



Vanishing Beauty Beneath the Waves: Coral Reefs

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Abstract

Underwater, coral reefs glisten with life in dense population-based biodiverse colonies. They create underwater cities able to rival the complexity and diversity of a rainforest. While coral reefs cover less than 1% of the seafloor, they blanket the sites of nearly 25% of all marine species. If it weren't for the rainforests, we could call coral reefs the most productive ecosystems on the planet, serving as nurseries, feeding and resource grounds, wave buffers and defense to coastal areas. Virtually at our doorstep, coral reefs have constantly been eroded away and no one seems to be paying attention. The shallow coral reefs being attacked by pollution, overfishing, coastal development or climate change, bleaching, breaking and disappearing. This paper sets out to examine the extraordinary value of coral reefs, not only highlighting their ecosystem unique lifestyle in including the incredible ecosystem profits that support human livelihoods and supporting potential life saving medicines. We will explore the threats of coral reefs, including the local pressures such as sedimentation and toxins, as well as the global challenges that include ocean acidification and warming seas. With this being said, it is worth detailing some of the bold and brave conservation initiatives including marine protected areas and new coral reef restoration initiatives as well as potential international collaborations. We are all stewards of our planet's oceans and reefs, we have a collective responsibility not just as conversationists but to honour the seabed legacy our planet has created for us so that others can experience the beauty of these underwater jewels.

Key words: Marine, Coral Bleaching, Ocean, Pollution, Protection, Fishing, Ecosystem, Environmental Threats



Introduction

Beneath the ocean surface lies one of our planet's most beautiful natural wonders 'coral reefs'. Coral reefs are underwater ecosystems built by colonies of tiny animals called coral polyps, held together by calcium carbonate. These vibrant structures are incredibly diverse, supporting a quarter of all marine life despite covering less than 1% of the ocean floor. Commonly referred to as the "rainforests of the sea," due to their high diversity. About 25% of the ocean's fish depend on healthy coral reefs. Fishes and other organisms' shelter, find food, reproduce, and rear their young in the many nooks and crannies formed by corals. Shallow water, reef-building corals have a symbiotic relationship with photosynthetic algae called zooxanthellae, which live in their tissues. The coral provides a protected environment and the compounds zooxanthellae need for photosynthesis. In return, the algae produce carbohydrates that the coral uses for food, as well as oxygen. The algae also help the coral remove waste. Since both partners benefit from association, this type of symbiosis is called mutualism. Deep-sea corals live in much deeper or colder oceanic waters and lack zooxanthellae. Unlike their shallow water relatives, which rely heavily on photosynthesis to produce food, deep sea corals take in plankton and organic matter for much of their energy needs. Great Barrier Reef (Australia) is the largest reef system in the world. India also possesses reefs in Gulf of Mannar, Lakshadweep, Andaman & Nicobar Islands. Unfortunately, these colourful environments are perishing at an alarming pace, and their demise could be disastrous for the earth.

Importance of Coral Reefs

Coral reefs are among the most diverse and valuable ecosystems on our planet. Corals, fish, and other marine wild life occupy over 4,000 species and, although coral reefs only exist on 1% of the world's oceans, they provide habitat for at least 25% of the world's marine life (many of which are yet to be discovered). Healthy coral reefs provide food for coastal and inland communities. Coral reefs are also critical to support commercial and recreational fisheries since greater than half of all U.S. fisheries species use coral reefs as part of their life cycles. Coral reefs provide individuals with recreational opportunities that include diving, snorkeling, fishing, and more. Coral reefs create jobs and businesses through tourism and recreation. Coral reefs support local economies, with local visitors and tourist spending billions of dollars on coral reef-related activities including dive tours, recreational fishing trips, hotel stays, restaurants, and other area businesses located near reefs ecosystems. Several different corals are also considered the basis for finding new medicines. Many drugs are being developed from compounds found in coral reef animals and plants that may treat cancer, arthritis, bacterial



infections, viruses, and other illnesses. It is cumulatively indicated that coral reefs similarly still have extensive and unexplored medicinal properties and potential future work is still required to assess their capabilities.

The Threats Confronting Coral Reef

1. Local Threats to Coral Reefs

Coral reefs are mostly found in shallow coastal waters, making them highly vulnerable to human impacts. These include direct damage from coastal development, dredging, harmful fishing methods, boat anchors, and recreational activities. Pollution from land-based sources also poses a major threat. Sediment from construction, agriculture, and forestry can smother corals, while excess nutrients from fertilizers and sewage promote algae growth that blocks sunlight and depletes oxygen. These conditions can also support harmful microbes that cause coral disease. Pathogens from untreated sewage and runoff may trigger disease outbreaks, especially in already stressed corals. Toxic substances like heavy metals, pesticides, and chemicals from industrial waste and sunscreens can interfere with coral growth and reproduction. Trash, especially plastics and microplastics, can entangle marine life or be ingested, causing harm. Overfishing affects food chains and reduces species that control algae, while blast fishing and coral harvesting damage reef structures and biodiversity. Combined, these stressors weaken coral reefs, making them more prone to disease and disruption from invasive species.

2. Global Threats to Coral Reefs

Rising ocean temperatures and changes in ocean chemistry are major threats to coral reefs, driven by increased air temperatures and higher carbon dioxide levels. Warmer seas cause corals to expel the algae that nourish them, leading to coral bleaching, which exposes their white skeletons. Prolonged bleaching can result in coral death or increased vulnerability to diseases. Climate change also brings rising sea levels, stronger storms, and altered ocean currents, all of which further damage reefs. Ocean acidification happens when more carbon dioxide is absorbed by seawater, forming carbonic acid and raising acidity. The ocean takes in about 25% of CO₂ from fossil fuel emissions, and since the Industrial Revolution, acidity has risen by 30%. It's expected to rise another 40% by century's end. Increased acidity reduces essential minerals needed by corals to build their skeletons, slowing reef growth or even causing skeletons to dissolve. Local pollution, such as nutrient runoff, can worsen acidification in coastal waters.



Fig: A changing climate for coral reefs, Janice Lough (2016)

Coral Reef Protection

Proper trash disposal is vital to protect coral reefs. Always recycle, especially plastics, and follow the 3 R' - reduce, reuse, recycle. Use bins to keep waste from reaching waterways, and never leave trash or cigarette butts on beaches. Join local or global cleanup efforts, like the International Coastal Cleanup, to help keep rivers and coasts clean. Limit fertilizer use, as excess nutrients like nitrogen and phosphorus from lawns can pollute oceans and harm coral reefs. Choose eco-friendly transport options: walk, bike, take public transit, or use fuel-efficient vehicles to reduce greenhouse gas emissions, which drive ocean warming and acidification. Also, reduce stormwater runoff by using rain gardens or water barrels to prevent polluted water from reaching oceans.



Fig: Way to protect coral reefs, NOAA



Governments Steps to protect Coral Reefs

Governments worldwide are actively working to protect coral reefs due to their importance for biodiversity, coastal protection, and the economy. Their strategies include laws, conservation programs, and international partnerships to ensure reef sustainability.

1. Marine Protected Areas (MPAs)

Governments establish MPAs to limit human activities like fishing and development. Notable examples include the Great Barrier Reef Marine Park. Zoning within MPAs allows for controlled eco-tourism and sustainable use.

2. Sustainable Fishing Enforcement

Laws regulate fishing practices, gear, and species protection to prevent overfishing. International efforts also combat illegal fishing through cooperation and shared policies.

3. Climate Change Mitigation

To address coral bleaching, countries reduce carbon emissions under agreements like the Paris Agreement. Some fund research on coral resilience, including breeding heat-tolerant corals and reef restoration.

4. Pollution Control

Regulations target land-based pollution sources, such as sewage, pesticides, and fertilizers. Bans on single-use plastics and stricter oil spill rules also help protect reef ecosystems.

5. Restoration and Research

Governments support coral restoration by transplanting nursery-grown corals and backing scientific research that guides conservation efforts and policies.

6. Public Awareness and Education

Sustainable tourism is promoted to minimize damage from recreational activities. Awareness campaigns educate the public about coral reef conservation and responsible behaviour.

7. International Cooperation

Cross-border initiatives like the Coral Triangle Initiative and global treaties (e.g., Convention on Biological Diversity) enhance collaborative reef protection.



8. Funding and Incentives

Financial aid is provided to developing nations for reef conservation. Incentives encourage sustainable tourism and fishing practices, including eco-certifications.

9. Monitoring and Law Enforcement

Governments use technologies like drones and satellites to monitor reefs and illegal activities. Violations are met with strict penalties to deter harmful actions.

Conclusion

Coral reefs are vital ecosystems. They provide biodiversity, protect coastlines, offer economic value, and deliver environmental benefits. Conserving these reefs is critical for maintaining marine life, supporting jobs, and reducing the effects of climate change. Protecting coral reefs helps ensure these important services continue for both current and future generations.

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