Digging Deeper: Gyre

Image caption

Gyre, 2009 8x11 feet, in three vertical panels
Depicts 2.4 million pieces of plastic, equal to the estimated number of pounds of plastic pollution that enter the world's oceans every hour. All of the plastic in this image was collected from the Pacific Ocean.

At a glance

24 million pounds of plastic are manufactured every hour, and around 10% of that eventually ends up in the sea. This plastic never goes away, instead collecting in the open ocean, carried by winds and currents. It can leach poisons into the water and fill the stomachs of animals that mistake it for real food. This problem can be solved by using different materials, wasting less and managing waste better.

Source

Captain Charles Moore, one of the first people to chart the plastic accumulation in the North Pacific, estimates that 10% of the plastic produced in the world ends up in the oceans.

How this happens

Plastic lasts for such a long time in the ocean that scientists believe every piece that people have left there is still around. It does break into smaller & smaller pieces, but even tiny fragments of plastic can be a problem.

About 20% of the plastic in the ocean is estimated to have come from boats, while the other 80% has come from on land, where it's washed down by rivers or blown out by the wind. Most of this plastic is garbage that was dropped carelessly, but some even comes from poorly managed dumps and landfills, where it can be blown out by the wind or picked up by animals scavenging for food.

Most plastic floats, at least for a while, and the winds & currents of the major oceans bring most of it to 5 "gyres", which are generally calm areas, mostly far from land, where this debris collects in the North & South Pacific, North & South Atlantic and Indian oceans. Some also washes up on beaches in even the remotest islands of the world, and some sinks and ends up on the sea floor.

Why this is important

As well as simply being ugly, plastic pollution causes serious problems for many kinds of wildlife.

The largest pieces of plastic—especially fishing lines and nets—are dangerous to boats because propellers can get tangled in them, and to wildlife because they can get stuck in them. "Ghost" or discarded fishing nets can keep catching fish for years, and discarded six-pack holders get stuck around animals' necks, deforming or strangling them as they grow.

Smaller pieces of plastic are often eaten by animals which mistake them for food. Because they can't digest plastic, they can collect so much of it in their stomachs that they no longer have space for as much real food as they need to eat, becoming malnourished or even starving to death.

Microscopic fragments of plastic are eaten by zooplankton, the tiniest animals in the sea. These are in turn eaten by slightly larger animals, and so on up the food chain, ultimately ending up in the bodies of top predators like whales, seals, sharks and us. Some of the chemicals in common plastics are known to cause cancer, birth defects, infertility and neurological damage, and unfortunately for us they become more concentrated as they are passed up the food chain.

How this is changing over time

Researchers disagree about whether or not this problem is getting worse. The Algalita Marine Research Foundation, Captain Moore's organization, says that the amount of plastic debris his group has been finding in surveys of the same area of the Pacific doubled between 1999 and 2009. On the other hand, researchers from the Woods Hole Oceanographic Institution found that the concentration of plastic debris in the North Atlantic had not increased between 1986 and 2008.

How you can help

We can't get all the plastic back out of the sea because it's spread across too vast an area, but there's a lot that each of us can do to stop it from getting in there in the first place. Here are some suggestions:

Use fewer disposable items

The single most important thing you can do is to use less plastic in the first place, so less is made and less is thrown away. Think about all of the throwaway items that you encounter in a day. Do you really need a new plastic water bottle every time or could you just get one long-lasting one and keep using? Could you take a reusable mug to the coffee shop, or reusable plates to that picnic? Why not bring a reusable bag the next time you go shopping? If you're not

used to doing these things they may seem like a lot of hassle at first, but it won't take long for them to become second nature.

Re-use things, even if they were meant to be disposable

Remember that you can re-use even a lot of things that were meant to be used once. Try refilling a plastic bottle, or washing up a plastic plate and using it again. Or if you want to be more ambitious, try upcycling: making something better from stuff you would otherwise have thrown away.

Use alternatives to plastic products

Many things are made out of plastic when they don't have to be. This can be bad for you, because of the toxic chemicals contained in several kinds of plastic, and adds to the garbage problem because the plastic itself lasts so much longer than the useful life of most things made out of it. If you use wood or paper instead of plastic—such as in more old-fashioned or hand-made children's toys—then the material will break down relatively quickly if it ends up in the sea, instead of lasting forever. If you use metal or glass—for reusable containers, for example—it still lasts a long time, but because it isn't blown around or washed away as easily it's much less likely to end up in the ocean. More natural materials also do less harm wherever they end up, because they are more like what plants and animals are adapted to.

Make sure that the plastic you do use gets recycled

Recycling is not a perfect solution. It uses a lot of energy, not all plastics can be recycled, and not all plastic products can be made with recycled material. At the same time, every piece of plastic that does get recycled has been successfully kept out of the ocean, and lets one less new piece of plastic be made. So whenever you do find yourself throwing away a piece of plastic, see if it can be recycled. If it can't be, then at least make sure it does get collected properly, rather than just throwing it outside. Note that exactly what can be recycled and how it should be collected is different from place to place - you'll have to find the right information for where you are.

Ask companies to waste less

A lot of the plastic we use is packaging, and a lot of it is completely unnecessary. You can't single-handedly stop it from being used, but companies do listen to their customers, so if something you use comes with a lot of wasteful packaging try writing to the supplier. Once you've done that yourself, see how many other people you can convince to do the same. It usually takes more than one person's comments to make a difference, but you might be surprised by how easy it is once you get a group of people interested.

Help scientists measure the problem

Anyone with a smartphone can download the Marine Debris Tracker app, which lets you report garbage you see in the water so that scientists can better understand exactly how much is out there, where it comes from and where it ends up.

Join a cleanup

Join the International Coastal Cleanup, or if there's no event near you you can start your own. You can probably also find local groups organizing regular cleanups of shorelines or rivers where you are, and if no-one's doing it then you can start one.

Policies that would help

None of us can solve a problem this big with our individual choices alone! Here are some policies that you can advocate for with governments or companies, each of which would do more to reduce the amount of plastic waste that gets to the ocean.

- Many places have banned plastic bags, which removes one of the bigger sources of plastic pollution.
- If you don't think an outright plastic bag ban would work where you are, you could push for a fee on throwaway plastic bags. Even very small fees make people more likely to bring reusable bags with them.
- If plastics aren't recycled where you are, you can help change that. Here are some suggestions for how to go about it.
- Tell companies you buy things from to make them modular and repairable, so that you don't have to throw something away as soon as one part stops working.
- Promote Cradle-To-Cradle design and manufacturing. This means that manufacturers take responsibility for what their products will become even at the end of their lives. Very few things really need to become waste, if they are designed right in the first place.

If you want to see a really comprehensive set of policies that would work together to almost completely solve this problem, take a look at this action plan from California.

Groups working on this issue

You don't have to do this alone! Always remember that there are millions of organizations working every day to make the world a better place. Here are a few working to reduce plastics pollution:

- Plastic Pollution Coalition - a global alliance of individuals, organizations and businesses working together to stop plastic pollution and its toxic impacts on humans, animals and the environment.
- The United Nations Environment Programme is developing a "global initiative on marine litter"
- Algalita Marine Research Foundation researches the extent of the problem, educates the public and promotes watershed restoration.
- The Monterey Bay Aquarium spreads awareness of the health of our oceans and all kinds of threats to it.
- The Ocean Conservancy has a comprehensive Trash Free Seas program

Further reading

Media coverage

- National Geographic: Plastic Breaks Down in Ocean, After All -- And Fast (see also http://www.nature.com/news/2011/110328/full/news.2011.191.html)
- http://5gyres.org/what_is_the_problem
- Discover Magazine: The Dirty Truth About Plastic - good coverage of human health impacts, lacking links to primary sources
- Environment Washington: Keeping Plastic Out Of Puget Sound - the executive summary includes a useful list of talking points, though it's heavily local-biased
- Mother Nature News: Wasting away: Our garbage by the numbers
- Monterey Bay Aquarium: Laysan Albatross & Plastics
- PBS: Plastic Pollution in the Ocean
- Greenpeace: Plastic Debris in the World's Oceans - great summary of the extent of the problem and some things being done to improve things, with an extensive list of references
- The pollution of the marine environment by plastic debris: a review
- Plastics, the environment and human health
- Conservation Magazine: Garbage In, Garbage Out
- Woods Hole Oceanographic Institution press release: Plastic Particles Permeate the Atlantic

Primary research

- Ocean, Coast, and Great Lakes Planning Data (US-specific, but a great resource with rich data and visualizations)
- **North Pacific Gyre extent and quantitites**
    - Day, Shaw & Ignell, 1989 The Quantitative Distribution And Characteristics Of Neuston Plastic in the North Pacific Ocean (also www.vliz.be/imisdocs/publications/135814.pdf)
    - Moore et al, 2001 A Comparison of Plastic and Plankton in the North Pacific Central Gyre (also http://5gyres.org/media/Moore_2001_plastic_in_North_Pacific_Gyre.pdf)
    - Dameron et al, 2007 Marine debris accumulation in the Northwestern Hawaiian Islands: An examination of rates and processes
- **Extent and quantities outside the North Pacific Gyre**
    - Martinez, Maamaatuaiahutapu & Taillandier, 2009 Floating marine debris surface drift: Convergence and accumulation toward the South Pacific subtropical gyre
    - Colton, Knapp & Burns, 1974 Plastic Particles in Surface Waters of the Northwestern Atlantic (official citation is

http://www.sciencemag.org/content/185/4150/491.extract but behind a paywall)
    - Carpenter & Smith, 1972 Plastics on the Sargasso Sea Surface (official citation is http://www.sciencemag.org/content/175/4027/1240 but behind a paywall)
    - Morris, 1980 Plastic Debris in the Surface Waters of the South Atlantic
    - Barnes, 2003 Natural and Plastic Flotsam Stranding in the Indian Ocean
- **Fate & transport**
    - Moore, Lattin & Zellers, 2011 Quantity and type of plastic debris flowing from two urban rivers to coastal waters and beaches of Southern California
    - Barnes et al, 2009 Accumulation and fragmentation of plastic debris in global environments
- **Effect on wildlife**
    - McCauley & Bjorndal, 1999 Conservation Implications of Dietary Dilution from Debris Ingestion: Sublethal Effects in Post-Hatchling Loggerhead Sea Turtle
- **Effect on human health**
    - Thompson et al, 1999 Plastics, the environment and human health: current consensus and future trends
    - Talsness et al, 1999 Components of plastic: experimental studies in animals and relevance for human health