ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
Vol. 2, Issue 5 May 2016

A review article: Pollution on marine organism

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Abstract

This review covers the biological effects of pollutants and human physical disturbances on marine organism ecosystems and habitats. The review, based largely on journal articles, covers field and laboratory measurement activities (bioaccumulation of contaminants, field assessment surveys, toxicity testing and biomarkers) as well as pollution issues of current interest including endocrine disrupters, emerging contaminants, wastewater discharges, dredging and disposal, etc

Key words: Tissue residues, toxicity, bioaccumulation, biomagnifications, biomarkers, sediment quality, ecological risk assessment, endocrine disrupters, nano particles, POPs, PCBs, PAHs, PBDEs, radio nuclides, pharmaceuticals, personal care products, trace metals, pesticides, biomarkers, marine biocides, oil spills, dispersants, sewage, debris, dredging, eutrophication, human disturbance.

Introduction:

Marine pollution was a major area of discussion during the 1972 United Nations Conference on theHuman Environment, held in Stockholm. That year also saw the signing of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. Pollution on Marine organism may be caused by several human activities and combined human activities plays a major role on the effect of marine organism pollution. In the oceans, the threat to marine life comes in various forms, such as overexploitation and harvesting, dumping of waste, pollution, alien species, land reclamation, dredging and global climate change (Beatley, 1991; National Research Council, 1995; Irish and Norse, 1996; Ormond et al., 1997; Tickel, 1997; Snelgrove, 1999).

Marine pollution includes a range of threats including from land-based sources:

The following are the major phenomenon that creats threat to marine organisms : oil spills, untreated sewage, heavy siltation, eutrophication (nutrient enrichment), Invasive species, persistent organic pollutants (POP's), heavy metals from mine tailings and other sources, acidification, radioactive substances, marine litter, overfishing and destruction of coastal and marine habitats.

Three main types of inputs of pollution into the ocean:

1. Direct discharge of waste into the oceans, 2. Runoff into the waters due to rain, 3. Pollutants that are released from the atmosphere

Direct discharge of waste into the oceans

Ganesh et al. (2014) characterized a 3- to 6-km gradient of benthic macro invertebrate assemblages offshore of a sewage discharge in the surf zone of the Bay of Bengal (India).

Pollutants enter rivers and the sea directly from urban sewerage and industrial waste discharges, sometimes in the form of hazardous and toxic wastes.

Smith, Flemings and Fulton (2014) studied the transport of hydrocarbons from two deep water vents in the Gulf of Mexico incorporating salinity and temperature gradients to include multi-phase hydrocarbon distribution.

Inland mining for copper, gold. etc., is another source of marine pollution. Most of the pollution is simply soil, which ends up in rivers flowing to the sea.

However, some minerals discharged in the course of the mining can cause problems, such as copper, a common industrial pollutant, which can interfere with the life history and development of coral polyps. Fisher et al. (2014a) documented adverse impacts attributable to the Deepwater Horizon oil spill to two additional deep sea coral communities located six kilometers and 22 kilometers away from the well-head. They also surveyed numerous coral communities around the northern Gulf of Mexico, and found no acute impacts to corals at depths between 400 and 850 km and greater than 30 km from the well-head.

Mining has a poor environmental track record. For example, according to the United States Environmental Protection Agency, mining has contaminated portions of the headwaters of over 40% of watersheds in the western continental US.Much of this pollution finishes up in the sea.

Acid mine drainage causes severe environmental problems in Rio tinto river, Spain.

Runoff into the waters due to rain

Surface runoff from farming, as well as urban runoff and runoff from the construction of roads, buildings, ports, channels, and harbors, can carry soil and particles laden with carbon, nitrogen, phosphorus, and minerals. This nutrient-rich water can cause fleshy algae and phytoplankton to thrive in coastal areas, known as algal blooms, which have the potential to create hypoxic conditions by using all available oxygen. Following a period in 2010 of warm water and increased storms and runoff, the shallow water reefs in St. John (U.S. Virgin Islands) showed relatively minor adverse effects in relation to the magnitude of potential stresses (Edmunds and Gray 2014).
Polluted runoff from roads and highways can be a significant source of water pollution in coastal areas. About 75 percent of the toxic chemicals that flow into Puget Sound are carried by storm water that runs off paved roads and driveways, rooftops, yards and other developed land.

Pollutants that are released from the atmosphere:

Windblown dust and debris, including plastic bags, are blown seaward from landfills and other areas.

Dust from the Sahara moves into the Caribbean and Florida during the warm season.

Dust can also be attributed to a global transport from the Gobi and Taklamakan deserts across Korea, Japan, and the Northern Pacific to the Hawaiian Islands.

Since 1970, dust outbreaks have worsened due to periods of drought in Africa.

Climate change is raising ocean temperatures and raising levels of carbon dioxide in the atmosphere. These rising levels of carbon dioxide are acidifying the oceans. This, in turn, is altering aquatic ecosystems and modifying fish distributions, with impacts on the sustainability of fisheries and the livelihoods of the communities that depend on them.

Gomiero and Viarengo (2014) investigated the effects of Cu and oxytetracycline, separately and in combination, at different temperatures on the survival, replication, endocytosis rate, and lysosomal membrane stability in the ciliated protozoa *Euplotes crassus*.

Deep Sea Mining:

Ocean mining sites are usually around large areas of polymetallic nodules or active and extinct hydrothermal vents at about 1,400 - 3,700 meters below the ocean's surface. The vents create sulfide deposits, which contain precious metals such as silver, gold, copper, manganese, cobalt, and zinc.

The deposits are mined using either hydraulic pumps or bucket systems that take ore to the surface to be processed and decrease toxicity of the water column.

Sediment plumes from tailings. Removing parts of the sea floor disturbs the habitat of benthic organisms, possibly, depending on the type of mining and location, causing permanent disturbances. Hwang, Lee, Choi et al. (2014) documented negative effects on fish assemblages of sand extraction activities in Gyeonggi Bay (Korea). When compared with two non-mining areas, the sand mining area had significantly lower values for total fish abundance, species richness, and species diversity.

Near bottom plumes occur when the tailings are pumped back down to the mining site. The floating particles increase the turbidity, or cloudiness, of the water, clogging filter-feeding apparatuses used by benthic organisms.

Surface plumes cause a more serious problem. Depending on the size of the particles and water currents the plumes could spread over vast areas. The plumes could impact zooplankton and light penetration, in turn affecting the food web of the area.

Aside from direct impact of mining the area, leakage, spills and corrosion would alter the mining area's chemical makeup.

Eutrophication:

An increase in chemical nutrients, typically compounds containing nitrogen or phosphorus, in an ecosystem. It can result in an increase in the ecosystem's primary productivity (excessive plant growth and decay), and further effects including lack of oxygen and severe reductions in water quality, fish, and other animal populations.

ISSN 2395-695X (Print)
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Multifactor models were reasonably accurate in predicting uptake of PCBs and polybrominated diphenyl ethers (PBDEs) in benthic macrofauna in the Strait of Georgia (Canada) (Burd et al. 2014). Overall, PBDEs were accumulated more extensively than PCBs, indicating that PBDE transfer to benthos is more dependent on recent organic detritus and associated contaminant levels from ongoing discharges.

Slijkerman et al. (2014) documented some evidence of eutrophication based on nitrogen concentrations recorded near the island of Bonaire, which has some of the highest quality coral reef habitats in the Caribbean.

The biggest culprit are rivers that empty into the ocean, and with it the many chemicals used as fertilizers in agriculture as well as waste from livestock and humans. An excess of oxygen depleting chemicals in the water can lead to hypoxia and the creation of a dead zone.

Acidification:

The oceans are normally a natural carbon sink, absorbing carbon dioxide from the atmosphere.

A well as the levels of atmospheric carbon dioxide increasing, as a result oceans are becoming more acidic.

Calcium carbonate may become vulnerable to dissolution, affecting corals and the ability of shellfish to form shells.

Oceans and coastal ecosystems have removed about 25% of the carbon dioxide emitted by human activities between 2000 and 2007 and about half the anthropogenic CO_2 released since the start of the industrial revolution. Rising ocean temperatures and ocean acidification means that the capacity of the ocean carbon sink will gradually get weaker.

A report from NOAA scientists published in the journal Science in May 2008 found that large amounts of relatively acidified water are upwelling to within four miles of the Pacific continental shelf area of North America. This area is a critical zone where most local marine life lives or is born.

Dolores- Basallote et al. (2014) exposed amphipods (*Ampelisca abdita*) to Gulf of Cadiz sediments that had been subjected to several pH treatments to study the effects of CO2- induced acidification on sediment toxicity.

Plastic Debris:

There are Eighty percent of marine debris is plastic - a component that has been rapidly accumulating since the end of World War II.The mass of plastic in the oceans may be as high as one hundred million metric tons.

Plastics are synthetic organic polymers, and though they have only existed for just over a century (Gorman, 1993), by 1988 in the United States alone, 30 million tons of plastic were produced annually (O'Hara et al., 1988).

Many discarded plastic bags, six pack rings and other forms of plastic waste which finish up in the ocean present dangers to wildlife, fisheries and other organisms.

Aquatic life can be threatened through entanglement, suffocation, and ingestion.

Fishing nets, usually made of plastic, can be left or lost in the ocean by fishermen. Known as ghost nets, these entangle fish, dolphins, sea turtles, sharks, dugongs, crocodiles, seabirds, crabs, and other creatures, restricting movement, causing starvation, laceration and infection, and, in those that need to return to the surface to breathe, suffocation.

Most of Plastic debris, when large or tangled, is difficult to pass, and may become permanently lodged in the digestive tracts and other organs of these animals, blocking the passage of food and causing death through starvation or infection.

The threat of plastics to the marine environment has been ignored for a long time, and its seriousness has been only recently recognized (Stefatos et al., 1999).

The Plastic debris tends to accumulate at the centre of ocean gyres. In particular, the Great Pacific Garbage Patch has a very high level of plastic particulate suspended in the upper water column.

The introduction of alien species can have major consequences for marine ecosystems Grassle et al., 1991). This biotic mixing is becoming a widespread problem due to human activities, and it is a potential threat to native marine biodiversity (McKinney, 1998) According to some estimates, global marine species diversity may decrease by as much as 58% if worldwide biotic mixing occurs (McKinney, 1998).

Chemical toxicity and Testing:

Many toxic additives used in the manufacture of plastic materials can leach out into their surroundings when exposed to water.

Waterborne hydrophobic pollutants collect and magnify on the surface of plastic debris,thus making plastic far more deadly in the ocean than it would be on land.

Hydrophobic contaminants are also known to bioaccumulation in fatty tissues, biomagnifying up the food chain and putting pressure on apex predators.

A few plastic additives are known to disrupt the endocrine system when consumed; others can suppress the immune system or decrease reproductive rates and also effect of other organism.

Most of the floating debris can also absorb persistent organic pollutants from seawater, including PCBs, DDT and PAHs. Aside from toxic effects, when ingested some of these are mistaken by the animal brain for estradiol, causing hormone disruption in the affected wildlife and other organism.

A radionuclide transfer model employed the known data on uptake of inorganic in marine organisms for use in a planned disposal site in the Baltic Sea (Konovalenko et al., 2014). The risk assessment utilized data known for grazers, benthos, zooplankton and fish. It showed that the data on organisms is in good agreement, but many elements (i.e. 26) need to be used in addition to just cesium and strontium (Konovalenko et al.,2014).

Renzi et al. (2014) exposed diatoms (*Phaeodactylum tricornutum*) to Zn, Cu, and dodecylbenzenesulfonic acid sodium salt in accordance with the AlgalToxkit protocol to quantitatively compare responses with growth rate inhibition tests morphological (biovolume) and physiological (chlorophyll-α, phaeophytin ratio) endpoints

Apart from plastics, there are particular problems with other toxins that do not disintegrate rapidly in the marine environment. Examples of persistent toxins are PCBs, DDT, pesticides, furans, dioxins, phenols and radioactive waste.

Heavy metals are metallic chemical elements that have a relatively high density and are toxic or poisonous at low concentrations.Examples are mercury, lead, nickel, arsenic and cadmium. Such toxins can accumulate in the tissues of many species of aquatic life in a process called bioaccumulation. They are also known to accumulate in benthic environments, such as estuaries and bay muds: a geological record of human activities of the last century.

In an effort to improve the medaka (*Oryzias latipes*) embryo-larval sediment contact assay, Le Bihanic et al. (2014) developed a reference exposure protocol with artificial sediment that was specifically designed to limit natural sediment composition uncertainties and preparation variability.

Noise Pollution:

Marine life can be susceptible to noise or sound pollution from sources such as passing ships, oil exploration seismic surveys, and naval low-frequency active sonar. Özhan et al. (2014) conducted a literature review on the effects of crude oil to phytoplankton species. The paper cites phytoplankton EC50's range from 1.03- >50mg/L when exposed to crude oil and 1.01-1031mg/L for crude oil compounds.
Marine animals, such as cetaceans, often have weak eyesight, and live in a world largely defined by acoustic information. This applies also to many deeper sea fish, who live in a world of darkness.

Between 1950 and 1975, ambient noise in the ocean increased by about ten decibels (that is a ten-fold increase).

Noise also makes species communicate louder, which is called the Lombard vocal response. Whale is longer when submarine-detectors are on. If creatures don't "speak" loud enough, their voice can be masked by anthropogenic sounds. These unheard voices might be warnings, finding of prey, or preparations of net-bubbling. When one species begins speaking louder, it will mask other specie voices, causing the whole ecosystem to eventually speak louder.

According to the oceanographer Sylvia Earle, "Undersea noise pollution is like the death of a thousand cuts. Each sound in itself may not be a matter of critical concern, but taken all together, the noise from shipping, seismic surveys, and military activity is creating a totally different environment than existed even 50 years ago. That high level of noise is bound to have a hard, sweeping impact on life in the sea."

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ISSN 2395-695X (Online)
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Vol. 2, Issue 5 May 2016

Other compounds:

PAHs. Mu et al. (2014) exposed early life stages of fish (*Oryzias melastigma*) to phenanthrene and retene (7-isopropyl-1-methylphenanthrene) and found retene to be more toxic. Both phenanthrene and retene caused developmental malformation of embryos with phenanthrene affecting the peripheral vascular system and retene affecting cardiac tissues.
Van Geest et al. (2014b) used the amphipod *Echinogammarus finmarchicus* to test the toxicity of the pyrethroid-based anti-sea lice pesticides, deltamethrin and cypermethrin in aqueous and sediment exposures.
Yusof et al. (2014) exposed fertilized fish eggs (*Oryzias javnicus*) to high concentrations (100 to 500 ppm) of a glyphosphate-based herbicide (Roundup®). Survival and hatching percentages decreased as glyphosphate concentrations increased.Teratogenic effects were observed.

Effect of pollutants on marine organism:

Major effects on marine organism includes Bioconcentration, Bioaccumulation, Biomagnifications, Biodegradation.

Bioconcentration:

Bioconcentration is the process where the chemical concentration in an aquatic organism achieves a level that exceeds that in the water as a result of the exposure of an organism to a chemical in the water but does not include exposure via the diet. Bioconcentration refers to a situation, typically derived under controlled laboratory conditions, wherein the chemical is absorbed from the water via the respiratory surface and/or the skin only. The extent of chemical Bioconcentration is usually expressed in the form of a Bioconcentration factor.

The bioconcentration factor (BCF) is the concentration of test substance in/on the fish or specified tissues thereof divided by the concentration of the chemical in the surrounding medium at steady state. In the context of setting exposure criteria it is generally understood that the terms “BCF” and “steady-state BCF” are synonymous. A steady-state condition occurs when the organism is exposed for a sufficient length of time that the ratio does not change substantially.

Biomagnifications

Bioamplification **or** biomagnification refers to an increase in the concentration of a substance as you move up the food chain. This often occurs because the pollutant is persistent, meaning that it cannot be, or is *very* slowly, broken down by natural processes. These persistent pollutants are transferred up the food chain faster than they are broken down or excreted. A stable nitrogen isotope was used to document the biomagnification pathway of mercury and selenium occurs in fish (Jones et al. 2014). Results indicated that mercury but not selenium was taken up by fish feeding upon the animals from the local area.

Bioaccumulation

ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
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The word *bioaccumulation* is used to describe the build up of chemicals in fish. Through the food chain, chemicals like PCBs, DDT, dioxins, and mercury build up in the bodies of the fish. The picture below shows how this might happen in a lake near you. People are at the top of this food chain. When you eat a lot of fish that have chemicals in them, those chemicals can build up in your body, too. While the chemicals in fish won't make you sick right away, they could cause health problems someday.

It was concluded by Malea et al. (2014) that the structure of the species of algae was the determining factor in the bioaccumulation of the element. The red seaweed *Gracilaria lemaneiformis* is an important plant used for food and for production of pharmaceuticals. Laboratory experiments were conducted to measure the bioaccumulations of cadmium, copper and lead (Wang, Wang and Ke, 2014)

An experimental study with mussel, *Mytilus galloprovincialis*, was conducted by Balbi et al. (2014) to determine if manoparticles, as n-TiO2, and cadmium together would induce measureable stress responses (biomarkers) without toxicity.

Biodegradation

Biodegradation is the decay or breakdown of materials that occurs when microorganisms use an organic substance as a source of carbon and energy. For example, sewage flows to the wastewater treatment plant where many of the organic compounds are broken down; some compounds are simply biotransformed (changed), others are completely **mineralized.** These biodegradation processes are essential to recycle wastes so that the elements in them can be used again. Recalcitrant materials, which are hard to break down, may enter the environment as contaminants. Kostka et al. (2014) discussed the impact that cutting edge molecular and biogeochemical techniques (including high throughput sequencing, isotope tracers, and _omic approaches) are having in advancing understanding of the biogeochemical processes and metabolic pathways that control hydrocarbon biodegradation in marine systems.

The ways to solve marine pollution to save marine organism:

Decrease Energy Consumption and control carbon emission: You must conscious about using energy at your home and workplace. This small effort can decrease pollution.get started today the following little things and get more efficient result: Switch to compact fluorescent light bulbs, take the stairs, and bundle up or use a fan to avoid oversetting your thermostat.

Change your food habits at the time of choosing seafood: Due to consumption of sea fish Global fish populations are rapidly being depleted demand, loss of habitat, and unsustainable fishing practices. Help reduce the demand for overexploited species by choosing seafood that is both healthful and sustainable.

Restriction on Plastic Products: Plastics debris contribute to habitat destruction and entangle and kill tens of thousands of marine animals each year. So carry a reusable water bottle, store food in no disposable containers, bring your own cloth tote or other reusable bag when shopping, and recycle whenever possible.

Help Take Care of the Sea Beach: When you enjoy diving, surfing, or relaxing on the beach, always clean up after yourself. Appreciate the ocean without interfering with wildlife or removing rocks and coral and encouraging others to respect the marine environment or by participating in local beach cleanups.

Stop buying items which exploit Marine Life: coral jewelry, tortoiseshell hair accessories (made from hawksbill turtles), and shark causes harming of fragile coral reefs and marine populations. Avoid purchasing these items.

Conscious about your Pet: Know pet food labels and consider seafood sustainability when choosing a diet for your pet. Stop cat litter, which can contain pathogens harmful to marine life. Don’t stock your aquarium with wild-caught saltwater fish, and never release any aquarium fish into the ocean or other bodies of water, which is harmful to the existing ecosystem.

Help Organizations Working to Protect Marine life and environment: The institutes and organizations who are fighting to protect ocean habitats and marine wildlife ,support them.Raise your hands to National organization and consider giving financial support or volunteering for advocacy.

Make aware Your Community: support marine conservation projects. Consider patronizing restaurants and grocery stores that offer only sustainable seafood, and speak up about your concerns if you spot a threatened species on the menu or at the seafood counter.

Be Responsible when travelling oceans: Never throw anything overboard, and be aware of marine life in the waters around you. Stop boating kayaking and other activities.

Be aware about the knowledge of Oceans and Marine Life: life is created from water on Earth. The more you learn about the issues facing this vital system, the more you’ll want to help ensure its health—inspire others to know the facts aware them to love marine life and organism.

Acknowledgement:

I would like to thank Dr Amiya kr. Sahoo, Scientist of CIFRI, Barrackpore,Kolkata whose constant support and guidance during the preparation of this article helped me to understand and achieve goal. Special thanks must go to Imtiaz Beelim (Ph.D Scholar, Bhabnagar University,Gujrat) valuable input.

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