



## Review Of The Impact Of Maritime Activities And Marine Debris On Marine E-Cosystems

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<p><b>CC License</b> CC-BY-NC-SA 4.0</p>	<p style="text-align: center;"><b>Abstract</b></p> <p><i>The oceans have always been central to many important human activities. To a varying extent, these activities have exerted adverse effects on the marine ecosystem either through pollution or physical destruction. The effects of marine pollution are drastic and far reaching. In contrast to this, physical damage is essentially limited to damage by groundings of ships, anchorage or construction works. Reports show that marine pollution affects the economy and health of people negatively. It means that the solution to the pollution of the aquatic environment is the enforcement of the necessary laws by Government in an effort to ensure that full compliance by stakeholders involved in maritime trade and related activities in order to preserve, conserve and protect aquatic resources, ensure safe seafood for human consumption and also protect means of livelihood.</i></p> <p><b>Keywords:</b> oceans, marine pollution, Government, stakeholders, preserve, conserve</p>
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### INTRODUCTION

Marine habitats and ecosystems all over the world have been contaminated with man-made debris and solid wastes. From time immemorial the oceans have always been subject to and central to human activities and to varying extents; these activities have adverse impacts on the state of the marine environment. Such detrimental effects on the environment depend upon the nature of human interference with nature and for purpose of convenience two broad categories have been distinguished, namely: pollution and physical destruction, with pollution causing far more significant and far reaching adverse effects.

Pollution has been defined as "Introduction of man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazard to human health, hindrance to marine activities including fishing, impairment of quality for use of seawater, and reduction of amenities."<sup>1</sup> In contrast to this very comprehensive definition, physical damage merely comprises those cases in which a marine habitat is destroyed or degraded by direct impact. They are essentially limited to damage by groundings of ships, anchorage or construction works.

Marine debris is described as any persistent, manufactured or processed solid material discarded, disposed

<sup>1</sup>Threats to the Marine Environment: Pollution and Physical Damage. In: Particularly Sensitive Sea Areas. Hamburg Studies on Maritime Affairs, vol 13 ( (2008). Springer, Berlin, Heidelberg.

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of, and/or abandoned in the marine and coastal environments. While this definition encompasses a rather wide range of materials, most of these items fall into a relatively small number of material types that include glass, metal, paper and plastic. It has been observed that plastic items are the most abundant type of waste that comprises marine debris on a global scale. Furthermore plastic is also the most frequently reported material in fatal encounters occurring between debris and marine organisms. Marine debris has its source mainly in shoreline and related recreational activities, ocean or waterway activities, industrial and similar waste dumping at sea.

Man-made items of debris have been recovered from marine habitats throughout the world, extending from the poles to the equator, including shorelines and estuaries as well as the most remote areas of the deep seas, and not excluding the sea surface to the ocean floor. This debris has been recognized as a global concern in addition to other key environmental issues, such as climate change, ocean acidification and the loss of biodiversity<sup>2</sup>. Marine debris is regarded as one of the most significant problems faced by the marine environment<sup>3</sup> with adverse and far reaching effects that eventually pose a major threat to coastal and marine life forms and their natural habitats<sup>4</sup>.

Marine debris is not only aesthetically detrimental, it is also a great hazard to commercial shipping crafts and fishing vessels and is capable of facilitating the transport of organic and inorganic contaminants and finally proves harmful to marine organisms and potentially also humans<sup>5</sup>. Three-quarters of all marine debris has been discovered to be plastic, which contaminates all habitats ranging from the poles to the equator and from shallow shorelines to the deep-sea<sup>6</sup>. Furthermore, marine debris is damaging to the economy, to the dependent wildlife as well as to the environment; and there is universal consensus that this issue needs to be addressed urgently<sup>7</sup>. Plastic materials are of such a particular cause for concern primarily due to their persistence in nature and their inherent or acquired toxicity.<sup>8</sup> Discarded plastics and plastic wastes degrade comparatively slowly and fragment into millions of microplastic pieces, thus enabling their uptake by a wide range of marine biota, right from the primary producers to high trophic-level organisms<sup>9</sup>, and thus become more likely to infiltrate food webs<sup>10</sup>. At present, the major perceived threats to marine biodiversity include the effects of climate change, ocean acidification, invasive species, overfishing and other extractive activities, pollution and marine debris, habitat degradation, fragmentation and loss, human population expansion, tourism, and the impact of a wide range of human activities in the coastal zone.<sup>11,12</sup>

Marine debris can severely impact biodiversity in a number of ways, the fatal ways being, through entanglement in, or ingestion of, debris items (including microplastics) by individual organisms or

<sup>2</sup>Sutherland, W. et al. 2010. A horizon scan of global conservation issues for 2010. *Trends in Ecology and Evolution* 25: 1-7.

<sup>3</sup>Gold, M. et al. 2014. Stemming the tide of plastic marine litter: A global action agenda. 27 *Tul. Env'tl. L.J.* 165 2013-2014.

<sup>4</sup>Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel-GEF. 2012. Impacts of marine debris on biodiversity: current status and potential solutions. Montreal, Technical Series No. 67, 6p. (and references therein), <https://www.cbd.int/doc/publications/cbd-ts-67-en.pdf>.

<sup>5</sup>Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel – GEF. 2012. Impacts of marine debris on biodiversity: current status and potential solutions. Montreal, Technical Series No. 67, 61 pp. (and references therein), <https://www.cbd.int/doc/publications/cbd-ts-67-en.pdf>.

<sup>6</sup>Barnes, D.K.A. et al. 2009. Accumulation and fragmentation of plastic debris in global environments. *Phil. Trans. R. Soc. B* 364: 1985-1998.

<sup>7</sup>Koelmans, A.A. et al. 2014. Plastics in the marine environment. *ET & C Perspectives. Environmental Toxicology and Chemistry* 33: 5-10.

<sup>8</sup>Inherent toxicity: hazardous chemical ingredients of plastics which can be the plastic monomers themselves or chemical additives; Acquired toxicity: adsorption of hazardous (persistent, bioaccumulative and toxic) chemicals and metals from seawater onto the surface of plastic debris.

<sup>9</sup>Ivar do Sul, J.A. and Costa, M.F. 2014. The present and future of microplastic pollution in the marine environment. *Env. Poll.* 185: 352-364.

<sup>10</sup>Browne, M.A. et al. 2008. Microplastic – an emerging contaminant of potential concern? *Int. Env. Assess. and Manag.* 3: 559-561.

<sup>11</sup>Occhipinti-Ambrogi, A. (2007). Global change and marine communities: Alien species and climate change. *Marine Pollution Bulletin*, 55, 342-352.

<sup>12</sup>Molnar, J., Gamboa, R. Revenga, C. & Spalding, M. (2008). Assessing the global threat of invasive species to marine biodiversity. *Frontiers in Ecology and the Environment*, 6, 485-492.

communities at large, through facilitation of the transport of organisms via rafting on marine debris, through the provision and/or introduction of new habitats for colonization, and finally through effects at an ecosystem level. Impacts vary depending on the type and size of the marine debris items and the organisms that encounter it. There are two major sources of marine debris that have been identified: land based sources and ship based sources. Ship based sources formed the crux of early concerns about marine debris and mainly include waste dumped at sea from commercial vessels such as cruise ships, as well as disposal from fishing vessels<sup>13</sup>. Land based sources are more varied, and is known to have several pathways by which this debris can enter the sea. The main pathways include the rivers and storm drains, and a smaller amount is transported by wind<sup>13</sup>. The most common sources have been identified as shoreline and recreational activities, ocean/waterway activities, smoking related activities, dumping activities and medical/personal hygiene<sup>14</sup>. A further source of debris comes from natural disasters, such as hurricanes and tsunamis<sup>15</sup>.

Shipping comprises about 90 percent of world trade by volume, and they contribute approximately twelve percent of the total marine pollution that arises from human activities on the ocean. These include shipping operations as well as the associated port activities that have the greatest potential impact on the marine environment. Some of these adverse effects include discharge of ballast water; the use of antifouling paints; disposal of marine debris; disposal of waste materials and sewage; dredging and the disposal of dredged waste (spoil); oil spills from routine activities or accidental incidents; spills of hazardous materials including chemical and radioactive materials; physical damage to marine habitats by ships' hulls (e.g. grounding); noise emissions; and air emissions. However the potential impacts are usually greater for inshore waters and in and around the port areas where complex ecosystems exist and there is a comparatively low water exchange rate.

The global importance of the marine debris problem was reflected in the resolutions by the UN General Assembly on oceans and the Law of the Sea. At its 65th session, the UN General Assembly urged states to support measures aimed at prevention, reduction, and pollution control of any source of marine debris. A resolution also called on states to cooperate regionally and sub-regionally to implement joint prevention and recovery programs for marine debris (A/65/L.20). The significant developments including the endorsement by the UN General Assembly of "The future we want", the Outcome Document of the United Nations Conference on Sustainable Development<sup>16</sup> (also known as the Rio+20 Conference) marked the most significant steps in bringing ocean pollution in general, and plastic debris pollution in particular, to the forefront of global priorities for sustainable development (A/66/L.56). The Rio+20 Outcome Document reaffirmed the concern for the health of the oceans and marine biodiversity, which is being negatively impacted by marine debris. It also committed nations to take action based on collected scientific data, by 2025 in order to achieve significant reductions in marine debris to prevent harm to the coastal and marine environment (para 163). Furthermore, the document recognized the importance of adopting a life cycle approach, and of further development and implementation of policies for resource efficiency and environmentally sound waste management. It called on nations to develop and enforce comprehensive national and local waste management policies, strategies, laws and regulations, including those pertaining to plastic waste (para 218). With the endorsement by the UN General Assembly of the Rio+20 Outcome Document, measures to address marine debris were included among global priority actions to assure sustainable development. There are multiple global legal instruments and voluntary agreements aimed at the prevention and management of marine debris, both on land and sea. Currently, the most applicable overarching legal framework addressing marine debris is provided by the United Nations Convention on the Law of the Sea (UNCLOS). It entered into force in 1994 calling for the protection of the entire marine environment from all sources and types of marine pollution, including marine debris.

A wide range of non-governmental organizations (NGOs) are focusing efforts on marine debris prevention, reduction, and clean up in the seas and shores, including Algalita Marine Research Foundation, 5 Gyres Initiative, International Coastal Cleanup by Ocean Conservancy, Project Kaisei, Plastic Pollution Coalition, Surfriders, Dyer Island Conservation Trust, Marine Conservation Society, World Wildlife Fund, Project

<sup>13</sup>Ryan, P., Moore, C., van Franeker, J. & Moloney, C. (2009). Monitoring the abundance of plastic debris in the marine environment. *Philosophical Transactions of the Royal Society B* 364, 1999-2012.

<sup>14</sup>Ocean Conservancy 2010. *Trash Travels: From our hands to the sea, around the globe, and through time.* International Coastal Cleanup Report, 2.

<sup>15</sup>Thompson, R.C., Moore, C., Andrady, A., Gregory, M., Takada, H & Weisberg, S. (2005). New directions in plastic debris. *Science*, 310, 1117.

<sup>16</sup>UNEP Press Release: UN and Partners Launch Global Partnership on Marine Litter at Rio+20 (<http://www.unep.org/newscentre/default.aspx?DocumentID=2688&ArticleID=9184&l=en>)

Aware, and many others. The International Coastal Cleanup by Ocean Conservancy is the largest global volunteer effort to clean up beaches, but also to address the sources and distribution of marine debris globally. Recognition that the problems and solutions to issues relating to marine litter are broad and have their roots on land is also emphasized by the recent STAP report, Marine Debris as a Global Environmental Problem<sup>17</sup>.

## Conclusion

Marine debris represents a significant threat and is an escalating anthropogenic adverse factor affecting both marine habitats and biodiversity considering the numbers of species, numbers of individuals as well as the substantial proportion of the populations affected. In situations where population level effects of marine debris are combined with other equally if not more significant anthropogenic stressors, it seems highly possible that marine debris could also contribute to extinction at species level, particularly where IUCN Red List species are concerned.

Furthermore, the consequences of marine debris on species and individuals may also have indirect effects on trophic interactions and on assemblages, something which will be particularly significant if and when keystone species are affected. While it is difficult to completely isolate the impacts of marine debris from other anthropogenic factors that are also adversely affecting marine biodiversity, various studies have proved beyond doubt that marine debris should be acknowledged as a major additional factor contributing to the extensive degradation of marine environments. Strategies for prevention at source, producer responsibility, and raising greater awareness have been identified as being instrumental in minimizing further increases in marine debris and its associated impacts. Control of sources of marine debris is an issue which can benefit from a broadly based framework approach focused on prevention. There are numerous policies, programs and instruments which have been successfully used in waste management and recycling programs. These measures can be effectively used in reducing debris at points of origin and in improved life cycle management. The attitude of non-adherence to standards laid down for the protection of marine environment is responsible for its destruction. Towards this goal, re-educating citizens, ship owners and crew, oil and shipping companies, and other corporate bodies, of the need to be concerned and responsible for respecting and protecting the marine environment is necessary to mitigate if not prevent marine pollution.

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<sup>17</sup>STAP. 2011 Marine Debris as a Global Environmental Problem: Introducing a solutions based framework focused on plastic. In A STAP Information Document. , pp. 40. Washington, DC: Global Environment Facility.