Hazards of Marine Pollution to Marine Organisms and Measures to Mitigate the Hazards

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Abstract. Marine pollution is a pressing global issue that has garnered increasing attention in recent years due to its detrimental effects on marine ecosystems and the urgent need for mitigation measures. This paper aims to provide a comprehensive analysis of the sources of marine pollution, the harmful effects on marine life, and potential solutions to address this critical problem. This article emphasizes the need for immediate action to combat marine pollution. While previous studies have examined specific types of pollutants, this paper takes a comprehensive approach, considering multiple sources of pollution and their diverse impacts on marine organisms. By analyzing the sources and effects of pollution, this paper aims to raise awareness and provide effective solutions to mitigate the ongoing damage. The research conducted in this paper serves as a valuable resource for policymakers, environmental organizations, and individuals concerned about the health of our oceans. By understanding the sources and impacts of marine pollution, stakeholders can implement targeted measures to mitigate pollution and promote sustainable practices. The findings of this study contribute to the growing body of knowledge on marine pollution, providing insights and recommendations for future research and policy development. Ultimately, the significance of this research lies in its potential to drive positive change and inspire collective efforts to protect marine life and preserve the invaluable resources provided by our oceans.

Keywords: Marine pollution; international governance; environmental monitoring; water pollution strategy.

1. Introduction

Marine pollution has become an increasingly serious global problem, posing a major threat to marine ecosystems and human health. This study aims to comprehensively analyze the major sources of marine pollution, assess the impacts of various pollutants on marine organisms and propose effective mitigation measures. By drawing public attention and calling for action, the study aims to protect and preserve our marine environment. Despite numerous studies on marine pollution, there is still a lack of comprehensive overviews that include different pollutants and their far-reaching effects on various marine organisms. Existing studies usually focus on specific types of pollutants, such as plastics or heavy metals. This paper aims to fill this gap by examining multiple sources of pollution, including plastics, oil spills, agricultural runoff, and sewage discharges. By considering the cumulative effect of these pollutants, seek to elucidate the complex ways in which biological and chemical processes are disrupted in the oceans, thereby jeopardizing the survival of many marine species. For example The cumulative effect of pollutants refers to the combined and progressive impact of multiple pollutants on organisms over time, resulting in The cumulative effect of pollutants refers to the combined and progressive impact of multiple pollutants on organisms over time, resulting in increased harm or disruption to their health, physiological functions, and overall well-being.

First, this paper will identify several major pathways by which pollutants enter the oceans. These include improper disposal of plastic waste, accidental or intentional oil spills, agricultural runoff containing fertilizers and pesticides, and untreated sewage discharges. Understanding these pathways will enable us to understand the complex mechanisms that lead to the release of pollutants into the marine environment. This paper will then examine the harmful effects of these pollutants on a variety of marine organisms, from tiny plankton to majestic whales. These effects manifest themselves in a variety of ways, including entanglement and ingestion of plastics by marine animals, as well as

poisoning and asphyxiation from oil spills. These impacts extend throughout the marine food web, disrupting the ecological balance and jeopardizing the resilience of marine ecosystems.

2. Sources of Marine Sewage

The ocean is one of the world's most important natural resources, providing opportunities for human economic and agricultural development. However, while the ocean brings sustainable economic development to human beings, a large number of pollutants from human production and life enter the sea, and the accumulation of domestic garbage along the coast, the reckless discharge of domestic sewage, the pollution of oil and organic matter caused by industrial production and experimental bases, nuclear leakage, etc., bring fatal threats to the marine ecosystem. Marine environmental pollution mainly comes from the discharge of land-based pollutants, among which industrial waste, urban household garbage and agricultural farming pollutants account for more than 80% of land-based pollutant discharge.

2.1. Land-based Pollution Flows into the Ocean

In the process of industrial production, the sewage discharged into the ocean through various channels is called land-source pollution, which has a wide range of pollutants, a large number of pollutants, and the largest pollution of the marine environment [1]. Before the 1970s, many countries in the world, such as the United States, supported the dumping of sewage and other types of waste into the ocean. In the long run, large amounts of polluting waste from sewers were found near beaches, as well as large amounts of household medical items such as syringes and tampons, among others [2]. In many old cities, it was common to adopt a combined flow system - a combined flow system is a drainage system that collects and conveys wastewater in the same pipe system, and is divided into direct-drain combined flow and intercepted flow combined flow. The direct-drain combined flow system is the oldest combined flow system, and its arrangement characteristics are similar to those of stormwater drains, which are old combined flow drainage systems that must be renovated due to their serious pollution of water bodies. The intercepted combined flow system is a system in which domestic sewage, industrial wastewater and stormwater, which are combined in street pipes and drains together to an interceptor trunk pipe along the river, all of which is conveyed to the sewage treatment plant on sunny days; on rainy days when the mixed volume of rainwater, domestic sewage and industrial wastewater exceeds the upper limit of the treatment capacity of the sewage treatment plant, resulting in sewage flowing into the ocean without being treated. The bacterial contamination in this sewage may cause the beaches to be suspended for sanitary reasons.

The interceptor combined sewerage system, in which the interceptor mains are built on the adjacent riverbank along with the overflow wells and the treatment plant. All wastewater from the day and the early stages of rainfall is sent to the treatment plant, where it is treated and discharged into the water body [3]. As the rainfall increases, so does the stormwater runoff, and when the flow of mixed effluent exceeds the capacity of the interceptor main, some of the mixed effluent is discharged directly into the water body and overflows the overflow wells, as shown in Fig. 1. Although most of the sewage can be treated, some of the mixed sewage is still discharged directly without treatment in rainy days, becoming a source of pollution in the receiving water body and causing pollution. If it does not flow directly into the city's wastewater treatment plant, stormwater flows directly into the water body, carrying many pollutants including sediment, grease, polycyclic aromatic hydrocarbons and heavy metals from the railroad tracks [2].

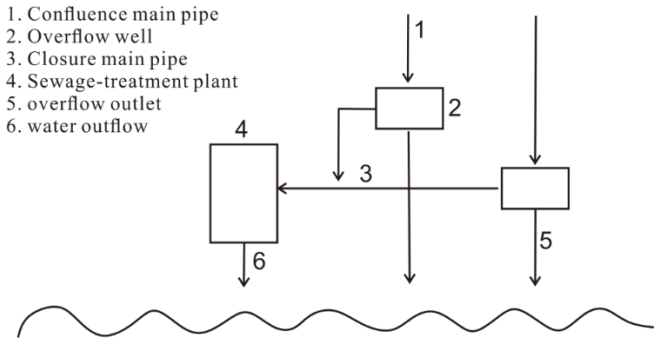


Fig 1. Mechanism of rainfall. (Picture credit: Original)

2.2. Garbage Pollution

The act of dumping garbage into the ocean through ships, air platforms or other tools to mitigate land-based environmental pollution can aggravate marine pollution, and by recycling, it will not only not improve the state of the environment, but also increase the damage to the environment [4, 5]. The large amount of plastic products flowing into the oceans has put tremendous pressure on the survival of marine life. The non-decomposable nature of plastic in the oceans makes the damage to the oceans long-term and can cause lasting damage in the areas concerned. This residual trash floats on the surface of the ocean and gathers together as the currents surge to the same location, creating a large area of trash pollution, the Pacific garbage island is a typical example.

2.3. Industrial Pollution

Industrial wastewater includes production wastewater, production sewage and cooling water, which refers to wastewater and waste liquids produced during industrial production. Industrial pollution includes many dimensions, such as marine ship pollution, marine construction pollution, and pollution caused by large accidents, etc.

Marine ship pollution - the long-term immersion of wooden structures such as quay piles and bulkheads in water is susceptible to corrosion and damage by microorganisms and wood-boring animals, including some mollusks such as wood-destroying water lice and ship maggots. To prevent these conditions, hull surfaces are often coated with highly concentrated, highly toxic compounds such as creosote and chromated copper arsenate. However, these compounds can escape from the wood and accumulate in the surrounding environment, causing poisoning of nearby plants and animals [2]. Antifouling coatings on ships are also toxic and are designed to reduce the adhesion of organisms such as barnacles and algae to the hull. The compounds released by this antifouling coating prevent these organisms in a floating state from attaching to the hull, and these compounds are also toxic to other organisms in the vicinity irgarol is widely used as a new antifouling coating, but it also exhibits significant toxicity to non-target organisms. The concentrations of Irgarol detected in the water column and sediments around the marina were sufficient to alter the phytoplankton community there.

Large-scale accidental pollution - Pollution caused by collisions and oil pipeline leaks while a ship is at sea is called accidental pollution, and a serious marine oil pollution accident occurred in 1976 when the tanker Tolikanion ran aground in the English Channel. It caused 11.8×104 t of crude oil to flow into the sea, resulting in serious pollution of 140km of the surrounding coast, the death of more than 25,000 seabirds and the failure of more than 50% of herring eggs to hatch, which seriously damaged the ecological balance. The accidental pollution is not frequent, but the damage caused by the accident is very extensive and can cause great harm to the surrounding organisms [2].

2.4. Agriculture and Aquaculture Pollution

Aquaculture is an industry that raises marine organisms for human consumption and is the use of agriculture in the sea. Fish farms have been found to be a source of pollution in local waters, with thousands of fish being concentrated in open nets, producing large amounts of feces [6-8]. This feces

sinks to the sea floor along with the food that the fish do not eat, affecting the environment, polluting the water and causing an overgrowth of plants and animals on the sea floor. “In areas such as South America, the abuse of antibiotics to maintain yields has led to a significant increase in bacterial resistance, which survives in the farmed organisms, causing harm to both the farmed organisms and the humans who eat them [2].

In traditional agriculture in Southeast Asia, farmers tend to use large amounts of pesticides on crops that are rooted in water, such as rice. This agriculture can end up in the ocean as the water drifts through the fields. The chemicals contained in pesticides that enter the ocean can lead to the overgrowth of plants and animals that exist underwater, causing harm to marine life.

3. Pollutant Hazards to Marine Life

Chemicals used in the agricultural and aquaculture industries flowing into the ocean can affect the environment, pollute the water column and lead to overgrowth of plants and animals on the sea floor. The nutrients in feed and fish waste that are not eaten by fish can cause local algae to overgrow, absorbing large amounts of oxygen in the process and causing the oxygen level in the water to drop, leaving plants without enough oxygen for respiration and photosynthesis resulting in lower and lower oxygen levels in the water.

The harm of chemicals to marine life is long-lasting. Chemicals enter aquatic animals through the skin, gills and digestive tract and are partially excreted by aquatic animals or filtered through the gills into the environment [9]. When the absorption rate exceeds the excretion rate, chemicals accumulate in the body. Chemicals that are poorly soluble and readily bind to sediment can accumulate to high concentrations in the body, especially in adipose tissue, and are less readily metabolized and excreted once absorbed by aquatic animals.

Pollutants in the ocean are constantly being transformed between producers and consumers in the food chain, and in the process, chemical compounds tend to become increasingly concentrated. This phenomenon is known as biomagnification, as shown in Fig. 2. It referring to the accumulation of substances in organisms at higher trophic levels. Consumers can have higher levels of toxic chemicals in their bodies than producers, and top predators at the top of the food chain such as sharks, whales and dolphins are often the biggest victims of these pollutants [10]. Biomagnification of contaminants in the marine food web is a complex process involving a variety of factors, including the chemical nature of the contaminants, the dietary habits of different organisms, and the physical and chemical conditions of the marine environment.

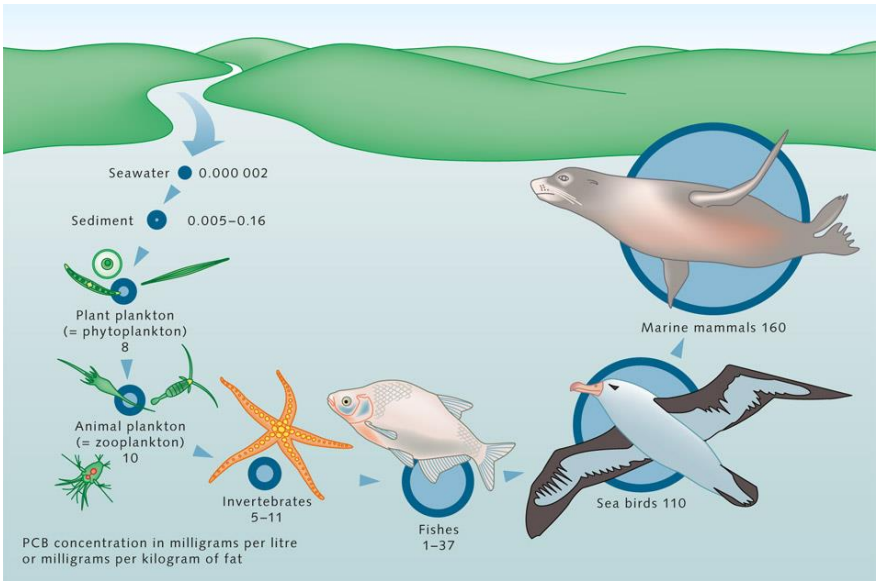


Fig 2. Phenomenon of biomagnification. https://worldoceanreview.com/en/wor-1/pollution/organic-pollutants/

Litter with toxic chemicals can disrupt the metabolic regulation of organisms and affect the immune system, as well as impair their ability to reproduce. Contaminants can also easily affect the behavior, development and physiology of organisms. Life is very fragile in its early stages and is very susceptible to the effects of pollutants. When life is exposed to certain hazardous substances in the early stages, the effects of these hazardous substances are not always immediately apparent, but may become apparent later or even years later. Polluting trash that does not carry toxic chemicals can affect the activities of marine life, as seen in recent years with the emergence of discarded fishing nets entangling large organisms in the ocean.

4. Marine Pollution Control Measures

The prevention and control of marine pollution to achieve good results is the premise of strict control of pollutant emissions, the ocean does not belong to a particular country or a particular region, the different standards of countries, different enforcement efforts make marine environmental law enforcement activities difficult to carry out smoothly [5].

If we want to strengthen ocean governance, we need to unify the enforcement force and enhance enforcement efforts. First, it is recommended that in the cross-regional and cross-sectoral integrated prevention and control mechanism of sea and land, the responsibilities and tasks of each department should be clarified, detailed work plans and implementation programs should be formulated, and effective communication and coordination mechanisms should be established. At the same time, the supervision and evaluation of marine environmental protection work should be strengthened to identify and solve problems in a timely manner to ensure the smooth implementation of the work [3]. Secondly, it is recommended to strengthen the training and specialization of law enforcement officers in the formation of marine environmental law enforcement teams to improve the level and capability of law enforcement. At the same time, the supervision and evaluation of enforcement work should be strengthened to ensure the legality and effectiveness of enforcement actions. In addition, it is recommended that the responsibilities and efforts of local environmental protection agencies be increased and their role in marine environmental management be given full play. In specific work, we should focus on strengthening cooperation with local governments, enterprises and social organizations to form a synergy and jointly promote marine governance, while implementing paid use of the marine ecological environment and using the revenue generated for marine environmental governance to enhance the management of the marine environment while maintaining it [11].

The source of the marine environment pollution problem lies in the lack of human awareness of the protection of the marine environment, for which we should start by improving the awareness of the masses of marine environment pollution prevention. Strengthen publicity and education. Through various media, such as TV, radio, newspapers, internet, etc., we can popularize the knowledge of marine environmental protection to the public and raise the public's awareness and consciousness of marine environmental protection. Strengthen the propaganda and enforcement of laws and regulations. This can be done by increasing the penalties for violations of the law and raising public awareness of the penalties for violations, thus achieving the goal of preventing and reducing violations.

5. Conclusion

Marine pollution is a growing concern worldwide, as the oceans are becoming increasingly contaminated with various forms of waste and chemicals. This pollution not only poses a threat to marine organisms, but also to human health, as many people rely on seafood as a primary source of protein. In this essay, we will explore the hazards of marine pollution to marine organisms, including the impact of plastic, chemicals, and oil spills on the marine ecosystem. We will also discuss measures that can be taken to mitigate these hazards, including sustainable practices to protect the ocean and its inhabitants. Additionally, we will focus on raising public awareness of marine conservation and the importance of protecting our oceans for future generations. One of the main sources of marine

pollution is the discharge of untreated or partially treated wastewater into the oceans. Sewage contains large amounts of organic matter, nutrients, pathogens and toxic pollutants that can reduce oxygen levels, spread disease and poison marine life. To solve this problem, governments and wastewater treatment plants need to invest in advanced treatment technologies and increase the wastewater treatment cycle. Tertiary treatment methods such as microfiltration and reverse osmosis can remove up to 99% of pollutants from wastewater. Wastewater treatment plants also need to be upgraded to handle increasing volumes of wastewater and higher concentrations of chemicals. Furthermore, treated wastewater can be reused for agricultural or industrial purposes to reduce discharges into the oceans. It is also necessary to introduce and enforce stricter regulations on wastewater discharge to hold polluters accountable. By improving wastewater infrastructure and maximizing water reuse, we can significantly reduce wastewater pollution in the oceans.

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