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THE LAW OF THE REEF: REGULATORY SHORTFALLS IN THE PROTECTION OF CORAL REEFS

Sanika Brahme

ABSTRACT

Coral reefs are among the most ecologically important marine ecosystems and, at the same time, among the most susceptible to increasing anthropogenic and climatic stress. Even though extensive coral reefs exist in other regions of India, including the Gulf of Mannar, Lakshadweep, and the Andaman and Nicobar Islands, their protection is indirect. The paper is a critical analysis of the current regulatory framework for the conservation of coral reefs in India and identifies structural and enforcement-related gaps that are weakening efforts to protect them. By examining domestic environmental laws, coastal controls, and judicial-administrative measures, the paper will show that coral reefs are mostly lost within broader environmental and wildlife legislation that lacks much ecosystem specificity. The paper also assesses India's international commitments under various instruments, such as the Convention on Biological Diversity, and evaluates the extent to which India has implemented them at the national level. The article compares ecological facts with two levels of legal response, suggesting that the ineffective application of existing laws and the lack of a dedicated statutory framework are among the culprits in the degradation of the reefs. The paper examines the reasons why a reef-based, coherent regulatory framework is needed to unite conservation concerns with sustainable coastal governance.

INTRODUCTION

The whole world is experiencing a rising call to take serious action against climate change. Across the globe, coral reefs have been falling prey to the side effects of aggravated climate change, a by-product of destructive human actions. Among the most biologically sensitive

and rich underwater ecosystems in the world, coral reefs are often called the tropical rainforests of the sea, comprising calcareous organisms that produce calcium carbonate ($CaCO_3$).[1] The soft-bodied marine creatures called coral polyps create a limestone skeleton by absorbing calcium from the water and attaching themselves to a rock, where they produce thousands of clones, forming reefs and, subsequently, a coral reef.[2] They live in a symbiotic relationship, where they photosynthesise and, in return, provide energy to the corals through their photosynthetic products.[3]

Due to their over-sensitive nature, coral reefs cover only an area of 260,000 to 600,000 km^2, approximately 0.2% of the ocean's surface[4], or less than 0.1% of the Earth's surface.[5] The crisis of coral reef extinction and excessive bleaching has been rapidly worsening globally, and despite the resolutions taken by the international community, the situation continues to deteriorate. The existing legal system of dealing with this crisis has not been effective in delivering results. As per the estimates made by the United Nations Environment Programme (UNEP), around 25% to 50% of the coral reefs around the globe have been destroyed, and 60% are under grave threat[6]

RESEARCH OBJECTIVE

The crisis of coral reefs' extinction and excessive bleaching has been rapidly increasing globally. The aims and objectives of this research work are as follows:

- To highlight the importance of coral reefs to marine organisms, nature, and humans
- To bring out the incomplete legal framework for the protection of coral reefs in India and the loopholes in it;
- To bring out the international legal initiatives that are contributing to the safeguarding of coral reefs
- To identify the existing threats to coral reefs and the best possible solutions

[1] Laurent Plaisance, Coral Reef Biodiversity, in *Life in the World's Oceans: Diversity, Distribution, and Abundance* 65, 65-74 (Alasdair McIntyre ed., 2010).
[2] Ibid, at 66
[3] Plaisance, supra note 1, at 66.
[4] UN Env't Programme, *Status of Coral Reefs of the World: 2020* (Oct. 5, 2021), at
[5] Plaisance, supra note 1, at 67.
[6] Coral reefs across the world are being threatened by climate change, United Nations in India, available at https://india.un.org/en/163326-bringing-coral-reefs-back-life (last visited Jan. 1, 2026).

- To highlight the current deteriorating situation and the importance of prevention from extinction

RESEARCH QUESTIONS

The following questions are attempted to be answered through this research:

- What are the international legal initiatives to protect and help in the rejuvenation of coral reefs?
- Whether India needs a separate law for the protection of coral reefs?
- Whether destructive human activities aggravate the natural threats to coral reefs?

HYPOTHESIS

- The lacuna of strict laws for the protection of coral reefs and the insufficient implementation of existing ones are the major causes of their depletion.
- There is no separate legal framework in India for the protection and revival of coral reefs, and no existing law is sufficient for the same.
- Man-made threats are more severe and devastating than natural threats, and they exacerbate existing climatic risks.

RESEARCH METHODOLOGY

The Methodology used in this research is doctrinal, i.e., primarily analytical and evaluative. This type of research has hypotheses to be verified by analysing various data sources. The doctrinal design has been employed to examine the significance of coral reefs, the threats to them, various international initiatives to protect them, and Indian laws that safeguard them. This has been done primarily with the help of different High Court judgments, which have been relied on to highlight the Indian legal stance on coral reefs' protection from illegal trade, and primary sources, including the Indian laws like the Environment Protection Act, 1986[7], the Wildlife Protection Act, 1972[8], and others. Additionally, inter alia, research by Spalding Mapping the Global Value and Distribution of Coral Reef Tourism,[9] the United Nations

[7] Environment (Protection) Act, No. 29 of 1986, India Code (1986).
[8] Wild Life (Protection) Act, No. 53 of 1972, India Code (1972).
[9] Mark Spalding *et al.*, *Mapping the Global Value and Distribution of Coral Reef Tourism*, 82 Marine Policy 104 (2017).

Convention on the Law of the Sea (UNCLOS, 1982),[10] the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES),[11] and the Convention on Biological Diversity (1992)[12] are relied upon to understand the international legal initiatives to protect and revive coral reefs. Conclusions and suggestions have been drawn with consideration for the need to protect coral reefs. To date, the researcher has not conducted any fieldwork.

IMPORTANCE

The contribution of Coral reefs to the ocean is way more than merely adding to its scenic view. Coral reefs have often been mistaken for mere decorative features of the ocean, when in fact they form one of the most significant marine habitats. As per estimates, coral reefs account for around $2.7 trillion per year in the ecosystem service value[13]. Reefs buffer coastlines from natural calamities, such as hurricanes, and also prevent erosion. Coral reefs serve as an anchor for the small vessels and also offer protection to the lagoons. It thus offers protection to communities, beaches, harbours, agricultural lands, property, and life. The protection offered by coral reefs helps save on the cost of coastal defence. A healthy reef can help to reduce coastal wave energy by 97 per cent. The most widely utilised medicine is coral reefs, known as the medicine chest of the sea. They provide cures for diseases such as leukaemia, skin cancer, cardiovascular and more. The skeletal structure is used for bone grafting.

They act as natural water filters by absorbing suspended matter, thereby improving water quality and clarity in areas around shorelines. They help maintain ocean water quality by converting dissolved carbon dioxide to limestone, thereby regulating the amount of carbon in the ocean. They assist in fixing nitrogen. Coral reefs are extremely important in the fisheries of the world. They are important sources of protein and food, and they serve as nurseries to marine life. The birth animals of reefs play a vital role in maintaining the food supply and protecting low-lying islands, and they serve as a large habitat for marine plants and animals. The importance of coral reefs to humans is evident from statistics showing that around 850 million people live within 100 km of coral reefs and that coral reefs offer economic benefits. Ironically, they are found in areas with high population densities. They are a boon to coastal

[10] United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397.
[11] Convention on International Trade in Endangered Species of Wild Fauna and Flora, Mar. 3, 1973, 27 U.S.T. 1087, 993 U.N.T.S. 243.
[12] Convention on Biological Diversity, June 5, 1992, 1760 U.N.T.S. 79.
[13] Mark Spalding et al., Mapping the Global Value and Distribution of Coral Reef Tourism, 82 MARINE POL'Y 104, 105 (2017).

economies by attracting tourists, thereby increasing job opportunities and enhancing local people's incomes. The economies of small Caribbean islands are largely dependent on coral reefs.

INTERNATIONAL LEGAL INITIATIVES

The principal flaw of the international legal regime is its enforceability only against countries that have signed or ratified it. However, the following are the international initiatives taken to protect and embrace coral reefs:

The United Nations Convention on the Law of the Sea (UNCLOS), 1982

It is the parent and principal convention pertaining to the ocean and its resources. It is a crucial treaty due to its conservation-oriented provisions. The preamble itself provides for *"study, protection and preservation of the marine environment"*. It states that the States shall preserve and conserve their marine creatures even in internal waters. The States have been given the right to exploit their natural resources while protecting their marine environment. It specifies that the required actions will be employed to prevent, control, and minimise pollution, and that the State will take into consideration all forms of pollution. The States that are party to the convention or have ratified it are bound by the above-mentioned duties provided under Articles 192 to 194[14]. In the arbitration matter between the *Republic of the Philippines and the People's Republic of China*, commonly referred to as the South China Sea Arbitration, the Permanent Court of Arbitration, inter alia, held that China violated the provisions of UNCLOS by indirectly permitting fishing vessels to conduct harmful harvesting practices for coral reefs and other marine organisms.[15]

Agenda 21

In 1992, the United Nations Conference on Environment and Development, held in Rio de Janeiro, adopted the final draft of Agenda 21[16]. The main focus was to introduce a comprehensive global program aimed at realising the Sustainable Development Goals. Chapter 17 of the Agenda, inter alia, provides protection to coral reefs and states that high priority shall be accorded to coral reef ecosystems.[17] Chapter 15 is also significant and

[14] Ibid. art. 194.
[15] In re Arbitration Between the Republic of the Philippines and the People's Republic of China, PCA Case No. 2013-19, Award (Perm. Ct. Arb. July 12, 2016) (constituted under Annex VII to the United Nations Convention on the Law of the Sea, Dec. 10, 1982).
[16] Agenda 21, U.N. Doc. A/CONF.151/26 (Vol. I), annex II (Aug. 12, 1992).
[17] Ibid., ch. 17.

relevant to coral reefs, as it supports the conservation of biological diversity.[18] In this regard, governments at the appropriate level should take action to strengthen protected areas, including aquatic, terrestrial, and marine areas, and to protect vulnerable coral reefs. In furtherance of implementing Chapter 17 and other conventions at the 1994 Small Island Developing States Conference, the International Coral Reef Initiative (ICRI) came into force.

The International Coral Reef Initiative (ICRI)

It is an informal international partnership between countries and organisations to preserve coral reefs and similar ecosystems worldwide. It has developed action plans in accordance with regional circumstances in collaboration with national governments. Its work is recognised by the UN. They proclaimed 2018 the third International Year of the Reef in Paris, France, at the 31st General Meeting, to raise awareness of their significance.[19] ICRI, a UNEP partner, implemented specific recommendations in May 2020 to protect coral reefs. These recommendations aim to bring coral reefs to the priority list of the Convention on Biological Diversity Post-2020 Global Biodiversity Framework, to be decided in May 2021.[20] The biggest drawback of this initiative is the non-binding nature of the resolutions it passes, even on the member countries. Thus, in the author's view, such initiatives lose their value due to their non-binding nature, as the states don't strictly adhere to the objectives.

Convention on Biological Diversity, 1992[21]

As the name suggests, it is an international, legally binding convention that aims to protect and maintain biological diversity, including coral reefs. India is a party to the Biological Diversity Act, 2002.[22] This was a landmark step as it made many countries implement national laws pertaining to the protection of wildlife

[18] Supra note 16, ch 15
[19] International Coral Reef Initiative (ICRI), International Year of the Reef (IYOR) 2018 End of Year Report (Dec. 2019).
[20] United Nations Environment Programme, Oil Spill in Mauritius Calls for More Efforts to Safeguard Coral Reef Ecosystems (Aug. 24, 2020), https://www.unep.org/news-and-stories/story/oil-spill-mauritius-calls-more-efforts-safeguard-coral-reef-ecosystems.
[21] Convention on Biological Diversity, June 5, 1992, 1760 U.N.T.S. 79.
[22] Biological Diversity Act, No. 18 of 2003, India Code (2003).

The Convention on International Trade and Endangered Species of Wild Flora and Fauna (CITES)[23]

It addresses international trade in endangered species, including various forms of coral reefs. Coral reefs are often traded for various purposes, such as jewellery and souvenirs. The Trade of species mentioned under Appendix I is prohibited.[24] It provides for a licensing system to be adopted by member states for the import, export, and re-export of species mentioned in Appendices II and III.[25] The members have banned international commercial trade in the list of endangered species, and also monitor trade in other species. All stony and reef-building corals are listed in Appendix II due to the deteriorating effect of the coral trade on their ecosystem. Thus, for the purpose of international trade of blue corals, black corals, and antler corals, a permit is required by the country of origin. Almost 230 species of corals are listed under the CITES Species Database. Earlier, traders often avoided the problem of illegal trade or trade without due permits by claiming that the coral is a living rock, not a hard rock, making it permissible to trade without a permit. After 2000, both hard and living rock are subject to convention.

The United Nations Framework Convention on Climate Change (UNFCC), 1992

It aims to stabilise greenhouse gas levels and thus control rising temperatures driven by climate change, ultimately protecting coral reefs from bleaching or extinction. Climate change is the primary driver of coral reef bleaching. Although this convention was a step in the right direction, climate change continues to take a dangerous shape.[26]

The United Nations Educational, Scientific and Cultural Organisation (UNESCO)

UNESCO is another useful convention, as it states that biological and physical formations of outstanding scientific or aesthetic value are considered part of the natural heritage. It provides financial and technical assistance for the protection of natural heritage listed on the 'World Heritage List'. The World Heritage List also includes 160 natural properties, including 11 coral reefs. There are three found in Australia, with the Great Barrier Reef. Two are in

[23] Convention on International Trade in Endangered Species of Wild Fauna and Flora pmbl., Mar. 3, 1973, 27 U.S.T. 1087, 993 U.N.T.S. 243.
[24] CITES, ibid, app. I.
[25] CITES, ibid, app. II & lll
[26] United Nations Environment Programme, *Can Coral Reef Restoration Save One of the Most Vulnerable Ecosystems to Climate Change?* (Jan. 18, 2021), https://www.unep.org/news-and-stories/story/can-coral-reef-restoration-save-one-most-vulnerable-ecosystems-climate (last visited Jan. 1, 2026).

Indonesia, and one is in the Gulf of Mannar, India; others are in the USA, the United Kingdom, the Philippines, Mexico, Belize, and the Seychelles.

The United Nations Environment Programme (UNEP), 1972[27]

It is the most imperative, commonly known as the voice of the environment within the UN. It is an important part of ICRI, as evidenced by the formation of the Coral Reef Unit (CRU) in 2000, which serves as the funding basis for the International Coral Reef Action Network (ICRAN). Its authority body is the United Nations Environment Assembly, the world's highest-level decision-making body in matters related to the environment. There are other organisations, such as the Global Coral Reef Alliance and the Global Coral Reef Monitoring Network (GCRMN), that play important roles in raising public awareness, conducting scientific research, and monitoring coral reefs.

INDIAN LEGAL REGIME

Despite the highly populated coastal areas, coral reefs in India are present in two areas off the mainland coast. These two areas are the Gulf of Kutch in the northwest and the Gulf of Mannar in the south. The remaining reefs are located in India's union territory islands, specifically the Lakshadweep Islands and the Andaman and Nicobar Islands.[28] The Ministry of Environment and Forests is the authoritative department responsible for managing coral reef areas. The absence of separate legislation for coral reefs in India is evident, as none of the existing laws distinguishes coral reef areas from the rest of the marine and coastal areas. However, there are certain environmental laws that are invoked for its protection, namely, the Environment (Protection) Act, 1986[29], the Coastal Regulation Zone (CRZ) Notification of 1991[30], and the Wildlife (Protection) Act (WPA)[31], 1972. Other laws, namely, the Forest Conservation Act, 1980[32], the Indian Fisheries Act[33], and the Indian Forest Act, 1927,[34] also have relevance in the protection of coral reef areas.

[27] G.A. Res. 2997 (XXVII), U.N. Doc. A/RES/2997(XXVII) (Dec. 15, 1972).
[28] Govt of India, Ministry of Environment & Forests, Coral Reefs of India (2007).
[29] Supra note 7
[30] Coastal Regulation Zone Notification, G.S.R. 114(E), Gazette of India, Extraordinary, pt. II, sec. 3, sub-sec. (i) (Feb. 19, 1991) (India).
[31] Wildlife (Protection) Act, No. 53 of 1972, INDIA CODE (1972).
[32] Forest (Conservation) Act, No. 69 of 1980, INDIA CODE (1980).
[33] Indian Fisheries Act, No. 7 of 1897, Acts of Parliament (India).
[34] Indian Forest Act, No. 16 of 1927, Acts of Parliament (India).

The Environmental Protection Act, 1986

The umbrella legislation of environmental laws in India provides general provisions that cater to the protection of all elements of nature, namely land, air, water, and their interrelation. The Act grants the Central Government authority to safeguard and conserve the marine environment; however, it does not include any special considerations for coastal reefs or any specific provisions regarding them. In this author's view, the major gap can be filled by including coral reefs as ecologically sensitive under the 1986 Act. The main objective would be to enable the concerned authorities to protect coral reef areas without any limitations on the seaward side, and to prevent any harmful industrial activity near the area.[35]

The Wildlife Protection Act, 1972[36]

Four species of coral are covered under the Schedule I list of the Wildlife Protection Act.[37] thereby covering them under the definition of wild animals under Section 2(36)[38] (Any animal mentioned under Schedule I to IV and found wild in nature is called a wild animal.) of the WPA. The coral species covered therein are Black corals, Sea Fan, Reef-building corals, Organ Pipes and Fire Corals. Inclusion in the Schedule offers them protection from exploitation and overuse by trade activities and industries.

Section 39(3)[39] provides that wild animals are government property, which shall not be acquired or kept in possession or transferred or destroyed or damaged unless the Chief Wildlife Warden permits. Section 29[40] and 35(6)[41] prohibit any person from destroying, removing or exploiting any wildlife from a sanctuary or a National Park, respectively, unless the Chief Wildlife Warden gives permission and the State government is satisfied. According to these sections, removing listed coral reefs from protected areas, such as sanctuaries or national parks, would be illegal. However, it doesn't cover all forms of coral, thereby leaving scope for misuse.

Madras High Court held in the case of the *State of Tamil Nadu & Another v. M/s.Kaypee Industrial Chemicals (P) Ltd. & Others*[42] that if the coral reefs are washed ashore after the

[35] Environment (Protection) Act, 1986, supra note 7, §§ 6(3)(d), 7(4)(d).
[36] Wildlife (Protection) Act, No. 53 of 1972, INDIA CODE (1972).
[37] Ibid., sched. I.
[38] Ibid., § 2(36).
[39] Ibid., § 39(3).
[40] Ibid., § 29.
[41] Ibid., § 35(6).
[42] State of Tamil Nadu & Another v. M/s Kaypee Industrial Chemicals (P) Ltd. & Others 2005 SCC OnLine Mad 252

death of the reef-building coral, they can be sold, bought and used for commercial purposes, and the government authorities do not have any right to interfere, as such activities do not violate the provisions of WPA. However, the Supreme Court had granted a stay on the above-mentioned judgment.

The opinion of the Madras High Court was contrary to the Delhi High Court's view in the case of *Cottage Industries Exposition Limited v. UOI*,[43] wherein dead corals were declared trophies or uncured trophies and thus were considered protected under the Act. The major concern here is that the coral invertebrates and reef fishes, whose absence would cause the coral reefs to fail to maintain a healthy ecosystem, are traded under the Act, leaving them vulnerable to exploitation. It would be interesting to note the Apex Court's view on this point, as this can help in the furtherance of the literature on the protection of coral reefs' in India

In another case of *C. Rathinavel v. The State of Tamil Nadu*,[44] the petitioner contended that the coral reefs are minerals and lifeless substances, and the WPA isn't applicable. The court held that the above-mentioned contention is fallacious and coral reefs are not just animal articles but also a habitat which provides a living environment to innumerable marine organisms, and thus Section 29[45] prohibits the destruction of such habitats. The Madras High Court thus relied on the inclusion of coral reefs under the WPA and the Supreme Court's stay in the *M/s Kaypee Industrial Chemicals Pvt. Ltd.* case[46] for the trading of skeletons of dead washed coral reefs ashore.

The Gujarat High Court in the case *Gujarat Positra Port Company Limited & Ors. v. Union of India, Ministry of Environment, Forest and Climate Change and Ors*.[47] rejected the petition of the petitioner seeking an order to grant permission for Environmental Impact Assessment for the development of a port at Positra. The Court highlighted the sensitive nature of coral reefs and stated that construction of shipping lanes and berths would, inter alia, destroy coral reefs and that the resulting turbidity would kill the corals. Thereby, the Court provided protection to the corals and denied permission. Despite the slight recognition by the Courts, the situation regarding various protection-related issues remains unanswered. Different High Courts have passed various judgments, including the above-mentioned ones;

[43] Cottage Industries Exposition Ltd. v. Union of India, 2007 (122) ECC 7
[44] D. Rathinavel Pandian v. State of Tamil Nadu, 2007 SCC OnLine Mad 840
[45] Wildlife (Protection) Act, supra note 36, § 29.
[46] Supra 42.
[47] Gujarat Positra Port Company Limited v. Union of India, 2011 SCC OnLine Guj 4703

however, the Supreme Court's view is awaited, which could create uniformity by setting a precedent.

CRZ Notification

Coastal Regulation Zone (CRZ) Notification of 1991[48] and 2011[49] which were issued under the EPA prohibits certain types of activities in the CRZ, inter alia, coral mining, setting up or expansion of industries, fish processing units, effluents and waste disposal units, and discharge of untreated effluents and waste from cities, towns, other human settlements and industries, dumping of ash or any thermal power stations' waste and city waste for landfilling. It classifies the Coastal stretches within 500 m of the High Tide Line (HTL) into four categories: CRZ-I, II, III and IV.[50] Corals and coral reefs fall under the CRZ-I, which declares them ecologically sensitive areas and offers protection.[51] According to the 1991 Notification, CRZ-IV encompasses the Lakshadweep Islands, the Andaman and Nicobar Islands, and any other island not covered under CRZ I, II, and III. CRZ-IV is a protected zone where construction activities, dredging, and blasting in and around coral reefs are prohibited. There's also a ban on using coral reefs from the shore for construction or any other purpose. Corals and sand from the beaches and coastal waters are prohibited from being used for construction or any other purpose. This part of the notification is often criticised for its limited application to the abovementioned islands rather than to other coral reef areas, such as the Gulf of Kutch and Mannar.[52] The 1991 Notification was revised 37 times, and the most recent Notification was issued in 2011. The current draft of the CRZ Notification 2018 is being highly criticised for permitting enhanced activities in the coastal regions.[53]

Others

Another hurdle is the old laws, which need to be amended but have been stalled for so long. One such law is the Fisheries Act, which penalises only the pollution of water and the use of explosives; it fails to account for the fact that, with the advancement of civilisation and the

[48] CRZ Notification, 1991, G.S.R. 114(E).
[49] CRZ Notification, 2011, G.S.R. 372(E).
[50] Id., sched. I, CRZ-I-IV.
[51] Devaki Panini, *Law and Policy for Conservation and Management of Coral Reef Areas in India*, in *Regional Workshop on the Conservation and Sustainable Management of Coral Reefs* 16 (Food & Agriculture Org. of the U.N., Fisheries & Aquaculture Dept. 1997)
[52] Rajesh Sehgal, *Legal Regime Towards Protecting Coral Reefs: An International Perspective and Indian Scenario*, 2 *Law, Env't & Dev. J.* 183 (2006).
[53] National Fishworkers Forum launch month-long national campaign against CRZ 2019 regulations, *SabrangIndia* (Feb. 27, 2019), available at https://sabrangindia.in/national-fishworkers-forum-launch-month-long-national-campaign-against-crz-2019-regulations/.

depletion of resources, methods of exploitation have diversified, causing harm to underwater organisms, including coral reefs. The Marine Fishing Policy, 2004,[54] bans all destructive methods of fishing; however, the term 'destructive' has not been defined.[55] Also, the policy does not embrace the interdependence between fishing practices and marine biodiversity. The legislature has yet to recognise that imposing bans alone is insufficient; measures to regenerate and develop coral reefs and coastal bio-shields are also required.

Marine Protected Areas (MPA)

MPAs are existing patchworks of local, state, and national efforts to protect biodiversity, particularly coral reefs. Above all, they play an essential role in protecting marine biodiversity. cover national parks & sanctuaries, national marine sanctuaries, and other protected areas. There are 36 MPAs currently in India, with just five of them being coral reef MPAs: Rani Jhansi Marine National Park, Mahatma Gandhi Marine National Park in the Andaman Islands, Gulf of Mannar National Park, Gulf of Kutch Marine National Park and Great Nicobar Biosphere Reserve. It is monitored by the Ministry of Environment and Forests.[56]

Indian Coral Reef Monitoring Networking (ICMRN)

Based on the recommendation of the National Committee on Wetlands, Mangroves and Coral Reefs, the Indian Coral Reef Monitoring Networking (ICMRN) was set up by the Ministry of Environment and Forests, GOI.[57] ICMRN has the responsibility to manage coral reef databases, monitor their health, strengthen, train, and build the capacity of institutions for reef management and the implementation of Management Action Plans. The USA has a special Coral Reef Task Force to protect and preserve the coral reef ecosystem. It also has a specific law, the Coral Reef Conservation Act of 2000, to restore and preserve the coral reef ecosystem. Moreover, a special list of corals is added to the Endangered Species Act, which penalises any offence committed against such endangered species. Nevertheless, the Indian laws on coral reefs have a loophole. India can implement a similar law specifically addressing coral reefs and establish a task force to monitor the deteriorating situation of coral reefs in the country.

[54] Ministry of Agriculture, Government of India, *National Marine Fishing Policy* (2004) (India)
[55] Supra 52
[56] Sehgal, supra note 52, at 189.
[57] Srihitha Baswapoor & Zareena Begum Irfan, Current Status of Coral Reefs in India: Importance, Rising Threats and Policies for Its Conservation and Management, Working Paper No. 175/2018, Madras Sch. of Econ., Chennai, India 15 (July 2018).

THE PRESENT DETERIORATING SITUATION

Threats

Coral reef depletion has disrupted the marine food chain. To gain a deeper understanding of the worsening situation, it is essential to identify the major threats. The threats can be categorised into three parts:

Natural/Climatic threats

The presence of certain marine organisms that graze on corals makes coral reefs more vulnerable to chemical or physical threats. An example is the lionfish, which is currently present throughout the Caribbean and is not indigenous to the area; it is a threat to coral reefs. Coral reefs are sensitive to the continuous high tidal amplitude, for instance, in the Gulf of Kutch, where corals are exposed to the atmosphere for several hours. When combined with warm or poor weather conditions, this can lead to coral death. As a part of the natural food chain, the triton snails, which feed on thorn starfish, are depleting, and in turn, the increasing starfish population feeds on the coral reefs[58], as seen in the Lakshadweep Islands and the Gulf of Mannar.[59]

Anthropogenic / Human-made threats

Coral reefs are harmed by marine pollution. Oil spills, ship discharges, and pipeline leaks have short-term to long-term detrimental effects. Exposure of coral reefs to oil leads to severe reactions, among others, expulsion of the algae zooxanthellae, death of tissues, alteration in calcification rate, and death of larvae[6061] The 2020 oil spill in Mauritius (more than 1,000 tonnes of oil, including fuel oil, were spilt into the sea) was not the only recent shocking tragedy that has highlighted the importance of protecting coral reefs.[62] Mauritius, an island country located in the southeast of the African continent in the Indian Ocean, is known for its

[58] D.J. Deaker & Maria Byrne, Crown of Thorns Starfish Life-History Traits Contribute to Outbreaks, a Continuing Concern for Coral Reefs, 6 *Emerging Topics in Life Sciences* 67 (2022).
[59] Ibid, 8.
[60] Lucas Fernandes et al., *Oil Spill Incidents on Coral Reefs: Impacts and Remediation Technologies*, in *Oil Spill* (IntechOpen 2023), https://doi.org/10.5772/intechopen.105354.
[61] Hoff, H., The Global Marine Environment: Issues and Policies, 12 *Mar. Pol'y J.* 45 (2001).
[62] United Nations Environment Programme, *Oil Spill in Mauritius Calls for More Efforts to Safeguard Coral Reef Ecosystems* (Aug. 24, 2020), https://www.unep.org/news-and-stories/story/oil-spill-mauritius-calls-more-efforts-safeguard-coral-reef-ecosystems (last visited Jan. 1, 2026).

world-class coral reefs. This has impacted coral reefs and the Nation's people who depend on the sea for food, tourism, and livelihoods.[63]

While removing coral reefs for the construction of houses and the production of lime, often dead corals aren't distinguished from live corals, resulting in the loss of large patches of reefs. With population growth, farmers are forced to expand their farming. They often engage in deleterious fishing practices; for instance, factory-type fishing scrapes the seabed clean. Some countries use dynamite to blow up the coral reefs, leading to the death of marine life in that water body. Fishing is also a threat to the reefs because chemical substances such as cyanide and organochlorines are used. Live bait fishing, in which coral reefs are surrounded and damaged using nets, has been highly damaging to coral species in the Lakshadweep Islands. The Status paper prepared by the Zoological Survey of India on the coral reefs of the Gulf of Mannar found that industrial pollution near the corals and local coral mining had driven corals to the brink of extinction[64]. Coral collection is another threat that promotes the use of branching corals for jewellery-making and souvenir purposes. Although laws are in place in India, the coral reefs of the Gulf of Kutch and the Andaman and Nicobar Islands continue to be damaged by this practice.[65] The destruction of mangrove forests affects coral reefs, as the forests bind the mud and reduce sedimentation on the corals. Mangrove forests in the Gulf of Kutch have experienced destruction and are prone to net expansion.[66] The increasingly irresponsible tourist activities, such as snorkelling, and the excessive amount of untreated waste exacerbate the problem.

CLIMATE CHANGE

Aggravating climate change is a result of human-caused catastrophic actions. Increased ozone layer depletion has, in turn, increased the number of ultraviolet rays (particularly UV-B) entering the Earth’s surface, and these increased UV rays can damage corals in shallow water bodies, resulting in bleaching, reduced growth, and DNA damage.[67] As water temperatures warm, corals expel the zooxanthellae living in their tissues, turning them white; this

[63] United Nations Development Programme, *Human Development Report 2007/2008* (2007)
[64] V. Venkataraman et al., Coral Reefs of India: Status and Conservation, 29 *Curr. Sci.* 1154 (2004).
[65] Sanjay Chandravanshi, Omkar Sahu & Pragya Mehta, *Coral Reefs in India: Threats, Status and Conservation*, 4 *AgriAllis* 42, 45–47 (Issue 8), https://www.agriallis.com/
[66] R. Prerna, V.S. Naidu, Soniya Sukumaran & S.N. Gajbhiye, *Observed Changes in Extent of Mangroves and Coral Reefs in Southern Gulf of Kachchh Over Ten Years Using Principal Component Analysis and Geo-Spatial Techniques: A Case Study*, 19 *J. Coast. Conserv.* 257, at 12, § 6.1.2 (2015).
[67] M.P. Lesser, *Effects of Solar Ultraviolet Radiation on Coral Reef Organisms*, 19 *W. Indian Ocean J. Mar. Sci.* 149, 151 (2006).

phenomenon is known as coral bleaching. As a consequence, the density of zooxanthellae decreases, with a 50%-80% decrease in their photosynthetic pigment.[68] The world witnessed its worst coral bleaching in 1998.[69] Ocean acidification is a phenomenon in which the absorption of CO2 by seawater reduces the concentration of carbon ions, which are needed by corals for calcification. The chemical composition of the water body changes, making it more acidic.[70] Coral reefs and other marine creatures cannot grow their skeletons in an acidic environment; even those that can are weaker and more susceptible to storm damage. Another effect of climate change is the increasing intensity of storms.

Powerful, long-lasting storms destroy coral branches and sometimes overturn the colonies. Due to rising temperatures, glaciers have been melting faster, thereby raising sea levels.[71] The rise in sea level causes corals to drift to deeper waters, where they receive less sunlight, thereby reducing their growth rate. The Global mean sea-level rise has been accelerating by 3mm per year, leading to glacier and ice sheet melt.[72] The rate of probable coral extinction has increased drastically, and one-third of reef-building corals face an elevated risk of extinction due to local impacts and climate change.[73] Three events in history are recorded as the most fatal to coral reefs: 1998, 2010, and 2014-2017. The 2014-2017 coral bleaching has proved to be the most widespread and the longest bleaching event in history, killing two-thirds of Australia's Great Barrier Reef.[74] The El Niño effect of 2015-16 was the most drastic ever recorded in coral reef history, exacerbated by deteriorating climate change conditions.[75]

[68] A.A. Venn, J.E. Loram & A.E. Douglas, *The Impact of Coral Bleaching on the Pigment Profile of the Symbiotic Alga*, 29 *Plant Cell & Env't* 2133, 2133–34 (2006).
[69] Wilkinson, Clive (ed.), *Status of Coral Reefs of the World: 1998* (Australian Institute of Marine Science 1998).
[70] Mollica, N. R., Guo, W., Cohen, A. L., Huang, K. F., Foster, G. L., Donald, H. K., & Solow, A. R., *Ocean Acidification Affects Coral Growth by Reducing Skeletal Density*, 115 Proc. Nat'l Acad. Sci. U.S.A. 1754, 1754-55 (2018)
[71] R. Steven Nerem et al., *Climate-Change–Driven Accelerated Sea-Level Rise Detected in the Altimeter Era*, 115 Proc. Nat'l Acad. Sci. U.S. 2022, 2023 (2018).
[72] Ibid at p. 2023
[73] Kent E. Carpenter et al., *One-Third of Reef-Building Corals Face Elevated Extinction Risk from Climate Change and Local Impacts*, 321 SCIENCE 560 (2008).
[74] Terry P. Hughes et al., *Global Warming Transforms Coral Reef Assemblages*, 556 Nature 492, 492-93 (2018); Ove Hoegh-Guldberg, *Climate Change, Coral Bleaching and the Future of the World's Coral Reefs*, 50 Marine & Freshwater Res. 839, 840-41 (1999); Clive Wilkinson (ed.), *Status of Coral Reefs of the World: 2008*, at 11-13 (Global Coral Reef Monitoring Network 2008).
[75] Terry P. Hughes et al., *Global Warming and Recurrent Mass Bleaching of Corals*, 543 Nature 373, 373-374 (2017).

Temperatures in the Great Barrier Reef in Australia and the Islands of Hawaii to Fiji recorded high temperatures, indicating alarming signs.[76]

SUGGESTIONS

Based on the above-mentioned discussion, this author has some suggestions for the continuing deteriorating situation of coral reefs:

Training and awareness shall be provided to people on the conservation and utilisation of coral reef resources, especially in developing countries like India. NGOs, Government Institutions, and International intergovernmental organisations shall be strengthened by merging their synergies to conserve coral reefs.[77] ICRMN should be given the mandate to coordinate local groups, enabling them to participate more effectively in management action plans.

The establishment of MPAs can be expanded to provide a safer, protected, and more sustainable environment for fishing, mining, and recreation. With MPA, coral reefs are healthier because they receive greater protection.[78] It cannot shield corals against heatwaves,[79] but a mechanism of checks and balances is a process that is run, whereby the fish contain the algae,[80] allowing corals to survive. Infrastructure and building capacity shall be strengthened.[81]

Establishment of no-take zones, which are a specific form of MPAs that completely forbids the harvesting, extraction and destruction of sea resources. Their objective is to provide a favourable environment for fish for their proper growth, which in turn benefits coral reefs.[82] Better fishing practices can be adopted to save the coral reefs.

[76] Terry P. Hughes et al., *Spatial and Temporal Patterns of Mass Bleaching of Corals in the Anthropocene*, 359 Science 80, 81-82 (2018).
[77] Rodney V. Salm, Terry Done & Elizabeth McLeod, Marine Protected Area Planning in a Changing Climate, in *Coral Reefs and Climate Change: Science and Management* 207-09 (J.T. Phinney et al. eds., Am. Geophysical Union 2006).
[78] Callum M. Roberts et al., Effects of Marine Reserves on Adjacent Fisheries, 294 Science 1920, 1921-22 (2001).
[79] Terry P. Hughes et al., *Global Warming Transforms Coral Reef Assemblages*, 556 Nature 82, 84-86 (2018).
[80] Peter J. Mumby et al., *Fishing, Trophic Cascades, and the Process of Grazing on Coral Reefs*, 311 Science 98, 100-01 (2006).
[81] Supra 77
[82] Supra78

The reduction or prohibition of harmful fishing practices facilitates the adoption of sound practices, which will benefit the settlements that rely on corals for income, as well as the corals themselves. Moreover, controlled harvesting of fish shall be ensured.[83]

UNESCO should add more coral reefs to its World Heritage List. It should protect coral reefs by listing them on the World Heritage in Danger list under Article 11.[84] Articles 19 and 22 provide that a State containing a reef can request and seek either monetary or technical international assistance.[85] Scientists have found that MPAs can help save reefs when properly placed.[86] The rapid development of genetic engineering and biotechnology has raised hope for the creation of heat-tolerant coral reefs; therefore, these efforts should be strongly supported to revive and prevent the extinction of coral reefs. Countries shall invest in their Research and Development wings to promote biotech engineering and ultimately such new creations.

Enacting certain laws to protect the Indian coral reefs is a strong argument. India is a signatory to various international conventions, including the UNCLOS, CBD, and CITES. Consequently, it has the sovereign right over the resources found within a 200 nautical mile zone of its shore. The Wetlands, Mangroves, and Coral Reefs National Committee shall constitute a national policy to preserve and restore the coral reef zones. Along with new legislation, there is a strong need for its proper implementation; measures must be taken to prevent corruption, bureaucracy, and unnecessary exploitation by those in power.

CONCLUSION

No one would be incredulous that coral reefs provide immense benefits to both nature and organisms. It should not ignore their contribution to the environment. It is evident from the current deteriorating situation and alarming statistical data that, if not addressed, we will soon witness the extinction of coral reefs. Various departments across the globe are working to restore bleached coral reefs before they die completely. Similarly, the Zoological Survey of India is attempting to restore coral reefs in the Gulf of Kachchh by applying mineral- or bio-rock-accretion technology. Thus, the hypothesis that a lacuna in strict laws for the protection of coral reefs and insufficient implementation of existing ones are the major causes of its

[83] Supra 80
[84] Convention Concerning the Protection of the World Cultural and Natural Heritage art. 11, Nov. 16, 1972, 1037 U.N.T.S. 151.
[85] supra note, art. 19, 22.
[86] Supra 77 at 1166.

depletion is confirmed. The second hypothesis, that there is no separate legal framework in India pertaining to the protection and revival of coral reefs, and that no present law is sufficient for this purpose, also stands positive. The last hypothesis is that man-made threats are graver, and that human actions exacerbate natural threats, some of which are even aggravated by human actions. This has a positive aspect, as even climate change is a by-product of human actions.