

Drowning in plastic: The Great Pacific Garbage Patch is twice the size of France

There are now 46,000 pieces of plastic per square kilometre of the world's oceans, killing a million seabirds and 100,000 marine mammals each year. Worse still, there seems to be nothing we can do to clean it up. So how do we turn the tide?

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Richard Grant reports on the Great Pacific Garbage Patch, and a new expedition that aims to make us reassess our relationship with plastic. Illustrations by Brett Ryder

Way out in the Pacific Ocean, in an area once known as the doldrums, an enormous, accidental monument to modern society has formed. Invisible to satellites, poorly understood by scientists and perhaps twice the size of France, the Great Pacific Garbage Patch is not a solid mass, as is sometimes imagined, but a kind of marine soup whose main ingredient is floating plastic debris.



A shark carcass on Kamilo Beach, Hawaii, where plastic particles outnumber sand grains until you dig down about a foot Photo: ALGALITA MARINE RESEARCH FOUNDATION

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It was discovered in 1997 by a Californian sailor, surfer, volunteer environmentalist and early-retired furniture restorer named Charles Moore, who was heading home with his crew from a sailing race in Hawaii, at the helm of a 50ft catamaran that he had built himself.

For the hell of it, he decided to turn on the engine and take a shortcut across the edge of the North Pacific Subtropical Gyre, a region that seafarers have long avoided. It is a perennial high pressure zone, an immense slowly spiralling vortex of warm equatorial air that pulls in winds and turns them gently until they expire. Several major sea currents also converge in the gyre and bring with them most of the flotsam from the Pacific coasts of Southeast Asia, North America, Canada and Mexico. Fifty years ago nearly all that flotsam was biodegradable. These days it is 90 per cent plastic.

'It took us a week to get across and there was always some plastic thing bobbing by,' says Moore, who speaks in a

jaded, sardonic drawl that occasionally flares up into heartfelt oratory. 'Bottle caps, toothbrushes, styrofoam cups, detergent bottles, pieces of polystyrene packaging and plastic bags. Half of it was just little chips that we couldn't identify. It wasn't a revelation so much as a gradual sinking feeling that something was terribly wrong here. Two years later I went back with a fine-mesh net, and that was the real mind-boggling discovery.'

Floating beneath the surface of the water, to a depth of 10 metres, was a multitude of small plastic flecks and particles, in many colours, swirling like snowflakes or fish food. An awful thought occurred to Moore and he started measuring the weight of plastic in the water compared to that of plankton. Plastic won, and it wasn't even close. 'We found six times more plastic than plankton, and this was just colossal,' he says. 'No one had any idea this was happening, or what it might mean for marine ecosystems, or even where all this stuff was coming from.'

So ended Moore's retirement. He turned his small volunteer environmental monitoring group into the Algalita Marine Research Foundation, enlisted scientists, launched public awareness campaigns and devoted all his considerable energies to exploring what would become known as the Great Pacific Garbage Patch and studying the broader problem of marine plastic pollution, which is accumulating in all the world's oceans.

The world's navies and commercial shipping fleets make a significant contribution, he discovered, throwing some 639,000 plastic containers overboard every day, along with their other litter. But after a few more years of sampling ocean water in the gyre and near the mouths of Los Angeles streams, and comparing notes with scientists in Japan and Britain, Moore concluded that 80 per cent of marine plastic was initially discarded on land, and the United Nations Environmental Programme agrees.

The wind blows plastic rubbish out of littered streets and landfills, and lorries and trains on their way to landfills. It gets into rivers, streams and storm drains and then rides the tides and currents out to sea. Litter dropped by people at the beach is also a major source.

Plastic does not biodegrade; no microbe has yet evolved that can feed on it. But it does photodegrade. Prolonged exposure to sunlight causes polymer chains to break down into smaller and smaller pieces, a process accelerated by physical friction, such as being blown across a beach or rolled by waves. This accounts for most of the flecks and fragments in the enormous plastic soup at the becalmed heart of the Pacific, but Moore also found a fantastic profusion of uniformly shaped pellets about 2mm across.

Nearly all the plastic items in our lives begin as these little manufactured pellets of raw plastic resin, which are known in the industry as nurdles. More than 100 billion kilograms of them are shipped around the world every year, delivered to processing plants and then heated up, treated with other chemicals, stretched and moulded into our familiar products, containers and packaging.

During their loadings and unloadings, however, nurdles have a knack for spilling and escaping. They are light enough to become airborne in a good wind. They float wonderfully and can now be found in every ocean in the world, hence their new nickname: mermaids' tears. You can find nurdles in abundance on almost any seashore in Britain, where litter has increased by 90 per cent in the past 10 years, or on the remotest uninhabited Pacific islands, along with all kinds of other plastic confetti.

'There's no such thing as a pristine sandy beach any more,' Charles Moore says. 'The ones that look pristine are usually groomed, and if you look closely you can always find plastic particles. On Kamilo Beach in Hawaii there are now more plastic particles than sand particles until you dig a foot down. On Pagan Island [between Hawaii and the Philippines] they have what they call the "shopping beach". If the islanders need a cigarette lighter, or some flip-flops, or a toy, or a ball for their kids, they go down to the shopping beach and pick it out of all the plastic trash that's washed up there from thousands of miles away.'

On Midway Island, 2,800 miles west of California and 2,200 miles east of Japan, the British wildlife filmmaker Rebecca Hosking found that many thousands of Laysan albatross chicks are dying every year from eating pieces of plastic that their parents mistake for food and bring back for them.

Worldwide, according to the United Nations Environment Programme, plastic is killing a million seabirds a year, and 100,000 marine mammals and turtles. It kills by entanglement, most commonly in discarded synthetic fishing lines and

nets. It kills by choking throats and gullets and clogging up digestive tracts, leading to fatal constipation. Bottle caps, pocket combs, cigarette lighters, tampon applicators, cottonbud shafts, toothbrushes, toys, syringes and plastic shopping bags are routinely found in the stomachs of dead seabirds and turtles.

A study of fulmar carcasses that washed up on North Sea coastlines found that 95 per cent had plastic in their stomachs – an average of 45 pieces per bird.

Plastic particles are not thought to be toxic themselves but they attract and accumulate chemical poisons already in the water such as DDT and PCBs – nurdles have a special knack for this. Plastic has been found inside zooplankton and filter-feeders such as mussels and barnacles; the worry is that these plastic pellets and associated toxins are travelling through the marine food chains into the fish on our plates. Scientists don't know because they are only just beginning to study it.

We do know that whales are ingesting plenty of plastic along with their plankton, and that whales have high concentrations of DDT, PCBs and mercury in their flesh, but that's not proof. The whales could be getting their toxins directly from the water or by other vectors.

Research on marine plastic debris is still in its infancy and woefully underfunded, but we know that there are six major subtropical gyres in the world's oceans – their combined area amounts to a quarter of the earth's surface – and that they are all accumulating plastic soup.

The Great Pacific Garbage Patch has now been tentatively mapped into an east and west section and the combined weight of plastic there is estimated at three million tons and increasing steadily. It appears to be the big daddy of them all, but we do not know for sure.

Dr Pearn Niiler of the Scripps Oceanographic Institute in San Diego, the world's leading authority on ocean currents, thinks that there is an even bigger garbage patch in the South Pacific, in the vicinity of Easter Island, but no scientists have yet gone to look.

The French cultural theorist Paul Virilio observed that every new technology opens the possibility for a new form of accident. By inventing the locomotive, you also invent derailments. By inventing the aeroplane, you create plane crashes and mid-air collisions.

When Leo Baekeland, a Belgian chemist, started tinkering around in his garage in Yonkers, New York, working on the first synthetic polymer, who could have foreseen that a hundred years later plastic would outweigh plankton six-to-one in the middle of the Pacific Ocean?

Baekeland was trying to mimic shellac, a natural polymer secreted by the Asian scale beetle and used at the time to coat electrical wires. In 1909 he patented a mouldable hard plastic that he called Bakelite, and which made him very rich indeed.

Chemists were soon experimenting with variations, breaking down the long hydrocarbon chains in crude petroleum into smaller ones and mixing them together, adding chlorine to get PVC, introducing gas to get polystyrene. Nylon was invented in 1935 and found its first application in stockings, and then after the Second World War came acrylics, foam rubber, polythene, polyurethane, Plexiglass and more: an incredible outpouring of new plastic products and the revolution of clear plastic food wraps and containers, which preserved food longer and allowed people to live much further away from where it was produced.

Single-use plastic bags first appeared in the US in 1957 and in British supermarkets in the late 1960s; worldwide there are more than a trillion manufactured every year, although the upward trend is now levelling off and falling in many countries, including Britain. We reduced our plastic bag use by 26 per cent last year, to 9.9 billion. Bottled water entered the mass market in the mid-1980s. Global consumption is now 200 billion litres a year and only one in five of those plastic bottles is recycled. The total global production of plastic, which was five million tons in the 1950s, is expected to hit 260 million tons this year.

Look around you. Start counting things made of plastic and don't forget your buttons, the stretch in your underwear, the little caps on the end of your shoelaces. The stuff is absolutely ubiquitous, forming the most basic infrastructure of modern consumer society. We are scarcely out of the womb when we meet our first plastic: wristband, aspirator,

thermometer, disposable nappy. We gnaw on plastic teething rings and for the rest of our lives scarcely pass a moment away from plastics.

The benefits of plastic, most of which relate to convenience, consumer choice and profit, have been phenomenal. But except for the small percentage that has been incinerated, every single molecule of plastic that has ever been manufactured is still somewhere in the environment, and some 100 million tons of it are floating in the oceans.

A dead albatross was found recently with a piece of plastic from the 1940s in its stomach. Even if plastic production halted tomorrow, the planet would be dealing with its environmental consequences for thousands of years, and on the bottom of the oceans, where an estimated 70 per cent of marine plastic debris ends up – water bottles sink fairly quickly – for tens of thousands of years. It may form a layer in the geological record of the planet, or some microbe may evolve that can digest plastic and find itself supplied with a vast food resource. In the meantime, what can we do?

What we cannot do is clean up the plastic in the oceans. 'It's the biggest misunderstanding people have on this issue,' Moore says. 'They think the ocean is like a lake and we can go out with nets and just clean it up. People find it difficult to grasp the true size of the oceans and the fact that most of this plastic is in tiny pieces and it's everywhere. All we can do is stop putting more of it in, and that means redesigning our relationship with plastic.'

At the far end of a huge loading warehouse on the San Francisco docks dub reggae is pulsing and two young women are shooting dry ice into two-litre plastic bottles. David de Rothschild, the tall, bearded, long-haired, environmentalist son of the Rothschild banking family, wearing hemp Nikes and a skull-and-bones belt buckle, strides in past a display of nurdles, an aquarium full of plastic soup and various rejected prototypes of the catamaran he intends to build and sail across the Pacific to Australia, visiting the Great Pacific Garbage Patch and various rubbish-strewn islands along the way.

He wants the boat to be made entirely out of recycled plastics and float on recycled plastic bottles, and this has presented a daunting challenge to his team of designers, consultants and naval architects. Human ingenuity has devised many fine applications for recycled plastic, but boat-building has not so far been one of them. The design team has had to start from scratch, over and over again. Furthermore, because the point of this voyage is to galvanise media and public attention on the issue of plastic waste, the boat needs to look dramatic and iconic, and it must produce all its own energy, generate no emissions and compost its waste.

'The message of this project is that plastic's not the enemy,' de Rothschild says, speaking rapidly and unstoppably in a mid-Atlantic accent. He is full of bright energy, good humour, marketing slogans and an almost childlike enthusiasm. 'It's about rethinking waste as a resource. It's about doing smart things with plastic and showcasing solutions. It's about using adventure to engage people and start a conversation that creates change in society. You're always going to get people who say, "Oh, he's a bloody Rothschild, sitting on a boat made of, what's that? Champagne bottles?" And that's fine because it gets people talking about it and thinking about where their rubbish goes.'

The idea took hold of him in July 2006. He had just got back from the North Pole, where he led an expedition designed to heighten awareness about global warming. On the internet he came across a UN report describing the Great Pacific Garbage Patch and estimating that there was now an average of 46,000 pieces of plastic per square kilometre of the world's oceans. 'I thought, this is nuts that we don't know about this! Six-to-one plastic-to-plankton ratio? This has got to be my next expedition.'

Born in London, de Rothschild, 31, was a reckless, hyperactive child and teenager who found an outlet for energies in competitive showjumping and triathlons. His school career was erratic but he managed to buckle himself down, pass his A-levels and get into Oxford Brookes University to study computing. Afterwards he got a job with a music licensing and merchandising company, designing websites for Britney Spears and U2, and absorbing lasting lessons on the power and strategies of marketing.

Then, with the encouragement of a girlfriend, he got deeply involved in alternative medicine, which led him to organic farming in New Zealand and the subsequent realisation that it was all for naught if the air, the water and the natural environment continued to be poisoned.

In 2004 a friend's brother invited him on a 1,150-mile traverse of Antarctica by foot and ski, and on a whim he invited schoolteachers and children in New Zealand to follow the expedition's progress and learn about Antarctica.

On his return he founded an organisation, Adventure Ecology, intended to use expeditions to get schoolchildren interested and actively involved in environmental issues. The Arctic global warming expedition was the first. Crossing the Pacific in a recycled-plastic boat will be the second.

He decided to name the boat *Plastiki*, in homage to *Kon-Tiki*, the raft of balsa logs and hemp ropes in which Thor Heyerdahl sailed across the Pacific in 1947. He recruited designers, a public relations team and corporate sponsors, including Hewlett-Packard and the International Watch Company. He won't say how much it is costing or how much of his own money is going into it, only that it is more than he would like and less than it could be.

Jo Royle, the renowned British yachtswoman, has signed on as skipper, and two of Thor Heyerdahl's grandchildren have agreed to join the crew. And through Adventure Ecology, de Rothschild has launched a competition called SMART, inviting individuals and organisations from science, marketing, art and industrial design research and technology to present tangible solutions to the problems of plastic waste, and offering grants and publicity to the winners.

In general terms, it is already clear what we need to do about plastic. Since it is made from oil, which will run out in our lifetimes and get more expensive as it does, we have to start re-using plastic and designing it for re-use. At present only a few of our many hundred plastics can simply be melted down and moulded into something else; the rest are cross-contaminated with other chemicals and types of plastic. But the billion-dollar plastic industry is tooled for virgin plastic and resistant to change.

Charles Moore gives talks to plastic industry executives whenever he can and finds very little interest in recycling, because it's the least profitable sector of the industry. 'A lot of companies and product designers and marketing people don't like recycled plastic either,' de Rothschild says, 'You can't dye it with those bright, attention-grabbing colours.'

For consumers, the easiest way to make a difference is to give up plastic shopping bags and plastic water bottles, which contribute more to plastic pollution than any other products. Then comes plastic packaging, which is a little more complicated. It is easy to point out examples of excessive packaging, but plastic does have the virtue of being lighter than paper, cardboard and glass, which gives it a smaller carbon footprint. For food especially, recyclable plastic packaging is probably the best option.

For the hull and cabin of the *Plastiki*, the team was enthused about recycled plastic lumber until they discovered that it sags badly unless reinforced with glass rods. Now they are excited about self-reinforcing PET, a new product manufactured in Denmark, similar to fibreglass but fully recycled and recyclable. When heat-fused to boards of PET foam, it appears to be capable of withstanding the battering of Pacific waves for a hundred days, although the effect of salt water on the material is still unknown. Dry ice in the two-litre bottles hardens them without losing any flotation, although some of the bottle caps have managed to work themselves loose and are now being resealed with what de Rothschild calls 'a very cool bio-glue' made from cashew nuts and sugar.

Sitting now with a pint of beer and an artichoke in a restaurant opposite the waterfront, he is confident that the *Plastiki* will be built and on its way to Australia some time this summer. 'We do need to get from A to B but what this project is really about is remarketing and rebranding the message about recycling, about sustainability, about interconnectedness,' he says. What he sees as the failure of the environmental movement, as measured by ever-increasing carbon emissions, rainforest destruction, species extinctions and marine plastic debris, he understands as a failure of marketing and communication, rather than insurmountable forces working in the opposite direction.

'The environmental message has been very exclusive, very guilt-mongering, very fear-mongering, and is that the right way to engage with people? We're bombarded by 2,500 images a day. How are you going to stop someone watching *Lost* and make them watch someone saying, "You're a bad person because you don't drive a hybrid"? To effect change, you've got to inspire people, not moan at them.'

After another pint, he admits to serious doubts – not that the *Plastiki* will get built and complete its voyage, but that it is still possible to save the oceans from ecological collapse. Overfishing is the most urgent problem, but what really scares him and the marine scientists is acidification caused by global warming. The oceans are absorbing more and more of the carbon dioxide that we are putting into the air and it is changing the pH of the water, turning the seas more acid, with potentially catastrophic effects on marine organisms and ecosystems.

'A lot of scientists think we're basically screwed, but what are you going to do?' he asks. 'Enjoy your beer, enjoy your

family, make the most of it while it lasts? I think there's a real big movement for that at the moment and part of me understands that. But there's a bigger part of me that says we've got to find a solution, collectively. I mean, come on. We spent \$265 billion preparing for the Y2K bug and we didn't even know if it was going to happen or not. We know for an absolute fact that if we continue on our current rate of consumption, we're going to run out of resources. But the annual budget for the United National Environmental Programme last year was \$190 million. And the budget for the latest James Bond movie was \$205 million.'

He chuckles at that, checks his watch and calls for the bill. It is time to walk the dogs and then work the second half of his standard 17-hour day. Outside, he points to San Francisco bay, looking pristine and lovely in the late afternoon sunshine. 'Maybe that's the trouble,' he says. 'You'd never guess what's under the surface if you didn't know, would you?'

[theplastiki.com](http://www.adventureecology.com/theplastiki/) (<http://www.adventureecology.com/theplastiki/>) ; algalita.org (<http://algalita.org/>)

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