



Conservation Challenges in Bleaching and Degradation of Coral Reefs Ecosystem

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Abstract

The coral reefs that surround the world were created by millions of tiny coral polyps over thousands of years as a gift to humanity. Reefs provide food for people, resources for scientific research, and a wealth of leisure activities. Reefs require our care because we depend on them, thus we should definitely protect them for future generations. Algal cover and coral death can be adversely affected by nutrient enrichment of remaining coral bleaching due to temperature stress, grazers, algal colonization and most influencing in an imbalance between production and consumption will outcome in community structure changes.

Keywords: Conservation, Coral Reefs, Degradation, Ecosystem

Introduction

Coral reefs form a unique ecosystem, richer in biodiversity than any other ecosystem in the world. Reefs are productive, shallow-water, marine ecosystems that are based on rigid lime skeletons; themselves formed through successive, growth, deposition and consolidation of the remains of reef-building corals and coralline algae. The basic units of reef growth are the coral polyps and the associated symbiotic algae that live in the coral tissues. This symbiotic relationship is the key factor explaining both the productivity of reefs and the rather strict environmental requirements of corals. Coral reefs have important ecosystem functions that provide crucial goods and services to hundreds of millions of people (Moberg and Folke 1999). These goods and services often form an important source of income for local populations (through fishing, mariculture, *etc.*) and sustenance to those living at subsistence levels. They are also a tourist attraction, contributing to local income and foreign exchange. In addition, they form a unique natural ecosystem, with important biodiversity value as well as scientific and educational values. In addition, coral reefs

form a natural protection against wave erosion. Corals play an important role in fisheries, tourism, and coastal preservation by supplying habitat for species and supporting these industries. Additionally, there is growing awareness of their biotechnological potential. Natural product-based drug discovery was particularly sparked by corals' and their microbial associates' production of compounds with potential for use in pharmaceuticals.

Origin of Coral Reefs

Coral reefs are formed when the freely moving larvae of corals attach themselves to sedimentary rocks or hard surfaces near the coastlines. This process is undertaken with the help of several other processes like sedimentation, compaction, cementation and solidification of the skeletons of coral polyps. The majority of reef building corals are found within tropical and subtropical waters. These typically occur between 30° North and 30° South latitudes.

Type of Corals

There are two main types of corals: hard corals and soft corals. **Soft corals**, like sea fingers and sea whips, are soft

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and bendable and often resemble plants or trees. These corals do not have stony skeletons and are non-reef-building corals instead; they grow wood-like cores and fleshy rinds for protection. Like hard corals, they tend to live in colonies. Soft corals' chief difference from hard corals is structural. While **hard corals** secrete calcium-based skeletons, soft corals do not. Instead, soft corals contain structures within their tissues called spiracles that support their bodies. Additionally, soft corals have eight fuzzy tentacles for feeding. Aquarium hobbyists often consider zoanths to be soft corals. While a biologist would consider zoanths a type of sea anemone, for aquarium purposes, their care is identical to true soft corals.

Type of Coral Reefs on the basis of Distribution

- Scientists generally agree on four different coral reef classifications: fringing reefs, barrier reefs, atolls, and patch reefs.
- **Fringing reefs** grow near the coastline around islands and continents. They are separated from the shore by narrow, shallow lagoons. Fringing reefs are the most common type of reef.
- **Barrier reefs** also parallel the coastline but are separated by deeper, wider lagoons. At their shallowest points, they can reach the water's surface forming a "barrier" to navigation.
- **Atolls** are rings of coral that create protected lagoons and are usually located in the middle of the sea. Atolls usually form when islands surrounded by fringing reefs sink into the sea or the sea level rises around them.
- **Patch reefs** are small, isolated reefs that grow up from the open bottom of the island platform or continental shelf. They usually occur between fringing reefs and barrier reefs. They vary greatly in size, and they rarely reach the surface of the water.

Ecology of Coral Reefs

Coral ecology is the study of relationships between living organisms found on coral reefs and their interactions with the natural and human environment. Increased ocean temperatures and changing ocean chemistry are the greatest global threats to coral reef ecosystems. These threats are caused by warmer atmospheric temperatures and increasing levels of carbon dioxide in seawater (Cardini *et al.*, 2014). Coral reefs' high productivity has been attributed mainly to photo symbioses between the coral animal and algae of the family Symbiodiniaceae, with the recognition that the host can increase algal photosynthesis by concentrating nutrients and enhancing the efficiency of light absorption. Coral reefs provide a habitat for a large variety of marine life, including various sponges, oysters, clams, crabs, sea stars, sea urchins, and many species of fish. Coral reefs are also linked ecologically to nearby sea grass, mangrove, and mudflat communities.

Benefits of Coral Reef Ecosystems

Coral reefs protect coastlines from storms and erosion, provide jobs for local communities, and offer opportunities for recreation. They are also a source of food and new medicines. Over half a billion people depend on reefs for

food, income, and protection. Fishing, diving, and snorkelling on and near reefs add hundreds of millions of dollars to local businesses. The net economic value of the world's coral reefs is estimated to be nearly tens of billions off site link of U.S. dollars year⁻¹. These ecosystems are culturally important to indigenous people around the world (Phelan *et al.*, 2020).

Economic Importance of Coral Reefs

Coral reefs often form the backbone of local economies. Tourists coming to dive need not only drive boats and guides, but also restaurants, hotels and commercial and entertainment facilities. In many cases, tourism associated with reefs has expanded to transform the entire economy of a region. This of course has both positive and negative consequences for both the marine environment and the communities involved. For example, someone who harvests sea turtle eggs may choose to sell turtle tours as an alternative livelihood. On the other hand, an unmonitored number of tourists may result in environmental problems such as coral damage, pollution and inadequate waste treatment.

Management of Coral Reefs

Marine Protected Areas (MPAs)

Strategically placed and well-maintained marine protected areas (MPAs) can aid in the preservation and restoration of coral reef ecosystems, particularly when combined with other management strategies like integrated coastal management and ecosystem-based fisheries management.

Monitoring, Mapping and Assessing of Coral Reef Ecosystem

NOAA Coral Reef Watch (CRW) uses satellite sea surface temperature data to alert managers and scientists around the world of the risk of coral bleaching. CRW has also recently developed a new system, which uses NOAA experimental sea surface temperature forecasts, to predict coral bleaching events. The prediction system uses forecast models to develop bleaching outlooks up to three months in advance. To continue addressing the threat of coral bleaching, reef managers are provided with tools to understand climate change and coral bleaching and information about how to take action in response to alerts of potential bleaching conditions. The National Coral Reef Ecosystem Monitoring Program (NCREMP) supports local shallow-water coral reef ecosystem monitoring activities. The goal of NCREMP is a nationally-coordinated, comprehensive, long-term monitoring program to assess the condition of US shallow-water coral reef ecosystems, evaluate the efficacy of coral reef ecosystem management, and communicate progress toward conservation of coral reef ecosystems.

Coral Reef Early Warning System (CREWS) stations loaded with meteorological and oceanographic instruments monitor the health of coral reefs at major US coral reef areas, and beyond. CREWS station instruments can include above-water meteorological devices that measure wind speed, gusts, wind direction, air temperature, barometric pressure, precipitation, and light. Underwater instruments include a light sensor and a device that measures the conductivity,

temperature, and depth of seawater. As part of the NOAA Integrated Coral Observing Network (ICON), the CREWS stations report weather and water data to the NOAA National Weather Service. The entire network of monitoring stations provides valuable information for future hurricane forecasts/models and can be used to understand coral bleaching and coral reef-related events. The CREWS system has been successfully used in modeling and alerts of coral bleaching conditions in the Florida Keys and the Great Barrier Reef (Toth *et al.*, 2022).

Conservation of Coral Reefs

The protection of coral reefs has been stressed under Wildlife Protection Act, 1972 and Environmental Protection Act, of 1986 and Coastal Regulation Zone Notification (CRZN) of 1991 coming under it. Other acts like Indian Forests Act, 1927, Forest Conservation Act, 1980 and Indian Fisheries Act also offer a sort of relief in the conservation of Coral reefs of India. But there is no separate legal status for coral conservation even under Wildlife Protection Act. The State forest department, fisheries departments and recently the state coastal management authority at the state level are taking up the responsibilities for coral reef conservations in India. Wildlife Protection Act include the protection of major ecosystems, there is no direct stress on coral reef conservations. Moreover, the CRZ notification essentially covers coastal areas extending 500 meters from High tide line and the land lying between the Low tide line and High tide line in the landward side, the areas extending beyond the coral and coral reefs on seaward side remain unprotected. The major coral reef areas could be declared ecologically sensitive under EPA 1986 and strict restrictions could be imposed on dangerous industries.

Threats to Coral Reefs of India

Unfortunately, coral reef ecosystems are severely threatened. Some threats are natural, such as diseases, predators, and storms. Other threats are caused by people, including pollution, sedimentation, unsustainable fishing practices, and climate change, which is raising ocean temperatures and causing ocean acidification. Many of these threats can stress corals, leading to coral bleaching and possible death, while others cause physical damage to these delicate ecosystems. Corals are able to recover from bleaching events if conditions improve before they die, though it can take many years for the ecosystems to fully heal. Scientists are also testing new ways to help coral reef ecosystems, such as growing coral in a nursery and then transplanting it to damaged areas.

Recent studies by the National Institute of Oceanography have shown that reckless tourism is damaging Malvan's coral reefs. Similar injuries to Goa's coral reefs are likely due to scuba diving and snorkelling and similar activities. The

Gulf of Mannar corals usually bleach in summer if water temperature surpassed 30 °C. The Space Applications Centre in Ahmedabad has created a coral reef atlas of India using remote sensing data to evaluate the area under coral reefs. They observed that Andaman, Nicobar, and Gulf of Kutch regions recorded threat in 2010, while the Gulf of Mannar recorded threat in 2016. According to the International Union for Conservation of Nature (IUCN), India's coastal and marine ecosystem along with coral reefs is under increasing threat due to overexploitation of resources (Naser, 2014).

Conclusion

Reef habitats were damaged already before more recent alterations caused by sewage waste, infectious diseases, climate change, over fishing, siltation caused by dredging. The sponges, gorgonians, and macroalgae are now the dominating benthic taxa on many reefs due to the drastic decline in fish diversity and abundance. Reef fishes may be affected by ocean acidification and warming through such a multiple way, including as decreased food sources for larvae, declining oxygen levels due to warming, and altered behavioral habits. By conducting research that focuses on solutions, by taking part more proactively in discussions to enhance coral reef legislation and implementation, and by making it absolutely clear that reefs can still be rescued if we preserve.

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