Marine debris – the global problem least studied in India

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The accumulation of macro- and micro-debris is a growing concern in the oceans and coastlines all over the world. However, the debris characteristics, accumulation and transport pathways along the Indian coastline remain poorly studied. Marine debris is not just an aesthetic problem; it poses a serious threat to marine organisms, ecosystems, human health and navigational safety. Despite the increased international attention, the build-up of these materials along the Indian coastline and coastal waters is poorly understood or reported. Since the debris problem is global, curbing the issue in our coasts is not a single-step process. Nevertheless, assessment and monitoring of this debris along the beaches, coastal waters and on the seabed is crucial for understanding the dynamics of debris movement and subsidence.

Marine debris in the environment

Marine debris has been defined as 'any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned in the marine environment'[1]. Almost all anthropogenic products have the potential to become marine debris if not disposed of properly. Although marine debris includes items made from plastic, glass, metal, wood and rubber, plastic has become increasingly dominant in marine litter as it has in the market for consumer goods. Plastics are often inexpensive, lightweight, strong, durable and corrosion-resistant, with high thermal and electrical insulation properties[2], and these very properties have made them persistent and easily driven by winds and currents over long distances[3]. Dramatic increases in coastal populations coupled with inadequate waste management plans have led to an enormous input of plastics into the marine environment[4]. While recreational beach-going activities are an important source of marine debris reaching the ocean[5], much of the marine debris originates from land, including mismanaged waste, littering in cities and coastal settlements, and is blown into the water or carried by rivers, storm drains and sewers[6]. The other sources of marine debris are sea- or ocean-based activities such as litter disposal from merchant, cruise, fishing, military and research vessels; offshore oil and gas platforms, drilling rigs and aquaculture installations.

According to the United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution, land-based sources can account for up to 80% of the world's marine pollution[7]. To understand the potential effects of plastic debris, large-scale and long-term monitoring is needed across environments and size ranges of the debris. The debris items can broadly be divided into macro-debris (>20 mm diameter), meso-debris (5–20 mm) and micro-debris (<5 mm)[8]. Globally, plastic debris poses serious threats through entanglement or ingestion by wildlife, distributing invasive and potentially harmful organisms, absorbing toxic chemicals and degrading to microplastics that may subsequently be ingested[9]. In addition to the already known harmful effects of plastic debris, it is now realized that these items may also transport persistent organic pollutants[10] and distribute algae associated with red tides[11]. Discarded and derelict nets and fishing lines lead to the serious problem of 'ghost fishing', causing entanglement and affecting populations of marine birds, fish, turtles and mammals, besides causing loss of revenue to the fishing industry[12]. To understand the presence and effects of this persistent marine debris around the country, we need further surveys and observations of spatial and temporal pattern of marine debris accumulation along our coastlines.

Debris studies – Indian scenario

The marine debris quantification and reporting is comparatively poor from India vis-à-vis other countries. While coastal clean-up activities happen periodically along the urban beaches, the published data are in the form of reports from NGOs and other voluntary groups, and do not follow any reliable and consistent methodology. The first report on the presence of plastics in India was in 1982, along the Caranzalem beach of Goa. The study found that plastic pellets were abundant on the beach in areas near plastic-manufacturing factories, cargo-loading docks and shipping lanes for raw plastic materials due to the improper cargo handling and disposal[13]. In 2003, unusual quantities of marine debris were reported along the Great Nicobar Island and the study speculated that this was due to improper handling of the solid waste in adjacent foreign countries[14]. The impact of ship-breaking and marine debris accumulation along the Gulf of Cambay was studied in 2006 and the debris items were categorized into different polymer groups[15].

A study that quantified plastic litter along five sandy beaches of Karnataka[16] revealed that the beaches on the southwest coast of India mainly consist of plastics used for food and fishing purposes. In 2011, the most common debris type was reported to be plastic in the northern Gulf of Mannar region on the southeast coast of India[17]. The impact of various anthropogenic activities along the coastline at Veraval, Mumbai, Mangalore, Kochi, Tuticorin, Mandapam, Chennai and Vishakapatnam was studied by monitoring several parameters, including quantity of plastics and other non-biodegradable materials[18]. The most recent study with a standard methodology for assessing the quantity of plastic debris occurring on recreational beaches in Mumbai appeared in 2013, and reported the seasonal changes in the debris load[19]. Even though some research is being carried out on our coastline, none of them focuses on quantifying the debris based on its type. Also, India being the second largest producer of fish in the world, contributing to 5.68% of global fish production with 3.44 million metric tonnes of marine catch between 2013 and 2014 (ref. 20), and as there is a growing dependency on fishing as a livelihood preference, there is a dire need for estimating the loss in revenue due to ghost fishing based on standardized methods. Interestingly, no efforts have been made so far towards understanding the quantities and the environmental impacts of microscopic plastic beads which are present in most of the consumer products such as body and face scrubs[21]. From the locational extent of the research carried out so far and from their objectives, it is evident that there is still a huge gap in knowledge which limits a complete understanding of the marine debris issue and its ecological, human and economic impacts at the national level.

Need of the hour

The marine debris problem arises as a cumulative consequence of ignorance of the quantities of debris, its threats to the marine environment, and lack of environmental awareness. Since debris enters the marine environment through various pathways, the vastness of the ocean, patchiness in the distribution of debris, and spatial and temporal variability add to its complex life cycle[22]. Hence following a more standardized scientific monitoring protocol for this debris is of utmost necessity to understand the source, distribution, abundance, pathway and impact of debris on a local, national and global scale. Above all, to develop an approach to combat marine litter, understanding the quantity, type and distribution of the debris will play an important part[23]. In order to compare the debris data in context with local to global scale, a standard methodology and reporting should be practised[24]. The NOAA Marine Debris Program has developed standardized, statistically valid methodologies for conducting rapid assessments of the debris material type and quantity present along the shoreline, surface water and on the seabed[1]. Although India is bound to the United Nations Convention on the Law of the Sea, MARPOL convention, Basel convention and other international treaties, there have to be rigorous monitoring protocols to regularly assess the implementation and enforcement of existing regulations and standards. Cooperation and collaboration at the local, regional, national and international level are necessary. Practising different simple management actions like use of degradable and reusable plastics, creating public awareness, careful handling at pre-production and industrial site, regulating source reduction schemes such as bans and fees, regular beach clean-up activities, and regulating and minimizing plastic debris load from shipping and other sea-based activities can help reduce an enormous amount of litter load to the marine environment[1,25,26]. A combination of legislation and the enhancement of ecological consciousness through education is likely to be the best way to solve the marine debris problem. The general public and the scientific community have the responsibility of ensuring that governments and businesses change their attitudes towards the debris problem.

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