

IMPACT OF MARINE LITTER ON SEA LIFE: A REVIEW

Stelios Katsanevakis^{1*} and Yiannis Issaris¹

¹ Hellenic Centre for Marine Research - skatsan@ath.hcmr.gr

Abstract

Marine litter (i.e., any manufactured or processed solid material that enters the marine environment) is a greatly underestimated component of marine pollution. Herein the impact of marine litter on sea life is reviewed. The entanglement of marine species, especially marine mammals, seabirds, turtles, fish, and crustaceans has been frequently described as a serious mortality factor. Marine species may ingest litter items, which has many harmful effects on their physical condition and survival. Other impacts include toxic contaminants entering food webs, assistance of the invasion of alien species, altering the structure of benthic biocommunities, and damage to coral reefs and coral facies.

Keywords: *Plastics, Pollution, Mortality*

Marine litter (or marine debris) is any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment from any source [1]. Although there are various types of litter, plastics (synthetic organic polymers) make up most of the marine debris worldwide. Most marine litter originates from land-based activities, and the main sources include storm water discharges, municipal landfills located near the coast, riverine transport of waste from landfills and other sources, discharges of untreated municipal sewage, unregulated disposal of litter due to absence of waste services or landfills, tourism, all types of vessels, offshore oil and gas platforms, and aquaculture installations. Litter densities that reach many thousands or even millions of items per hectare have been reported on the seafloor or along beaches [2]. Mediterranean is among the areas with the highest reported marine litter densities [2].

A direct threat to marine life is entanglement in loops or openings of floating or sunk marine litter. The most problematic marine litter for entanglement appears to be lost or discarded fishing gear, six-pack plastic rings, and packing strapping bands. Entangled animals may get killed by drowning, suffocation, or strangulation. Even if they manage to survive, entangled animals may suffer restricted efficiency of movement and swimming, and thus an impaired ability to catch food and avoid predators, whilst their demand for food may increase significantly due to elevated energetic costs [3]. Entanglement could cause lacerations and infections from the abrasive or cutting action of attached litter. In addition, entangled animals may exhibit altered behavior patterns that place them at a survival disadvantage [4].

The entanglement of marine species in marine litter, especially marine mammals, seabirds, turtles, fish, and crustaceans, has been frequently described as a serious mortality factor. Derelict or discarded fishing gear may continue to fish for years, a process that has been termed 'ghost' fishing. Many marine species interact with marine litter as a result of their normal behavior patterns and suffer by high rates of entanglement. Entanglement in marine litter has been reported for at least 20 pinniped species, i.e. 61% of existing species worldwide, at least 14 cetaceans: six species of baleen whales and eight species of toothed whales, and all seven species of marine turtles (Table 1).

The impact of entanglement in marine litter on marine populations is difficult to quantify as unknown number of marine animals die at sea and decompose without being recorded. Animals that become entangled and die may quickly sink or be consumed by predators at sea, eliminating them from potential detection. Some endangered species may be very rare and their detection quite difficult, so that entanglement incidents to marine litter are scarce and almost impossible to detect even with intense sampling efforts. Hence, the estimated mortality rates and the effects on the population dynamics of many affected species are probably underestimated [2].

Many marine species such as marine mammals, seabirds, marine turtles, and fish have been reported to ingest marine litter, especially plastics. Ingestion of marine litter may occur either because of misidentification of litter as natural prey or accidentally during feeding and normal behavior. The most serious effects of ingested litter are the blockage of the digestive tract and internal injuries by sharp objects, which may be a cause of mortality. Other harmful effects include blockage of gastric enzyme ingestion, diminished feeding stimulus, nutrient dilution, reduced growth rates, lowered steroid hormone levels, delayed ovulation and reproductive failure, and absorption of toxins [5]. At least 32 species of cetaceans (43% of existing species worldwide) and all species of marine turtles have been reported to ingest marine litter (Table 1).

All Mediterranean marine mammals and marine turtles have been reported to either ingest or get entangled in marine debris, i.e. the Mediterranean monk seal (entanglement), all three marine turtles, and all 14 cetaceans that either have permanent populations or are occasionally observed in the Mediterranean (entanglement: 8/14; ingestion: 13/14).

Plastics may release toxic chemicals when ingested because of the chemical additives they contain. Several additives like nonylphenols, polybrominated diphenyl ethers, phthalates, and bisphenol A are used as plasticizers or are added to plastic during production to give it desirable properties. Furthermore, plastics have the potential to absorb hydrophobic pollutants like PCBs and DDT from seawater. There is great concern about the possible transfer of these toxic pollutants to marine organisms due to plastic ingestion [5], [6].

Other known impacts of marine litter include altering the structure of benthic communities [7], causing damage to coral reefs and coral facies [8], and assisting invasions of alien species [9].

Tab. 1. Species of marine mammals and turtles with records of entanglement (EN) or ingestion (IN) of marine litter. Species with permanent populations or occasionally observed in the Mediterranean are marked with an asterisk

Taxon	Affected species by marine debris
Pinnipeds	<i>Arctocephalus australis</i> (EN), <i>Arctocephalus forsteri</i> (EN), <i>Arctocephalus gazella</i> (EN), <i>Arctocephalus philippii</i> (EN), <i>Arctocephalus pusillus</i> (EN), <i>Arctocephalus townsendi</i> (EN), <i>Callorhinus ursinus</i> (EN), <i>Eumetopias jubatus</i> (EN, IN), <i>Haliastur grypsus</i> (EN), <i>Hydrurga leptonyx</i> (EN), <i>Mirounga angustirostris</i> (EN, IN), <i>Mirounga leonina</i> (EN), <i>Monachus monachus</i> * (EN), <i>Monachus schauinslandi</i> (EN), <i>Neophoca cinerea</i> (EN), <i>Otaria flavescens</i> (EN), <i>Phoca groenlandica</i> (EN), <i>Phoca vitulina</i> (EN), <i>Phocartos hookeri</i> (EN), <i>Zalophus californianus</i> (EN)
Cetaceans	<i>Balaena mysticetus</i> (EN, IN), <i>Balaenoptera acutorostrata</i> * (EN, IN), <i>Balaenoptera edeni</i> (IN), <i>Balaenoptera physalus</i> * (IN), <i>Berardius berardii</i> (IN), <i>Delphinus delphis</i> * (IN), <i>Eschrichtius robustus</i> (EN), <i>Eubalaena australis</i> (EN), <i>Eubalaena glacialis</i> (EN), <i>Globicephala macrorhynchus</i> (IN), <i>Globicephala melas</i> * (IN), <i>Grampus griseus</i> * (EN, IN), <i>Hyperoodon ampullatus</i> (IN), <i>Kogia breviceps</i> (IN), <i>Kogia simus</i> (IN), <i>Lagenorhynchus albirostris</i> (IN), <i>Lagenorhynchus obliquidens</i> (IN), <i>Lissodelphis borealis</i> (IN), <i>Megaptera novaengliae</i> * (EN), <i>Mesoplodon densirostris</i> (IN), <i>Mesoplodon europaeus</i> (IN), <i>Mesoplodon stejnegeri</i> (IN), <i>Neophocoena phocoenoides</i> (IN), <i>Orcinus orca</i> * (EN, IN), <i>Phocoena phocoena</i> * (EN, IN), <i>Phocoenoides dalli</i> (EN, IN), <i>Physeter macrocephalus</i> * (EN, IN), <i>Pontoporia blainvilliei</i> (IN), <i>Pseudorca crassidens</i> * (IN), <i>Sotalia fluviatilis</i> (IN), <i>Sotalia guianensis</i> (IN), <i>Stenella attenuata</i> (IN), <i>Stenella coeruleoalba</i> * (EN, IN), <i>Steno bredanensis</i> * (IN), <i>Tursiops aduncus</i> (IN), <i>Tursiops truncatus</i> * (EN, IN), <i>Ziphius cavirostris</i> * (IN)
Turtles	<i>Caretta caretta</i> * (EN, IN), <i>Chelonia mydas</i> * (EN, IN), <i>Demochelys coriacea</i> * (EN, IN), <i>Eretmochelys imbricata</i> (EN, IN), <i>Lepidochelys kempi</i> (EN, IN), <i>Lepidochelys olivacea</i> (EN, IN), <i>Natator depressus</i> (EN, IN)

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