



STUDIES OF POINT SOURCE AND NON-POINT SOURCE POLLUTION ON THE BIODIVERSITY OF MARINE ENVIRONMENT

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ABSTRACT

Resources are utilized in the context of some specific aim only. These are the sources of those means which are essential for our survival and flourishing. There are different many more types of resources. Marine is also come under the category of natural resources. We can call every such matter or substances, a resource which we can make useful and significant. Around 70% of the earth's crust is covered by ocean. The ocean has always been subjected to human activities. To a varying extent these activities had adverse impacts on the state of marine environment. Various substances for human welfare are obtained from oceans. Like living resources includes algae and animals. Non-living resources, includes sea-water, sea beds are rich in many minerals and most important salt, medicine, pearl and coral. But the continuing human population explosion has compelled human beings to think about the final limitations of the earth rather than their normal local limitations. The introduction of different types of point and non-point source pollution by human population directly or indirectly of substances or energy to the marine environment resulting in deleterious effects such as: hazards to human health, hindrance to marine activities, impairment of the quality of seawater for various uses and reduction of amenities. Now the greatest question, how to face the danger of rapid destruction of marine resources. Thus, the aim of the present study is, how we can save the marine resources and marine life from point source and non-point source pollution.

Keywords: Resources, Pollution, Biodiversity.

INTRODUCTION

The term 'pollution' describes the occurrence and inputs of wastes and the impact of these wastes on their environment. Marine water becomes polluted when foreign substances enter the marine environment and are transported into the marine cycle, contaminate the water and harmful to the marine life. Sources of marine pollution are divided into two main categories: point source pollution (it occurs when a pollutant is discharged at a specific source like, leaking pipe or a holding tank with a hole in it, polluted water leaving a factory, or garbage being dumped into sea) and non-point source pollution (it contributes more pollution and mainly come from pesticides, fertilizers, or automobile fluids washed off the ground by a storm, urban-industrial, agricultural and atmospheric sources). Various types of algae such as brown, green and red algae are found in ocean. Many

brown algae such as *Laminaria*, *Sargassum*, *Alaria*, *Macrocystis* etc. and red algae such as *Porphyra Chondria*, *Rhodomenia* etc. are used as food in many countries [1-11]. Several useful substances such as Alginic acid (used for artificial skin and adhesive, obtained from cell wall of brown algae), Carrageenin (used as emulsifying and stabilizing agents in ice-cream, chocolates, jellies and blood coagulant etc. obtained from the cell wall of red algae), Agar – Agar (it is used to prepare culture medium, medicinal tablets, balm and laxative, obtained from the species of *Gracilaria*, *Gelidium*.) Red algae *Digenia* is used to kill worms of stomach, Brown algae *Laminaria* and *Fucus* which are rich in iodine are used to prepare medicine for the treatment of goiter. Various types of marine animals such as crustaceans, fishes, molluscs and mammals are useful for man obtained from ocean.

A number of crustaceans such as Prawn, Lobsters and Crabs etc are used as food. Besides food, several other products such as gum, flour, oils, proteins, vitamins are also obtained from marine fishes. Many molluscs are commercially important. Pearls are obtained from pearl oysters (*Pinctada vulgaris*). The most of the supply of common salt is done by evaporation in marine salty reservoirs.

METHODS AND MATERIALS

Pollutant water sample was taken out from oceans, which was near the any industry, factory or generally used as beach, because there are very high risk of poisonous and dirty water because of release of industrial waste including organic matter (highly acidic and highly basic material), heavy metal compounds (lead, mercury, copper etc.) the effect of all these components in marine is death of completely marine life (algae, plants and animals). Reductions in water quality and quantity have serious negative impacts on marine life. Water quality is not simply "good" or "bad", but usually is applied to its purpose. Chemical tests have been developed which are easy to determine water quality of marine in very short time. The factors that affect water quality are pH, dissolved oxygen, temperature, and salinity. Parameters that may be tested include temperature, pH, turbidity, salinity, nitrates and phosphates. An assessment of the aquatic macro invertebrates can also provide an indication of water quality.

Materials

Small cups, Measuring cup, Teaspoon measure Stir sticks, Test strips for pH, and alkalinity Water samples from different locations, Laboratory quality pH meter and electrode pH "pocket pals" and multi-parameter probes, Color comparators / pH strips.

Method

Label each sample with a number, Set out cups to test the samples, Label the cups with corresponding sample numbers, Measure and pour the same amount of water into each cup, Add ½ table spoon of sample 1 to water cup 1 and stir, Clean the measuring spoon between uses, Use the test strips to test the solution and measure the pH of each water sample, Perform the same test for each sample using alkalinity test strip, Record the results for each sample.

Temperature

Temperature of marine water is significant because it affects the amount of dissolved oxygen in the water. The amount of oxygen that will dissolve in water increases as temperature decreases. Water at 0°C will hold up to 14.6 mg of oxygen per litre, while at 30°C it will hold only up to 7.6 mg/L. Thermal pollution is an

increase in water temperature caused by adding warm water to lakes and rivers that all are finally mix with sea. The source of this warm water is runoff from streets and pavements, or from power plant.

Salinity

Salinity is a measure of the dissolved salts in the water. Salinity is usually highest during periods of low flows and increases as water levels decrease. Sources of salinity include urban and rural run-off containing salt, fertilizers, organic matter and dissolved solids from industry, sewage, agriculture and storm water. Salinity is measured as either TDS (Total Dissolved Solids), which measures the amount of dissolved salts in the water, or as EC (Electrical Conductivity), which is the property of a substance which enables it to serve as a channel or medium for electricity. Salty water conducts electricity more readily than pure water. A certain amount of salt necessary for marine life. Dissolved salts help marine organisms. However, changes in the amount of dissolved salts can be harmful for those organisms which are adapted to life within a range of salinity.

Some EC and TDS Ranges

Water type	EC $\mu\text{s/cm}$	TDS mg/L
Very pure marine water	< 15	< 10
Pure marine water	0 - 800	100 – 1,000
Poor marine water	1,600 – 4,800	1,000 -3,000
Very poor marine water	> 4,800	> 3,000
Dirty water	51,500	35,000

pH

pH, is one of the most common analyses for marine or sea water testing, is the standard measure of how acidic or alkaline water is. The pH scale ranges from 0 to 14:

Acidic: 0 to 6.9, Neutral: 7, Alkaline: 7.1 to 14

Hydrogen (H⁺) ions control acidity levels. pH measures the concentration of H⁺ and hydroxide (OH⁻) ions which make up water (H₂O):



When the two ions are in equal concentration, the water is neutral, whereas the water is acidic if H⁺ > OH⁻ and basic when OH⁻ > H⁺

Marine organisms need the pH of their water body to be within a certain range for optimal growth and survival. Although each organism has an ideal pH, most marine organisms prefer pH of 6.5 – 8.0. pH is measured by using a colorimetric test - litmus paper changes colour with increased acidity or alkalinity, it can also be measured by electronically or visually. Alkalinity is the buffering capacity of a water body. It measures the ability

of water bodies to neutralize acids and bases thereby maintaining a fairly stable pH. To maintain a fairly constant pH in marine body, a higher alkalinity is preferable. High alkalinity means that the marine body has the ability to neutralize acidic pollution from rainfall or basic inputs from waste water.

At Ph :	Effects On Marine Life:
11.0 – 11.5	Lethal to all fishes species
10.5 – 11.0	Prolonged exposure is lethal to some species
9.0 – 10.5	Prolonged exposure is harmful to some species
8.2 – 9.0	Unlikely to be directly harmful to fish
6.5 – 8.2	Optimal for most organisms and plants
6.0 – 6.5	Unlikely to be directly harmful to fishes and algae
5.5 – 6.0	Metals trapped in sediments are released in forms toxic to marine life
5.0 – 5.5	Bottom dwelling bacteria die, detritus accumulates, plankton begin to disappear
4.5 – 5.0	Many algae species absent, most fish eggs will not hatch
4.0 – 4.5	All fish, most marine plant, and animals absent
3.5 – 4.0	Lethal to some fish species
3.0 – 3.5	Unlikely that fish can survive for more than a few hours in this range

Turbidity

Turbidity is a measure of the ability of light to pass through water, that is, a measure of the water's murkiness. Measuring murkiness gives an estimate of suspended solids in the water. Turbidity is measured in Nephelometric Turbidity Units (NTU's). Suspended Solids usually enter the marine water as a result of soil erosion from disturbed land or can be traced to the inflow of effluent from sewage plants or industry. Turbidity measurements also take into account algae and plankton present in the marine water.

Category	NTU's
Excellent	≤ 10 NTU's
Fair	15-30 NTU's
Poor	> 30 NTU's

Faecal Coliforms

Faecal Coliforms are naturally occurring bacteria found in the intestines of all warm blooded animals (including humans) and birds. The presence of Faecal Coliforms in the marine water is an indicator of contamination by sewage waste. Faecal Coliforms can enter marine via: sewer and septic systems, feedlot and dairy run-off, run-off from broad acre farming, stormwater, livestock defecating directly into the water.

Category	Total FC/100mL	Contact
Very good	0	
Good	> 0 to 35	Primary
Fair	< 35 - 230	Secondary
Poor	> 700	No contact

Primary contact refers to activities where we are completely immersed in water, e.g swimming. Faecal Coliforms should not exceed 150/100 mL. Secondary contact refers to activities where we come into contact with water but are not completely immersed in it. Faecal Coliforms should not exceed 1000/100 mL.

Dissolved Oxygen (DO)

The amount of oxygen in water, to a degree, shows its overall health. That is, if oxygen levels are high, one can presume that pollution levels in the water are low. Conversely, if oxygen levels are low, one can presume there is a high oxygen demand and that the body of water is not of optimal health. Apart from indicating pollution levels, oxygen in water is required by aquatic fauna for survival. In conditions of no or low oxygen availability, fish and other organisms will die. Oxygen enters in marine by two processes Diffusion and Photosynthesis.

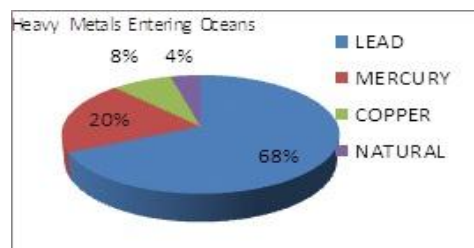
Ecosystem Type	Dissolved oxygen trigger value range (DO %)
Upland marine	60 - 120
Middle marine	90 - 110
Lowland marine	60 - 120

Nutrients and Heavy Metals

The three main plant nutrients are nitrogen, phosphorus and potassium. of these, only phosphorus is tested by Waterwatch groups. Nutrient levels in marine waters are naturally very low but due to human impacts these levels are often too high, resulting in algal blooms and excessive growth of marine -plants including seaweed which are very toxic.

Phosphates

Phosphates are often the limiting nutrients in marine environments. Therefore, high phosphate levels could lead the problems. The main sources of phosphorus in local catchments are: sediments from rocks and soil, effluent from waste water treatment plants and onsite sewage disposal units, detergents and fertilisers that have been washed down drains or that have run off from properties due to poor land management practices and storm water pollution, decaying organic matter.



Category	Total PO ₄ (mg/L)
Low	< 0.06
Medium	0.06 -0.15
High	> 0.15 -0.45
Very High	> 0.45

Heavy Metals: Introduced dangerous heavy metals include mercury, lead, and copper. Fuel combustion, electric utilities, steel and iron manufacturing, fuel oils, fuel additives and incineration of urban refuse are the major sources of oceanic contamination by heavy metals. Copper is dangerous to marine organisms and has been used in marine anti-fouling paints. Contaminated land runoff, rain of pollutants from the air, and fallout from shipwrecks pollute the ocean with dangerous metals. Human activities release 5 times as much mercury and 17 times as much lead as is derived from natural sources.

Marine Microinvertebrates organism (MMO)

Marine microinvertebrates are animals without backbones, small but we can see them with naked eyes and live in marine water. An assessment of the marine microinvertebrates in the marine can provide an indication of water quality. MMO are rated according to their sensitivity to pollution.

'Pollution rating' numbers from 1 to 10 indicate how sensitive each organism is.

There are four 'grades':

Very sensitive – 10, 9

Sensitive – 8, 7, 6

Tolerant – 5, 4, 3

Very tolerant – 2, 1

Stream Pollution Index (SPI) calculates a stream quality rating based on: Sensitivity of MMO to pollution, Different types of MMO found (biodiversity), Number of MMO found (abundance)

Stream Pollution Index (SPI)	Stream Quality Rating
Less than 3	Poor
3 to 4	Fair
4 to 6	Good
More than 6	Excellent

RESULTS AND DISCUSSION

The present study revealed the how point and non-point source pollution destroying the marine environment. We studied different types of parameters how the growth and reduction of these parameters affecting the marine life and marine resources. Some marine resources are very essential for survival and flourishing of living beings.

Temperature

Many marine water algae, plants and animals have adapted to survive in a certain range of temperatures.

Increasing in temperature affects the rate of photosynthesis of marine plants, the metabolic rate of aquatic animals, rates of development, timing, success of reproduction of marine fishes, mobility, migration patterns and the overall health of the marine shed. Temperature ranges for algae, plants and animals can be affected by man-made structures.

Salinity

Salinities higher or lower than a certain range places stress on the marine organism and very harmful, or lead to death. These can be natural and occur seasonally or they can be the result of human influence, such as increasing freshwater flow discharging from power plants or diverting freshwater for drinking and irrigation of fields. High levels of salinity in water may have adverse impacts upon sensitive flora and fauna, which are not salt tolerant. High levels of salinity also have implications when using marine water for stock watering.

pH

A pH range of 6.5 – 8 is optimal for freshwater. A range of 8 – 9 is optimal for estuarine and marine water. Outside of this range, organisms become physiologically stressed. Reproduction can be impacted by out-of-range pH, and organisms may even die if the pH gets too far from their optimal range. For example, in fishes may develop skin irritations, ulcers and impaired gill functioning as a result of water that is too acidic. Death of most aquatic fauna may result from extremely acid or alkaline water. Low pH or alkaline water can cause the release of toxic elements and compounds from sediments into the water where they may be taken up by marine animals, plants or algae. Changes in pH also influence the availability of plant nutrients, such as phosphate, ammonia, iron and trace metals, in the water.

Turbidity

Pollutants such as nutrients and pesticides may bind with suspended solids and settle in bottom sediments where they may become concentrated. It can also smother aquatic plants as they settle out in low flows, clog mouthparts, gills of fish and marine microinvertebrates. High turbidity affects submerged plants by preventing sufficient light from reaching them for Photosynthesis, it also have the capacity to significantly increase water temperature. Water temperature needs to remain fairly constant so marine fauna can survive. Though high turbidity is often a sign of poor water quality.

Faecal Coliforms

Faecal Coliforms indicate a risk to marine life. They are not pathogenic (disease causing) but indicate that pathogenic bacterial and viruses may be present in marine water.

Dissolved Oxygen (DO)

When the level of dissolved oxygen is above or below these ranges, the marine life will become increasingly stressed.

Nutrients and heavy metals

The effects of consistently high levels of nutrient levels are: water bodies choked with vegetation or algae - often weed species, changes in aquatic flora and fauna composition. This is often a change to a monoculture that is a change to a system dominated by a single plant species, increased fluctuations of dissolved oxygen levels. This places stress on aquatic fauna, an increase in total organic load, resulting in odours and reduced aesthetic quality. When heavy metals are incorporated into the marine ecosystem, they quickly become absorbed into marine food chain. Once in the food webs, these pesticides can cause mutations, as well as diseases, which can be harmful to humans as well as the entire food web. These can cause a change to tissue matter, biochemistry, behaviour, reproduction, and suppress growth in marine life. Also, many animal feeds have a high fish meal or fish hydrolysate content. In this way, marine toxins can be transferred to land animals, and appear later in meat and dairy products.

Marine Microinvertebrates organism (MMO)

Different microinvertebrates have different tolerances to pollution. Highly sensitive marine can only live in marine with high marine water quality. Tolerant and very tolerant organism can withstand lower water

quality. Healthy marine water has a higher biodiversity of micro invertebrate organisms.

CONCLUSION

It has now become quite clear that the marine resources is only a huge space craft which has its own definite limits of productivity and tolerance towards pollutants. Management of such natural resources for all the organism of biosphere including human beings through which not only the needs of present generation may be fulfilled but also there may remain all possibilities of nurturing the future generation is conservation. Conservation does not mean the accumulation, nor does it mean that the resources may not be used, nor does it still mean by control over the supplies so that some resources may be left over for future. The correct meaning of conservation is to take full advantage of ecological knowledge and to manage the ecosystems of the world in such a way so as to establish a balance between yield and its renewal. The blind destruction of whales, the excessive catching of fresh water and marine fishes, pollution of ocean by sewage water, industrial and agricultural waste products, entertainment in beach etc. all such affairs have resulted into wastage of whole marine water and silting of ocean. These are some marine resources whose improvement cannot be expected. Although on the state and national levels, various measures for the conservation of various resources by various departments are being adopted, yet the most important work is to make the larger population aware of this problem and to ensure their help and involvement in this work.

REFERENCES

1. Dahm CN. Pathways and mechanisms for removal of dissolved organic carbon from leaf leachate in streams. *Canadian Journal of Fisheries and Aquatic*, 1981.
2. Fisher SG and GE Likens. Stream ecosystem: organic energy budget. *Bio Science*, 22, 1972, 33-35.
3. Kaplan LA and JD Newbold. Biogeochemistry of dissolved organic carbon entering streams, *In* T.E. Ford (Editor), *Aquatic Microbiology: An Ecological Approach*. Blackwell Scientific, Oxford, UK, 1993, 139-165.
4. Lamberti GA and ME Berg. Invertebrates and other benthic features as indicators of environmental change in Juday Creek, Indiana. *Natural Areas Journal*, 15, 1995, 249-258.
5. Diaz RJ, Rosenberg R. Marine Benthic hypoxia: a review of its ecological effects and the behavioural responses of benthic macrofauna. *Oceanography and Marine Biology*, 33, 1995, 245.
6. Kannan K, J Newsted, RS Halbrook and JP Giesy. Perfluorooctanesulfonate and related fluorinated hydrocarbons in mink and river otters from the United States. *Environ Sci Technol*, 36, 2002d, 2566-2571.
7. Hansen KJ, LA Clemen, ME Ellefson and HO Johnson. Compound specific quantitative characterization of organic fluorochemicals in biological matrices. *Environ Sci Technol*, 35, 2001, 766-770.
8. Preen A. The Status and Conservation of Dugons in the Arabian Region, MEPA Coastal and Marine Management Series, MEPA Coastal and Marine Management Series-27.
9. Al-Yamani FY, Al-Rifaie K and Ismail W. *Marine Pollution Bulletin*, 27, 1989, 239-243.
10. ROPME. Manual of Oceanographic Observations and Pollutant Analyses Methods, Regional organization for the protection of the marine environment, Kuwait, 1989.
11. Jones DA. Proc. ROPME Symposium on Regional Marine Pollution Monitoring and Research Programme, ROPME/GC-4/2, 1985, 71-89.