[1] [2] [3]Effects of Ship pollution in Marine Life

Rasik Akhtar Apon
Department of Naval Architecture and Marine Engineering
Military Institute of Science and Technology, Bangladesh
Email: rasikakhtar@gmail.com

Abstract:

In this review, we will show how the pollution from ship is affecting the animals of ocean. Some impacts and solution will be also discussed. Shipping moves over 80% of the world's commodities and transfers approximately 3–5 billion tons of ballast water internationally each year. Ballast is very important for modern ships for its safe voyage over one sea. It gives ship stability and provides balance. Ship is one of the important source of marine pollution. It pollutes ocean in many ways. The bilge, ballast and sewage of vessels have a great impact on the Marine life. Pollution from ships can come from various sources, such as oil spills, chemical discharges, garbage, sewage, emissions from the ship's engines and bunker fuel, as well as the anti-fouling paint applied to the hull. This pollution from ships is the main reason for the displacement of marine animals from their permanent habitats and cause for some species to disappear. Marine Animals in Danger from Ocean Pollution are: Florida Manatee, Seabirds, Hawksbill Turtle, Beluga Whales etc. Some species are dramatically changing their structure and their ecosystem function, which are harmful for native species. Noise pollution in sea from ship and other marine structures have a great impact on the life of sea. Research on the effects of noise pollution in marine environments has primarily centered on adult fish and mammals, which make up more than 50% and 20% of documented cases, respectively. Findings reveal that human-made noise can lead to auditory masking, resulting in cochlear damage, behavioral changes in both individuals and groups, disrupted metabolisms, reduced population recruitment, and ultimately harm the health and functioning of marine ecosystems.

Keywords
Ship pollution, marine life and environmental impact, marine ecosystem, pollutants, ballast water, oil spill, chemical discharge, biodiversity, toxicity, habitat degradation, regulations and policies, bioaccumulation, climate change, marine pollution control.

1. Introduction:

Marine plays a vital role in on the global shipping. Basic Human needs are also depended on the marine routes. Reason why it is important because cheaper, has more connection and higher efficiency. Each day, approximately 50,000 merchant ships operate across the world's oceans, handling the majority of global trade. This number includes cargo vessels, tankers, and container ships. Alongside merchant ships, thousands of fishing boats, cruise liners, and military vessels. It very difficult to alter the marine routes for shipping. However, we can reduce the marine pollution from ships.

Ships have carried solid ballast, in the form of rocks, sand or metal, for thousands of years. In modern times, ships use water as ballast. It is much easier to load on and off a ship, and is therefore more efficient and economical than solid ballast. When a ship is empty of cargo, it fills with ballast water. When it loads cargo, the ballast water is discharged. Shipping moves over 80% of the world's commodities and transfers approximately 3–5 billion tons of ballast water internationally each year. Ships' ballast water can carry a vast range of marine species anything small enough to pass through the ballast water intake ports and pumps. This includes bacteria, other microbes, small invertebrates, and the eggs, cysts, and larvae of various organisms. The issue is made worse because nearly all marine species go through one or more planktonic stages during their life cycle, making them easily transported in ballast water. Noise from the ship is increasing due to rapid increase of heavy engines and other machinery equipment in ship. Noise pollution affecting the fishes and other animals, which lives on the upper part of the sea. Marine fishes are changing their habitat and moving towards the deep sea.

2. Literature Review

Empirical studies, which analyze specific problems connected with the pollution of ships to the aquatic environment, have recorded serious quantities of some of the most harmful pollutants, which include oil spills, ballast water use, underwater sound, and emission of gases among others, which greatly disrupt the marine ecosystem. In this line, Gong et al. (2014) and Peterson et al. (2003) illustrate with studies that chronic oil pollution on a large scale can result in irreversible losses in the biodiversity of the marine environment affecting the reproduction and growth of different species and the health of the habitats of the species. Besides such acute events, there are severe indentations on the ocean due to chronic pollution from routine ship operations like illegal discharges of bilge water-which is usually overshadowed by disastrous incidents.

Mentioning from such sources, invasive species like zebra mussels dramatically disturb ecosystems and economies wherever they are introduced. Regions and countries who do not have uniform regulations in place for controlling ship pollution, however, experience such effects. Evidence of such limitations, perhaps unsurprisingly, relate to both enforcement and coverage; although, there remains attempts to furnish additional methods and strategies for the management of ship pollution.

3. Case Study

In 1989, the Alaskan coastal areas witnessed the worst marine pollution disaster in history, the Exxon Valdez oil spill, which released approximately 11 million gallons of crude oil into Prince William Sound. Its impact on the marine environment was witnessed both in the short term and in the long term. The oil spill had an estimated toll of 250,000 seabirds, 2,800 of the sea otters, and several central species of fish including populations of the Pacific herring which were gravely affected. Peterson et al. (2003) also reported that those who managed to survive the spill were disrupted as to their ways of reproduction and feeding, while Harwell and Gentile, 2006 explain that certain species were chronically exposed to low levels of oil that led to health complications, such as in the case of killer whales. It served to underline oil-spill response deficiencies, and since it also called for enhancement of maritime operations, it resulted in amendment of MARPOL which aims more at preventing oil pollution from ships. This example shows that oil spillages are not only damaging in the short term but can alter the ecosystem in many ways even in the long run and as such there is a serious need for proper waste management practices.

4. Types of Ship Pollution:

Main Ship pollutions on the sea is given below:

4.1 Ballast water

Ships take in ballast water to maintain stability during voyages, but when discharged in different regions, this water can introduce invasive species, bacteria, and pathogens. These organisms can disrupt local ecosystems, outcompeting native species and causing ecological imbalance

4.2 Oil Spills

Oil spills play a major threat on the environment of the ship. Ship spills oil in sea both accidentally and during operation. When oil spills in sea, it makes a layer of oil on the up of sea, which prevents the mixing of oxygen with water and going sunlight UV inside water. If any fished have, this oil and human eat them, there will be a serious health problem. The plans inside the water dies due to oil effect.

4.3 Sewage & Wastewater

Ship discharge most of its sewage and wastewater on the sea. They carry some harmful pathogenic bacteria and viruses that spread from one place to another in the water.

4.4 Marine Noise Pollution

The constant noise of ships' engines, propellers and sonar systems creates underwater noise pollution, which disturbs marine life, especially cetaceans such as whales and dolphins. These animals rely on sound for communication, navigation and hunting. Chronic noise exposure can lead to behavioral changes, stress and even stranding in some cases.

5. Impact on Marine Species:

Ship pollution produces a broad range of deleterious effects that build a different balance of marine ecosystems. These impacts have physiological, behavioral, and ecological natures that are triggered by the direct input of pollutants such as ballast water contaminants, chemical residues, and oil spills, whereas indirect effects from noise and air emissions. It basically deals with the biological effects of various types of ship pollution on marine organisms and, in detail, explains how these pollutants act in disrupting marine life.

5.1 Bioaccumulation and Bio-magnification of Toxic Substances:

Different types of marine pollutants are released from ships, such as heavy metals, through oil spills, ballast water, and antifouling paints. Toxic substances such as these can be ingested by marine organisms, creating bioaccumulation: the gradual process by which toxins build up in the tissues of individual organisms.
These become more concentrated in higher trophic levels-such as large predatory fish, marine mammals, and seabirds-through a process called bio-magnification as these contaminants make their way up the food chain. For example, PCBs have been shown to interfere with reproductive functions in marine mammals, while heavy metals can cause neurological damage and developmental abnormalities in fish and invertebrates. This puts a great health risk on species such as dolphins and humans consuming fish from contaminated waters because of bioaccumulation.

5.2 Physiological Stress and Mortality

Exposure to pollutants from ship activities can result in physiological stress for marine organisms. For example, oil spills coat marine species' bodies such as seabirds and marine mammals, which reduces their insulation and buoyancy by causing hypothermia, drowning, or impairment in hunting and feeding behaviors. In addition, hydrocarbons in oil may be resorbed by gills and skin, causing internal damage in fish such as liver, kidney, and reproductive failure.

These are the bases of the marine food web and consist of microorganisms and plankton, which are more sensitive to the presence of oil and chemical contaminants. Any disturbance at this level will move upwards within an ecosystem by affecting species higher in the chain. Moreover, sewage and gray water from ships release undue levels of nutrients into coastal waters, causing the process of eutrophication and creating hypoxic zones (dead zones) that deplete the water of dissolved oxygen. This in turn yields mass mortality of organisms that cannot move away from these regions, including benthic invertebrates and fish.

5.3 Interference with Reproductive and Developmental Processes

Many forms of contamination impede the reproductive output and early life stages of marine life. For instance, TBT was used in antifouling paints and has, since then, been shown to induce impose-a mingling of male characteristics on female organisms-in mollusks, leading to population declines in affected species. Similarly, the intake of EDCs from discharging wastewater from ships disrupts hormone regulation in fish and amphibians, altering their reproductive cycles and generally leading to a decline in fertility and abnormal offspring development.

Invasive species in ballast water discharge contribute further to reproductive problems. Many of these compete with native organisms for resources, or they prey on the local fauna or bring in new diseases, thereby reducing the successful reproduction of native organisms. For example, the zebra mussel, coming into the Great Lakes through ballast water, outcompetes native mussel species and creates ecological imbalances impacting a host of aquatic species.

5.4 Alteration of Behavior and Habitat Use

Generally, ship noise related to the engine and propeller action has brought about considerable changes in the behavior of aquatic species such as cetaceans-whales and dolphins-and fish. Many marine animals depend on sound for communication, orientation, hunting, and predator avoidance. Long-term noise pollution masks these critical acoustic signals, thus compelling the animals to change their behaviors. For instance, it includes changing whale vocalization by increasing the frequency or intensity of calls; this will involve a greater use of energy, possibly at the expense of reducing effectiveness in communication, especially in mating calls or group coordination.

In extreme cases, ship noise has been attributed to disorienting and stranding deep-diving species like beaked whales. Similarly, fish have been observed to abandon noisy habitats, disrupting feeding patterns and increasing predation risk as they move into less optimal environments. Chronic exposure to noise raises marine species' stress hormone levels, which can undermine immune function and reduce survival in the end.

5.5 Habitat Degradation and Ecosystem Shifts

Habitat degradation resulting from ship activities encompasses a variety of impacts, such as the physical destruction of habitats due to anchor damage, among others, chemical contamination, and introducing invasive species. This type of pollution usually emanating from ships tends to affect coral reefs and seagrass beds, major nursery areas for many marine species. Oil spills and chemical runoff associated with shipyards can smother corals, inhibit photosynthesis in seagrass, and lower overall biodiversity in such areas.

Second, there is a real possibility that invasive species can be transported in ballast water and cause great ecological changes. Such invasions can lead to new species dominating certain ecosystems, outcompeting native species, which in turn leads to modifications of food web structures and habitat loss. For example, the comb jellyfish Mnemiopsis leidyi was transported into the Black Sea via ballast water and collapsed local fisheries by outcompeting native fish for plankton, thereby initiating a trophic cascade of ecosystem changes.

5.6 Population Declines and Threats to Endangered Species

Cumulative impacts, such as bioaccumulation of toxins, degradation of habitat, reproductive difficulties, and disruption of behavior, ultimately

lead to population decline. Ship strikes, noise pollution, and habitat loss hugely threaten critically endangered marine mammals like the North Atlantic right whale and the vaquita porpoise. Continued exposure to ship pollution raises the risk for such species and their survival; it can really push them to the edge of extinction.

6. Impact of Invasive Species

The critical threat of invasive species to marine ecosystems occurs mainly via ships' ballast water. While transporting from one port to another, a ship takes on ballast water and discharges it, carrying with it a host of organisms-from bacteria and algae to invertebrates and larvae. These nonindigenous species often thrive in new environments where they have no natural predators and outcompete native species, disrupting local ecosystems. This has caused a loss of biodiversity, as in the case of zebra mussels in North America, which have greatly devastated native mussel populations and aquatic food webs. Other invasive species, like the comb jellyfish Mnemiopsis leidyi, have even caused fishery collapses because plankton depletions have disrupted entire food chains. Economically, invasive species may clog the infrastructures such as water intake pipes and cause damages to the local industries, especially fisheries. It can also act as a vector for transport of dangerous pathogens such as Vibrio cholerae thereby posing public health hazards. Due to these issues, IMO in 2004 formulated the Ballast Water Management Convention that imposed duties on ships to treat the ballast water onboard to decrease the risk of an invasive species being transported. Global efforts are still needed to help avoid any future invasions and manage the species already established.

7. Regulations and Mitigation Efforts

7.1 MARPOL Convention and IMO Regulations

MARPOL Convention by IMO has regulated the different kinds of pollution emanating from ships through rules and standards, which include oil, sewage, garbage, and air emissions. The Global Sulfur Cap tends to put a limit on the sulfur emissions to reduce air pollution from ships.

7.2 Ballast Water Management Convention (BWMC)

BWMC provides that ships are to be treated or ballast water exchanged to avoid the introduction of invasive species by filtration, UV treatment, or chemical disinfection.

7.3 Port State Control and National Regulations

With port state control, countries apply their flag state's international and also national laws against vessels on environmental concerns like standards of ballast water, among others, as well as oil spill prevention.

7.4 Oil Spill Mitigation

Legislation like the U.S. Oil Pollution Act (OPA) and the IMO's OPRC Convention require spill response plans and regular drills for preparedness by vessels operating in specific waters.

7.5 Noise Pollution Mitigation

Quieter designs of ships, optimized propellers, and speed reductions are recommended by the IMO guidelines to reduce the level of underwater noise to protect marine mammals and other species. Sustainable Shipping and Green Technology
Cleaner fuels, such as LNG, are also being implemented in parallel with electrification to decrease air emissions and lessen environmental effects. Energy efficiency standards for vessels also continue to be enhanced via the IMO Energy Efficiency Design Index.

7.6 Enforcement Issues

Compliance monitoring has been primarily an international process. Satellite monitoring and the use of new technologies also have been studied in order to enhance enforcement.

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