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Effect of Contaminants on Coral Reefs – A Study on Oceanic Species

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Abstract:

Coral reefs are structures that are biogenic in nature, it often contributes to the seaward section of tropical shorelines, and it usually buffers the coast from wave action and erosion. Almost 600 species of calcifying corals contribute to the nature by being habitat of thousands of tropical fishes and algae. These structures have existed from past 500 million years.

In this study an evaluation had been made on the various factors that have been effecting life of coral reefs and giving rise to oceanic pollution. Unfortunately the growth of the industries are leading to the end of healthy oceanic ecosystem, one can claim that the coral reefs has become one of the most endangered species of the ocean, it has been found that twenty per cent of reefs has been disappeared from earths face in just forty years.

Keywords: *Oceanic Pollution, Coral Reef, Bleaching.*

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Introduction

Coral reefs are thought to be a significant natural resource that is found in tropical waters all over the world. (Spalding et al. 2001). Coral reefs are important as a national and international community not only this, it holds great importance to neighboring coastal communities as well. They also contribute in different ways to production of ocean and provide other substantial benefits interconnected to their role in leisure industry, recreation and as indicators for climate change and waste treatment.

Coral reefs are known to be the maximum producer of biological goods and diverse ecosystems of the world, it is also found to be land to thousands and lakhs of different species, out which only one tenth have been identified (Birkeland 1997)

Authors believe that the degradation of coral reefs are due to the reckless nature of humans, it houses several variant species of marine ecology.

Coral reefs grow in clean and clear water, let's say it is their need in order to survive and when human made pollution such as sediments and other pollutant enter the water, they suffocate coral reefs, and hamper the speed of growth hence damaging the algae, which only take down the water quality. Due to pollution corals become more vulnerable to diseases and it can directly affect the reproduction and growth of the same which eventually changes the food structure of the reef.

Types of Coral Reefs

Coral reef are divided into four broad classes naming:

- Fringing Reefs
- Barrier Reefs
- Atolls
- Patch Reefs

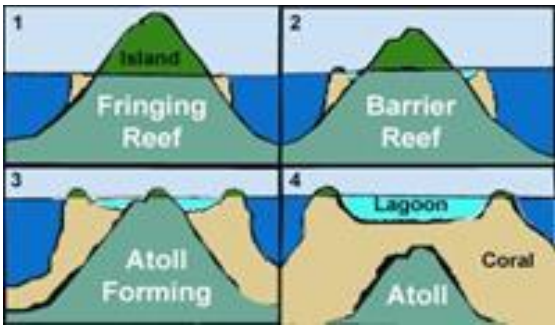


Figure 1: Fringing reefs: These are the most common type of reefs that could be found, it grows near the coastline of islands and continents.

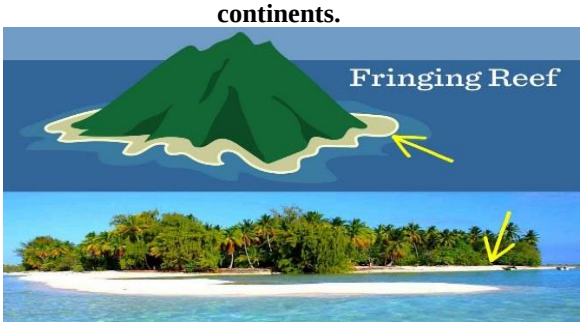


Figure 2: Fringing Reef; Pic Credit: thinga.com

Barrierreefs: These reefs are also found at the parallel areas of the coastline but these are separated by deeper, and wider lagoons and are present at the shallowest points of the lagoons. Its name has been based on the fact that these type of reefs can reach the water's surface by forming a barrier to navigation. Australian reef also known as the "Great Barrier Reef" is the most famous and the biggest reef that one can see.

Figure 3: Barrier Reef; Pic Credit: thinga.com

Atolls: Atolls are seen as the rings of coral that usually create protected lagoons and is mainly found at the center of the sea, these kind of reefs usually form when islands that are surrounded by fringing

reefs sink into the sea or when the situation comes that the sea level rises around them. P.S- this sort of islands are often found on the top of underwater volcanoes. What really happens is that the fringing reefs continue to grow and end up eventually forming a circle with lagoons inside.

Figure 4: Atoll Reef; Pic Credit: Coral Reef Alliance

Patch reefs: These are the small isolated reefs that grow up on the bottom strata of the island platform or continental shelf. It is normally found in between fringing reefs and barrier reefs, they are different in size and hardly ever reaches the surface of water.
Some such as Darwin think patch reef as micro scale reef that is feature of all three of the macro scale reef types.

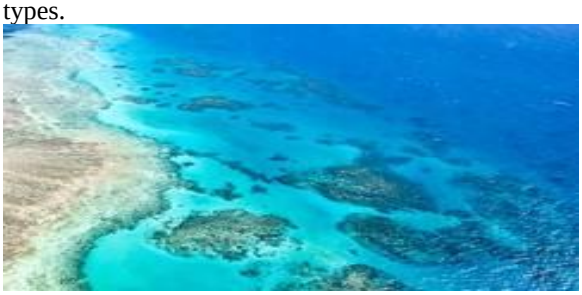
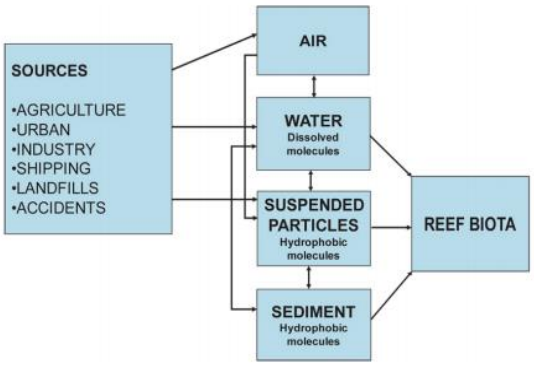


Figure 5: Patch Reef; Pic Credit: Coral reef info.com

Sources of Oceanic Pollution
Marine pollution have different origin, there are different kind of contaminants that are associated with particular environment section as it depends on their physicochemical characteristics. These contaminants reaches reef biota from different paths, in order to explain this we have shown a flow diagram that clears the various route taken up by the various contaminants
All the source that could create contaminant are:

- Agriculture
- Urban
- Industry
- Shipping
- Landfills
- Accidents



Flow chart showing source and route of contaminant entering the reef biota.

Effect of Pollution on Coral Reefs Community:
In an article of Florida Keys National Marine Sanctuary it was published that that their water shed comprise of rivers and streams that are directly drained into Florida Bay, by southwest Florida Shelf, the Gulf of Mexico, The Florida Straits and the Atlantic Ocean. Which means that pollutant enters the bay from as far as Mississippi Basin and as close as one's backyard enters the water system. Not only has this sewage pollution been identified as one of the major environmental problem from some time now (Doty 1969).

There are several regions where sewage pollution has effected coral reefs some of them are:

- Red Sea
- Caribbean
- Hawaii
- Caroline island

Coral reefs are among the most diverse and complex communities in the oceanic environment, for the formation of the structure of coral reefs hermatypic corals play a vital role as it provide substrate and shelter to the wide variety of organism. Apart from this their ecosystem is highly sensitive to environment perturbations, this sensitivity is linked to following factors:

- Corals have narrow physiological tolerance that is different for different environmental conditions. Coral growth and survival is

dependent of variation in physical-chemical conditions.

- Pollutant stress put in direct effect on the coral reefs.
- In environment of coral reefs during high water temperature effect of toxic substances gets enhanced. Few effects generated by high temperature are: increase in solubility, increase in the rate of biotic intake and great level of toxicity.

Effect of Oil Pollution on Coral Reefs:

There is very little or no information present in form of literature that depends only on the effects of oil pollution on algae or higher marine plants, mostly the reports that we get is based on the qualitative records on oil spills in reef areas.

Shinn in his work "Coral reef recovery in Florida and in the Persian Gulf" referred that crude oil possess minor or no threat to coral reefs. He concluded this on the basis of his observation, and observation was based on the reef recovery from oil polluted areas, it was a qualitative study. His study was backed by Spooner where he reported no damaging effects were produced to coral reefs in Tarut Bay, of Saudi Arabia. His work stated that the area that was chronically polluted by the oil, there was an area that bore corals which grew in healthy manner and had diverse and abundant fauna associated to it.

Another study "effects of chronic oil pollution on a Caribbean coral reef" by- Bak became suggestive that reef had gradually deteriorated, coral cover was low and juveniles were less in number near the refinery. And some coral species such as: A. *palmate* and M. *annularis* had large gap in their distribution pattern along the coast whereas some species showed growth in abundance for example: *Diploria strigosa*. This researcher had basically studied sub-lethal effect of oil pollution on coral reefs.

Dafni a student of Israel University conducted a research work for his thesis, under the heading- "Annual communities on dead corals under pollution conditions at Eilat Red Sea" where he had installed bleached coral skeletons in two shallow water areas in Eilat area of Red Sea, one of the area was chronically polluted by oil whereas the other was pollution free, it was left for observation for one whole year.

It is a known fact that coral skeleton functions as a substrate where different sort of organisms can settle down. Colonizing of diverse species took place in less density on skeleton of polluted area as compared to that of clean water skeleton.

Johannes 1975 summarized report on "the impact of oil spills on reef organism" in form of a table:

Table 1: Field Report of Researchers compiled by Johannes.

Time, Tanker and Site	Amount and Type of Oil Spill	Reported Effects
1971, MV Solar Trader, West Fayu, Caroline Is	520 tons Fuel and Lubricants	After eight months, large algal growth on corals were seen
1974, Sygna, Stockton Bight, East coast of Australia	400 tons	No damage to marine life was reported
1975 MV Lindenbank Fanning Atoll, Pacific Ocean	10,000 tons copra, palm oil, coconut oil, cocoa beans	Fishes, crustaceans and molluscs killed
1969-1979, two oil terminals, Eilat, Red Sea, Israel.	Many small-scale oil spills. Various tankers	Decrease in level of coral and fish diversity was observed.

Effect of Urbanization and industrialization on Coral reefs

Worldwide population has been on rise, and with this increasing population upsurge diversity and intensity of anthropogenic stressors can be seen.

And due to exploiting use of resources and coastal development coral reefs are increasing under pressure. A study by Wilkinson suggested that to the least 19% of the reefs worldwide has been lost permanently, and those which are remaining among them 60% are at direct risk from human activities.

The relevant stressors on reefs is anthropogenic in nature, and has pressure or turbidity gradient due to coastal development. It is believed that the dreadful conditions of reef has direct influences on coastal communities, as they hinge on reef resources for their means of support.

Now the main problem that comes up in front of management strategists is that they have to develop ecofriendly and conservative plans that can account for the connection between local habitats and reef betterment. Experts have come up with ideas such as increasing the distance of city center markets from sea-shores such ideas prove to be of benefit in areas that has extreme urbanization such as megacities, where different stakeholders are active user of resources.
According to UN world urbanization prospect in today 28 megacities are present out of which sixteen are Asian out which many are located around the coast, hence witness human induced marine problem. In correspondence to this Blackburn says in his work Mega-Urbanization on the coast that, coastal areas are suffering from various problems such as:

- Water Pollution
- Exhaustion of fishery resources
- Contamination of sea food
- Loss of habitat for many organism
- Eutrophication
- Sedimentation rate increase.

Another study conducted by researchers from New York Cornell University took place in United Kingdom, an excerpt was printed in the newspaper that suggested that man-made plastic acts as a poison for reefs, and more than eleven billion plastic pieces were found to be loaded in the Asia-Pacific Oceans Corals,
He advised that debris seemed to be leading towards occurrence of coral diseases, hence they concluded that this increased the disease striking corals formation from 4 per cent to 89 per cent.

Figure 6: Coral wrapped inside plastic; Pic Credit: Lalita Putchim

A senior author Professor Drew Harvell, quoted "Our work shows that plastic generated pollution is killing corals" it is so because plastic blocks light and oxygen, and since it gets blocked photosynthesis rate stops, the deprivation of light and oxygen makes corals easily available to infections by harmful microbes commonly known as pathogens.

Another researcher Doctor Joleah Lamb, who is a marine biologist at New York University of Cornell and a leading author of the new study said that debris generated from plastic works as motorhome of marine for microbes, she further adds that plastic items are usually made up of polypropylene, which have shown tendency of becoming heavily inhabited by bacteria which eventually gives rise to group of coral diseases commonly known as white syndrome. In this disease bacteria spreads vastly and causes the death of parts of corals and leaves behind a white band of dead tissues.

Effect of Chemicals on Coral Reefs:
Coral reefs are structures that are biogenic in nature, it often contributes to the seaward section of tropical shorelines, and it usually buffers the coast from wave action and erosion. Almost 600 species of calcifying corals contribute to the nature by being habitat of thousands of tropical fishes and algae. These structures have existed from past 500 million years.

Dam in his study showed how chemical pollutants impose a damping effect on the coral reef at various stage of its life cycle, to be precise we have taken up the data from their study:

Diuron	Adult	Bleaching
		Symbiont Density
		PSII inhibition
		Photopigment composition
		Lipid Content
Diuron	Juvenile	Bleaching
		Tissue Retraction
		PSII inhibition
		Energy acquisition
	Isolated Symbionts	PSII inhibition
	Larvae	Metamorphosis
	Gametes	Fertilization
Atrazine	Adult	PSII inhibition
	Isolated Symbionts	H14Co3 incorporation
Irgarol	Adult	Bleaching
		PSII inhibition
		H14Co3 incorporation
	Isolated Symbionts	H14Co3 incorporation

Dam in his study has said that waterborne chemicals that effect tropical marine communities are bound to have both point and non-point sources and it can be transported to distant reefs too. The process of dispersion, transport and ultimate biological effects of pollutant that are present in marine system are dependent of the tendency of persistency of the chemicals that are under tropical condition. It is normally found that pollutants with the high solubility rate in surrounding water always finds its way to the offshore. It is believed that biota that carries accumulated loads of tenacious chemicals in the tissues also easily transport pollutant in between ecosystem and far from their site of application and deposition. He also goes on explaining that the researchers have found that from last two decades it has come to notice that coral reefs are threatened by various number of stressors some of them are:

- Elevated Ocean Temperatures
- Acidification of Oceans
- Overfishing
- Nutrient input
- Turbidity

He further explains that these pressures vary in huge amount from region to region.

Key areas of further monitoring and research

According to Dam there are few areas that needs more consideration of research, following to the para we will discuss them:

- There is need of strong monitoring policies, as he claims that strong efforts are needed to be made in order to link pollution monitoring and Eco toxicological studies.
- Studies are required towards effects of chronic pollutions
- Experimental work is needed to be done, in order to understand the potential interactive effects amongst combination of pollutants in flood plumes during the period of monsoon
- Another area of work that comes up is the way of identification of pollutant, its region in which it may be reducing the resilience of corals and many other organisms. And whether or not climate change is effective i.e. it is effecting the target.
- To introduce changed policy of development management that can increase the chances of survival and improve life prospects.

Conclusion:

Conclusively, it can be said in order to save the coral reefs of different areas one need to avoid human activities near the coastal areas, and it is imparting serious health diseases on the coral reefs, hence destroying habitat of various species of fishes. Also despite of the evidences indicating relatively low risk associated with chemical pollution on the GBR, researchers have found the evidences that are suggestive of linkage between rate of population and resilience of corals.

Hence it would not be wrong to conclude that better managing plans need to be proposed for betterment of oceanic species.

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