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MARINE POLLUTION

The world's marine pollution comes in many forms – from toxic chemicals, sewage and fertilisers to plastics, discarded fishing nets and even the noise from shipping and drilling. Over 80% of it originates from land-based activities (WWF, n.d.), whether due to accidental spills, deliberate dumping, untreated effluent, atmospheric fall-out, or the run-off from drains and rivers.

Marine pollution is highlighted as a major challenge by the ground-breaking 2019 UN IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) assessment, which states that more than 80% of global wastewater is being discharged back into the environment without adequate treatment, while 300–400 million tonnes of heavy metals, solvents, toxic sludge and other industrial waste are dumped into the world's waters every year (UN, 2016).

In the UN's Sustainable Development Goal target 14.1, states pledge to: ''By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution."(UN SDG, 2019)

WHAT IS MARINE POLLUTION?

Marine pollution is defined by the 1982 UN Convention on the Law of the Sea as: "the introduction by man, directly or indirectly, of substances or energy into the marine environment … which results or is likely to result in such deleterious effects as harm to living resources and marine life." (UNCLOS, 1982)

It can change the physical, chemical, and biological state of the ocean and coastal areas, posing a threat to marine wildlife and ecosystems, and the industries and livelihoods dependent on them, such as fisheries and tourism. Toxic chemicals also become concentrated in the food chain and can impact human health.

There are three significant forms of oceanic and coastal pollution:

- nitrogen-phosphorous pollution from agriculture, sewage, and urban and industrial run-off;
- chemical pollution that comprises, but is not limited to, pesticides, petroleum, pharmaceuticals and personal care products, heavy metals and industrial discharge;
- plastic-debris pollution.

NITROGEN AND PHOSPHOROUS POLLUTION

Nitrogen and phosphorus pollution, also called nutrient or eutrophic pollution, has a global impact on ocean bodies and is particularly concentrated in coastal areas near the estuaries of major rivers.

Agriculture is a primary source of nitrogen and phosphorous, through the run-off of excess nutrients from animal manure and chemical fertilisers. On average, around 20% of nitrogen fertiliser is lost through surface run-off or leaching into groundwater and up to 60% can vaporise into the atmosphere, a portion of which will subsequently fall on the ocean (World Resources Institute, n.d.).

There has been a tenfold increase in global fertilizer use since the mid-20th century and nitrogen discharges from rivers into the sea rose by 43% between 1970 and 2000, with more than three times as much coming from agriculture as from sewage (Breitburg et al., 2018). However, there are regional variations. While agriculture is the leading source of nutrient pollution in the United States and the European Union, urban wastewater is often the primary source in South America, Asia and Africa (World Resources Institute, n.d.).

Non-agricultural sources of excess nitrogen and phosphorus include stormwater, wastewater, fossil fuel burning, aquaculture and domestic waste (EPA, n.d.). In the Baltic Sea, atmospheric depositions from burning fossil fuels accounts for 25% of nitrogen input. Similarly, in the Chesapeake Bay in the United States, atmospheric deposition accounts for 30% of all nitrogen input, while the smog from industry and vehicles in China blown over Yellow Sea is a significant source of nitrogen causing severe eutrophication (World Resources Institute, n.d.).

A serious impact of eutrophication is the algal blooms that can be toxic to marine ecosystems. When the dense algal blooms die off, their decomposition severely depletes the dissolved oxygen in the water, potentially causing "dead zones" where the oxygen levels are so low that fish and other organisms struggle to survive. This impacts fisheries and tourism. One of the world's largest dead zones occurs every summer in the Gulf of Mexico as a result of nutrient pollution from human activities throughout the vast Mississippi River watershed. In 2017, it reached a record size of 8,776 square miles (NOAA, 2019).

CHEMICAL POLLUTION

A host of chemical pollutants are having a harmful effect on ocean health. These chemicals come from a range of sources including crude oil and other petroleum products, antifoulants, pesticides, pharmaceuticals and personal care products. It is estimated that the total amount of chemicals entering the ocean rose by 12% between 2003 and 2012. Although the level coming from North America and Europe dropped by 60% during that period, in the Pacific it rose by 50% (UN, 2016).

Marine water quality and wildlife are seriously affected by oil from spills, discharge and shipping. Major oil spills capture headlines and are difficult to clean up but are in fact declining due to improved technologies and policies. In 1990, 1.1 million tonnes of oil were lost in spills. By 2015 this was down to around 25,000 tonnes, but this still represents over 10% of the oil entering the ocean (Anderson, 2013). The remainder enters the ocean via rivers, drains, coastal activities and shipping.

The most dangerous pollutants are the persistent, bioaccumulative, and toxic substances. Even chemicals banned decades ago, like polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), are still found in high concentrations in deep sea creatures despite being banned by the 2001 Stockholm Convention (Jamieson et al., 2017). Since they do not break down easily, these chemicals accumulate in marine organisms, becoming more concentrated further up the food chain. Animals like seals, polar bears and large fish can have contamination levels in their bodies millions of times higher than the surrounding water.

Pollutants recognised as endocrine disruptors and teratogens, which impact the ability of marine species to reproduce or reduce offspring survival rates, present a growing concern (IPSO, 2019). Personal care products in particular contain cryptic chemicals that have a significant impact on human and ocean health (Dinardo and Downs, 2018). For example, oxybenzone, a common ingredient in sunscreens, has been found to negatively impact coral health and reproduction (Downs et al., 2016).

PLASTIC POLLUTION

Plastic pollution in the ocean has captured the attention of the global public in recent years, following the publication of alarming statistics and the circulation of distressing images showing the harm plastic is causing to ocean wildlife. Marine plastic pollution is flagged as a major threat by the 2019 IPBES Assessment, which warns that it has increased tenfold since 1980, affecting at least 267 species, including 86% of marine turtles, 44% of seabirds and 43% of marine mammals (IPBES, 2019).

An important 2015 study calculated that 275 million tonnes of plastic waste was generated in 192 coastal countries in 2010, with 4.8 to 12.7 million tonnes entering the ocean (Jambeck et al., 2015). Taking an average of 8 million tonnes of plastic flowing into the ocean every year, that is equivalent to dumping the contents of one garbage truck every minute. If no action is taken, this is expected to increase to two per minute by 2030 and four per minute by 2050. Considering that the best research currently available estimates that there are over 150 million tonnes of plastics in the ocean today, a business-as-usual scenario would result in 1 tonne of plastic for every 3 tonnes of fish by 2025, and more plastics than fish (by weight) by 2050 (Ellen MacArthur Foundation, 2017).

It is estimated that between 1.15 and 2.41 million tonnes of plastic waste enters the ocean every year from rivers, with over 74% of this occurring between May and October. The top 20 polluting rivers, 15 located in Asia, account for 67% of this global total, while the top 122 polluting rivers contribute over 90% (Lebreton et al., 2017).

Other sources are coastal mismanagement, abandoned fishing gear and microplastic particles from household cleaners, personal care products and viscous clothing. Ocean currents are gathering much of the plastic within the five sub-tropical ocean gyres – including the infamous 1.6 million km^2 Great Pacific Garbage Patch (Lebreton et al., 2018). This is causing some, even very remote places to be inundated with plastic. Henderson Island in the Pacific has been named the most polluted island on the planet when it comes to plastics, while plastics have been found at the depths of the Mariana Trench and embedded in ice in the Arctic.

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Briefing prepared on behalf of the OneOcean initiative www.oceanprotect.org contact info@oceanprotect.org