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Plastic Pollution of the Marine Environment 13941-01-2025

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ABSTRACT

Plastic pollution is a massive issue which is being imposed on marine and coastal ecosystems by human beings on the entire planet. The issue is growing with more waste being produced by humans, which kills the functionality of ecosystems and their advantages. Plastic waste has terrestrial and aquatic sources. The current review elucidates various aspects of plastic pollution in marine and coastal ecosystems. Plastic is present in different forms and sizes, including megaplastic, macroplastic, mesoplastic, and microplastic. Microplastics, either directly synthesized or degraded from large plastics, are ubiquitous in the ocean, water, sand, and even inside animals. The water can contain a concentration of microplastic ranging from 0.001 to 140 particles per cubic meter, and in the sand it can range from 0.2 to 8766 particles per cubic meter, varying with the location. The marine and coastal organisms may contain a concentration of microplastic ranging from 0.1 to as high as 15,033 counts. This contamination has several undesirable impacts on the environment, society, and economy. It also provides new habitats where toxic species can breed, and that is unwanted to biodiversity and nutrition. Environmental and ecosystem changes can result in the loss of valuable services and benefits. It impacts tourism, fishing industries, shipping, and human health. We need to prevent

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more plastic from getting in, implement the 3Rs (Reduce, Reuse, Recycle), raise awareness among people, and hold industries accountable. International, regional, and domestic legislation and policy is needed in curbing plastic waste in oceans and coastlines. Conducting research and developing new solutions to fill in the gaps in our understanding can assist in developing more effective ways of managing this environmental issue.

Keywords: Environmental Management, Pollution, Plastic Sources, Ecological Health, Ecological Restoration, Marine Biology

Introduction

The ocean and the area surrounding it are dynamic areas that have a lot of various things, like coral reefs and sea grass. They are life-filled and inhabited by a lot of various species of animals, from older species like horseshoe crabs to newer ones like dolphins. The ocean surrounds around 71% of the Earth's surface. But the oceanic realm is divided into five great oceans and some seas, as per history, culture, geography, science, and size. The five great ocean basins the Atlantic, Pacific, Indian, Arctic, and Antarctic are the most well-known ones and have been deeply affected by human beings. The Southern Ocean that encircles Antarctica was officially declared to be the fifth ocean by the International Hydrographic Organization. All of these bodies of saltwater help the environment and economy, and they improve the quality of human life. Fresh water like streams and rivers run into the sea and ocean and create peculiar bodies of water like estuaries and lagoons. The continental shelf is where saltwater and freshwater mix to create a special coastal area. Marine and coastal systems offer several useful services and values to society and other living organisms. Some of the services and values include the provision of food, materials, and medicine, water purification, and climate regulation, support of life, and the delivery of pleasures and cultural values. These services are useful both to society and to the environment. As these ecosystems hold significant contribution to the health of human beings, this paper will focus on the hazards that are emerging and being generated by human beings within the marine ecosystem. This will assist in the process of prevention and managing the oceans in a sustainable way (Reddy et al., 2018).

Marine and coastal ecosystems add a myriad of valuable attributes that are beneficial

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to human well-being and the well-being of all living things, with or without a backbone. They impact in a thousand different manners, including to supply food, resources, and drugs, filtration of water and regulation of the weather, to keep life alive by producing oxygen and keeping places safe for animals to grow , live and entertainment and cultural activities. They are just so important to the environment and the economy. However, these ecosystem play such an integral role in human health, this review looks at the new threats that are being brought into the ocean environment by humans. This is an important aspect of moving in the correct direction to preserve and manage the ocean sustainably (Adams, 2005; Richmond, 2015).

The land and the ocean converge, so whatever happens to one has implications for the other. Over many years, a wide range of factors, some of which are manmade, have placed pressure on oceanic and coastal regions (Rosevelt et al., 2013; Nualphan, 2013). They include pollution and environmental degradation. Among the most devastating consequences caused by man's activities is the proliferation of waste and refuse in the sea from the uninhibited growth and development. Plastic, in contrast to other wastes like glass, paper, metal, or food waste, is especially hazardous. Plastic has the ability to float on the sea for a very long time and is water- and wind-borne. Approximately five trillion pieces of plastic waste float on the surface of the ocean with a weight of over 260,000 tons because of poor waste management. Plastic pollution is now a big issue in nearly every corner of the oceans in both developing and developed countries (Eriksen et al., 2014).

Causes of the Accumulation of Plastic

Plastic pollution enters the aquatic ecosystem directly and indirectly from numerous sources. Terrestrial sources as well as marine sources play significant role in generating marine and coastal plastic pollution in one way or another. The principal land sources of plastic contamination include freshwater sources, household activity and daily life, tourism, and other economic activities such as in ports. More than 75% of plastic garbage in the ocean originated from land (Andrady, 2011). Coastal regions are where a majority of human beings reside, and these regions are also economically advanced with ample industry. Consequently, there are numerous industrial and several activities being conducted here. Individuals residing on the

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coast might apply air sprays or cosmetics, and these products contribute plastic directly to the coastal environment. Occasionally, the plastic containers find their way into wastewater or drainage. Studies conducted by Browne et al. (2007) indicate that the majority of plastic trash still leaves such treatment systems. Subsequently, the plastic ends up entering freshwater systems such as rivers and streams or even leach into groundwater and reach the ocean. Current water habitats such as rivers eliminate plastic trash to accumulate along coastal regions. For instance, waste plastic from two coastal sites is found in the sea along the California coast and up to two billion pieces of plastic may drain into the ocean within three days (Moore, 2008). Polluted river basins are the major source of microplastic deposition in South American Goiana Estuary (Lima et al., 2014).

In addition, Thushari et al. (2017b) affirmed that domestic practices and domestic waste in coastal regions are primary contributors of local accumulation of waste deposition. Based on reports, tourism activities and recreation remain a principal source of plastic materials found in ocean and coastal waters. Thushari et al. (2017b) affirmed that more than 60% of beach litter along the east coast of Thailand is generated from tourism and recreational activities. Beach plastics become part of the sea as microplastics or as small fragments of plastic (Cole et al., 2011). Plastic fragments and pellets were identified as pollutants in northeast Brazil. The plastic litter is primarily caused by the disintegration of large plastic on the beach, while the pellets are from activities in nearby port terminals (Costa et al., 2010). The second potential source of plastic pollution is the ghost fishing fleet, which is reported in research (Ivar do Sula et al., 2013).

Plastics may either be primary or secondary plastics that flow into the sea. Pieces of plastic such as megaplastic or macroplastic can be left as big pieces, or fragmented into tiny pieces known as microplastics after a period. Primary microplastics are small right from the start, while secondary microplastics are created when large plastics degrade through activities such as waves, wind, or water. Some of these heavier plastics remain on the surface of the ocean, and some sink to the bottom of the ocean because they are too heavy. Large plastics tend to deteriorate into small pieces due to causes such as fragmentation, degradation by sunlight, mechanical breakdown, and chemical degradation. It's important to

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understand how plastics deteriorate because it tells us where they end up and how they change in size. That is why it is important to study this subject thoroughly. Microplastics are too small to a point that even by using a microscope, they can only be observed, as cited by (Hartmann et al. in 2019).

Consequences of plastic pollution on the environment in each ecosystem Animals themselves are also greatly affected due to large pieces of plastic. Gall and Thompson (2015) opined that over 13,000 animals that belonged to 208 species and over 30,000 animals that belonged to 243 species were entangled in or ingested massive plastic. The majority of the entanglements occurred when animals became ensnared in fishing nets or plastic fibers that were employed for fishing. Swallowing primarily occurred when the animals ingested small amounts of plastic. Entanglement, nevertheless, is more prevalent on the beach and in the sea than swallowing. Swallowing and entanglement are lethal or injurious even if the animal does not die. Due to such issues, sea animals perish or are injured. Some of the other negative effects are having a hard time finding food, not being able to reproduce, loss of sense, not being able to run away from predators, less frequent migration, slower growth, and illness. Sea turtles, marine mammals, and birds are most vulnerable. Some of the affected species are green sea turtles, hawksbill turtles, fulmars, sea lions, seals, puffins, albatrosses, right whales, and greater shearwaters. Hong et al. (2013) reported that nearly half of the northern fulmar seagulls contained over 0.1 grams of plastic waste in their stomachs. 83% of a Norway lobster species called Nephrops norvegicus contained plastic thread within them (Murray and Cowie, 2011).

Critically endangered, endangered, vulnerable, or near-threatened IUCN Red List species are also affected by the build-up of plastic trash. 49% of hook and line and lobster trap in Florida Keys injured or killed sessile marine animals. Chiappone et al. (2005) observed a 84% increase in litter fishing using line and hooks, injuring animal organisms such as jellyfish and sponges and containing toxic as well as harmful effects. Nicely working chemicals including Bisphenol-A (BPA), flame retardants, monomers, oligomers, metal ions, and antibiotics are used to mix with plastics. These toxic compounds can accumulate in the bodies of aquatic organisms, which absorb plastic unintentionally (Lithner et al., 2011). Plastic flame retardants and phthalates impact mollusks, mammals, and fish (Teuten et al., 2009; Oehlmann

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et al., 2009). It is revealed from research that plastic phthalates and BPA are able to produce a drastic impact on the reproductive system of the organism, genetic mutation, and development (Oehlmann et al., 2009).

These natural or food-borne toxins are very lethal. Plastic also holds toxic chemicals that remain active in the environment for decades. They are known as Persistent Organic Pollutants (POPs), which are very resistant to degradation. POPs comprise old pesticides such as DDT, by-products of production processes such as dioxins such as Polychlorinated Dibenzo-p-Dioxins (PCDD) and Dibenzo Furans (PCDF), and industrial chemicals such as Poly-Chlorinated Biphenyls (PCB). Plastic collects such types of chemicals much more so than seawater around it. Plastic waste, if exposed to such chemicals, can release such toxic chemicals into the body of sea animals when ingested. Metal ions and antibiotics have been shown to absorb to plastics as well. Microplastics and one of an antibiotic, Sulfamethoxazole (SMX), are commonly seen quite often in water systems. They become interactive to each other under the conditions of the environment. SMX will adsorb on microplastics and equilibrate after approximately 16 hours. Sulfamethazine (SMT), another antibiotic, will adsorb on six microplastics, polyethylene (PE), polypropylene (PP), polyamide (PA), polyethylene terephthalate (PET), polystyrene (PS), and polyvinyl chloride (PVC). However, the adsorption of SMX and SMT by microplastic is based on parameters such as pH and salinity (Guo et al., 2019b, 2019c). These potent antibiotics have their damaging impact on the environment with their potency to influence living organisms and kill bacteria (Dlugosz et al., 2015). Under water, in the presence of antibiotics, distortion of the microbial equilibrium by promoting the development of antibiotic-resistant bacteria can be triggered. This can be the reason for critical human and other water lives' health risks (Baran et al., 2011; Hoa et al., 2011).

Global-Scale Initiatives

United Nations General Assembly and others like the Law of the Sea are global initiatives to address ocean problems. The UN Convention on the Law of the Sea (UNCLOS) is a legal framework that addresses how plastic pollution would be handled. Specifically, Articles 207 and 211 of UNCLOS talk about marine pollution, specifically reducing and preventing the introduction of plastic waste into the sea.

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They are also trying to control the land and sea pollution. The UN General Assembly has provided informative statements that have helped in the preservation of the oceanic environment. These include the plastic pollution reporting, its effects on nature, human, and the economy and linking these activities to national agendas. The Convention on Migratory Species (CMS) has also intervened, such as determining where sea trash is most concentrated, studies on the impact of plastic and other litter on marine life, determining ways to reduce trash at the regional scale, and designing national plans for averting litter-borne contamination of the seas. Scholars also suggested investigation of how waste impacts wildlife that moves across different areas, investigation of emerging challenges in connection to public knowledge concerning ocean waste, and determination of optimal practices concerning waste management on ships and ships. While waste management and plastic pollution are alike, there isn't any single international law or treaty that specifically addresses waste management (Thevenon et al., 2014).

While many global initiatives have been directed towards waste management either directly or as a component of pollution prevention and control, no single international law or treaty has a specific goal of waste management. UNEP council, resolution 25/8, opted to take a pragmatic path to managing waste. They chose to implement a national policy with the subtopic of "transitions from a conventional end-of-pipe strategy in waste management to an integrated waste management strategy" (UNEP, 2011). The solutions to problems like plastic waste in the ocean and plastic pollution are directly connected to waste management practice. Because of this, it has been suggested to have an internationally harmonized waste management program that can tackle these issues. Basel Convention is among the strongest international legislation related to hazardous waste and disposal. Plastic solids are also hazardous waste and can be liable for severe harm to human health (UNEP, 2005).

The Basel Convention in 2008 initiated the Bali Declaration on the topic "Waste Management for Human Health and Livelihoods." The declaration is aimed at improving waste management practices. Since plastic waste is a component of hazardous waste, plastic pollution management goes hand in hand with the Basel Convention. Then, in 2010, the Global Partnership on Waste Management (GPWM)

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of UNEP started working with international and non-governmental organizations on waste management as a way of combating plastic pollution in the ocean. GPWM activities that were to be carried out included the identification of the problems, proposing solutions for reducing such problems, dissemination of research, mobilization of international participation and support, creation of awareness, securing political support, facility planning, and capacity building for waste handling.

Regional Initiatives

Region-wise, UNEP's Regional Seas Program organized activities for 13 regions: Mediterranean Sea, Baltic Sea, Black Sea, Caspian Sea, East Asian Seas, Red Sea, Eastern African Sea, South Asian Sea, Wider Caribbean Sea, Northeast Atlantic Sea, Gulf of Aden Sea, Northwest Pacific Sea, and Southeast Pacific Sea. Clean-ups were organized in all these regions as part of an international campaign. The European Union's Framework Directive for Marine Strategy started in 2008 and aims to reduce marine litter on the regional level. The directive is aimed at sustainable use of the resources in maintaining the integrity of ecosystems through an Ecosystem-Based Approach. It is a common effort of all the European countries. Each of the member countries is mandated to scrutinize its maritime areas and set goals that must be attained by 2020. Interventions are also set to facilitate the achievement of these objectives. South Korea embarked on a ten-year project tackling marine litter, which entailed surveying, monitoring, problem identification, prevention, removal, treatment, and recycling for ten consecutive years, as reported by the GEF in 2012. Elsewhere, like in Hawaii and South African coastlines, there was a project for collection of lost fishing gear that was conducted with the help of NOAA/MDP. Researchers also suggest studying the spread of plastic pollution in the estuary ecosystems of South America for better management plans, as suggested by Chen in 2015 and Costa and Barletta in 2015 and 2016. Barletta et al. in 2019 also suggested creating conservation plans for South American estuaries on the basis of seasonality, waste storage or reusing, and its effect on the food web for the entire estuary region. They also proposed the re-introduction of tidal and river forces as the most suitable method to support the ecosystem to recover by improving the environment in South America's estuarie(Storm et al., 2005; Slater, 2016).

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National-Level Initiatives

The majority of the national legislation discusses how we handle solid waste and lower our waste production, particularly plastic that ends up on the ocean and beaches. There are two significant legislations in America, which are the Marine Debris Research, Prevention, and Reduction Act and the Marine Plastic Pollution Research and Control Act. They both seek to prevent plastic pollution in the United States. South Korea employed the Practical Integrated System of Marine Debris from 1999 to 2009 to discourage the accumulation of marine trash. Scotland suggested a plan referred to as the Scottish Marine Litter Strategy in 2013. New law was enacted in Sri Lanka in 2017 to regulate the utilization of plastic, such as polythene. The law was enforced under National Environmental Act No. 47 of 1980 and the 19th amendment. These include: (i) banning production of polythene items 20 microns and thinner in thickness, food packets, high-density polythene bags, and expanded polystyrene items; (ii) burning ban of plastic and other waste materials; and (iii) ban on plastic decoration. Also included are the Marine Pollution Prevention Act No. 35 of 2008 in Sri Lanka which assists in regulating and preventing marine pollution. Marine Environment Protection Authority, or MEPA, is the central organization established by the Sri Lankan government under this act. MEPA has the mission of combatting pollution in Sri Lanka's marine environment. With other plastic pollution on the increase, alien invasions, oil spills, ballast water, and shipping, MEPA revised its Policy Strategies and National Action Plan for the protection of the marine environment with the help of IUCN between August 2017 and January 2018. The plan is mainly aimed at the war against plastic pollution in the Sri Lankan marine environment as a significant challenge.

Reuse, Recycle, and Reduce (the 3Rs) are sustainable ways to reduce plastic pollution. The 3Rs of plastic waste i.e., Reduce, Reuse, and Recycle play a crucial role in the elimination of places being plastic. Various strategies have been created to assist in this mission. One of the principal methods of assisting is in cutting back on packaging and plastic, which is the primary component of EPR (see the section titled EPR and producer responsibility for additional information). Procedures taken by organizations and people who manufacture or utilize plastic can do a great deal of reducing and reusing plastic. Such actions can be carried out by individuals or

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organizations to assist in conserving plastic from being dumped in the ocean. Organizations that produce and provide goods are requested to observe green programs while conducting their businesses. Eco-labeled products help consumers choose products that are environmentally friendly and cause less pollution. There are more than 25 member programs of the Global Eco-Labeling Network (GEN) to help create a world free of plastic. Ten countries use 43 types of greener packaging labels (GEN, 2019) to show their attempt at reducing plastic pollution at a national level. New Zealand also gives eco-labels to recyclable plastic products. Green packaging and green products can be promoted by using environmentally friendly and non-polluting green procurement. Reducing packaging and recycling are therefore essential in green procurement. Biodegradable plastic packaging is another alternative for certain products (Mudgal et al., 2012) in order to minimize plastic waste. As an alternative, rewarding people in cash or in goods will encourage people to recycle and gather plastic. If such initiatives are encouraged at national, regional, and international levels, they will likely offer additional economic advantages to society beyond preventing plastic waste from accumulating in the ocean and coastal areas.

Conclusion

Marine and coastal ecosystems are complex and dynamic systems that assist nature and the economy to advance the standard of human life. However, nowadays oceans and most coastlines are being degraded due to many natural and human processes. Urbanization and industrialization are huge reasons for pollution produced by human beings, for example, additional plastic waste in the sea and along the coast. Estuaries are among the most important coastal biomes and are impacted by plastic pollution to a great degree. Plastic pollution is now of both direct and indirect nature. They are land and water based. Plastic waste collects together with other toxic substances like persistent organic pollutants, antibiotics, and heavy metals and does a lot of harm to the environment. Plastic waste collection ruins the environment and is harmful to human life and economic activity in numerous various ways. However, the economic and environmental effects of plastic pollution heavily rely on each other.

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References

Adams, S. M. (2005). Assessing cause and effect of multiple stressors on marine systems. Marine Pollution Bulletin, 51, 8–12.

Andrady, A. L. (2011). Microplastics in the marine environment. Marine Pollution Bulletin, 62, 1596–1605.

Baran, W., Adamek, E., Ziemiańska, J., & Sobczak, A. (2011). Effects of the presence of sulfonamides in the environment and their influence on human health. Journal of Hazardous Materials, 196, 1–15.

Barletta, M., Lima, A. R. A., & Costa, M. F. (2019). Distribution, sources and consequences of nutrients, persistent organic pollutants, metals and microplastics in South American estuaries. Science of the Total Environment, 651, 1199–1218.

Browne, M. A., Galloway, T. S., & Thompson, R. C. (2007). Microplastic – an emerging contaminant of potential concern? Integrated Environmental Assessment and Management, 3, 559–561.

Chen, C. L. (2015). Regulation and management of marine litter. In M. Bergmann, L. Gutow, & M. Klages (Eds.), Marine Anthropogenic Litter (pp. 395–428). Cham: Springer.

Chiappone, M., Dienes, H., Swanson, D. W., & Miller, S. L. (2005). Impacts of lost fishing gear on coral reef sessile invertebrates in the Florida Keys National Marine Sanctuary. Biological Conservation, 121, 221–230.

Cole, M., Lindeque, P., Halsband, C., & Galloway, T. S. (2011). Microplastics as contaminants in the marine environment: a review. Marine Pollution Bulletin, 62, 2588–2597.

Costa, M. F., & Barletta, M. (2015). Microplastics in coastal and marine environments of the western tropical and sub-tropical Atlantic Ocean. Environmental Science: Processes & Impacts, 17, 1868–1879.

Costa, M. F., & Barletta, M. (2016). Special challenges in the conservation of fishes and aquatic environments of South America. Journal of Fish Biology, 89, 4–11.

Costa, M. F., Ivar do Sul, J. A., & Silva-Cavalcanti, J. S. (2010). On the importance of size of plastic fragments and pellets on the strandline: a snapshot of a Brazilian beach. Environmental Monitoring and Assessment, 168, 299–304.

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

Dlugosz, M., Zmudzki, P., Kwiecien, A., Szczubialka, K., Krzek, J., & Nowakowska, M. (2015). Photocatalytic degradation of sulfamethoxazole in aqueous solution using a floating TiO_2-expanded perlite photocatalyst. Journal of Hazardous Materials, 298, 146–153.

Eriksen, M., Lebreton, L. C. M., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., … Reisser, J. (2014). Plastic pollution in the world's oceans: more than five trillion plastic pieces weighing over 250,000 tons afloat at sea. PLoS ONE, 9(12), e111913.

Gall, S. C., & Thompson, R. C. (2015). The impact of debris on marine life. Marine Pollution Bulletin, 92, 1–2.

GEF. (2012). Impacts of marine debris on biodiversity: Current status and potential solutions. Montreal: Secretariat of the Convention on Biological Diversity & STAP.

GEN. (2019). Global Ecolabelling Network (GEN). Retrieved from https://globalecolabelling.net

Guo, X., & Wang, J. L. (2019b). The chemical behaviors of microplastics in marine environment: a review. Marine Pollution Bulletin, 142, 1–14.

Guo, X., Chen, C., & Wang, J. L. (2019c). Sorption of sulfamethoxazole onto six types of microplastics. Chemosphere, 228, 300–308.

Hartmann, N. B., Huffer, T., Thompson, R. C., Hassellöv, M., Verschoor, A., Daugaard, A. E., … Wagner, M. (2019). Are we speaking the same language? Recommendations for a definition and categorization framework for plastic debris. Environmental Science & Technology, 53, 4678–4679.

Hoa, P. T. P., Managaki, S., Nakada, N., Takada, H., Shimizu, A., Anh, D. H., … Suzuki, S. (2011). Antibiotic contamination and occurrence of antibiotic-resistant bacteria in aquatic environments of northern Vietnam. Science of the Total Environment, 409(15), 2894–2901.

Hong, S., Lee, J., Kang, D., Choi, H., & Ko, S. H. (2013). Impacts of marine debris on wild animals in the coastal area of Korea. Marine Pollution Bulletin, 66, 117–124.

Ivar do Sul, J. A., Costa, M. F., Barletta, M., & Cysneiros, F. J. A. (2013). Pelagic microplastics around an archipelago of the Equatorial Atlantic. Marine Pollution Bulletin, 75(1–2), 305–309.

Online ISSN 3007-3197
Print ISSN 3007-3189

Lima, A. R. A., Costa, M. F., & Barletta, M. (2014). Distribution patterns of microplastics within the plankton of a tropical estuary. Environmental Research, 132, 146–155.

Lithner, D., Larsson, Å., & Dave, G. (2011). Environmental and health hazard ranking and assessment of plastic polymers based on chemical composition. Science of the Total Environment, 409, 3309–3324.

Moore, C. J. (2008). Synthetic polymers in the marine environment: a rapidly increasing, long-term threat. Environmental Research, 108, 131–139.

Mudgal, S., Muehmel, K., Hoa, E., Gremont, M., & Labouze, E. (2012). Options to improve the biodegradable requirements in the Packaging Directive. Brussels: DG Environment – European Commission.

Murray, F., & Cowie, P. R. (2011). Plastic contamination in the decapod crustacean Nephrops norvegicus. Marine Pollution Bulletin, 62, 1207–1217.

Nualphan. (2013). Types and sources of marine debris in Bang Saen Beach, Chonburi Province [Master's thesis, Chulalongkorn University].

Oehlmann, J., Schulte-Oehlmann, U., Kloas, W., Jagnytsch, O., Lutz, I., Kusk, K. O., … Tyler, C. R. (2009). A critical analysis of the biological impacts of plasticizers on wildlife. Philosophical Transactions of the Royal Society B: Biological Sciences, 364, 2047–2062.

Reddy, M. T., Natarajan, S., Venkateswaran, K., Someswara, R. P., Neelam, S., & Nilamani, D. (2018). Classification, characterization and comparison of aquatic ecosystems in the landscape of Adilabad district, Telangana, Deccan Region, India. OALib Journal, 5, e4459.

Richmond, R. H. (2015). Coral reefs: present problems and future concerns resulting from anthropogenic disturbance. Integrative and Comparative Biology, 33(6), 524–536.

Rosevelt, C., Los Huertos, M., Garza, C., & Nevins, H. M. (2013). Marine debris in central California: quantifying type and abundance of beach litter in Monterey Bay, CA. Marine Pollution Bulletin, 71, 299–306.

Slater, F. M. (2016). Ecotones, ecoclines and eco-perturbations: the aquatic flora and fauna of the S'Albufera Natural Park, Majorca. Mediterranean Journal of Bioscience, 1, 120–127.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
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Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

Storm, C., van der Velden, J. A., & Kuijpers, J. W. M. (2005). From nature conservation towards restoration of estuarine dynamics in the heavily modified Rhine–Meuse estuary, The Netherlands. Archiv für Hydrobiologie, 155, 305–318.

Teuten, E. L., Saquing, J. M., Knappe, D. R., Barlaz, M. A., Jonsson, S., Björn, A., … Takada, H. (2009). Transport and release of chemicals from plastics to the environment and to wildlife. Philosophical Transactions of the Royal Society B: Biological Sciences, 364, 2027–2045.

Thevenon, F., Carroll, C., & Sousa, J. (2014). Plastic debris in the ocean: The characterization of marine plastics and their environmental impacts, situation analysis report. Gland, Switzerland: IUCN.

Thushari, G. G. N., Senevirathna, J. D. M., Yakupitiyage, A., & Chavanich, S. (2017b). Effects of microplastics on sessile invertebrates in the eastern coast of Thailand: An approach to coastal zone conservation. Marine Pollution Bulletin, 124, 349–355.

UNEP. (2005). Marine litter: An analytical overview. Nairobi: United Nations Environment Programme.

UNEP. (2011). Towards a green economy: Part II Waste, Investing in Energy and Resources Efficiency. Nairobi: United Nations Environment Programme.