

Marine litter – Trashing the waves

Thomas Maes explains how a lack of litter awareness is clogging up our oceans

What is marine litter?

Some of us might wonder exactly what marine litter is and where it comes from. We all know the term “litter” and have seen it in some form in our daily lives; an empty plastic bag drifting in the wind, cigarette butts on the pavements, empty drink bottles in the park or even remote and idyllic places blighted by the presence of litter. What we see as litter on land is not different from what is found in the sea and thus the term “marine litter” has been introduced to describe discarded, disposed of, or abandoned man-made objects present in the marine and coastal environment worldwide. Originating from both ocean-based (fishing vessels, cargo ships, stationary platforms, fish farming installations, pleasure crafts and other vessels) and land-based sources (littering, dumping, poor waste management practices, untreated sewage and storm water discharges, riverine inputs, industrial facilities, tourism, extreme natural events), marine litter can now be found around the globe. The major sources of marine pollution are land based, and some studies have indicated that up to 80% of marine litter originates on land. Marine litter, mainly plastic, can pose a serious environmental threat to marine organisms as well as a series of economic and social problems. The majority of marine litter consists of plastic materials, between 60 and 80% overall, and 90% of the marine litter is floating¹.

How did it get so bad?

Plastics began being produced on an increasingly industrial scale midway through the 20th century. Since 1950, there has been an average annual global increase of 9% in the production and consumption of plastics. From 1.5 million tonnes in 1950, total global production reached 245 million tonnes in 2008, and

this number will continue to grow, reaching over 365 million tonnes in 2015 and 540 million tonnes in 2020 (using a conservative annual rate of increase of 6.5%)². The ever-growing demand for plastic and single-use items, in combination with ineffective waste management and slow degradability, has led to an enormous surplus of mainly synthetic polymers, commonly known as plastics. Plastic waste of all sizes and shapes eventually ended up in the marine environment and became a transboundary pollution problem with a powerful driver – the ocean. Scientists began reporting the spread of plastic litter in the oceans in the early 1970s. Across Europe, the distribution and abundance of marine litter on the seabed has been investigated in conjunction with existing International Council for the Exploration of the Sea (ICES) stock assessment surveys since the beginning of the 1990s. In the United States, the National Oceanic and Atmospheric Administration (NOAA) estimates that three times more rubbish is dumped into the world’s oceans annually than the weight of fish caught during the same period³.

“Marine litter has the potential to kill or harm marine life through entanglement or ingestion”



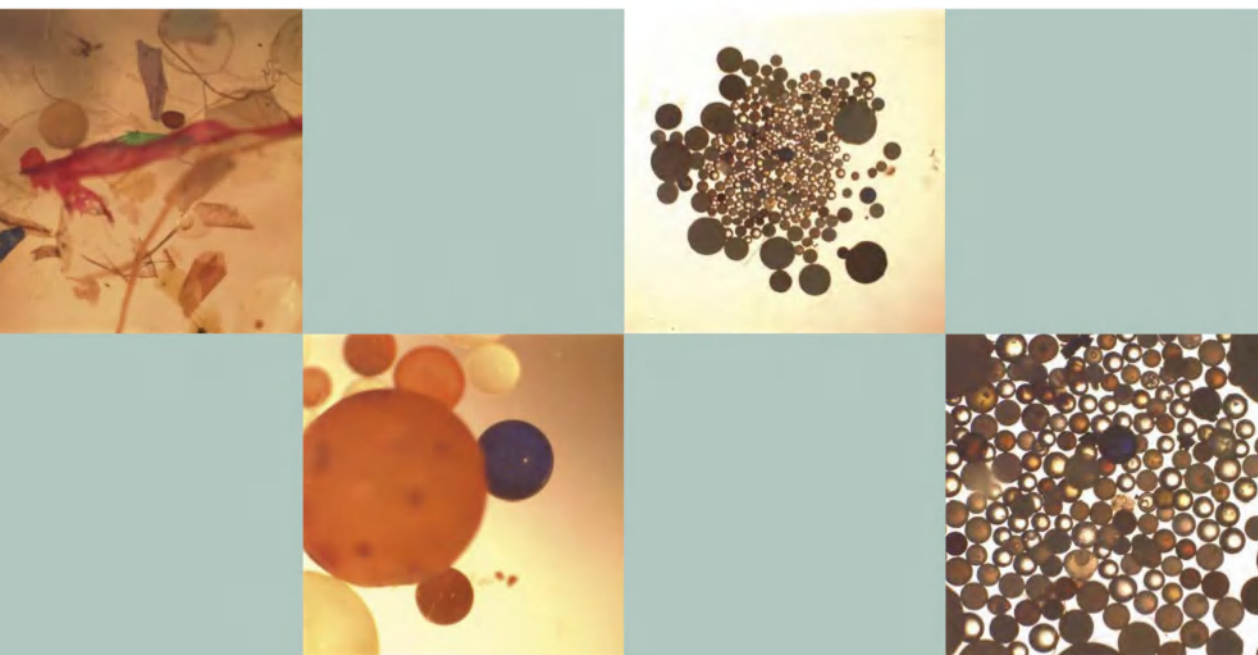
Does it have an impact on the marine environment?

Marine litter has the potential to kill or harm marine life through entanglement or ingestion and thus could put an even higher strain on systems already under stress from overfishing and other anthropogenic influences. “Ghost fishing” by discarded or lost fishing nets is just one of several examples of that. The Convention on Biological Diversity (CBD) Secretariat and the Scientific and Technical Advisory Panel (STAP) recently reviewed and synthesized the available literature in order to describe the impact of marine litter on biodiversity and concluded that around 663 different animal species, mainly birds and fish, have been impacted by marine litter. The report also revealed that all known species of sea turtles, about half of all species of marine mammals, and one-fifth of all species of seabirds, have been affected by entanglement or ingestion of marine litter⁴.

Plastics also create habitats for micro-organisms and other species, allowing would-be invasive species to hitch rides to new areas of the ocean. Other threats to wildlife include the smothering of the seabed, or environmental habitat disturbances created by marine litter. It is clear that impacts may vary depending on the type and size of the marine litter items and the organisms that encounter them. Marine litter also causes damage to people, property, and livelihood and thus incurs high economic costs. People are affected when litter fouls boat propellers or nets, clogs water intakes, blocks pumping systems, or causes risks to human health. In addition, the presence of litter along shorelines can lead to a loss in aesthetic value and result in serious economic problems for regions that are dependent on tourism.



*Divers remove netting from a reef.
Photo: Dwayne Meadows, NOAA*



Microplastics under the microscope. Photo: © Crown copyright, permission granted by Thomas Maes, Cefas.

Macro and micro?

The lightness and durability of plastic makes it such a useful and versatile material for manufacturers, but also makes it a long-term problem for the environment. Plastics accumulate because they don't readily biodegrade, unlike many other organic substances. Although they don't degrade they do fragment in the environment; this is caused by a combination of mechanical forces like waves and/or photochemical processes triggered by sunlight. This means that plastic breaks down into smaller and smaller fragments, better known as microplastics. The origin of these fragments can be determined as stemming from fishing nets or lines, plastic bags, films and bottles, remains of oxo-biodegradable plastic, industrial raw materials like plastic pellets, or from other direct sources of microplastics such as facial cleansers or toothpastes. Another source of microplastics has recently been identified, namely the shedding of synthetic fibres from textiles through washing. Those fibres pass through treatment screens at wastewater plants and eventually arrive in the marine environment. Microplastics normally float on the surface because they are less dense than seawater, but the buoyancy and density of such plastics may change during their time at sea, due to weathering and biofouling, which means they are eventually found at the sea surface as well as in both the water column and the sediments. Because of their size, they are available to a broad range of organisms and have been shown to be ingested by several species, ranging from lugworms, mussels, and crustaceans to fish, and even birds. The ingestion of microplastics by species at the base of the foodweb

causes concern as little is known about its effects and transfer across trophic levels.

Contaminated pills?

To make matters worse, plastics can leach toxic additives, used in the manufacture of plastic materials (e.g. Tetrabromobisphenol-A or TBBP-A), into the marine environment and can also absorb and accumulate other persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and organochlorine pesticides. Plastic litter can absorb and concentrate POPs, yielding up to a million times higher concentrations than in the surrounding seawater which, when consumed by marine animals, could endanger both the creatures that ingest them and organisms higher up in the food chain. This means that the possible effects of microplastics on marine organisms after ingestion are probably twofold: the physical blockage or damage of feeding apparatus or digestive tract, and the leaching of plastic additives and POPs into organisms after digestion, with the potential for toxic effects and bioaccumulation. Although some evidence may still be lacking, it is clear that marine litter could have a significant impact on individuals as well as potentially on populations and ecosystems. Alongside other significant anthropogenic stresses this could affect the important marine services on which our planet relies.

Solutions and measures?

The most effective way to manage the marine litter pollution issue is by limiting inputs, by changing the behaviours that allow marine litter to enter the environment initially by collection, retention, and disposal of waste in proper reception facilities. Targeted educational programmes for the general public and other stakeholders could encourage a change in littering behaviour. We must reduce the production of litter, but in many countries some plastic will always escape the preferred disposal routes and find its way into the ocean, from which it cannot realistically be collected. Obviously, we can reverse the current trends through reduction or better use of plastic packaging, the development of better designed plastics, improved labelling, and the promotion of local products and markets. Globally, a lot of sewage and associated litter is discharged without treatment of any kind, particularly during periods of high rainfall. Improving the function, storage, and efficiency of combined sewage overflows should effectively limit this input.

Land-based management

A lot of countries face significant barriers to the effective control of marine litter. In many cases, financial, cultural, and awareness barriers may impede development of political will to address the problem. This problem is not one that is merely typical of developing countries or industrialized areas, although regional differences and pressures may leave different imprints. In the European Union alone, three billion tonnes of waste is thrown away annually. This amounts to about six tonnes of solid waste for every man, woman, and child each year. Most of what we throw away is either burnt in incinerators or dumped into landfill sites (67%). The Organisation for Economic Co-operation and Development (OECD) estimates that by 2020, we might be gener-

ating 45% more waste than we did in 1995⁵. Unfortunately, stockpiling waste is not a viable solution and simply destroying it is unsatisfactory due to the resulting emissions and highly concentrated, polluting residues produced.

Prevention: Refuse, reduce, reuse, recycle

The EU is aiming for a significant cut in the amount of rubbish generated, through new waste prevention initiatives, better use of resources, and encouraging a shift to more sustainable consumption patterns. Where possible, waste that cannot be recycled or reused should be safely incinerated, with landfill used only as a last resort. Both of these methods require close monitoring because of their potential for causing severe environmental damage. EU laws governing waste disposal require more recycling of paper and plastic each year while generally prohibiting dumping in landfills; incineration, meanwhile, is now heavily taxed in most European countries⁶. These regulations also prohibit exporting waste to poorer parts of the world, unless the receiving country accepts that type of waste for processing by a certified recycler. The European guidelines ban the export of certain hazardous materials and so-called "problematic" waste, defined as waste that is not amenable to recycling and which would be harmful to the environment at its destination.

The waste trade, legal and illegal, is partly propelled by the fact that large fast-growing economies need raw materials. Recycled materials are cheaper than virgin ones; they reduce greenhouse gas emissions and the dependence on imports. So the primary objective should be to couple waste with money. Seeing waste as a resource may prove a powerful factor in litter reduction in the coming decades.



The effects of marine litter as found on Cefas cruises. Photo: © Crown copyright, permission granted by Thomas Maes, Cefas.

A life cycle assessment by the UK Environment Agency has shown that plastic carrier bags are the most environmentally sustainable option for carrying goods and protecting them from contamination. Replacing all plastic by organic products would put more stress on food production due to the spatial competition with production of edible crops, jeopardizing food security. Transport costs and oil consumption would also rise and there would be direct impacts on CO₂ production. Thus, instead of completely banning a product with clear pros and cons, we should target the negative points and reduce, re-use, and recycle single-use disposable products and packagings that often end up as waste.

Employment: Revalue, repurpose, rethink, and rebuild

A recent report on waste from the European Commission has indicated that waste management and recycling could make a big contribution to economic growth and job creation. The study provided an in-depth analysis of the effects of better implementation and enforcement of legislation and showed that benefits would be significant. The economic crisis in Europe is setting new priorities for our societies, and job creation and sustainable resource management should be at the core of it. The EU's waste management and recycling sector is very dynamic but still offers economic opportunities with vast potential for expansion⁷.

Meeting the global challenge

The plastic litter problem has become a global problem requiring global solutions. Solutions should be based on sound science, including preparation of a global assessment. This would collate the available scientific information and make recommendations of use to the wide variety of policy, industry, and societal organizations with responsibility in this area, including waste management at the local level. Policymakers will need to take an integrated view of the whole process and develop a range of options for guidelines and directives, including packaging and treatment of integrated waste management from collection to final disposal.

There is a clear need for improved legislation and broader litter strategies with involvement of key stakeholders, local governments, and members of the public. In the end, the only sure solution is to prevent plastics from entering our waterways and reaching the sea. In order to reduce the sources of pollution, improved knowledge is critical. Scientific support and clarifying the key processes involved such as degradation, dynamics, and impacts, while also looking at the economics as well as social and employment aspects, will be crucial in developing the required global standards and wider perspec-

tives on marine litter. Building a broad consensus around such integrated perspectives is the most promising approach to meeting the now global challenge of marine litter.

"Seeing waste as a resource may prove a powerful factor in litter reduction"

ICES scientific work involves delivering advice on the management of more than 200 finfish and shellfish stocks and conveying scientific information on how anthropogenic activity impacts the marine environment. Because of its nature, marine litter can be seen as a modern example of an anthropogenic pressure with an impact ranging across the wider marine environment and its users. Monitoring of marine litter can easily be integrated with existing ICES stock assessment surveys to determine potential influences on fish stocks and biodiversity. By taking advantage of research cruises already undertaken for other purposes, reliable data on marine litter can be obtained at affordable costs. ICES already provides advice to OSPAR, HELCOM, and the European Commission on the monitoring of marine litter in relation to the Marine Strategy Framework Directive (MSFD). The occurrence and effects of marine litter in the ICES area and complexity of this vast problem is still yet to be fully understood. It is hoped that the theme session at the ICES Annual Science Conference in Reykjavík focusing on marine litter will aid the understanding of this multifaceted issue.



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