LOST AT SEA:

The urgent need to tackle marine litter



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INTRODUCTION

Hailed as 'the material for the 21st century', global plastics production has grown continuously from five million tonnes per year in the 1960s to 299 million tonnes in 2013.[1]

Found in our clothes, computers and cars, plastics are now ubiquitous in modern life. In Europe, the world's second largest plastics producer after China, the majority of plastics are destined for packaging. Building and construction, motor industries and electrical applications also use significant amounts.

Plastics are so named for their plasticity, or malleability, allowing them to be manufactured in a variety of shapes and forms and it is this property – along with their durability, low cost and low weight – which has led to their adaptation to a multitude of purposes and their proliferation in single-use products.

It is these same properties which have made plastics so successful, in particular their low weight and durability, and have contributed to the accumulation of plastic in the marine environment. Originating from land due to littering and poor waste management, transported via wind, rivers and untreated sewage to the sea, an estimated 4.8-12.7 million tonnes of plastics are estimated to enter the ocean each year from land.[2] By 2025, it is predicted that without improvements in waste management, this will increase to 10.5-28 million tonnes annually.

Plastic waste has polluted the oceans to such an extent that no area remains uncontaminated. Plastics are ingested by seabirds off remote islands,[3] concentrated in Arctic Sea ice[4] and are accumulating in deep sea sediments where microplastics are now more numerous than in surface waters.[5] Plastics may fragment but do not biodegrade, leading to a progressive rise in quantities found in the marine environment. In 2014, it was estimated that more than five trillion plastic particles are floating in the world's oceans.[6]

Defined as "any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment", marine litter has now been recognised as a major threat to biodiversity.[7] While marine litter can encompass a wide range of materials, plastic items are thought to comprise 60-80 per cent of all marine litter items[8] and account for 92 per cent of reported impacts on marine organisms.[9]

An estimated 80 per cent of marine litter originates from terrestrial waste sources, although this can vary considerably according to geographical area.[10] Shipping and fisheries also contribute significantly, through loss or illegal dumping of waste and fishing gear.

The main plastic items observed in beach clean-ups worldwide[11] can be broadly grouped into:

- packaging-related litter, including bags, drink bottles, cups, caps, lids, straws, stirrers, disposable cutlery, food wrappers, containers and polystyrene;
- fishing and shipping-related litter, including bait containers and strapping bands, buoys, fishing line, nets, traps, ropes and plastic sheeting;
- sewage-related litter, including sanitary towels and tampons, wet wipes and cotton buds;
- micro- and nanoplastics, including industrial pellets or 'nurdles', fragmented plastics, synthetic clothing fibres and microplastics from personal care products.

This report outlines some of the impacts on marine creatures, with recommended actions to reduce the rising tide of plastic waste entering the oceans.

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MARINE LITTER IMPACTS

"At least 693 species have ingested or been entangled in marine litter"

Studies have documented at least 693 species that have ingested or been entangled in marine litter; 17 per cent of these are listed as threatened or near threatened according to the International Union for Conservation of Nature (IUCN).[12]

Impacts on marine fauna can be both lethal and sub-lethal. Mortality may be caused by ingestion of plastic waste that damages or blocks the digestive tract, while entanglement in litter can lead to drowning or strangulation. Sub-lethal impacts are less well understood but include injury, disease and compromised feeding and movement, leading to malnutrition and reduced reproductive output, growth rates and longevity.[13]

Turtles

All species of turtle have been documented ingesting and becoming entangled in debris. One study in Brazil found that up to 100 per cent of examined animals had ingested plastic litter and another that litter was responsible for the deaths of over 13 per cent of examined turtles.[14] Post-hatchling turtles have an extremely limited ability to cope with decreased nutrient intake resulting from litter ingestion and the impacts on reproductive output and survivorship may have serious conservation implications.[15]

Seabirds

About 56 per cent of all seabird species are affected by marine litter, with major proportions of tube-nosed seabird species ingesting plastic on a very regular basis. Ingestion is documented in 97.6 per cent of laysan albatross chicks and 95 per cent of northern fulmars, with an average of 35 plastic items found in each individual fulmar. Such high ingestion rates spur serious concern regarding the cumulative physical and chemical impacts at the population level. Ingestion does not appear to be a major cause of mortality but may contribute to poor nutrition and body condition which likely influences overall fledgling success.[16] Plastic waste also causes entanglement of seabirds; in North American gannet populations, almost 75 per cent of the nests contain fishing debris, increasing the risk of lethal entanglement for adults and chicks.[17] Experts predict that plastic ingestion will reach 99 per cent of all seabird species by 2050.[18]

Marine mammals

In whales, dolphins and porpoises (collectively known as cetacans), 56 per cent of species have either ingested or been entangled in marine litter, with rates of ingestion as high as 31 per cent in some populations.[19] There are a number of cases where


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whales have died through ingestion of large quantities of plastic waste or entanglement in lost fishing gear, although population level impacts remain hard to determine due to difficulties in establishing causes of death and in collating strandings data. Microplastics also pose a threat, particularly to filter feeding baleen whales, with microplastic uptake and associated contaminants documented in a number of species.[20]

Entanglement of seals and sea lions has been documented in numerous populations worldwide and identified as partially responsible for the population decline of the northern fur seal.[21] In Cornwall, UK, the average annual entanglement of grey seals varies from 3.6 to five per cent, with an increased mortality rate for entangled seals.[22] A study in The Netherlands found 11 per cent of examined seals had ingested plastic.[23]

Fish and other marine fauna

Many species of fish, crustaceans, corals and invertebrates are also impacted by plastic waste through ingestion or entanglement. In the UK, 83 per cent of Norway lobsters (often sold as scampi) sampled contained microplastic debris.[24] In the English Channel, 36.5 per cent of sampled fish, including whiting and mackerel, had ingested plastic.[25] In the Mediterranean, micro- and macroplastic ingestion was documented in 18.2 per cent of bluefin tuna and albacore tuna.[26]

Ecosystem level effects

Ecosystem level effects of plastic waste have been documented around the world. Litter accumulation has a high potential to impact benthic habitats and organisms in particular. For example, coral cover and species diversity have been shown to decrease with increasing litter abundance in the Pacific, and reduced abundance of benthic invertebrates was found in heavily littered sites in Indonesia.[27]


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Consequences for humans

Marine litter also has substantial negative socio-economic impacts. The cost of damage to marine ecosystems from plastics is estimated to be $13 billion a year.[28] Plastic waste presents a hazard to shipping, can increase flood risk through blockage of drainage channels and is aesthetically detrimental, causing or contributing to economic losses to industries such as commercial fishing and shipping as well as recreation and tourism.[29] Perhaps of even greater concern are the human health implications of plastic contamination of seafood and the potential for plastics to increase the transport of contaminants into the food chain.[30]

"In the UK, 83 per cent of Norway lobsters sampled contained microplastic debris"



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MICROPLASTICS

"Almost 100,000 microbeads are released in each application of some facial scrub products, resulting in up to 80 tonnes of unnecessary microplastic waste entering the sea every year in the UK alone"

Microplastics are defined as plastic fragments less than 5mm in size. Sources of microplastics include:

- primary microplastics
  - plastic pellets (also known as nurdles), used in the production of larger plastic items;
  - microbeads used in 'down-the-drain' personal care products (e.g. toothpaste, facial scrubs) and household cleaners;
- secondary microplastics
  - derived from fragmentation of larger plastic items;
  - microfibres from synthetic clothing.

Recent studies have shown that almost 100,000 tiny microbeads are released in each application of products such as facial scrubs, resulting in up to 80 tonnes of unnecessary microplastic waste entering the sea every year from using such products in the UK alone.[31] Tests of waste water from domestic washing machines have shown about 1,900 individual fibres can be rinsed off a single item of synthetic clothing.[32]

Due to their small size, microplastics are not intercepted by conventional sewage treatment and so are released into rivers and oceans. They are now abundant and widely distributed in the marine environment, floating at the sea surface, in deep sea sediments, on shorelines and concentrated in sea ice.[33] More than five trillion plastic particles are floating in the world's oceans, with even higher concentrations in deep-sea sediments.[34]

Microplastics are ingested by a range of marine organisms, from commercially important fish and shellfish to baleen whales. Such ingestion can potentially lead to physical and toxicological effects.[35] Persistent organic pollutants in seawater concentrate on the surface of plastics and can become orders of magnitude more concentrated than in the surrounding water.[36] These chemicals, as well as additives already present in the plastic, can be transferred to organisms through ingestion.[37]
In laboratory and field studies, adverse effects of microplastic ingestion have been documented in a number of species, including zooplankton (decreased feeding),[38] lugworms (weight loss, decreased energy reserves, compromised fitness),[39] fish (hepatic stress)[40] and corals (impaired health and potentially starvation over time).[41] Basking sharks have been estimated to consume approximately 13,110 microplastic items per day and Mediterranean fin whales approximately 3,653 items.

REDUCING PLASTIC WASTE

Despite growing international attention to marine litter, meaningful action at national levels is still lacking. Single-use plastic items remain common and only 26 per cent of plastic waste in Europe is recycled, with the rest going to landfill or incineration.[42] Averting marine plastic litter requires a dual approach of preventing waste by reducing consumption of single-use plastics and increasing reuse and recycling of plastics while also preventing waste plastics from reaching the marine environment through adequate treatment and management of waste streams.

Here we outline some case studies of existing actions being taken to address plastic waste and recommended future actions that can be taken throughout the production and consumption chain, from governmental and industry to public actions.

Reducing consumption of single-use plastics

A symbol of a throwaway culture and a prevalent type of marine litter, single-use carrier bags have been successfully targeted in efforts to reduce plastic waste. Bans on single-use bags exist in countries including in Bangladesh, India, Rwanda, Tanzania, Taiwan, South Africa and South Australia.[43] Levies have also been highly effective, with a 5p charge implemented in Wales for all single-use carrier bags resulting in more than a 70 per cent decrease in consumption.[44] A 2015 EU Directive amending the Packaging and Packaging Waste Directive requires Member States to reduce consumption of lightweight plastic bags to 90 bags per person per year by 2019 (about 50 per cent of average levels) and 40 bags by 2025 (an 80 per cent reduction).

Some 70 cities in the US have enacted local bans on Styrofoam (expanded polystyrene) containers used for take away food and drinks and loose-fill polystyrene packaging because polystyrene is particularly prone to fragmentation and difficult to recycle. In 2015, Oxford became the first UK city to enact a similar ban, requiring vendors to use recyclable or biodegradable food containers to reduce the amount of waste sent to landfill.[45] San Francisco recently became the first US city to ban the sale of plastic water bottles and Selfridges store in the UK is removing all single-use plastic water bottles from its food halls and restaurants.[46]

BELOW:
Bottle recycling machine in a Lidl grocery store in Western Germany.

BOTTOM:
One of many pieces of plastic littering the Taputeranga Marine Reserve in Wellington, New Zealand.



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TOP:
Microbeads extracted from facial scrubs.

ABOVE:
Wildlife entangled in ghost fishing gear.

Removal of plastics from down-the-drain products

As awareness of the threat posed by microplastics in the marine environment has emerged, NGOs have launched campaigns calling on manufacturers to eliminate microplastics from their personal care and cleaning products. The international coalition Beat the Microbead has successfully persuaded many companies to commit to phasing out microplastics and has developed an app to help consumers choose microplastic-free products. In the UK, Fauna & Flora International and partners have produced the Good Scrub Guide which lists microplastic-free products. There remains a need, however, for legislative action to speed progress, maintain commitments and ensure a level playing field for manufacturers. US states such as Illinois and Colorado have been among the first to enact such legislation.

Although not intended to be down-the-drain products, sanitary and personal care items are often flushed down the toilet, ending up in the sea. Items such as cotton bud sticks, wet wipes, tampons and other sanitary items comprised 5.4 per cent of UK beach litter in 2014.[47] UK organisations Surfers Against Sewage and Marine Conservation Society have championed campaigns such as Think Before You Flush, which aims to change public behaviour to not flush such items down the toilet and convince manufacturers to go plastic-free and use biodegradable components in their products.

Tackling ghost fishing gear

'Ghost gear' refers to any fishing equipment or fishing-related litter that has been abandoned, lost or otherwise discarded. About 25,000 nets are lost in European fisheries each year, a combined length of 1,250km.[48] Such nets can remain in the marine environment for decades, causing suffering and mortality in marine life. World Animal Protection

has recently launched the Global Ghost Gear Initiative (GGGI), a cross-sectoral alliance committed to driving solutions to the problem of lost and abandoned fishing gear worldwide. At a local scale, there are a number of 'fishing for litter' and closed-loop fishing gear recycling schemes which aim to actively remove fishing litter from the marine environment but there remains a need for measures to prevent gear loss and wider availability of appropriate gear recycling facilities.

Applying waste hierarchy and circular economy principles to plastic waste

The EU Waste Framework Directive sets out the waste hierarchy in the following priority order: (i) prevention; (ii) reuse and preparation for reuse; (iii) recycling (reprocessing of waste materials into products or secondary raw materials); (iv) recovery (for example, through waste incineration); and (v) disposal (landfilling, incineration, gasification etc). Circular economy models are based on similar principles, seeking to retain the value of products for as long as possible and eliminate waste, keeping resources within the economy by recovering and recycling products and materials when a product reaches the end of its life. Transitioning to a circular economy requires cross-sectoral changes, from product design to new ways of turning waste into a resource and new modes of consumer behaviour. Eco-design, re-using, repairing, refurbishing and recycling existing materials and products will need to become a central focus of businesses and consumer chains in order to effectively prevent waste.

Extended producer-responsibility schemes can form part of a circular economy approach, in which the producer retains responsibility for a product after it has been sold. This principle has already been applied to plastic waste in the establishment of deposit return schemes for beverage containers. In Denmark, consumers pay a deposit of 1-3DKK (approximately 10-30p) depending on the size and type of bottle or can, which is refunded when they return the empty container to reverse vending machines or retail outlets. In 2013, consumers in Denmark returned 89 per cent of empty beverage packaging on which deposits had been paid, representing more than 950 million items.[49] Such schemes reduce littering, increase recycling and increase the use of refillable containers and could be highly effective if rolled out more widely.[50]

"Eco-design, re-using, repairing, refurbishing and recycling existing materials and products will need to become a central focus of businesses and consumer chains in order to effectively prevent waste"



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CONCLUSIONS

With plastics production continuing to rise and escalating trends in both plastic litter in the marine environment and its impacts on species, there is a critical need for urgent action to prevent plastic waste.

EIA calls for a focus on:

- reducing consumption of single-use plastics;
- removal of plastics from down-the-drain products;
- more stringent application of waste hierarchy and circular economy principles to plastic products and packaging.

Such principles can be applied throughout the user chain; from governmental measures and industry action to actions taken by the public.

We all have a vital role to play in reducing the amount of plastic waste entering the marine environment and protecting its biodiversity for decades to come.

RECOMMENDATIONS

Governments

Governments can reduce and prevent waste through regulatory and economic measures that decrease consumption of single-use products and packaging, prevent waste, improve recycling and encourage a circular economy. These should include:

- binding waste prevention and recycling targets, leading to a ban on landfilling and incineration of recyclable waste
- improved waste collection and recycling facilities
- bans and levies on single-use plastics such as carrier bags
- deposit-return schemes for drinks containers
- elimination of non-recyclable packaging
- standards to minimise packaging, ensure recyclability and use recycled materials
- minimum standards for Extended Producer Responsibility (EPR) schemes
- strengthened implementation of waste legislation, increased enforcement and sentencing
- bans on microbeads and plastics in down-the-drain products, including personal care and sanitary items
- reformed fee systems for port waste reception facilities to incentivise waste delivery, with harmonised port control of waste deliveries and increased enforcement
- management of fisheries to prevent gear loss and increased facilities for gear recycling
- support for national education and awareness-raising campaigns and industry training programmes

Industry

- minimisation and design of packaging for re-use and recycling, using secondary raw materials where appropriate, e.g. production of refillable beverage containers
- industry training programmes and use of best available technologies in waste management, fisheries and shipping sectors
- eco-labelling and product passport schemes informing consumers of environmental footprint and potential for product repair and recycling
- expansion of Operation Cleansweep to prevent loss of microplastic pellets, with auditing of safeguards
- development of fabrics with minimal fibre loss and development of a filter to catch microfibres from washing
- production of fisheries gear designed for closed-loop recycling and which facilitates gear marking, with gear leasing schemes where appropriate; bait and catch containers should similarly be reusable and recyclable
- development of multi-stakeholder ghost gear prevention and recovery teams and expansion of fishing for litter schemes

Retailers

- minimisation and use of re-usable, recyclable packaging in supply chain and consumer packaging
- replacement of polystyrene containers for fast food with recyclable/reusable and biodegradable items
- economic incentives for use of refillable beverage containers e.g. discounts for customers using a refillable container, deposit-return schemes and levies;
- participation in EPR schemes

Public

- avoid single-use plastics and unnecessary packaging
- carry a re-usable bag and drinks bottle
- re-use, recycle and dispose of waste responsibly
- 'Think before you flush' – avoid disposing of any plastics down the toilet or drain
- only buy microplastic-free personal care and household products (see Beat the Microbead's app and Fauna & Flora International's Good Scrub Guide)
- participate in beach cleans (see www.mcsuk.org, www.sas.org.uk and www.nurdlehunt.org.uk) and diving-for-debris programmes (see www.projectaware.org/Diveagainstdebris and www.narc-cc.org.uk)

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