UN environment

FORESIGHT Brief

002
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Early Warning, Emerging Issues and Futures

Marine Plastics Litter and Microplastics

Background

The UN Environment Foresight Briefs are published by UN Environment to highlight a hotspot of environmental change, feature an emerging science topic, or discuss a contemporary environmental issue. This provides the opportunity to find out what is happening to the changing environment and the consequences of everyday choices, and to think about future directions for policy.

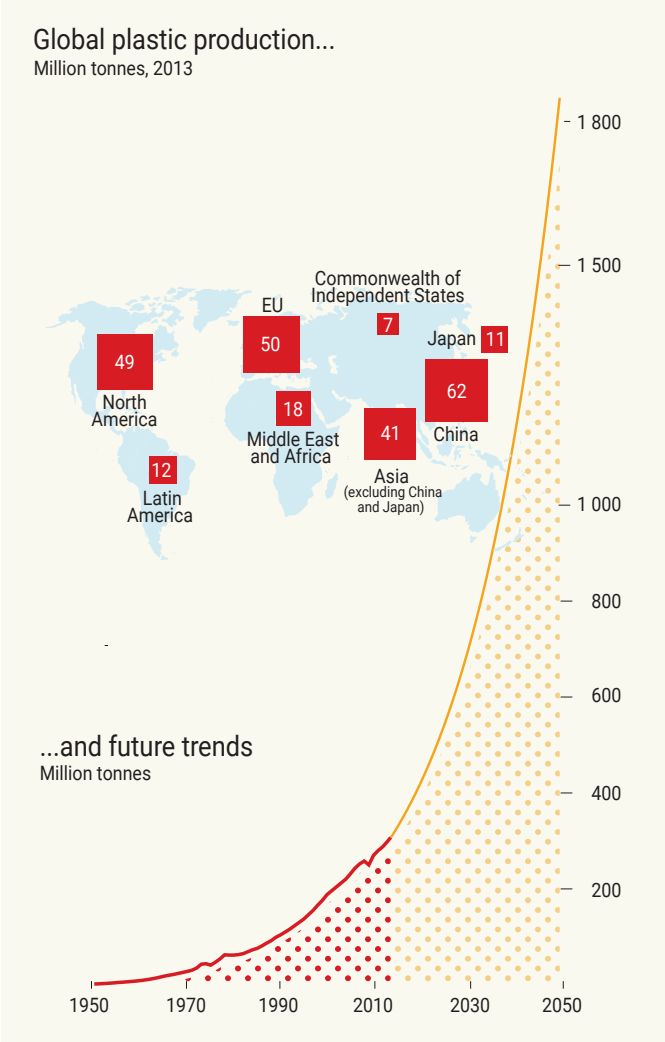
Introduction

The primary success of plastics lies in their versatility for all kinds of domestic, commercial and industrial uses such as packaging, agriculture, fisheries, building and construction, electronics, medical, sports and transportation.

Plastics are a diverse group of synthetic materials composed of polymers predominantly derived from petrochemicals, such as petroleum and natural gas. Lately, innovative developments in plastics manufacture have allowed them to even challenge traditional materials such as steel in every day usage (PlasticsEurope 2016).

The global production of plastics has increased from 1.5 million tons in 1950s to about 300 million tons currently, at an average rate of 4 per cent per annum and is expected to continue growing (Boucher and Friot 2017). About 50 per cent of the plastics produced is for single use, and the literature estimates that 8 million tons (2.5 per cent) of the plastic produced are leaked into the oceans annually (PlasticsEurope 2016). China is the dominant producer at 27.8 per cent of world production (PlasticsEurope 2016).

Trends in global plastic production



Ryan in UNEP 2015 and GRID-Arendal 2016

The use of plastic shopping bags is ubiquitous around the world
Photo credit: Ipek Morel / Shutterstock.com

The consumption of plastics has been growing and averaged 45 kg/per capita in 2015 with highest consumption in the North American Free Trade Agreement region (139 kg/capita) and lowest consumption in Africa and the Middle East region at 16 kg/capita. In 2015, the packaging sector used up almost 40 per cent of the global plastic production followed by the consumer and household goods, furniture, sport, and the health and safety sectors altogether taking up more than 22 per cent of the production (PlasticsEurope 2016).

Plastic objects or fragments of them get into the oceans either by direct input from activities happening at sea or the coastline such as fishing, shipping and tourism or are transported by rivers and wind from land-based sources linked to almost every human activity but specially mismanaged waste. These fragments are of different polymer types and of varying sizes ranging from items that are large and easily seen to those that are small and unnoticeable (microplastics). These small (less than 5 mm) plastic particles are coming into the marine environment already as small fragments or result from the breakdown of larger plastic particles due to degradation by sunlight, abrasion by wave activity at the coast and interaction with animals.

Why is this issue important?

The issue of marine plastic litter is important because unfortunately a fraction of all the plastics produced and used are leaked into the world's oceans as large plastic objects or microplastics. They are found in all oceans of the world and have serious environmental, social and economic impacts.

What are the findings?

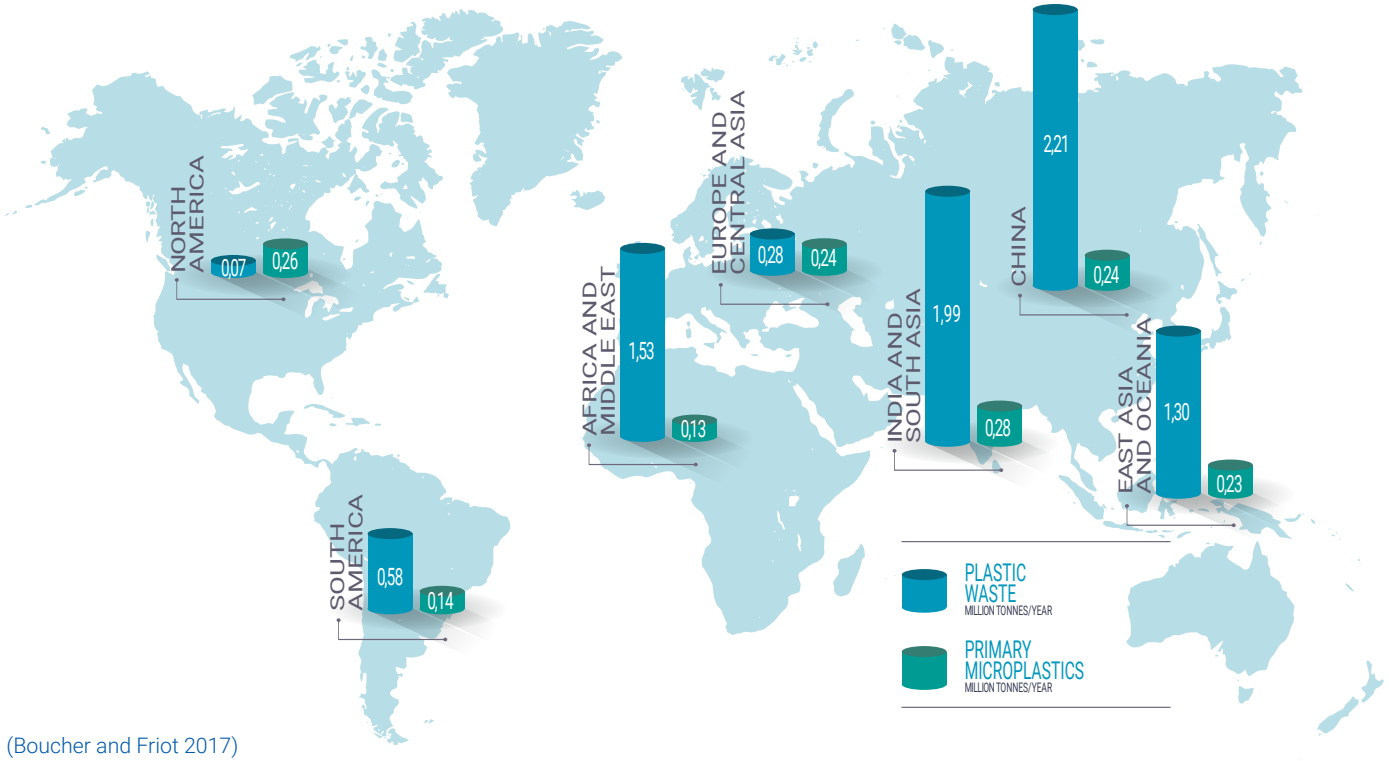
Volumes are increasing

The volume of plastics in the marine environment is increasing as the removal rate is negligible compared to the increasing input rate. The different characteristics of marine litter impact the way it behaves once brought to the ocean. For instance, once deposited in the seas by rivers the lighter plastics such as polyethylene tend to float and get transported by the ocean currents while the heavier plastics (PS, PVC and PET) may sink and accumulate on the ocean floor with most accumulation zones found along the coastal areas (Stuparu, et al. 2015). However, questions still remain regarding the exact abundance, distribution and final destination of plastics in the oceans.

Plastics are found all over the oceans

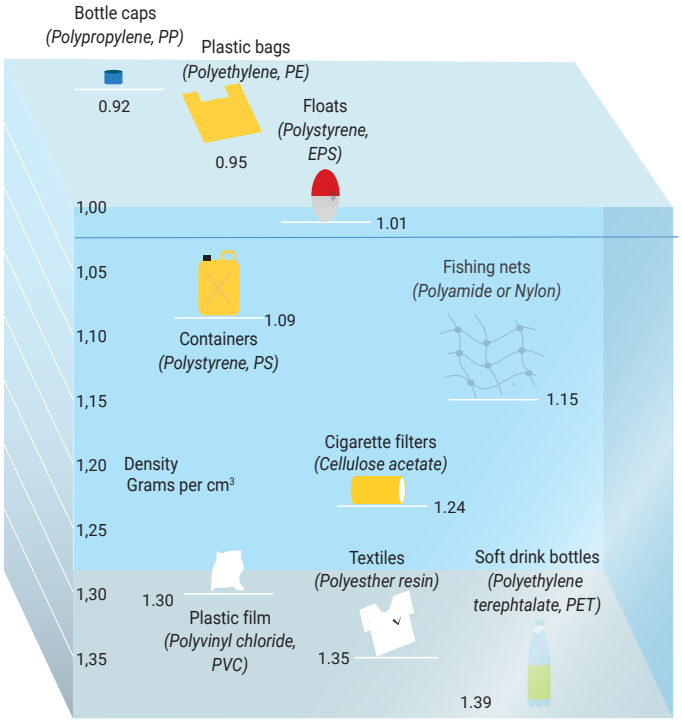
Plastics persist in the oceans with the different sizes and types behaving differently in the waters. Although more research is needed, it is certain that there is some degree of transfer between the different ocean compartments bringing plastic pollution to every corner of it.

Global releases of plastics into the worlds oceans: A comparison of microplastics with plastics originating from mismanaged wastes



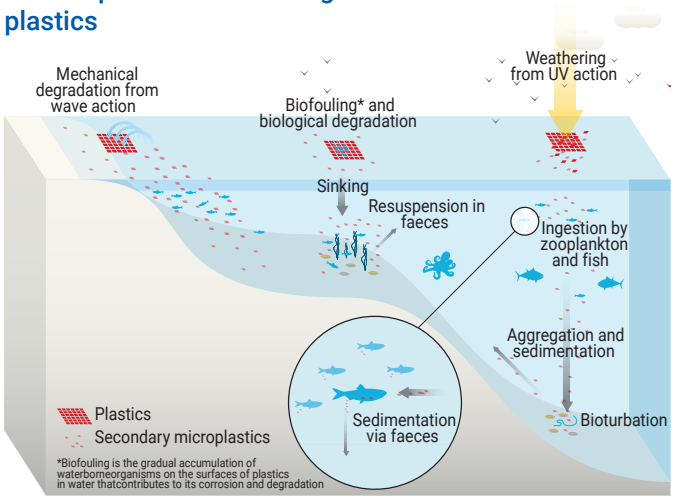
(Boucher and Friot 2017)

Which plastics float and which sink in seawater



Source: UNEP and GRID-Arendal 2016

Natural processes affecting the distribution and fate of plastics



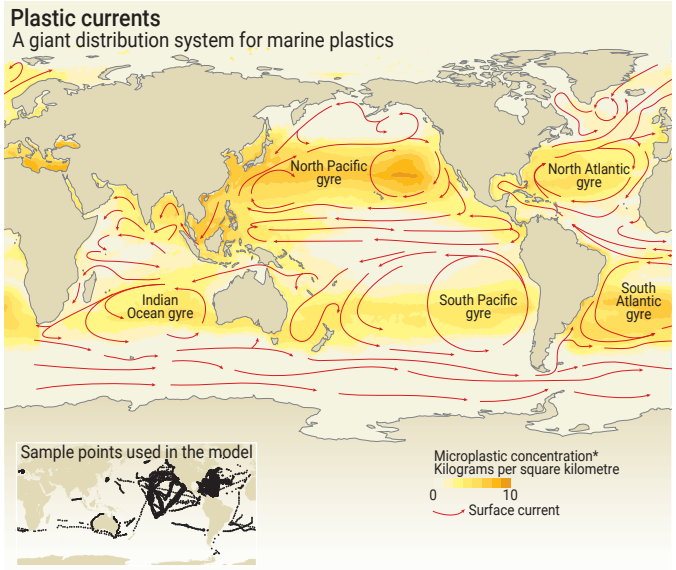
Source: UNEP and GRID-Arendal 2016

Hotspots appear to be emerging with marine plastics seeming to congregate in certain areas through the action of the waves, wind and surface currents (UNEP 2016). Some of these hotspots are located on shorelines and shipping routes close to shore, coastal waters near highly populated coastal areas, and in mid-ocean hotspots where plastics tend to congregate and remain.

The well documented large systems of ocean currents or gyres carry the floating plastics 'concentrating' them into five mid-ocean convergence zones. Actually, most of the litter is quite dispersed and exhibits variations depending on the extent of ocean turbulence and the season (UNEP 2016).

The shipping industry as a source of plastic waste is regulated under Annex V (revised in 2013) of the MARPOL Convention which aims to eliminate and reduce the amount of garbage, including plastic waste, being discharged into the sea from ships.

Plastic currents and the location of the five mid-ocean convergence hotspots



Source: UNEP and GRID-Arendal 2016

Environmental, social and economic impacts

Plastic pollution is reported to affect more than 700 marine species with 17 per cent of these species identified as near threatened, vulnerable, endangered or critically endangered on the IUCN Red List (Gall and Thomson 2015). Examples include the vulnerable Northern fur seal (*Callorhinus ursinus*), endangered Loggerhead turtle (*Caretta caretta*) and the critically endangered Hawaiian monk seal (*Monachus schauinslandi*) (UNEP 2016). These impacts include entanglement, ingestion and suffocation among others. The literature on this is growing, however indications are that marine plastics also have potential as a pathway for invasive species (NOAA 2017) (Carlton, et al. 2017).

Northern fur seal *Photo credit: Vasik Olga / Shutterstock.com*

The impacts of plastics on human and ecological health still requires some study as information on exposure (ingested dose) to these substances is still lacking, but likely to be minor compared to other ways of exposure. However, some additives used in the manufacture of certain plastics are listed in Annex I or II of the Basel Convention and are known to have harmful health effects (UNEP 2016). Such impacts may include neurological, reproductive and developmental disorders in humans and also in aquatic flora and fauna (Thevenon, Carroll and Sousa 2014).

Plastics are made from fossil fuels which are a major source of the greenhouse gases that contribute to climate change. Eight per cent of the annual global oil production, goes towards the manufacture of plastics

Loggerhead turtle *Photo credit: Henner Damke / Shutterstock.com*

either directly as feedstock or indirectly by providing fuel to drive the manufacturing processes (Worldwatch Institute 2015). The growing accumulation of plastic waste at times leads people to burn them as a means of reducing the volume of litter. Although it is a common regulated waste management practice, the open burning or incineration of plastic waste, has negative impacts as it releases dioxins and furans into the atmosphere. Dioxins and furans are well known to have negative impacts on human health, with dioxins well documented as carcinogens (North and Halden 2013).

The socio-economic impacts include losses in earnings due to beach cleaning, damage to beach use and the related impacts on tourism earnings. Large amounts of marine plastic debris end up on beaches (Lee 2014) with much potential for loss in shoreline aesthetics. A study in South Africa found that a decrease in beach cleanliness could decrease tourism spending by up to 52 per cent (Balance, Ryan and Turpie 2000). In a country like Great Britain where coastal tourism accounted for £5.48 billion in 2013, this would amount to a substantial loss (Lee 2014).

An analysis of 21 Asia-Pacific Economic Cooperation economies estimated the economic loss associated with marine debris at US $1.265bn using 2008 prices with losses estimated at US $279m, US $364m, and US $622m from the shipping, fishing and marine tourism sectors respectively (Lee 2014).

What is/has been done?

UN Environment, among other institutions, has been at the forefront of highlighting this problem. UN Environment provides the secretariat for the Global Partnership on Marine Litter (GPML) to prevent and reduce marine litter and microplastics which was established through the 2012 Manila Declaration. This inter-governmental partnership is promoting a joint approach to sustainable marine management and its aim is to enhance cooperation amongst key stakeholders such as governments, industry and others (UNEP 2016). The UN General Assemblies of 2005 and 2008 also addressed the marine litter issue in Resolutions S/60/L.22 (2005) and A/63/L.42 (2008) on oceans and the law of the sea, and Resolution A/60/L. 31 (2005) and A/63/L.43 (2008) on sustainable fisheries. With the mandate provided by the June 2014 United Nations Environment Assembly (UNEA) Resolution 1/6 on 'Marine plastic debris and microplastics', UN Environment undertook a study on the issue and is further supporting the development of country action plans on marine litter.

More recently, the 2016 UNEA Resolution 2/11 recommended the prevention, clean up and sound management of waste, including along transfer pathways such as sewage effluents and inland water bodies. Some of the recommended waste minimization approaches include market-based environmental policy instruments, adoption of environmental best practice, technologies and legislation (UNEP 2016).

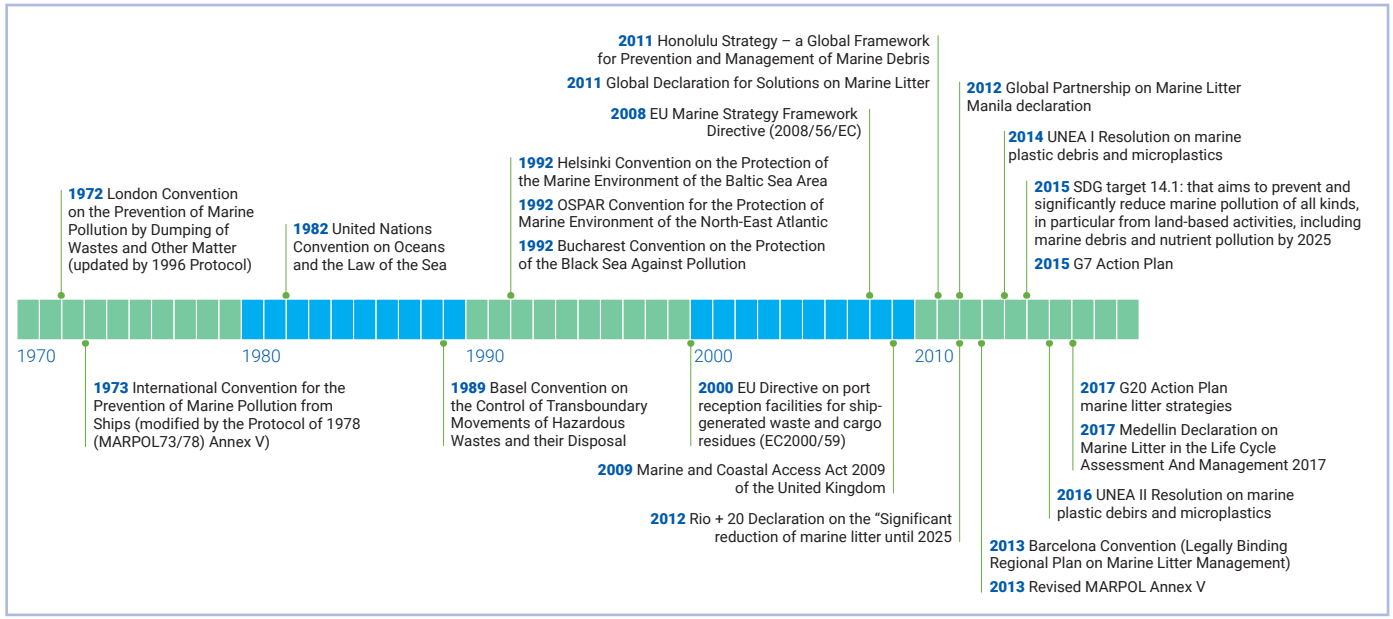
Plastic bottle prepared to recycle by pressing into bales
Photo credit: AlexZaitsev / Shutterstock.com

World leading economies have also acknowledged this problem in the G7 summit in June 2015 issuing a declaration on the protection of the marine environment specifically highlighting the danger posed by plastics. The G7 countries include Germany, France, the United Kingdom, Italy, Japan, the United States of America and Canada. The G20 Action Plan on Marine Litter was adopted in 2017 as part of the G20 commitment towards implementing the 2030 Sustainable Development Goals Agenda. The G20 plan aims to prevent and reduce marine litter and its impacts by 2025. The G20 members include the European Union, 19 leading and emerging economies worldwide plus some guest countries and organizations.

The European Union, through its EU Marine Directive has a time-based goal to maintain and protect marine biodiversity by 2020. It aims to do so by improving environmental protection in the marine environment including addressing issues of marine plastics pollution (European Commission 2017).

Cleaning up Chaupati Beach in south Mumbai
Photo credit: CRS PHOTO / Shutterstock.com

Some international agreements, goals and strategies addressing marine litter



Source: GRID-Arendal 2016

What are the implications for policy?

Some of the policy recommendations by the UN Environment ((UNEP 2016) include:

Strengthen the implementation and enforcement of existing international and regional frameworks

There is a multitude of institutional and regulatory frameworks around the world dealing with the issue of marine plastic litter. Their enforcement at times leads to overlap, duplicity and gaps in implementation. For a more sustainable approach, it is important that cooperation between the different bodies be encouraged as this will easily identify areas of strength and synergy enabling each to leverage their comparative advantage and leading to better use of financial and human resources.

Improve the data foundation to feed policy and implementation processes

There are many gaps in the knowledge about marine plastics litter and these need to be addressed if appropriate actions for marine litter mitigation and effective monitoring and evaluation systems are to be designed. For instance, there is urgent need to quantify and document the land and sea-based sources of all types of marine plastic litter. A strong data foundation is the cornerstone to the monitoring systems that will provide the numbers required for this. It will be necessary to harmonize and standardize data collection methodologies to allow for sharing and use of data and information across countries. Development of indicators to guide data collection and assessment reporting is also recommended. Indicators will also be useful in flagging hotspots where urgent attention may be required.

Strengthen public awareness and education

Employ and improve information, education and communication approaches targeted at the management of marine plastics so as to increase awareness and promote positive behaviour at personal, community and industry levels.

Develop a global marine pollution policy

There is a serious need for a binding global marine pollution policy that specifies clear targets to help reduce marine plastic litter; and includes a methodology to monitor progress.

Reduce leakage of plastic waste to the environment

Proper handling of plastic waste is a necessary part of addressing the problem of marine plastic litter. Employing a lifecycle approach encourages production, management and disposal of plastics in such a way that prevents them from entering the waste stream for as long as possible.

There are many private initiatives on-going to promote the reduction of marine plastics litter (UNEP 2016). Two of these include the Global Declaration for Solutions on Marine Litter of 2011 that was launched by 47 plastics associations from regions across the globe (PlasticsEurope 2016); and the Medellin Declaration on Marine Litter in Life Cycle Assessment and Management 2017 which is facilitated by the Forum for Sustainability through Life Cycle Innovation (FSLCI 2017).

Acknowledgements

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