focused on ridding the world's oceans of plastic. With more than \$2.2 million raised through donations from over 38,000 individuals, Slat and his team have spent the last three years analysing the patch via the most comprehensive sampling effort to date.

In 2015, 30 boats crossed the GPGP in parallel, creating the largest ocean research expedition ever. Dragging nets that captured high volumes of plastic, the vessels mapped 3.5 million square kilometers in total and gathered more data than had been collected in the previous 40 years combined.

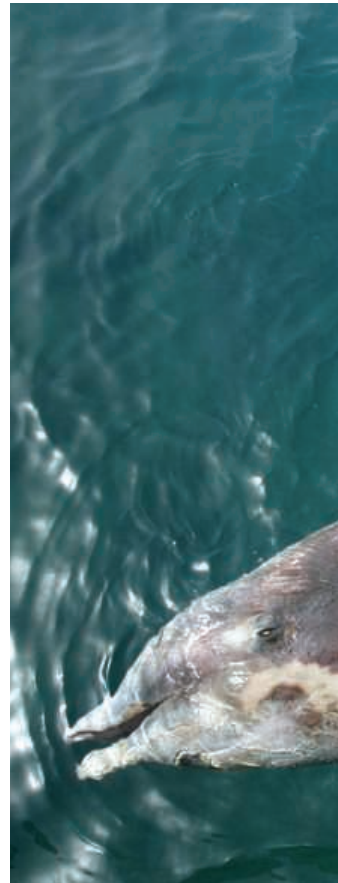
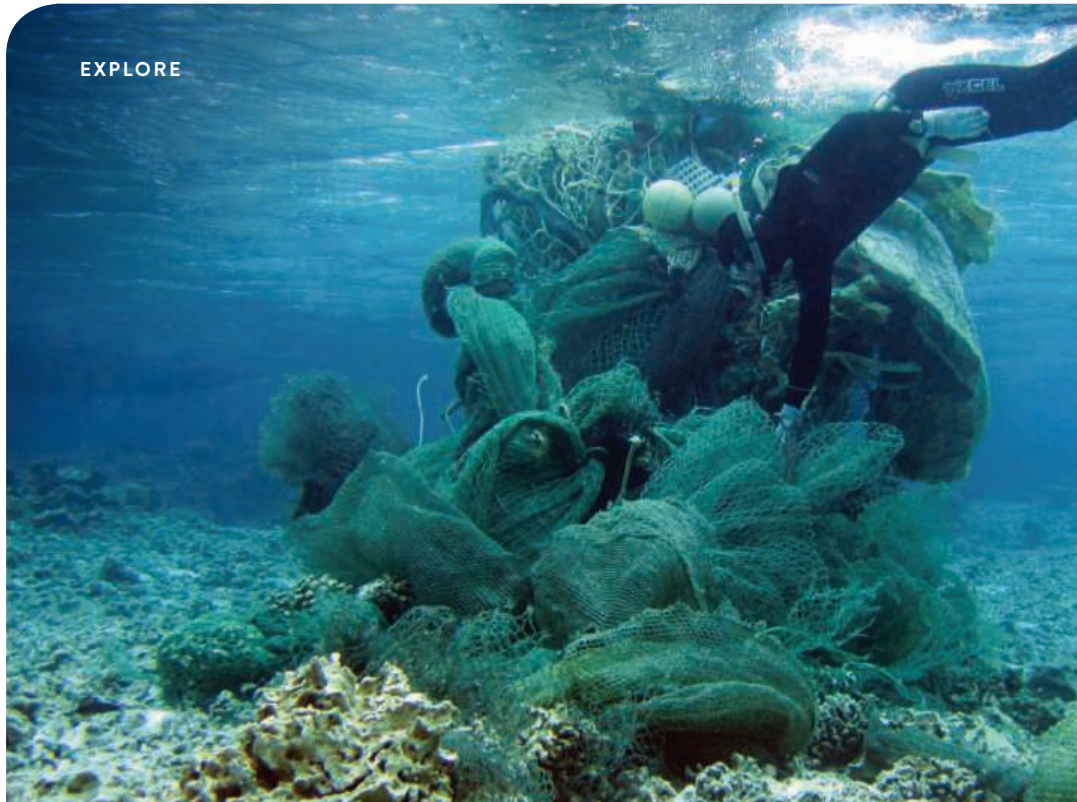
Separate expeditions also measured the vertical distribution of plastic at sea. While plastic floats at the surface, small pieces can be pushed down by wind and wave action. Knowing to which depth the ocean needs to be cleaned is essential to dimensioning any clean-up operation.

The results, published last month in *Scientific Reports*, are alarming. They reveal that 1.8 trillion pieces of plastic, weighing almost 80,000 metric tonnes, has accumulated in the area. Enough trash to fill 500 jumbo jets, the volume is 16 times higher than previous estimates.

What's more, larger objects make up 92% of the mass, while only 8% is made of microplastics, defined as pieces smaller than 5mm in size.

Speaking to *Flashes*, Slat explains: "Large pieces are bigger than 5mm. These can be anything from dustbins to buckets and fishing nets to plastic bottles. The microplastics are the result of these large pieces breaking down and sinking in the ocean."





Above left:
Derelict fishing gear is removed from an impacted reef habitat at Midway Atoll.

Left: A sea turtle is snared by marine debris. Photo: Eryn Opie, Hawaii Department of Lands and Natural Resources

Above right:
Emaciated whale in Norway before it was put down

Slat and his team are surprised by the amount of large plastic objects polluting the patch. Previously, they believed that most of the debris consisted of small fragments but the results show otherwise.

Surprisingly, the data also reveals that fishing nets account for 46% of the rubbish, with the majority of the rest composed of other fishing equipment, such as ropes, oyster spacers, eel traps, crates and baskets. Globally, fishing gear is thought to make up 20% of marine debris so, at nearly half, the figures are unexpectedly high.

And what of other pollution? What does it comprise and from where does it originate?

"Most of the pollution comes from consumers using one-use plastic items," says Slat. "Plastic bottles and cups are some of the most wasteful products floating in the ocean at this time. It is not just groups but individuals using these non-recyclable products and discarding them after just one use.

"The largest polluters are, logically, the surrounding countries," he adds. "This is evident from specific pieces of plastic found during our surveys, both by



water and air. It is not that important who the biggest polluter is, as plastic pollution can only be limited when all countries and large companies work together on a global scale to reduce usage.”

DEADLY EFFECTS

Approximately 100,000 marine animals are killed or injured by plastic every year. One of the most famous cases is that of the Cuvier's beaked whale in Norway in 2017. Twice locals tried to save the mammal by pushing it back out to sea. Twice they failed. When the exhausted and emaciated whale became stranded in shallow waters off the island of Sotra for a third time, it was put down.

At just under two tonnes, the whale's weight was well below average. What's even more alarming, however, is the contents of its stomach: 30 large pieces of plastic, including carrier bags and flimsy sheets.

This incident isn't a one off. Another Cuvier's beaked whale died on the Isle of Skye with four kilograms of plastic bags and sheeting in its stomach. Dr Andrew Brownlow is a veterinary pathologist at the Scottish Marine Animal Stranding Scheme (SMASS), the organisation that discovered the animal.

Speaking to the UK's Sky News, he said the plastic, which ranged from black bin liners to zipped freezer bags, had “twisted into the whale's intestine and completely blocked its digestive system”.



ENVIRONMENT

OCEAN PLASTIC IN NUMBERS

5 TRILLION plastic pieces currently litter our oceans

1.8 TRILLION plastic pieces are contained in the Great Pacific Garbage Patch (GPGP)

5 GYRES two in the Pacific Ocean, two in the Atlantic Ocean and one in the Indian Ocean, collect plastic in areas known as ‘garbage patches’

50% by which The Ocean Cleanup hopes to reduce the GPGP in the next five years

30 VESSELS crossed the GPGP in parallel in 2015 in an attempt to capture and analyse the extent of the plastic pollution

80 MILLION kilograms of floating plastic debris, principally made of Polyethylene and Polypropylene, are found in the GPGP

1 C-130 HERCULES aircraft, named Ocean Force One, flew at low altitude to help map the GPGP

Dr Brownlow added: “For every one of these pieces it is possible that there would have been some form of human action that could have stopped it from getting into the marine environment.

“This was an animal that went to places that are very difficult for us to go and sample, and sadly he paid pretty much the ultimate price for that.”

It's not just fish that are suffering but birds, too. A dead albatross chick was recently found with extensive plastic in its stomach on Midway Atoll, in the northwestern Hawaiian Islands.

“Ultimately, none of these plastics are meant to be in the ocean,” says Slat. “It's important to try and remove as much foreign material as possible, so as not to have a greater adverse effect on the oceans' ecosystem.

“A future with clean oceans is much more inspiring than one in which we only don’t make it worse”

BOYAN SLAT,
founder of The Ocean Cleanup

“Direct plastic consumption can affect an animal’s ability to swim, hunt, feed and reproduce, disrupting its normal behaviour. Consequences can span from starvation, weakness, disorientation, migration-avoidance and eventually death,” he adds.

Humans are also at risk. As affected marine life is caught for human consumption, so the microplastics enter our food chain, potentially resulting in poisoning, infertility and genetic disruption if consumed in high quantities.

Mussels, a popular dish in many parts of the world, have been found to contain tiny plastic particles. So, too, have anchovies – a common pizza topping – and many other fish that mistake the pieces for food.

The full risk to people is not yet known but there are real concerns that microplastics can accumulate toxic chemicals within the human body.

WHAT’S NEXT

Based on the findings, The Ocean Cleanup will begin its first clean-up operation of the GPGP later this year. The team will monitor and assess progress and apply newfound knowledge to subsequent systems, which will be rolled out gradually until they reach full-scale deployment, planned for 2020. The aim is to halve the size of the patch in the next five years.

The speed of rollout depends on the level of investment and the results of operational risk assessments. Recycling capacity on land is also a factor as The Ocean Cleanup plans for all material to be reused.

While much responsibility for the future of our oceans lies with large companies and governments, what can individuals do to help? A great deal, according to Slat.

“On land, ocean pollution can be stemmed by organising beach clean-ups, using cups intended for multiple uses and canvas bags rather than plastic bags. Simply think about the way people throw away plastic on a day-to-day basis,” he says.

Right: First North Sea prototype deployed in June 2016

PLASTIC IN THE OCEAN

The common form of marine debris, the plastic in our seas can come from a variety of land and ocean-based sources. It enters the water in many ways, and impacts the ocean and great lakes. Once in the water, plastic debris never fully biodegrades.

COMMONLY FOUND PLASTICS



Cigarette butts



Food wrappers



Beverage bottles



Straws, cups & plates



Bottle caps



Plastic bags

HOW TO HELP?



Reduce



Reuse



Recycle



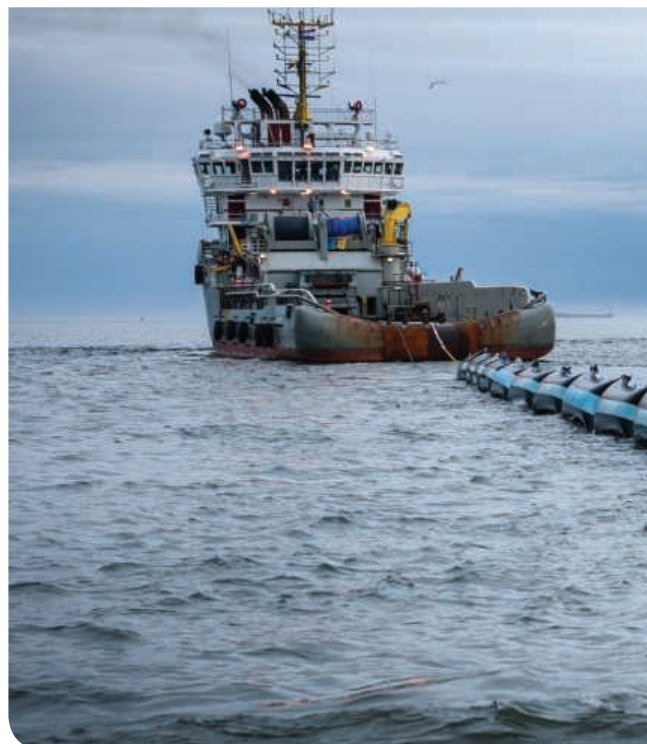
Dispose properly



Get involved in local clean-ups



Remember that our land and sea are connected



MICROPLASTICS

Microplastics are small pieces less than 5mm

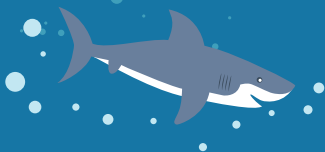


BOATS/NETS

Fishing gear become marine debris when it is lost or abandoned

ENTANGLEMENT

Marine life can get caught and killed in derelict fishing nets and other plastic debris



INGESTION

Animals and birds can easily mistake plastic debris for food



RAIN AND WIND

Rain and wind can sweep debris in to nearby waterbodies

LITTERING

Intentional littering or improper disposal of trash can cause marine debris



STREAMS & STORM DRAINS

Streams and storm drains can carry debris directly into the ocean and great lakes

Source: marinedebris.noaa.gov



"It is important to understand that all plastic eventually ends up in the oceans through rivers and other water ways. By stepping up our game, all individuals can help."

Slat also believes that governments should introduce bottle deposit schemes, and new regulations that control the use of plastic bags. "The ocean plastic problem is a perfect example of a tragedy of the commons," he says. "Since the gyres [large ocean whirlpools] are mostly located outside of national territories, no single party can be held responsible for causing or clearing away the plastic pollution there. As a result, intergovernmental bodies or independent private initiatives are the only entities likely willing to tackle the problem," he adds.

And what of the future? How does Slat envisage our oceans in the years to come?

"Now there is a feasible way to clean up what is already out there, it shows the problem is not a lost cause. This will hopefully motivate us to make sure no more plastic enters the oceans," he says.

"A future with clean oceans is much more inspiring than one in which we only don't make it worse. The oceans can become clean again, helping restore and protect marine life. In the end, it will be better for all humans, too." ↑