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Plastics in the Oceans

Throttling Marine Life

Infographic by unknown:
Plastic iceberg.

People across the world need to stand together and say no to plastics if we have any hope of reducing the amount of plastic polluting the marine environment.

PLASTIC in marine ecosystems is an environmental issue that has affected every country in the world, even the remotest shores uninhabited by humans, making it one of the biggest environmental challenges we face today.

Plastic not only looks unsightly, it maims and kills marine life, and poses a serious threat to entire population of many marine species. It also poses a health risk to humans. Scientists have warned that there will be more plastic than fish in the ocean by 2050 unless a concerted effort is made to reduce our dependence on single-use plastic items such as plastic bottles and plastic bags. It is now time for us to take immediate action and to create public awareness of just how dire the situation is.

Where do they come from?

Marine plastic debris originates from two sources: Land-based sources and Ocean-based sources.

Land-based sources, including litter left behind by beach-goers and plastic that is washed into the ocean via rivers or blown in from the land, accounts for 80% of the total volume of marine debris found in our oceans.

Ocean-based sources, including garbage dumped at sea by ocean-going vessels and fishing debris — for



A crab uses as shelter a piece of plastic debris on the beach on Henderson Island.
Photo by: Jennifer Lavers.



Left: The unaltered stomach contents of a dead albatross chick photographed on Midway Atoll National Wildlife Refuge in the Pacific in September 2009 include plastic marine debris fed the chick by its parents. Photo by: Chris Jordan. ([https://commons.wikimedia.org/wiki/File%3AAlbatross_at_Midway_Atoll_Refuge_\(8080507529\).jpg](https://commons.wikimedia.org/wiki/File%3AAlbatross_at_Midway_Atoll_Refuge_(8080507529).jpg))



Turtle in 6-pac ring.
Photo by: Unknown.



A seal entangled in discarded netting and fishing gear.
Photo by: The Clipperton Project.

According to figures released by the Worldwatch Institute, every year the average European or American uses around 100 kilograms of plastics, primarily packaging materials, while the average Asian uses around 20 kilograms. However, while Asian consumption is notably less, this is expected to increase in line with economic expansion in Asian countries.

Around 90% of all marine debris is composed of plastics and styrofoam (polystyrene foam), with food and beverage packaging being one of the most widespread items commonly found during coastal surveys of beaches around the world. Because of its lightweight characteristics, it is readily blown into rivers or directly into the ocean.

While only making up a relatively small percentage of the total amount of plastic in the ocean, discarded fishing gear is highly destructive. Abandoned fishing nets drift about endlessly in the ocean, effectively ‘ghost fishing’ — indiscriminately trapping marine organisms that haplessly swim into them. Discarded fishing line can entangle birds, turtles and other marine life while larger marine animals such as seals are vulnerable to being ‘noosed’ by bait box strapping that has been slipped off bait boxes rather than cut off.

Microplastic is another growing concern. Microplastics are tiny bits of plastic measuring less than 5mm in diameter. These include: Microbeads (commonly used in cosmetics and toiletries such as facial/body scrubs, toothpaste and shower gels, etc.) and Microfibres (tiny strands of fabric that break away from clothing made from synthetic fibres when they are washed).

These tiny microplastics are washed down the drain, making their way to wastewater treatment plants. But because wastewater treatment facilities do not have filters fine enough to remove these micro-particles, they are discharged into rivers with the treated effluent, eventually making their way to the ocean.

Other sources of microplastics include tyre dust; paints, including road paint, building paint and marine paint;

example, fishing line, fishing nets, bait box strapping and other discarded fishing gear — accounts for 20% of marine debris polluting our oceans.

Since the mid-1900s, the use of plastics to manufacture goods has dramatically risen largely because it is cheap, durable, and therefore long-lasting — a trait which unfortunately leads to it persisting in the environment. For a very long time! According to the marine plastic awareness group, “Plastic Ocean”, every year the world produces 300 million tonnes of plastic, half of which is used to manufacture disposable single-use items. Consequently, every year over 8 million tonnes of plastic is added to the ever-growing scourge of plastic accumulating in the ocean from years before. Once this plastic ends up in the ocean it doesn’t simply go away.

Land based litter enters the ocean primarily through rivers. A 2017 study published in *Nature Communications* estimates that every year between 1.15-2.41 million tonnes of plastic flows into the ocean via rivers, with the Yangtze River in China being the biggest contributor of ocean plastics, followed by the Ganges River flowing between India and Bangladesh.

and accidental spills of microplastic pellets that are used to manufacture plastic products.

Buying ‘mineral’ water? Microplastics have also been found in more than 90% of bottled water samples tested. A study of bottled water conducted by Sherri Mason and her colleagues from the State University of New York at Fredonia, who tested 259 bottles of water from nine countries, including India, found an average of 325 microplastic particles per litre of bottled water. This is twice the amount found in their previous study conducted on tap water. The researchers conclude that the contamination is originating from the plastic bottles the water is packaged in or the bottling process itself.

Why is it important?

According to a 2015 Worldwatch Institute report, between 10-20 million tonnes of plastics end up in the world’s oceans every single year. As a result, there are around 5.25 trillion bits of plastic currently drifting around our oceans. This causes massive financial losses, estimated to be in the region of \$13 billion annually, resulting from the negative impact that plastic debris has on marine ecosystems, the economic losses suffered by the tourism and fishing sectors, and the financial cost associated with coastal cleanups.

According to Greenpeace’s 2006 report: *“At least 267 different species are known to have suffered from entanglement or ingestion of marine debris including seabirds, turtles, seals, sea lions, whales and fish. The scale of contamination of the marine environment by plastic debris is vast. It is found floating in all the world’s oceans, everywhere from Polar regions to the Equator.”*

Because plastics are long-lasting by design, they tend to persist in our oceans. Plastic is photodegradable — it becomes brittle and breaks down into smaller particles when it is exposed to ultraviolet radiation from the sun. However, because ocean temperatures are much lower than temperatures on

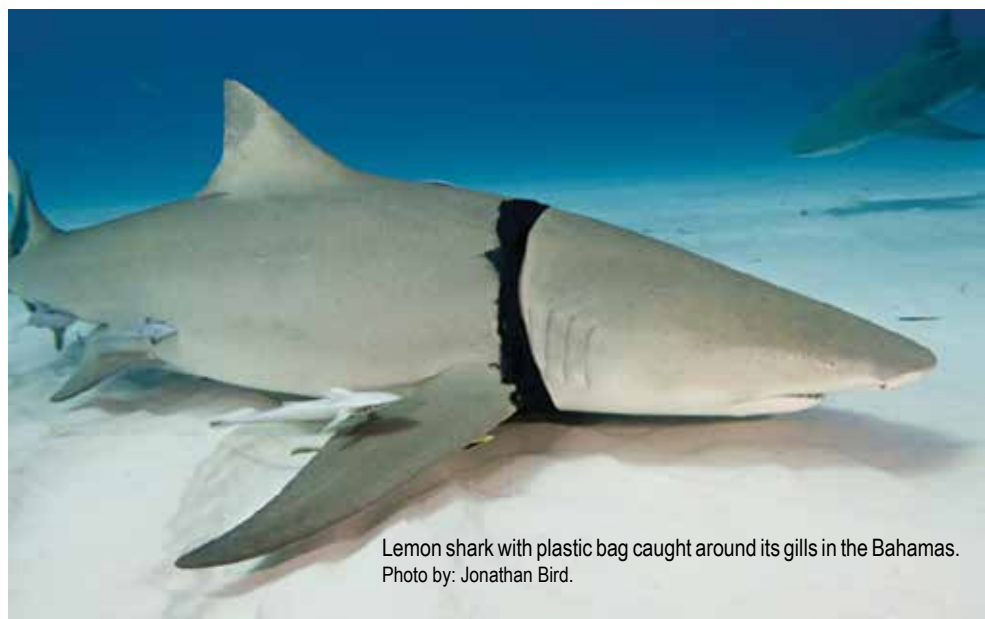


Plastic straw removed from turtle’s nose.

Photo by: Unknown (Video snapshot).(<https://www.sciencedirect.com/science/article/pii/S0025326X16301205#0005>)



The female Eleonora’s falcon providing nestlings with plastic waste (snack wrapper).
Photo by: Steen et al.



Lemon shark with plastic bag caught around its gills in the Bahamas.
Photo by: Jonathan Bird.



Above: Oystercatcher dead because of bottle cap. Photo by: Peregrine Craig Nash.



Fish in plastic ring. Photo by: Marcus Eriksen. (<https://sustainablefred.wordpress.com/tag/plastic-gyres/>).

Below: Plastics on a beach. Photo by: Unknown.



land, plastics tend to breakdown much more slowly in seawater than they do on land. And all the while, more plastic is being added from both ocean- and land-based sources.

Once plastics reach the ocean, they don't simply sink to the bottom to litter the ocean floor. The lightweight nature of plastics makes them float around near the surface. Organisms can become entangled, causing their movement to become impaired, which can result in them starving to death or drowning.

Plastic bags resemble jellyfish when submerged underwater. As a result, turtles often ingest them, mistaking them for food. Other forms of plastics break down into tiny pieces which tend to float on the surface or be suspended in the water column, where they may be mistaken for edible morsels of food by marine creatures or surface feeders such as fish or seabirds. Discarded plastic items and bits of plastic of various sizes are ingested by seabirds, who feed them to their still developing chicks, which ultimately causes the chicks to die of malnourishment as they are not receiving any true sustenance, but rather just bits of plastic. This can affect the survival rates of chicks in seabird colonies, and can ultimately cause entire populations to decline.

According to the Ocean Conservancy's *International Coastal*

Cleanup 2017 Report, during the 2016 International Coastal Cleanup 1,066,644 pieces of polystyrene foam and 1,212,602 pieces of plastic less than 2.5 cm in size were collected from beaches across the world. In total, more than 2 million bits of foam and plastic were collected during this one beach cleanup event — imagine how much more went undetected on beaches that were not covered in this cleanup.

Because plastic pellets and styrofoam beads are not readily digested, they accumulate within the digestive tracts of marine organisms that ingest them, causing the animal to feel satiated. As a result, the animal stops foraging for food and becomes more and more emaciated before eventually dying of starvation. The accumulation of plastic in the gut can also block the digestive system, resulting in the animal's death even if it is getting enough food to eat. When predators higher up the food chain feed on an organism that has a digestive tract filled with bits of plastic and styrofoam, these undigested plastics are ingested by the predator, who also struggles to digest it.

Styrofoam and plastics contain chemical toxins, such as petroleum, which can be released into the digestive tract as the digestive system attempts to digest them. These toxins are then absorbed by the body and stored in fatty tissue. Toxins can also leach from bits of plastic as they break down and contaminate filter feeders who ingest seawater whilst feeding.

Persistent organic pollutants such as DDT and PCBs — both harmful endocrine disruptors — can accumulate on the surface of plastics at concentrations that are hundreds of thousands or even a million times higher than concentrations naturally occurring in seawater. These pollutants are stored in the fatty tissue and organs of the body and get passed on up the food chain, becoming more and more concentrated in animals at the top of the marine food webs. Consequently, the ocean's apex predators become more and more contaminated over the course of their lifetime as they continue to prey on contaminated organisms.

Plastic Pollution in Oceans and Coral Decline

GLOBAL use of plastics has also affected the oceans. It is estimated that approximately 165 million tonnes of plastic pollution is present in the oceans. Plastic in oceans typically degrades within a year; nevertheless, the process generates toxic chemicals that are released into the water.

Marine animals are lethally impacted by plastic either through entanglement or ingestion of toxic waste/exposure to chemicals. A recent discovery reported in the journal *Science* by Dr. Lamb from Cornell University in USA has highlighted the impact of plastic pollution on marine ecosystem particularly on the establishment of the delicate coral and coral reefs.

Corals are colourful invertebrate animals prevalent in the tropical oceans. Over the years they secrete calcium carbonate to form a hard skeleton giving rise to a coral reef. With climate change induced rise in ocean temperature and disease outbreaks, the severity of damage to coral reefs is expected to rise. Since these reefs provide coastal defense, act as breeding ground for fisheries and attract marine tourism their protection from the ravages of non-degradable plastic draws urgent attention.

According to the finding, maximum plastic waste is present in the benthic floors of Indonesia while Australia accounts for minimum plastic waste. The presence of these non-degradable plastic wastes in the benthic floor enhances diseases among keystone reef-building corals in the Asia-Pacific region. With each passing year, more and more plastic waste enters the ocean to form these debris, which in turn gets laden with opportunistic pathogenic bacteria and cause a disease among corals known as “White syndrome”.

The constant contacts of plastics with tissues of corals have exposed the corals to two more fatal diseases – skeletal eroding band disease and black band disease.

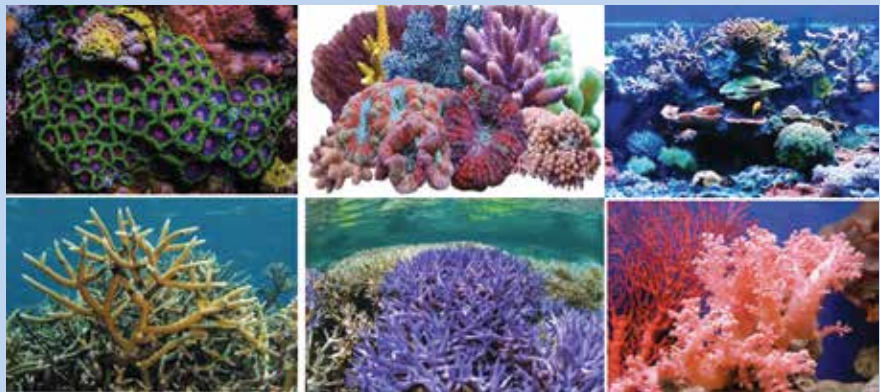
Besides diseases, plastic harms the corals in many other ways, such as (i) physical injury and abrasion to coral tissues facilitating invasion of pathogens; (ii) introduction of foreign pathogens or alteration in beneficial microbial symbionts, and (iii) ushering in shading/low-light micro-environments leading to anoxic conditions favoring diseases.

These key diseases have markedly increased coral mortality in benthic floors. Since terrestrial plastic waste has already created havoc because of the incidence of surface endemic diseases, eliminating plastic waste in the ocean is of significant importance for the sustenance of the natural wonders – the “Coral reefs”.

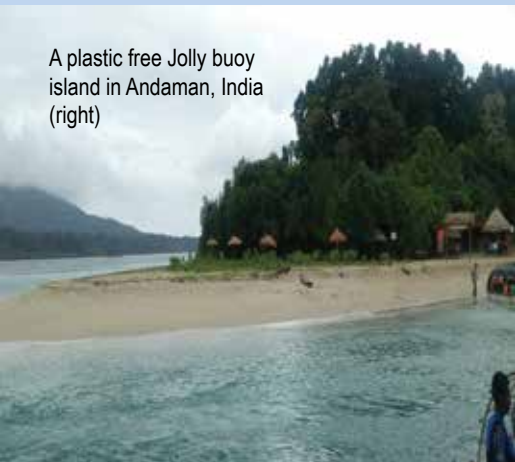
Dr(s) Prasanta K. Dash (prasanta01@yahoo.com), Rohini Sreevathsa, and Rhitu Rai are scientists in NRC on Plant Biotechnology, Pusa Campus, New Delhi-110012.



Plastic pollution among corals
picture source
Science magazine



Natural corals and their diversity (picture source : Google) in benthic floors of Asia-Pacific regions



A plastic free Jolly buoy island in Andaman, India (right)

Scientists have found that apex predators in the marine environment, such as polar bears and killer whales, are some of the most contaminated organisms on the planet. They suffer negative impacts to their productivity and health, including reduced fertility and lower breeding success, with compromised immune functioning that

makes them less resilient to infections and diseases.

This has implications for human health too. Plastics and microplastics are so prolific throughout the world’s oceans that scientists are not only concerned about their impact on marine life, but also the threat they pose to public health, particularly communities who depend

on seafood as a staple source of protein in their diets.

Seafood, including shellfish, fish and other marine organisms, is an important protein source for humans across the world and is essential to the food security of many nations. Yet, as a top predator in the marine food web, humans face similar health risks to those



View of marine debris from below, as fish or sea turtles might see it.
Photo by: NOAA.



In June 2004, a Humpback Whale was stranded on the coast of Vlieland an island in the north of the Netherlands. The whale was entangled in a nylon rope that was wrapped around the head. The rope had cut deeply into its body and was probably the cause of the animal's death.
Photo by: Dirk Bruin.

faced by top predators in the marine environment. That fish on your plate may have been gutted with all traces of plastic removed before being served to you at dinner, but the reality is that the toxins from those plastics are still stored in the tender flesh you are about to tuck into, and will make their way into your body tissue once ingested.

What can we do about it?

A good starting point is to switch from styrofoam and plastic packaging to eco-friendly, biodegradable alternatives that contain no toxic chemicals and which break down quickly in the environment without any negative impacts. We can also say no to single-use items, such as plastic shopping bags, plastic straws,

plastic cutlery, styrofoam cups and other fast-food packaging, and opt for beverages in glass bottles rather than plastic bottles.

Many cities, and even countries, have taken the initiative to ban plastic shopping bags, while others have implemented control measures to curb their use. Perhaps its time to control the use of plastic straws, plastic beverage bottles and other disposable plastic items as well.

Consumers can play a part here. Your shopping choices either fuel or curb demand. For example, by refusing to accept a plastic straw when you purchase a beverage you are decreasing the demand for this unessential disposable plastic item. When there is no demand for these products, suppliers will have no option but to phase them out.

Consumers can also choose food items packaged in reusable containers as opposed to food packaged in disposable containers when they shop. Some stores

Scientists have warned that there will be more plastic than fish in the ocean by 2050 unless a concerted effort is made. It is now time for us to take immediate action and to create public awareness of just how dire the situation is.

Practical solutions to address the problem of marine plastics is required, and we need to tackle the issue from multiple angles. **We can all do our bit. It starts with each and every one of us; it starts right now.**



even allow you to bring your own reusable containers. This helps suppliers reduce the cost of packaging, which in turn translates into savings for you – the customer. Take every opportunity to reduce your use of plastics.

However, to address the damage done, the vast amount of plastic already lying scattered on the shores of the world, together with the endless supply of plastics drifting around our oceans, still needs to be either physically or mechanically removed from the environment.

The Ocean Conservancy organises an International Coastal Cleanup annually, supported by other environmental groups, schools and community programmes across the world that encourage volunteers to pitch in and help clean up their local beach in an effort to reduce the amount of plastic littering the world's beaches. But this could be ramped up a notch if local community groups organised beach cleanups more frequently — for example monthly. Frequent beach users could also take a stand and commit to picking up at least three items of plastic every time they leave the beach. If everyone that visited the beach made an effort to leave with three pieces of plastic every time they walked off a beach it would certainly make a difference.

Because plastic is so durable it makes perfect sense to recycle it for reuse. Besides separating plastic waste for recycling, plastic can be recovered

from beaches and recycled for use. The sustainable fashion industry is a good example of how recovered plastics can be reused to manufacture sustainable clothing. This not only makes use of waste material but reduces the demand on other natural resources.

Other innovative suggestions for tackling the problem of marine plastics include placing floating booms in the ocean to trap any plastic that floats by, and deploying floating garbage bins in harbours or estuaries to suck up discarded plastic floating on the surface.

Selecting products that are free of microplastics will ultimately help to reduce the volume of microplastics that end up in the ocean. If you simply must exfoliate, choose facial and body scrubs that contain natural alternatives such as ground peach pips instead of plastic microbeads. *Beatthemicrobead.org* has even developed the 'Beat the Microbead' App to help consumers make the right choice.

Similarly, choose clothes made from natural fibres such as cotton, linen and wool rather than synthetic-based fibres. Wash synthetic fabrics less frequently, and only when you have a full load, and use a guppy friend wash bag or lint filter in your washing machine to catch any fibres that break free from the fabric during the washing process.

India, which currently uses 15 million tonnes of plastic a year and is expected to use 20 million tons by

2020, introduced new plastic waste management regulations in March 2016 (http://www.moef.gov.in/sites/default/files/PWM%20Rules,%202016_0.pdf) in an effort to reduce the amount of plastic waste its citizens generate. These include: stricter regulations controlling plastic bags; phasing out the manufacturing of non-recyclable, multi-layered plastics; business and industries to take responsibility for sorting and separating the plastic waste they generate at source for recycling; anyone organising a function in a public place is responsible for ensuring all plastic generated at that function is disposed of appropriately; efforts to improve plastic waste management in rural areas; and encouraging utilizing plastic waste in waste-to-energy and road construction projects.

Marine plastic is a worldwide problem that needs a global commitment if we have any hope of stemming the tide of plastic entering the marine environment. We need to come up with practical solutions to address the problem of marine plastics, and we need to tackle the issue from multiple angles. We can all do our bit. It starts with each and every one of us; it starts right now.

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