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Impact of Marine Pollution Threats and Conservation of Marine Biodiversity

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Abstract

Ocean occupies 71% of earth's surface and is traditionally divided into four large basins including North and South Atlantic, North and South Pacific, Arctic and Indian oceans. In India we have a vast coastal area of 7516.6 km from Kolkata to Gujarat and also many islands including Andaman and Nicobar and Lakshadweep with vast fin and shellfish biodiversity. Human interference and both natural and artificial factors pose the biggest threat to the marine ecosystem. These days, various pollutants generated by human activity have a major negative impact on marine environments. The significance of the marine ecosystem, the state of the marine biodiversity, the marine protected area, the activities of natural and human-induced species that impact the biodiversity, and conservation tactics were all covered in this review. The pollutants also seriously affect the marine flora, fauna and disturb the food chains. Natural radiation, storms, waves (including cyclones), volcanic lava, tsunamis, vertical movement of ocean waters, global warming, and freshwater runoff were a few of the factors that were discussed. Discussions were also held regarding the human-related anthropogenic activities that included oil spills, hazardous heavy metals, persistent toxic substances (PTS), radiation, thermal discharges, ship-based hazards, harmful algal blooms, plastics and microplastics, ocean acidification, solid wastes, coastal tourism, ballast water, and marine littering. Ultimately, the tools, bylaws, and act were discussed in relation to biodiversity and environmental conservation. The public must strictly observe the laws governing maritime and coastal activities. The laws and acts including Indian port act 1902, Water act 1974 (prevention and control of pollution), Wildlife protection act 1972, Fisheries Management and Conservation Act – 1976, National Marine sanctuaries Act of 1972, Clean Water Act of 1977, Environment protection act 1987 and Endangered Species Act, Indian fisheries act 1987, Marine zones of India act 1987, Oceans Act of 2000 and Estuaries and Clean Waters Act of 2000 etc.

Keywords Conservation, marine biodiversity, marine protective area, pollution

INTRODUCTION

The marine ecosystem, which comprises living and non-living elements, is essential to maintaining life on Earth and acts as the main climate regulator for terrestrial ecosystems. Living organisms such as parasites, predators, rival species, and others are referred to as biotic components. Temperature, salinity, turbulence, density, sunlight, and nutrient concentration are examples of abiotic components [15]. This environment includes Open Ocean, seafloor areas, shoreline regions, sandy areas, coastal areas, estuaries, lagoons, coral reefs, saline marshes, and mangrove forests, among others. The pelagic ecosystem is the most efficient in terms of productivity and boasts the highest level of diversity, while it is also highly responsive to changes in the environment [20]. Benthic ecosystem has lower productivity levels compared to the open ocean and shows a reduced diversity. India boasts an extensive shoreline exceeding 7,500 kilometers, and its oceanic assets are distributed across the

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Indian Ocean, Arabian Sea, and Bay of Bengal. Many species in India's vast marine ecosystem are supported by it, and the coastal population depends on its resources [3].

Status of Marine Biodiversity

Marine biodiversity is about the variety and number of different species found in the world's oceans and seas. It can also be investigated at various scales of biological structure, ranging from genes, species, functional categories; environments to entire ecosystems [12]. They provide the entire spectrum of ecosystem services that benefit people locally, regionally, and globally. They are the fundamental basis for the composition and operation of ocean ecosystems. They serve as the crucial base upon which ocean ecosystems are built and operate, offering all the diverse services that support human well-being at the local, regional, and worldwide levels. The benefits including many visible and un-visible services including oxygen for breathing, storing blue carbons, sea food we eat, nutraceuticals, medicines and protecting shorelines etc. There are about 238,165 accepted marine species described in the World Register of Marine Species database (WoRMS, http://www.marinespecies.org/) [11]. A vast array of coastal ecosystems, including lagoons, sandy stretches, backwaters, estuaries, mangroves, salt marshes, coral reefs and rocky coasts are found in India, which boasts a 8,129-kilometer coastline and an exclusive economic zone spanning 2.02 million square kilometers, all of which are characterized by distinct biotic and abiotic processes and properties [19]. It depicts a total of 18,135 species from the faunal and floral communities reported from the seas around India. The data reveal that India contributes 7.33% to global marine biodiversity [14].

Marine Protective area and Protective Species

Marine protected Area (MPA) is a section of ocean specifically set aside for the preservation and upkeep of biodiversity, along with natural and related cultural assets, and governed by legal or other efficient methods [4]. In order to protect sea grass beds, mangroves, rock platforms, reefs, shipwrecks, salt marshes, tidal lagoons, mudflats, underwater areas and archaeological sites, on the coast and the seabed in deep water, as well as open water, MPAs include marine parks, nature reserves, and community-controlled coastal zones [9]. Marine Protected Areas offer numerous advantages for fishing industries, nearby economies, and the ocean ecosystem, such as the preservation of diverse life forms and habitats; halting and potentially turning around the worldwide and regional drop in fish numbers and their ability to produce by safeguarding essential spawning, nursery, and feeding areas; creation of dispersal hubs for the distribution of young fish to fisheries, and enhanced social and economic results for nearby communities, including assistance in maintaining the stability of fisheries, among others. Currently, 16,430 marine species have been assessed by the International Union for the Conservation of Nature (IUCN) Red List, with 1,358 species listed as vulnerable, endangered, or critically endangered [11]. In India, 730 areas including Wildlife Sanctuaries, National Parks, Conservation Reserves and Community Reserves have been designated as protected areas in order to preserve the natural environment and wildlife. Due to the decline in their natural populations, the marine fauna of six phyla including Porifera, Coelenterata, Arthropoda, Mollusca, Echinodermata, fish, reptiles, and mammals are classified into several categories (Schedules I, II, III, and IV) [14]. To safeguard the environmentally significant regions, the Indian Government took steps by collaborating with state governments to establish a network of Marine Protected Areas (MPAs) through the Wildlife (Protection) Act, 1972.

Marine Biodiversity Threats

Human interference and both natural and artificial factors pose a threat to the oceanic environment. Natural phenomena that impact the marine biodiversity either directly or indirectly include storms, waves, including cyclones, natural radiation, volcanic lava, tsunamis, and freshwater runoff [3]. Natural factors have the power to alter the pH or temperature of the ocean, which can have an impact on the availability of nutrients, biological productivity, reproductive success, biogeography, migration patterns, community structure, predator-prey relationships, and even entire biomes [5]. The vertical movement of ocean waters, or upwelling and down-welling, will be influenced by changes in wind and water circulation patterns in the ocean environment [17]. Extreme wave action brought on by strong winds destroys a great deal of plant and animal life and destroys coral into rubble [14]. Numerous

oceanic processes and ocean chemistry are changing due to global warming, threatening many marine animal species that are unable to adapt to the rising temperatures [18]. Marine mammals like ice seals and polar bears are impacted by the melting of Arctic sea ice, which is a result of rising air and ocean temperatures. Normally, the oceans absorb carbon dioxide from the atmosphere naturally by acting as a carbon sink. On the other hand, the oceans become more acidic as atmospheric carbon dioxide levels rise. Acidity affects a calcareous formation in shellfish and corals [1]. Invasion of nonnative or invasive species is a major natural threat to native species. Being a nonnative species, they occupy the habitat of a native species and absorb or use the local nutrient cycle, which may cause species competition that leads to the death or destruction of the natives. Ozone depletion has caused increased UV radiation that affect the productivity of phytoplankton is reduced due to the radiation in surface waters, which will affect the entire marine ecosystem, especially the coral reef ecosystem. Typhoons, earthquakes, and tsunamis can all be attributed to storms and wave energies. These are the natural catastrophic events that may cause the destruction of marine biodiversity [14].

Excessive fish and shellfish harvesting (including bycatch) caused by human activity will alter the species composition of prey and predators as well as the balance of the entire food chain, in addition to reducing the size of fisheries resources [3]. The reproduction of marine animals is impacted by excessive mangrove plant cutting. The normal biodiversity will be severely impacted by the overuse or illegal exploitation of marine animals for oil extraction or medicinal purposes. There will be significant harm to fisheries resources and biodiversity if the Wedge Bank is disturbed for oil extraction [16]. Ship anchoring, overfishing for cement factories, and decorative aquarium embellishments can all have an impact on coral beds. These days, a variety of pollutants caused by human activity have a major negative impact on marine biodiversity. For phytoplankton and zooplanktons, small fish, and birds, hydrocarbon compounds from oil spills such as alkenes, naphthalenes, benzenes, xylene, and polycyclic aromatic hydrocarbons are extremely toxic [7]. Heavy metals generated from various industries including mercury, lead, copper, nickel, cadmium and copper enriched anti-fouling paints have a severe negative impact on marine life by causing a variety of deformities [6]. The water discharged from thermal power plants and nuclear reactors depletes oxygen; the altered or low level of oxygen disrupts the level of degradation and causes suffocation, which has an impact on animal migration and primary productivity [8]. Elevated temperatures can disrupt the food chain by causing the release of immature eggs, preventing normal development, increasing metabolic rate, and activating enzymes [10]. The productivity is impacted by excessive nutrient and hydrogen sulfide inputs from freshwater bodies, which upsets the food chain. Mass mortality results from noise pollution caused by passing ships, seismic surveys conducted for oil exploration, and low-frequency active sonar used by the navy [13]. The typical biodiversity is threatened by operational and accidental pollution discharges from ships, including sewage, tank residues, bunker oils, trash, and ballast water. Benthic organism habitat is disturbed when portions of the seafloor are removed for ocean mining purposes. Throwaway plastic bags, six-pack rings, and other plastic debris threaten fisheries and kill seabirds and turtles. Microplastics released by detergents and cosmetics have an impact on human and fish reproduction. Microplastic debris is now observed in mother milk, blood, and placenta. Fish behavior, sediment degradation, and other processes are impacted by microplastics [2].

Conservation Remedies and Marine Acts

On all scales, conservation seeks to preserve or restore the diversity of genetics, populations, species, habitat, communities, and ecosystems [11]. Laws pertaining to fisheries, wildlife, coastal, environmental, and forests all provide different forms of protection for marine areas. But no single tool can offer reliable defense by itself. Developing a plan to preserve marine diversity requires an understanding of the many aspects of coastal ecosystems, including environmental processes, resource flow, and conflict dynamics [18]. To preserve and protect marine biodiversity from anthropogenic and natural disturbances, a number of actions are required. It is time to put an end to the overuse and illegal capture of fisheries and other animals for food, medicine, and other purposes. It is recommended that fishermen and fishing vessels follow the legislation pertaining to fisheries and take action to stop illegal fishing. Illegal cutting down of mangrove forests and hunting of threatened species must stop.

Nearly all of the biodiversity may be preserved if different pollutants brought about by human activity are stopped or reduced. To make the public and student body aware of the deplorable consequences of marine biodiversity impacts and destruction, the government must educate them about laws pertaining to the environment and the marine environment. The coastal and marine laws including Indian Port Act of 1902, Water Act of 1974 (which addresses preventing and controlling pollution), Wildlife Protection Act of 1972, National Marine Sanctuaries Act of 1972, Merchant Shipping Act of 1974, Fisheries Management and Conservation Act of 1976, Clean Water Act of 1977, Coast Guard Act of 1978, Indian Maritime Zones (Regulation of Fishing by Foreign Vessels) Act of 1981, Environment Protection Act of 1987, The Indian Fisheries Act of 1987 and Marine Zones of India Act of 1987 must strictly follow by the public. Coastal Regulation Zone (CRZ), Endangered Species Act, Oceans Act of 2000, Estuaries and Clean Waters Act of 2000 and Biological Diversity Act, 2002 additionally adhere to rigorously. Another crucial and effective criterion for addressing the pollution issues is awareness, particularly among the general public and school students. Due to the fact that young people in school assume responsibility for the public, families, and allied communities in regards to marine pollution and future conservation efforts, etc. Another important strategy for preventing pollutants from entering clean water bodies through effluents is waste management. It is recommended that industries establish appropriate waste treatment facilities, reduce waste in order to implement appropriate measures, recycle and reuse waste, and recover wastewater effluents.

CONCLUSION

We have the power to restrict or reduce pollution; by doing so, we can protect the environment and preserve it for future generations. Bringing reusable, biodegradable bags to the grocery store, reducing, reusing, and recycling waste materials, raising awareness among friends and family, limiting the use of plastic bags, and picking up and disposing of various types of litter at the appropriate location are just a few pollution prevention strategies that can be implemented. Severe waste recycling in all sectors of the economy will protect marine life and keep pollutants out of freshwater and the ocean.

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