

ENVIRONMENTAL IMPACTS AND REMEDIES OF MARINE POLLUTION



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1. Introduction

Marine pollution causes mainly due to an increasing urbanization, industrialization and tourism thereby affecting the quality to a greater extent. The pollution of the sea from hydrocarbons like crude oil, fuel, petrol, oily waste, etc., is a global problem that introduces tonnes of these products reaching the sea each year. The disasters in the oceans includes a range of threats that include oil spills, untreated sewage, heavy siltation, organic pollutants, heavy metals from mining activities, acidification, marine litter, resulting in destruction of marine ecosystem. The types of pollution that originate from ships include oil, chemicals, garbage sewage, air pollution from the ship's engines and bunker fuel. The following can be distinguished as main sources of marine pollution from ships:

- Release of oil and chemicals through **accidental spills** and operational discharges
- Transfer of invasive alien species through **ballast water** and on ship hulls
- Releasing toxic chemicals used in antifouling paints
- Dumping of waste such as **garbage and sewage**
- Air pollution through emission of **sulphur dioxide, nitrogen oxides and carbon dioxide**
- Physical and other damage through dropping of anchors, noise and wave disturbances, and striking of whales and other marine mammals

2. Causes, impacts and remedies of marine pollution

Ocean and human life is independent of each other and thus marine pollution is drastically visible. Since oceans are part of the food chain, marine pollution affects wide-spectra of species, including humans. The major impacts caused include global warming, the melting of polar ice caps, the extinction of endangered marine species, etc. Some of the major causes of pollution from ships and their impact on the oceans are given below:

CAUSE 1: Oil pollution from operational oil spills caused mostly by human error or sometimes intentionally when the ship's crew does not follow the strict regulations and break the law.

IMPACTS: Oil is the most dangerous form of marine pollutant. Its impacts are not only the most harmful but are also permanent. The chemical ingredients of oil cause physical changes in the organisms damaging marine life. The thick oil sticks to the body of marine organisms making them incapable of performing their normal metabolism. Sea birds are most affected as the oil sticks to their wings, rendering them flightless. As the density of oil is less than water, it floats on the top, forming a thick impermeable membrane. As the layer is black and opaque, the sunlight cannot pass through the surface thus, preventing the marine plants for their growth through photosynthesis.

REMEDIES:

Shipboard Oil Pollution Emergency Plan

Since January 2003, every oil tanker of 150 tons and above and every ship other than oil tanker of 400 tons gross tonnage and above shall carry on board a *Shipboard Oil Pollution Emergency Plan* approved by the administration.

Tankers should be allowed only when the following guidelines of International and National laws in discharge of oil and dangerous chemicals are met

- The total quantity of oil discharged in ballast voyage must not exceed 1/15,000 of the total cargo carrying capacity of the vessel.
- The rate at which oil may be discharged must not exceed 60 litres/mile travelled by ship.
- No discharge of any oil must be made from the cargo spaces of a tanker within 50 miles of the nearest land.
- In special areas, vulnerable to pollution by oil and oil discharge within has been prohibited.

Responses that government and corporations can act to both types of petro-pollution by

- Quickening the pace of moving the world's tanker fleet to all double-hull ships.
- Strict regulations, governing maintenance and inspections of commercial ships, motor boats and recreational water craft, which can leak oil and fuel into the water.
- Requiring filtration ponds and natural buffer zones around roads and parking lots to help keep runoff contaminated with oil and gas drips from getting into waterways.

CAUSE 2: Disposal of ballast water from ships affects marine life.

IMPACTS: Ballast water tanks are carried by ships for balancing as while unloading, ship is subjected to undulation. When a ship takes in ballast from one region, along with sea water it takes in native marine organisms as well. The ship then travels to other part of the world and discharges ballast during cargo loading or unloading. In this way aquatic plants and animals are transported from one region to another and get prone to become vulnerable as a result of introduction of alien species.

REMEDIES: A ballast water management plan should be prepared comprising the details of ballast tanks for safe and effective disposal. The structure should be maintained and regularly monitored for



Figure 1: A cargo ship pumps ballast water over the side

its effective performance. Strictly following the guidelines of the ballast operations and any disfunctioning of vessel/tanks should be reported quickly. The exchange of ballast should take place under low depth waters. Eco-friendly ballast water treatment plants to be adopted. Disposal of sediment by cleaning the tanks should be done on regular basis.

CAUSE 3: Atmospheric air pollution is caused from the exhaust emissions from a ship's engine. The most harmful emissions are nitrogen and sulphur resulting from burning ship's bunker oil.

IMPACTS: The changes in climate are a result of increased ocean temperatures and rising levels of CO₂, NO_x and SO₂ in the atmosphere resulting in acidifying the oceans. Thus altering aquatic ecosystems and the livelihoods of the communities that depend on them. Healthy ocean ecosystems are also important for the mitigation of climate change.

NO_x emissions have increased by nearly 4 million tons each year that includes compounds like nitrogen dioxide and nitric oxide. These compounds play an important role in the atmospheric reactions creating harmful particulate matter, smog, acid rain and eutrophication. SO_x emission interacts with the moisture in the atmosphere forming sulphuric acid, which in turn condenses in the clouds and causing acid rain. In this form SO_x is also implicated in climate change.

Acidification: The oceans are normally a natural carbon sink, absorbing CO₂ from the atmosphere. Because the levels of atmospheric CO₂ are increasing, the oceans are becoming more acidic. The potential consequences of ocean acidification are not fully understood, but there are concerns that structures made of calcium carbonate may become vulnerable to dissolution, affecting corals and the ability of shellfish to form shells. Oceans and coastal ecosystems play an important role in the global carbon cycle. Rising ocean temperatures and ocean acidification means that the capacity of the ocean carbon sink will gradually get weaker, giving rise to global concerns.



Figure 2: Island with fringing reef in the Maldives. Coral reefs are dying around the world

REMEDIES: International regulations require ship's engines to be designed to minimise nitrogen emissions. Sulphur emissions depend on the amount of sulphur in the bunker fuel being used. There is a worldwide regulation that limits the amount of sulphur in bunker fuel. Sulphur and nitrogen chemicals in the air can have a harmful effect on plants and marine animals and can cause breathing problems in people. The production of greenhouse gases by ships is slowly being addressed. Until international regulations can be agreed the shipping industry is taking a number of voluntary steps like:

- Ships can reduce their speed by half a knot.
- Ships use weather direction-finding systems to avoid storms and strong head winds. Bad weather increases their fuel consumption.

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- Developing more fuel efficient ship engines and propellers.
 - Building larger efficient ships that can carry more cargo to avoid movement of more ships.

CAUSE 4: Plastics waste disposal from ships

IMPACTS: Debris into the sea is mainly discarded with human rubbish which either floats or suspended in the ocean. Around 80% of marine debris is plastic; the mass of it in the oceans is increasing and tons of waste gets accumulated since years. When settled on the sea bed, the plastics can also suffocate the living organisms. Many marine animals consume flotsam by mistake, as it often looks similar to their natural prey.



Figure 3: A mute swan builds a nest using plastic garbage

REMEDIES: The oceans can be polluted from the ship's garbage and sewage when there is violation of international rules and regulations. This happens when garbage is thrown overboard and not stored on the ship in the special containers provided for offloading garbage in port. Plastic usage should be banned or at least use of it should be minimized in the ship.

CAUSE 5: Pollution from disposal of waste water from ships

IMPACTS: The sewage when disposed contains organic matter. The matter gets absorbed with available dissolved oxygen reducing the level of oxygen in the ocean that marine organisms require. The matter also feeds on algae blooms that are present in the water, stimulating their growth. This decomposing algae releasing toxic substances harmful to marine organisms that can enter through fish or other organisms. Sea food when consumed has a tendency of concentrating pathogens in their gut, consumption of which will increase the possibility of food poisoning creating possible health risks.

REMEDIES: Sewage must be treated in specially provided sewage treatment tanks. Once treated it is safe to be pumped overboard. Pumping untreated sewage overboard in some areas is prohibited by law. The waste water treatment equipment can be used as given below:

1. Oily Water Separator equipment consists of an Oily Water Separator, Oily Water Separator Pump, Strainer, Discharge Water Collecting Device
2. *Discharge Water Oil Content Monitor*
3. *Sludge Storage Equipment* consisting of Sludge Tank and Sludge Piping
4. *Automatic discharge stop device*

The initiatives to be initiated by the government and the corporations:

- Strengthen progress on cleaning up superfund sites and reestablish the "polluter pays" principle.
- Synthetic chemicals should be considered toxic unless it can be proved otherwise.

- Upgrade water treatment plants for enhancing the efficiency.
- Regular maintenance and monitoring of septic system
- Continue the fight to stop emissions of acid rain chemicals like sulfur and nitrogen that acidify oceans.

3. World's environmental degradation examples of marine pollution

- Chinese and Russian industrial pollution such as phenols and heavy metals in the Amur River have devastated fish stocks and damaged its estuary soil.
- Wabamun Lake in Alberta, Canada, once the best whitefish lake in the area, now has unacceptable levels of heavy metals in its sediment and fish.
- Some shellfish and crabs can survive polluted environments, accumulating heavy metals or toxins in their tissues. For example, mitten crabs have a remarkable ability to survive in highly modified aquatic habitats, including polluted waters. The farming and harvesting of such species needs careful management if they are to be used as a food.
- Heavy metals enter the environment through oil spills - such as the Prestige oil spill on the Galician coast - or from other natural or anthropogenic sources.
- In 2005, the 'Ndrangheta, an Italian mafia syndicate, was accused of sinking at least 30 ships loaded with toxic waste, much of it radioactive. This has led to widespread investigations into radioactive waste disposal rackets.
- Since the end of World War II, various nations including the Soviet Union, the United Kingdom, the United States and Germany, have disposed of chemical weapons in the Baltic Sea, raising concerns of environmental contamination.

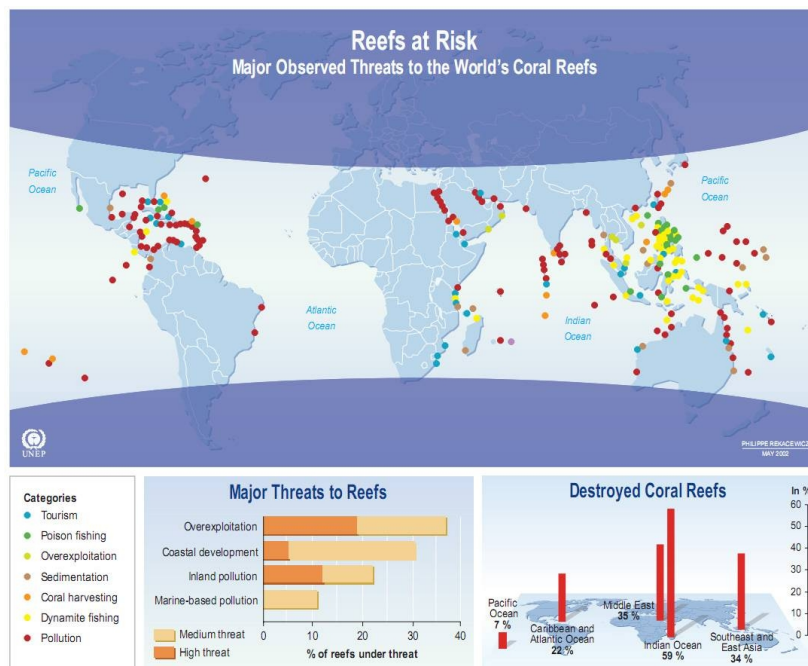


Figure 4: Threats to the World's coral reefs

Note: Threats to the world's coral reefs include extreme climate events, shipping, unsustainable tourism practices, sedimentation, coral harvesting and overexploitation by fisheries. The graphic explains activities affecting coral reefs throughout the world. The graphic 'Major Threats to Reefs' shows the percentage of reefs that are threatened by overexploitation, coastal development, inland pollution and marine pollution and the degree to which they are under threat. The graphic 'Destroyed Coral Reefs' shows the percentage of coral reefs that have been destroyed in the world's major regions.

Source: <http://www.grida.no/publications/rr/our-precious-coasts/page/1292.aspx>

4. Legislations and Conventions

Beginning of formulating laws: In 1954, United Kingdom organized a conference and adopted International Convention for Prevention of Pollution of the sea from oil pollution (OIL POL). It was enforced in July 1958 and amended in 1962, 1969 and 1971. Analyzing the need for improvement in the convention due to severe marine pollution, there was another convention in 1973, adopting the International Convention for the Prevention of Pollution from Ships in 1978 (MARPOL Protocol) focusing on operational pollution, chemical pollution, sewage, garbage and harmful substance in packages. Some of the important legislations framed in India are:

- Coastal Regulation Zone Notification, 1991
- Forest (Conservation) Act, 1980
- Water (Prevention & Control of Pollution) Act, 1974
- Hazardous Waste Management Act, 1989
- Environmental Impact Assessment Notification, 1994
- Environmental Protection Act, 1986
- The Indian Wildlife (Protection) Act, 1972
- Biological Diversity Act, 2002
- Indian Fisheries Act, 1987
- Deep Sea Fishing Policy, 1991
- Marine Fisheries Regulation Acts
- Indian Ports Act, 1908
- Major Port Trust Act, 1963
- Merchant Shipping Act, 1958
- Coast Guard Act, 1978
- Maritime Act
- National Environment Tribunal Act, 1995

5. Convention signed by India

1. **UNCLOS:** Disposal of ship-based wastes
2. **Basel Convention, 1992:** Contains specific provisions for the monitoring of hazardous waste. A number of articles in the convention oblige parties (national governments which have acceded to the Convention) to take appropriate measures to implement and enforce its provisions, including measures to prevent and punish conduct in case of violation.
3. **Ocean Policy Statement:** Sets out basic principles for the development of oceans.
4. **Convention on Migratory Species:** Protection for many species of crocodiles, sharks, etc.
5. **MARPOL 73/78:** Disposal of ship-based wastes

6. Conclusion

The oceans are a vast resource whose usefulness to the global society is continuing to be realized. The guidelines set needs to be followed in order to minimize the probability of future introductions of harmful substances into the marine ecosystem while protecting the safety of ships and benefit of natural resources. Marine ecosystems will become more fragmented and less equipped to adapt to changing conditions, such as the effects of climate change. Thus, it is in the best interest of humanity that the natural resources are exploited and preserved in a sustainable manner.

7. References

<http://www.grinningplanet.com/2005/09-06/water-pollution-causes-article.htm>
<http://www.suite101.com/content/marine-pollution-from-ships-ballast-water-a262315>
http://www.amsa.gov.au/Publications/Marine_Environment_Protection/POS.pdf
<http://wwf.panda.org>