

BENEATH THE **WAVES**

EXPLORING TAMIL NADU'S
CORAL REEFS



PUBLICATION INFORMATION

BENEATH THE WAVES

EXPLORING TAMIL NADU'S CORAL REEFS

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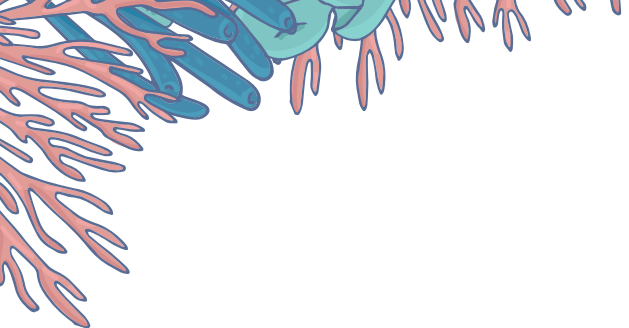
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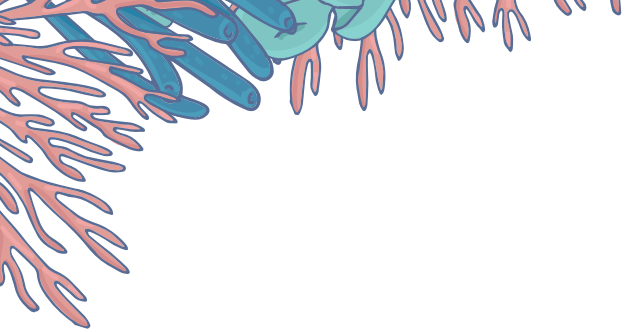
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Platygyra lamellina





KEY MESSAGES

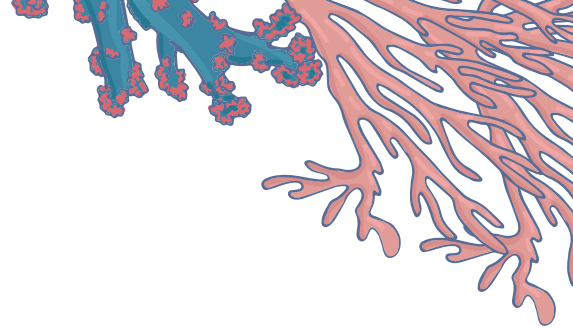
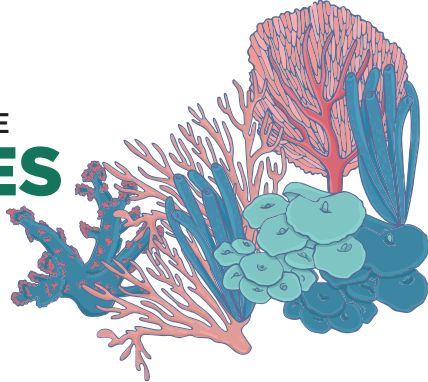
- 1 Tamil Nadu's coral reefs, particularly those in the Gulf of Mannar and Palk Bay, are biodiversity hotspots and they are essential for ecological balance.
- 2 The global and local coral reefs face significant threats from climate change, pollution, and other human activities, necessitating urgent conservation measures.
- 3 Successful conservation in Tamil Nadu includes legal protection, community involvement, and innovative restoration projects.
- 4 Coral reefs are vital for the local economy and culture in Tamil Nadu in terms of support to fisheries, tourism, and coastal communities.
- 5 Individual and community actions, like sustainable practices and responsible tourism, are crucial for the conservation of coral reefs.



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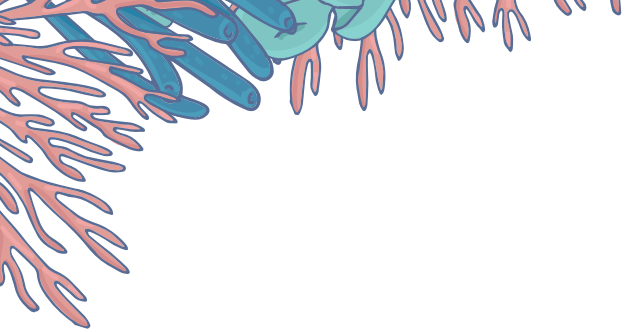
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Turbinaria spp.





1

Introduction to Tamil Nadu's Coastal Ecosystem

Tamil Nadu, a vibrant state in southern India, is bordered by the majestic Bay of Bengal, the vast Indian Ocean, and the Arabian Sea contributing to its extensive coastline that stretches to 1,076 km. TN coast represents 13% of India's total coastline of 7,500 km. The state boasts a significant continental shelf area of 41,412 sq km and an expansive Exclusive Economic Zone covering 1.9 lakh sq km. In the year 2020-21, Tamil Nadu achieved a remarkable marine fish production of 5.48 lakh tons.

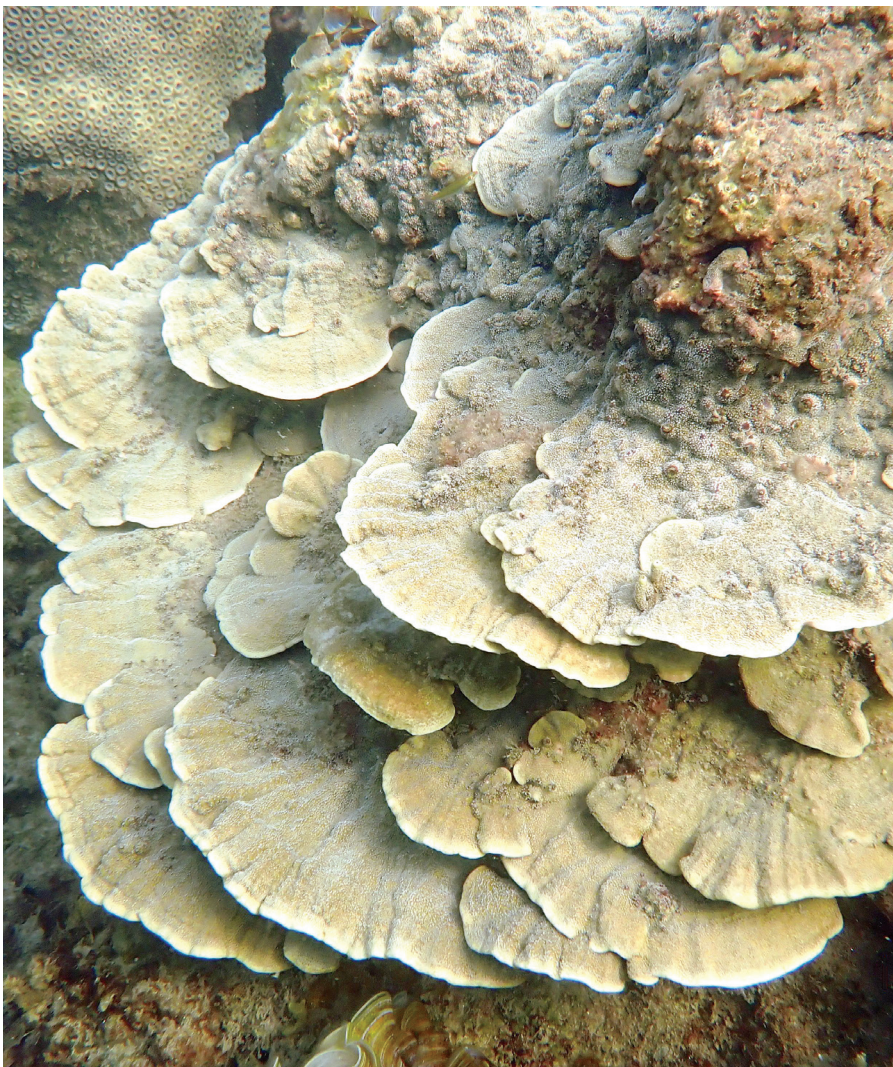
Coastal Habitats: The coast of Tamil Nadu is a mosaic of diverse and rich coastal habitats. They include coral reefs, seagrass meadows, mangrove forests, salt marshes, estuaries, sand dunes, and mudflats. These varied ecosystems not only have stunning natural beauty but also serve as refuge for a plethora of biodiversity.

Coastal Development: Home to 14 coastal districts, Tamil Nadu is a hub of significant coastal developments. It harbors 3

major ports along with 17 minor ports, each playing a pivotal role in the state's maritime activities and contributing to its economic growth.

Coral reefs, often referred to as the underwater rainforests, are vital components of marine biodiversity for they hold immense ecological and economic value worldwide, including for the state of Tamil Nadu. They are crucial in maintaining marine biodiversity, protecting coastlines, and supporting local economies through fisheries and tourism.

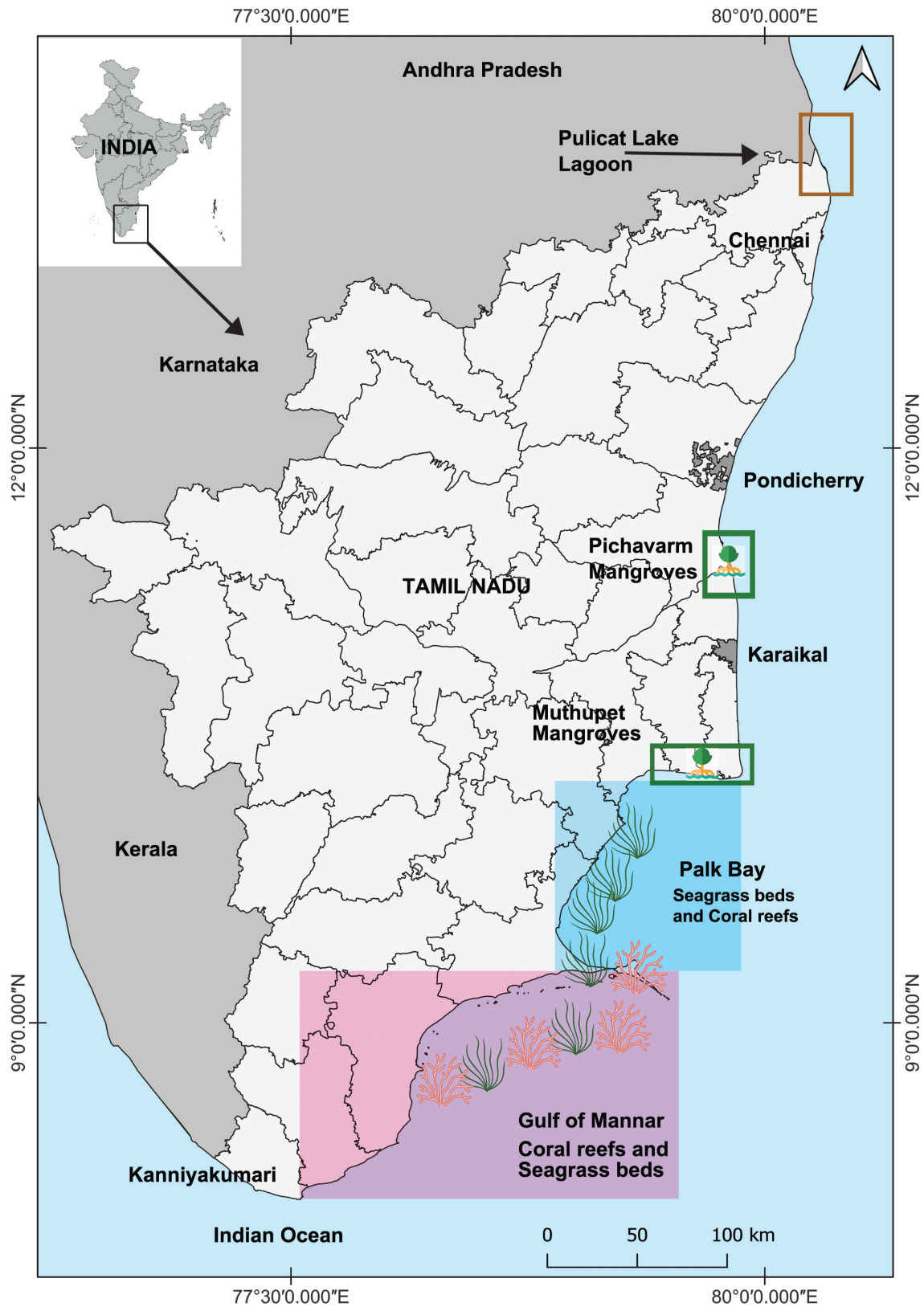
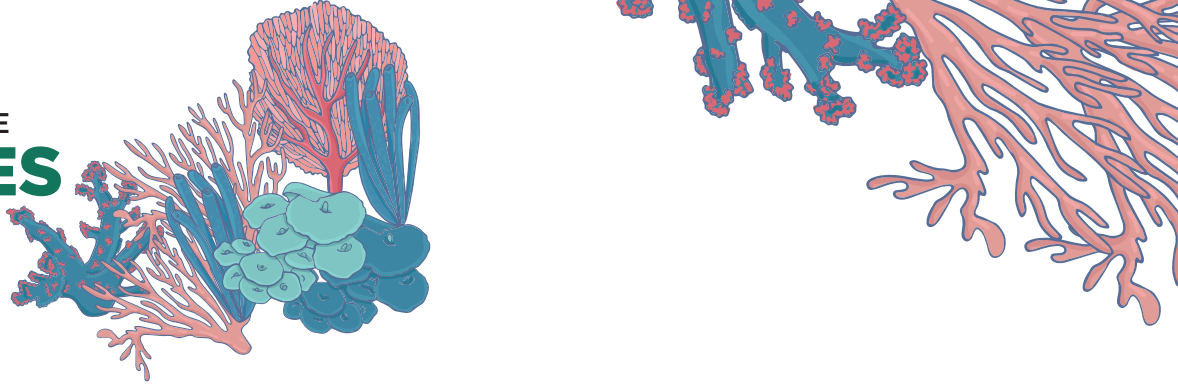
Montipora foliosa



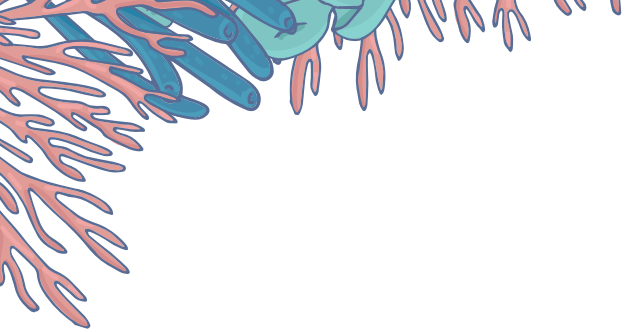
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Map showing coastal habitats in Tamil Nadu



2

Understanding Coral Reefs: The Ocean's Rainforests

What are Coral Reefs?

Coral reefs, often described as the ocean's rainforests, are intricate underwater ecosystems composed predominantly of reef-building corals. These ecosystems are not only remarkable in their construction but also vital for marine life.

Composition and Structure: Corals are formed by small organisms known as polyps. These polyps engage in a unique process by which they extract calcium carbonate from seawater to construct robust, durable exoskeletons. These exoskeletons serve as a protective shell for their delicate, sac-like bodies.

Symbiotic Relationships: At the heart of coral survival is a symbiotic relationship with microscopic algae known as zooxanthellae. This mutually beneficial relationship is crucial as the corals rely on the zooxanthellae for nourishment, which the algae produce through photosynthesis. Additionally, it is the zooxanthellae that impart the vibrant colors to the corals.

Habitat Preferences: Coral reefs primarily thrive in warm ocean waters, necessitating their presence predominantly in tropical and subtropical regions of the world, specifically between the latitudes of 30°N and 30°S. However, certain species of deep-sea corals have been adapted to survive in colder temperatures at higher latitudes, showcasing the adaptability and diversity of coral species.

Turbinaria crater



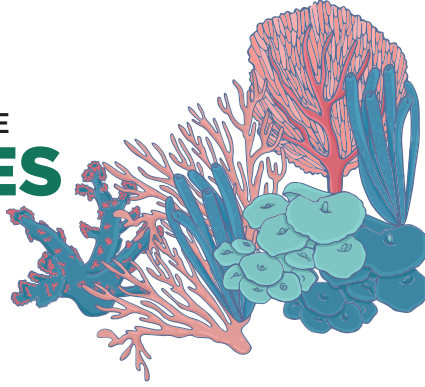
Goniopora sp.



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3

India's Coral Reef Ecosystems

The ecological significance of India's coral reefs is underscored by their rich biodiversity. According to a study by De et al. (2017), these reefs provide habitat for a wide range of marine life, including 1,284 species of fishes, 3,271 species of mollusks, 765 species of echinoderms, 519 species of sponges, 607 species of crustaceans, and 624 species of marine algae.

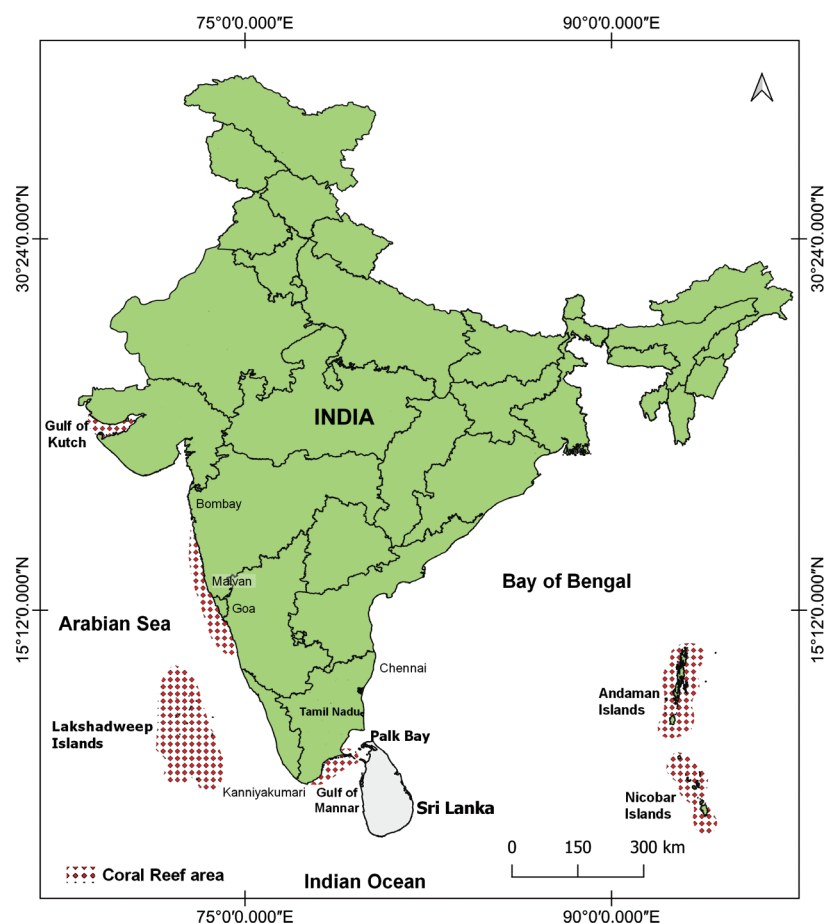
This biodiversity highlights the critical role of coral reefs in India's marine ecosystems and underscores the importance of their conservation.

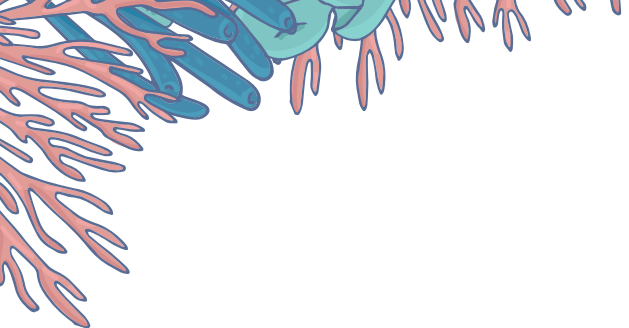
Map showing coral reef areas in India

India boasts a rich and diverse array of coral reef ecosystems, encompassing four principal reef regions: the Gulf of Mannar and Palk Bay in Tamil Nadu, the Gulf of Kachchh in Gujarat, the Lakshadweep Archipelago, and the Andaman and Nicobar Islands. According to satellite data analyzed by Bhatt et al. (2012), these reef areas collectively span an approximate expanse of 3,063 square kilometers.

Each of these regions exhibits distinct reef types. The Gulf of Mannar and Palk Bay are characterized by fringing reefs, while platform reefs are predominant in the Gulf of Kachchh. The Lakshadweep Archipelago is distinguished by its atoll formations. Both fringing and barrier reefs are found in the Andaman and Nicobar Islands.

In addition to these primary reef formations, smaller coral patches are also present along India's west coast, extending through the states of Kerala, Karnataka, Goa, and Maharashtra in the Arabian Sea.





4

Coral reefs in Tamil Nadu: **A Regional Perspective**

Tamil Nadu features prominent coral reefs primarily in the Gulf of Mannar and Palk Bay. These reefs are situated adjacent to four southern coastal districts: Ramanathapuram, Thoothukudi, Tirunelveli, and Kanniyakumari.

The total area encompassed by these coral reefs in Tamil Nadu is 107.38 sq km. Notably, the predominant reef type in this region is the fringing reef. Additionally, smaller reef patches are interspersed along the coastlines of the aforementioned districts.

4.1 Coral reefs of the Gulf of Mannar

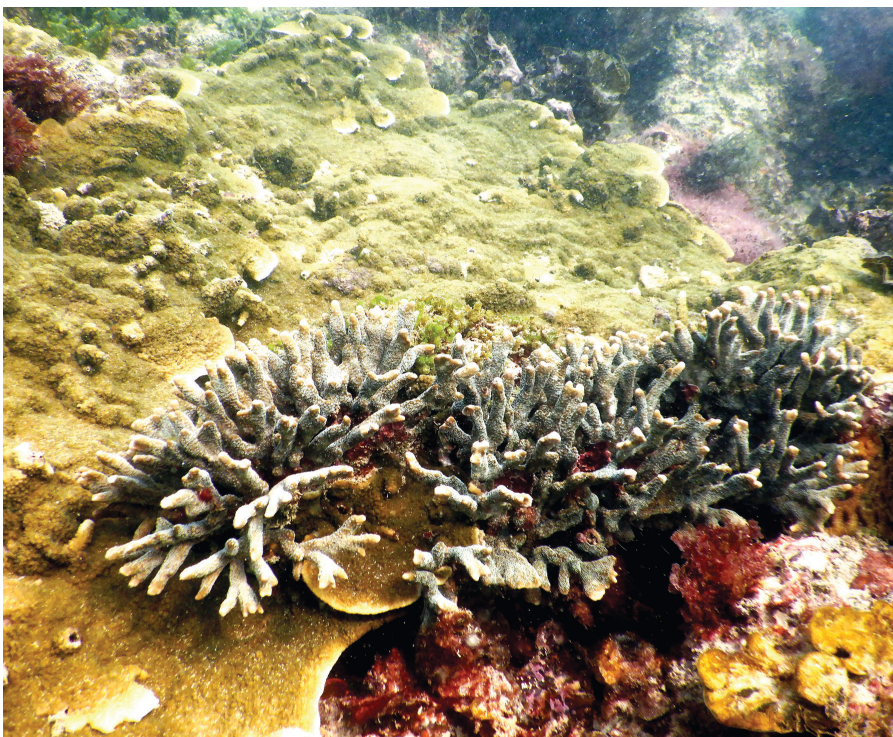
The Gulf of Mannar, located between Rameswaram and Tuticorin in Tamil Nadu, is renowned for its major coral reef formations. These formations are primarily concentrated around the 21 uninhabited coral islands. In recognition of their ecological importance, this area was designated as the Gulf of Mannar Marine National Park (GOMMNP) in 1986 by the Tamil Nadu Government.

The marine biodiversity within the Gulf

of Mannar is remarkable, with a recorded 4,223 species of marine flora and fauna. This high level of biodiversity is largely attributed to the extensive coral reefs in the region, as highlighted in the study by Balaji et al. (2012). Additionally, Edward et al. (2023) reported the presence of 132 coral species belonging to 47 genera in the GOMMNP. *Acropora*, *Montipora*, *Porites*, *Dipsastraea*, *Favites* and *Turbinaria* are some of the most common coral genera.

The total area of the major reefs in the GOMMNP currently spans 66.28 sq km. However, over the past five decades, these coral reefs have experienced a decline in their health and coverage due to a combination of climatic and anthropogenic factors. These include coral mining (active until 2005), overfishing, destructive fishing practices, pollution, coral bleaching, disease outbreaks, bio-invasions, space competition, and algal blooms.

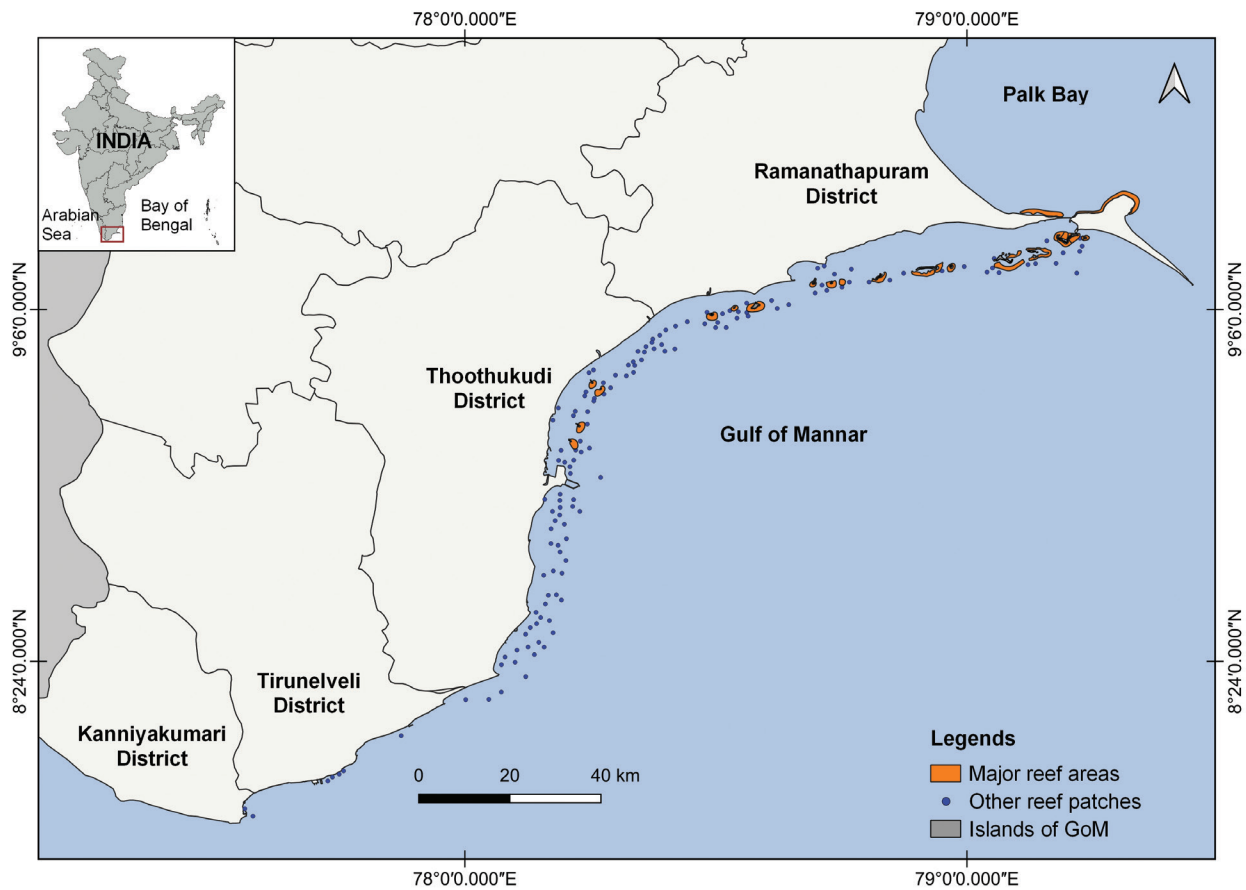
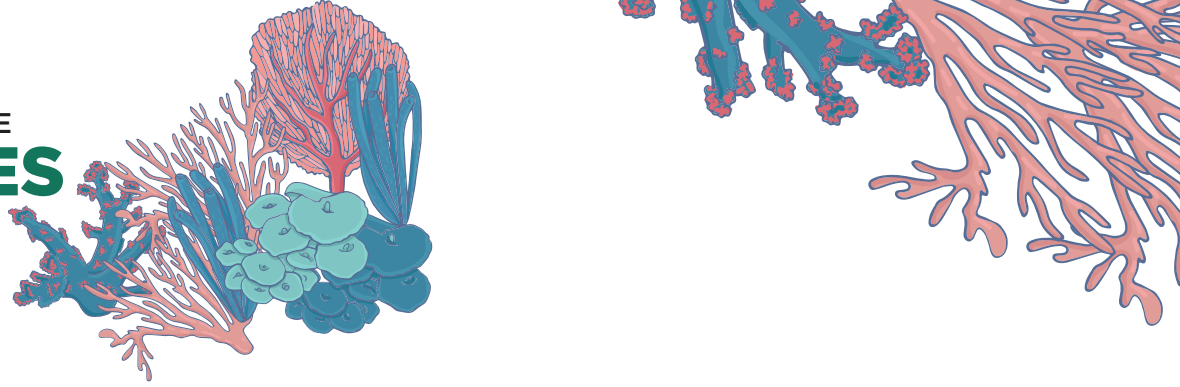
Montipora spp.



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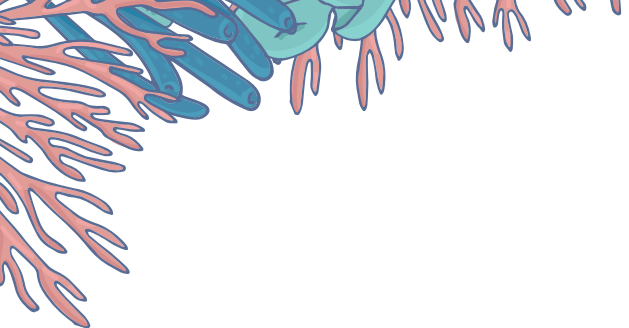
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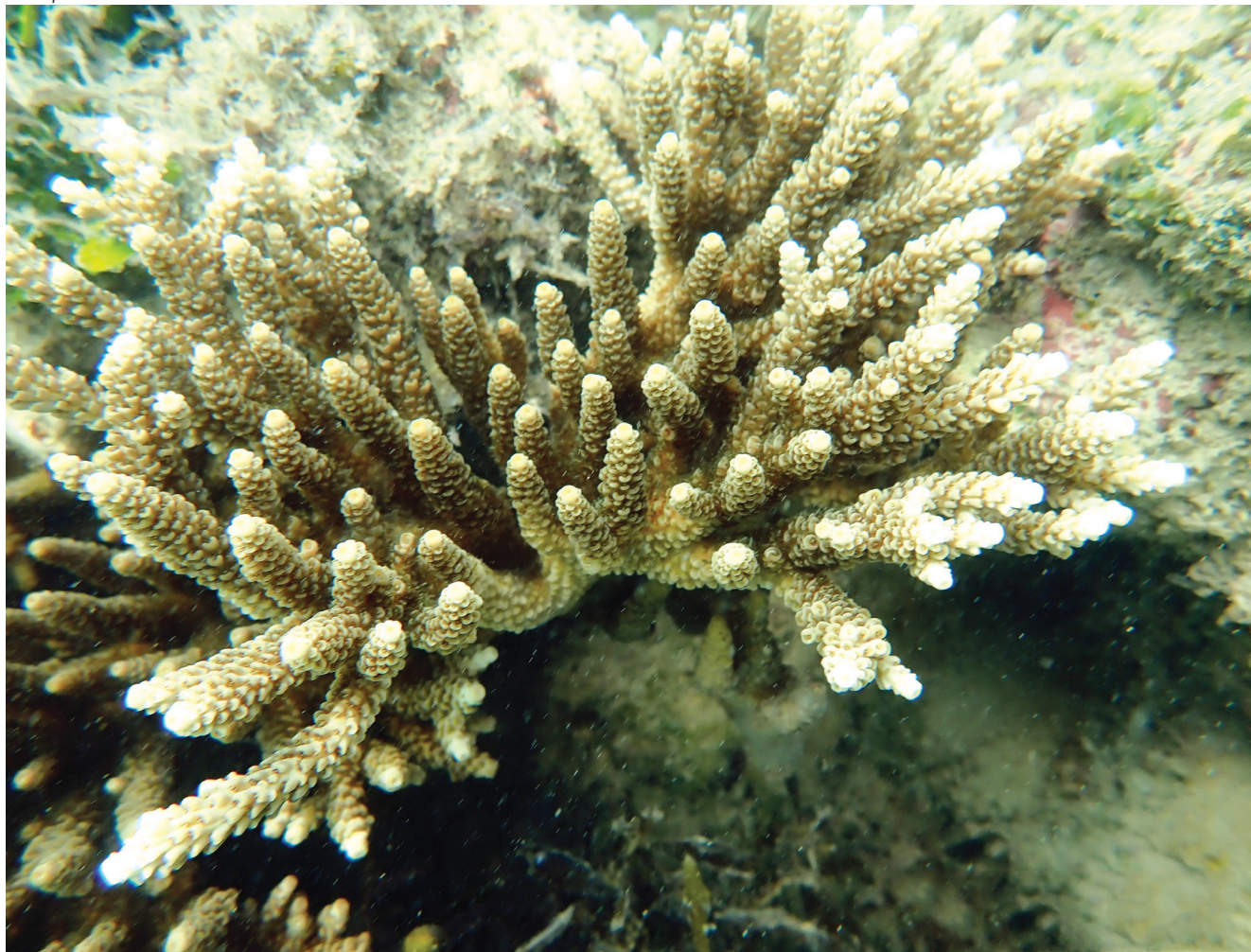
Map showing coral reef areas in Tamil Nadu



Turbinaria mesenterina



Acropora valida



The live coral cover in the Gulf of Mannar has undergone a significant decrease from 37.0% to 27.3% between 2005 and 2021 as reported by Edward et al. (2023). This decline emphasizes the urgent need for conservation and restoration efforts in the region. Furthermore, the NAFCC, MoEF&CC Report (2019) indicates the presence of additional coral reef patches extending from Rameswaram to Kanniyakumari, covering an area of 20.6 sq km. These patches lie up to 10 km from the shoreline, with more offshore patch reefs existing beyond this distance, awaiting detailed mapping and study.

The conservation of these diverse

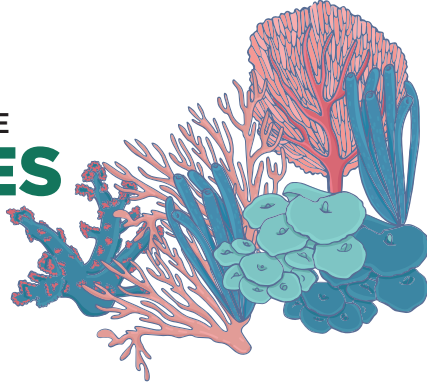
Goniastrea retiformis



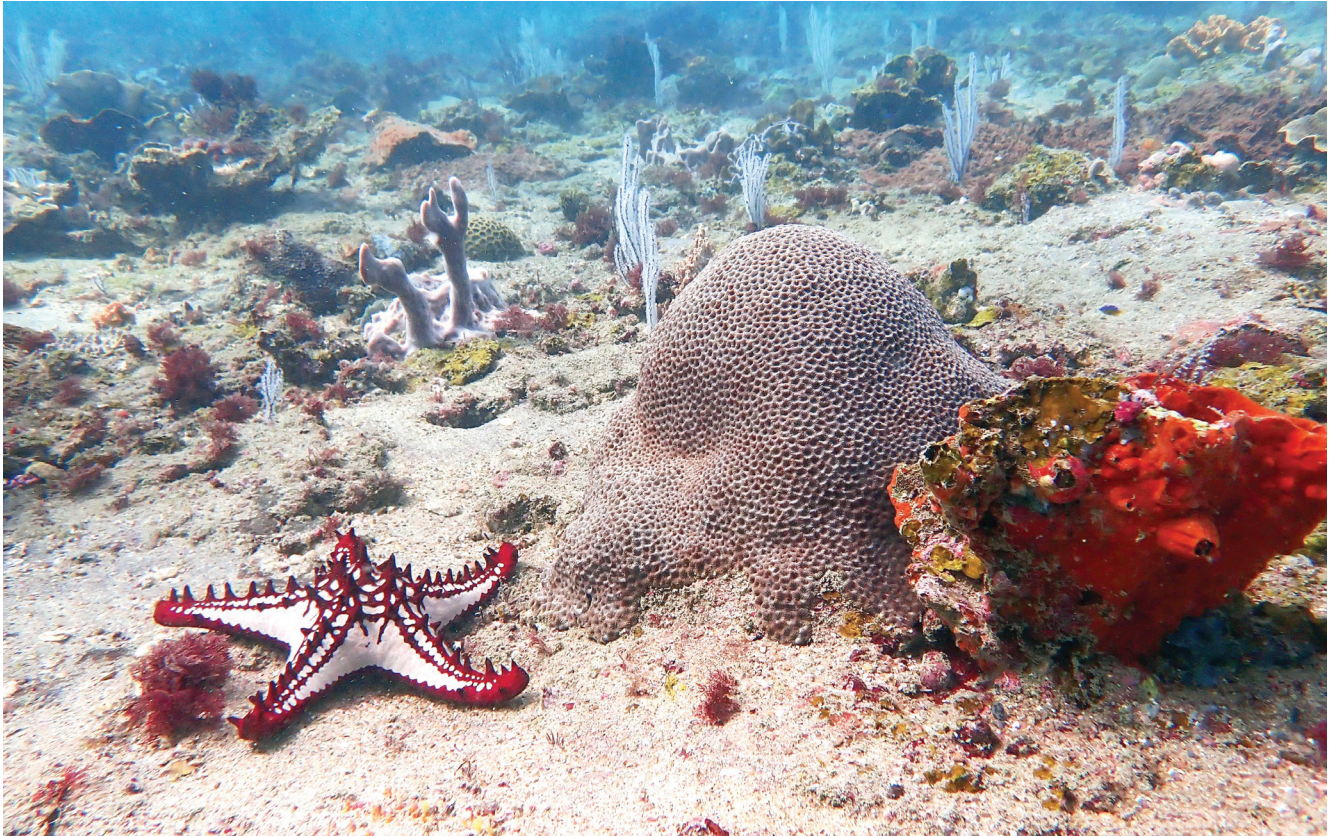
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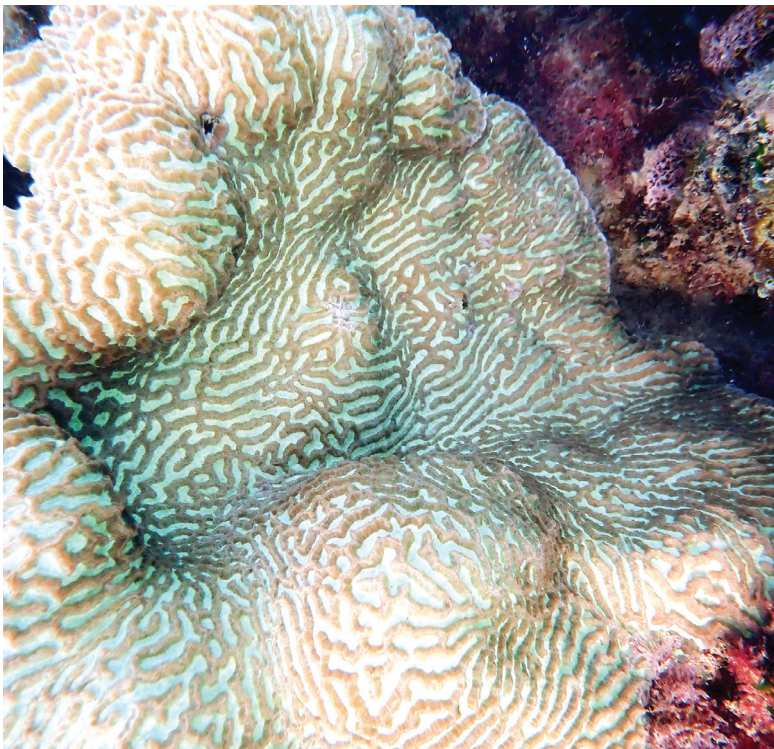
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Favites pentagona



Platygyra lamellina

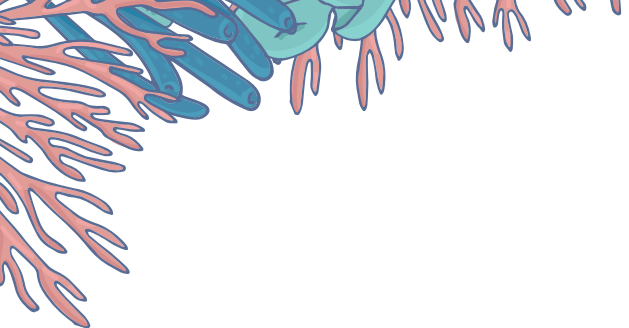


and ecologically significant coral reef ecosystems in the Gulf of Mannar is imperative for maintaining the region's marine biodiversity and supporting local livelihoods.

4.2 Coral reefs of the Palk Bay

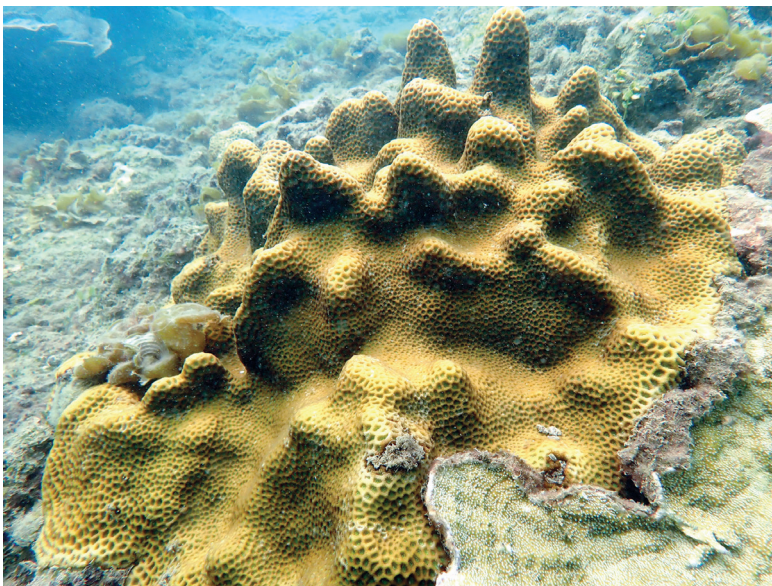
Palk Bay, located between the Nagapattinam and Ramanathapuram districts in Tamil Nadu, is adjacent to the Gulf of Mannar. This area is notable for its coral reefs, particularly in the southern region between Vedhalai and Rameswaram in Ramanathapuram district.

Coral species diversity in Palk Bay is significant, with a recorded presence of 63 species under 22 genera, as identified by Pillai (1969). Additionally, Kumaraguru et al. (2008) have documented a total of 3,289 floral and faunal species in Palk Bay, underscoring its rich biodiversity.



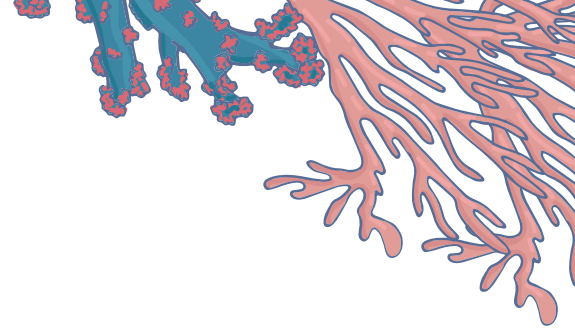
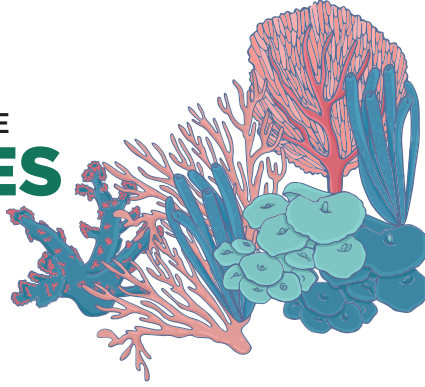
Regarding the extent of coral reefs in Palk Bay, the area is about 20.5 sq.km. Edward et al. (2015) noted that the average coral cover in Palk Bay was 30.8% in 2007. However, this figure experienced a substantial decline to 18.72% by 2019, primarily due to a range of climatic and non-climatic threats. A critical aspect of Palk Bay's reefs is their location near the mainland. Despite their ecological significance, these reefs do not currently receive the same level of legal protection as the coral reefs in the Gulf of Mannar. This absence of formal protection raises important considerations for the conservation and management of Palk Bay's coral reef ecosystems.

Favites abdita



Montipora foliosa





5

Global Importance of Coral Reefs

5.1 Ecological and Economic Significance

Coral reefs, comprising a diverse array of marine flora and fauna, are critical for both ecological balance and economic prosperity. These ecosystems are pivotal habitats, offering sustenance and shelter to numerous species of significant commercial value, including various fish and shellfish.

Despite occupying a mere 0.1% of the ocean floor, coral reefs are a sanctuary for approximately 25% of all known marine species, as highlighted by Hoegh-Guldberg et al. (2017). Fisher et al. (2015) estimates the number of species associated with coral reefs to be around 830,000, underscoring their rich biodiversity.

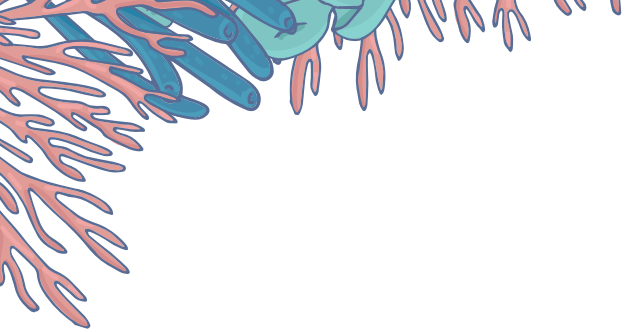
Coral reefs function as natural defense systems against coastal threats such as waves, storms, and tsunamis. According to Ferrario et al. (2014), they are crucial in coastal protection, mitigating erosion and property damage due to wave action. Additionally, they play a vital role in dissipating the energy of waves and currents, thus fostering calm environments that benefit seagrass and mangrove ecosystems.

Guannel et al. (2016) emphasize that coral reefs contribute significantly to beach sand formation and the protection of productive coastal wetlands globally. Furthermore, Burke and Spalding (2022) note that coral reefs are instrumental in addressing climate change impacts, particularly in mitigating the effects of sea level rise and erosion.

In terms of economic value, coral reefs are 70 times more valuable than tropical forests (Fezzi et al. 2023). The United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC) in 2006 reported that the total annual economic value of healthy coral reefs ranges from US\$ 100,000 to 600,000 per sq km, considering their contributions to fisheries, tourism, and coastal protection.

Acropora cytherea





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COASTAL PROTECTION

Protection of the shore from erosion and natural disasters



BIODIVERSITY SHELTER

Provision of shelter to a multitude of marine organisms

FISHERY

Contribution to higher production of commercially important fish species



TOURISM

Generation of revenue through tourism activities

LIVELIHOOD

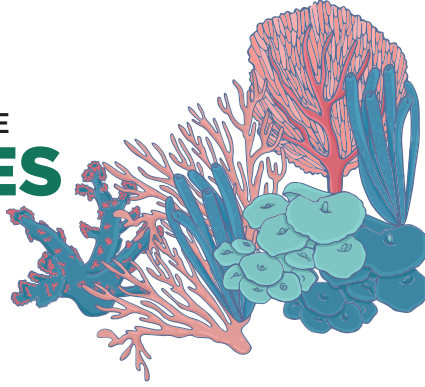
Support to thousands of coastal fisher folk to have sustained livelihood



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However, the sustainability of these services is threatened by climate change. Hoegh-Guldberg et al. (2015) predict that the loss of ecosystem services provided by coral reefs due to climate change could amount approximately to US\$ 500 billion annually by the year 2100. This underscores the urgent need for concerted efforts in coral reef conservation and climate change mitigation to preserve these invaluable ecosystems.

5.2. Coral Reefs and Coastal Communities

Coral reefs play a vital role in the lives and economies of coastal communities worldwide. According to Burke et al. (2011), approximately 850 million people reside within 100 km of coral reefs. Further emphasizing their importance, around 275 million people live within 30 km of these ecosystems, deriving direct or indirect benefits from them.

The productivity of healthy coral reefs is noteworthy, with one sq. km capable of yielding 5 to 10 tons of fish annually, as highlighted by Burke et al. (2011). This yield is a significant source of support for global

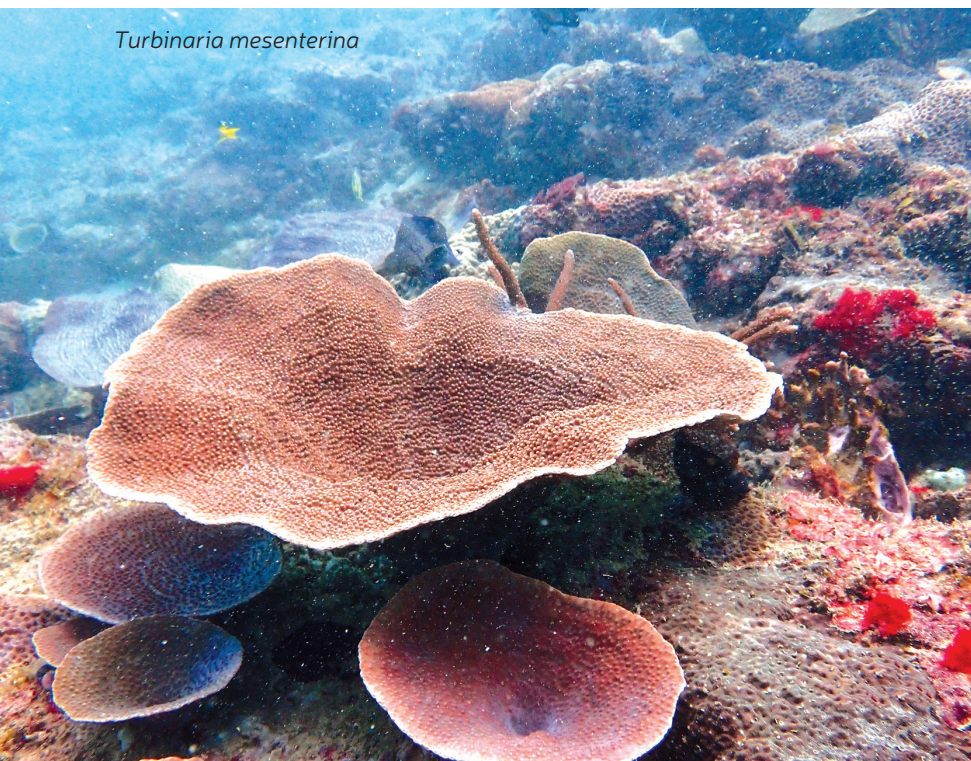
fishing communities. The value of the global coral reef fishery is estimated at US\$ 6.8 billion per year, supporting numerous local economies, as reported by Spalding et al. (2016).

In nations with coral reefs, the average seafood consumption per person is 29 kg each year, contributing to 77% of the animal protein intake in their diet (Burke et al. 2011), which underscores the critical role of coral reefs in global food security.

Moreover, coral reefs provide essential coastal protection for over 150,000 km of shoreline across 100 countries, safeguarding lives and properties (Burke et al. 2011). This natural barrier function of coral reefs is invaluable in mitigating the impacts of coastal erosion and storm surges.

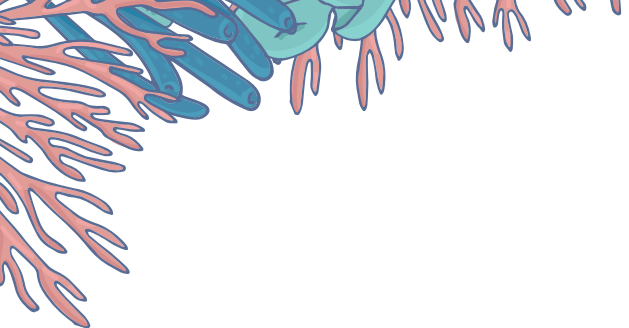
The economic impact of coral reefs extends to tourism as well. Coastal communities in 94 countries benefit from coral reef tourism. In 23 of these countries, reef tourism alone constitutes more than 15% of the GDP. This underlines the significant

Turbinaria mesenterina



Fishermen with their catch





contribution of coral reefs to national economies, particularly in regions where they are a major attraction for visitors.

The data from Burke et al. (2011) and Spalding et al. (2016) highlight the multifaceted importance of coral reefs, not only in ecological terms but also in their substantial economic and social contributions to coastal communities around the world.

5.3. Community Engagement and Educational Initiatives in Conservation

The active involvement of local communities in decision-making processes has been instrumental in achieving positive outcomes for coral reef recovery. This community participation not only fosters acceptance but also ensures the sustainability of management policies.

One notable example is the community-led initiative in Wakatobi National Park, Indonesia. In collaboration with park authorities, local communities halted fishing in crucial fish aggregating areas, effectively reversing the decline in reef fish

populations (Burke et al. 2011).

In Prony Bay, southern New Caledonia, a nickel mining corporation invested in coral transplantation to mitigate the impact of mining activities. Remarkably, this initiative recorded an 80% survival rate of transplanted corals after three years (Burke et al. 2011).

The Namena Marine Reserve in Fiji saw its community leaders establish a locally managed marine area (LMMA) network. This initiative not only preserved traditional fishing practices but also generated tourism revenue, which supported a scholarship fund for local children and aided in reef recovery (Burke et al. 2011).

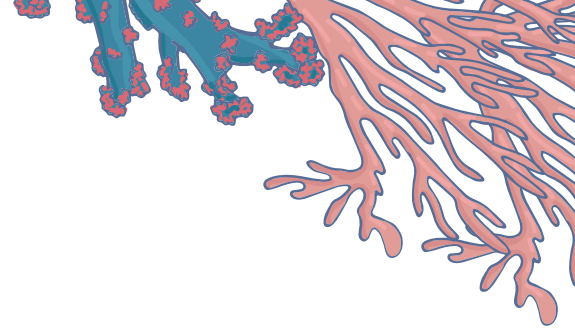
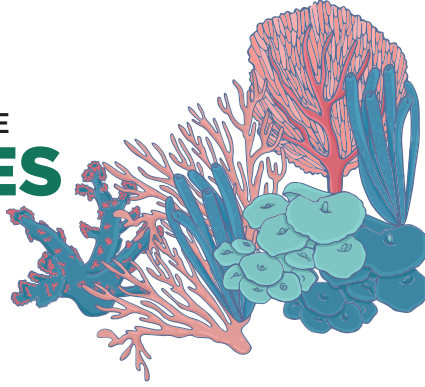
Educational programs play a vital role in coral reef conservation by raising awareness about the adverse impacts of human activities on marine ecosystems. The Coral Reef Education Institute is a prime example, offering resources and solutions to address these challenges (<https://www.onecoralreef.org/>).

The Khaled bin Sultan Living Oceans Foundation is committed to enhancing ocean literacy, particularly about coral reefs, through its dedicated educational portal (<https://www.livingoceansfoundation.org/education/portal/>).

Additionally, the Reef Environmental Education Foundation (REEF) engages volunteer divers in data collection on marine fish populations in the Caribbean and Pacific, contributing valuable information for reef conservation efforts (<https://www.reef.org/>).

These examples underscore the effectiveness of combining community-led conservation efforts with educational outreach in protecting and restoring coral reef ecosystems.





6

Significance and Role of Tamil Nadu's Coral Reefs

6.1. Biodiversity and Environmental Importance

In terms of biodiversity, the flora and fauna associated with Tamil Nadu's coral reefs are notably more diverse than those in the other reef regions of India. This rich biodiversity is critical for maintaining ecological balance and supporting marine life.

The coral reefs in the Gulf of Mannar and Palk Bay play a pivotal role in creating calm near-shore environments. This tranquility is crucial for fishermen, enabling them to fish throughout the year, even during rough weather conditions.

The protective function of these coral reefs was dramatically highlighted during the 2004 Indian Ocean tsunami. Notably, the coastal areas between Tuticorin and Rameswaram, shielded by coral islands and reefs, did not report any casualties, demonstrating the reefs' efficacy in coastal defense.

Historically, during the 1960s and 1970s, coral reefs in Tamil Nadu were exploited

for construction purposes, with the coral used as a building material. This practice underscores the need for sustainable management and conservation efforts to protect these vital ecosystems.

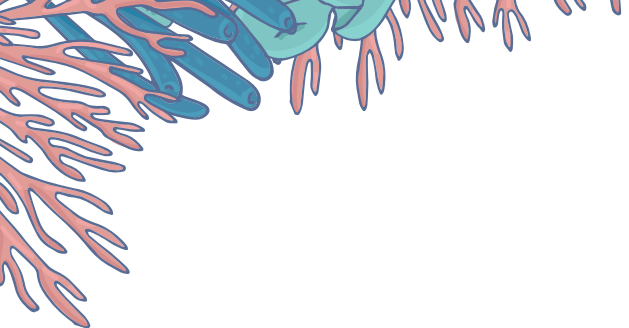
6.2. Socio-Economic Impact on Local Communities

Tamil Nadu's coral reefs are distinguished by their considerable extent, diversity, and overall health. These reefs demonstrate remarkable resilience, having successfully recovered from severe bleaching events in 2010 and 2016.

The socio-economic impact of these coral reefs is profound, especially for the local fishing communities. Over 100,000 low-income, small-scale traditional fisherfolk rely heavily on the fishery resources associated with these reefs for their daily sustenance and food security. In particular, the reef-dependent fishery is the primary source of livelihood for thousands of fishermen in Ramanathapuram and Thoothukudi districts.

Cleaning fishnets,
Vellapatti



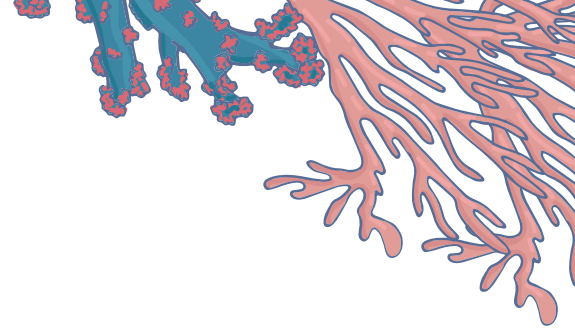
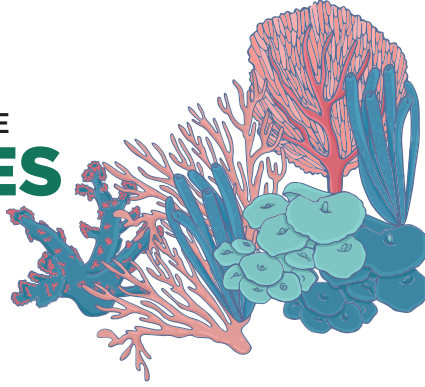


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Collecting fish catch,
Sippikulam





7

Threats to Coral Reefs: **Global and Local Perspectives**

7.1 Global Threats

According to the Inter-Governmental Panel for Climate Change (IPCC 2018), a distressing forecast has been made for the world's coral reefs. By the year 2100, with a global temperature increase of 1.5° C, coral reefs are predicted to decline by 70-90%. Should the temperature rise reach 2° C or higher, the prognosis is even direr, with almost complete loss of coral reefs anticipated.

Recent decades have seen climate change emerge as the foremost threat to the survival of coral reefs globally. This is primarily manifested through coral bleaching, ocean acidification, and ocean deoxygenation, as detailed in the findings of Hughes et al. (2018).

In addition to these climate change-induced phenomena, several other human activities have contributed significantly to the degradation of coral reefs. These include coral collection, over-exploitation of marine resources, destructive fishing practices, impacts from tourism, coastal development, and various forms of

pollution, as reported by Hughes et al. (2017).

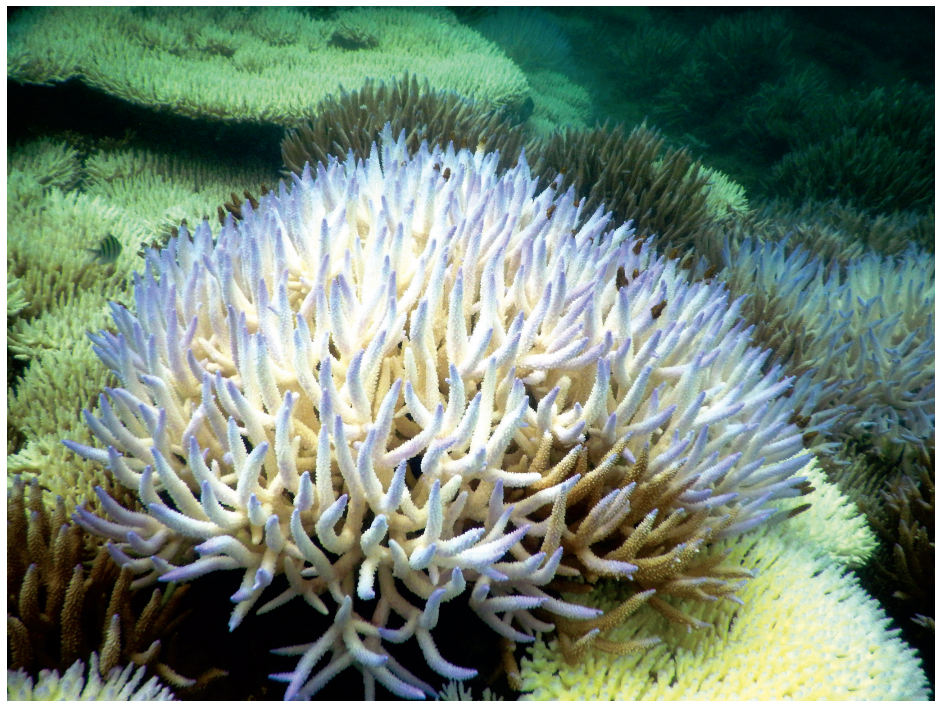
Furthermore, coral reefs are facing threats from biological challenges such as coral diseases, algal blooms, invasive species, and competition for space. These factors collectively pose a considerable risk to the health and sustainability of coral reefs worldwide, necessitating urgent and effective conservation measures.

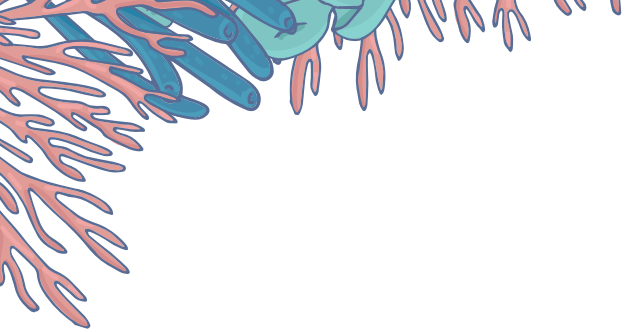
7.2 Climatic threats to the coral reefs of Tamil Nadu

The coral reefs along the Tamil Nadu coast are primarily threatened by climate change-induced coral bleaching. Edward et al. (2018) have noted that coral bleaching occurs when water temperatures exceed 30° C. This phenomenon has become an annual occurrence during the summer months.

While corals typically recover from bleaching as temperatures drop, the events

Bleached *Acropora muricata*

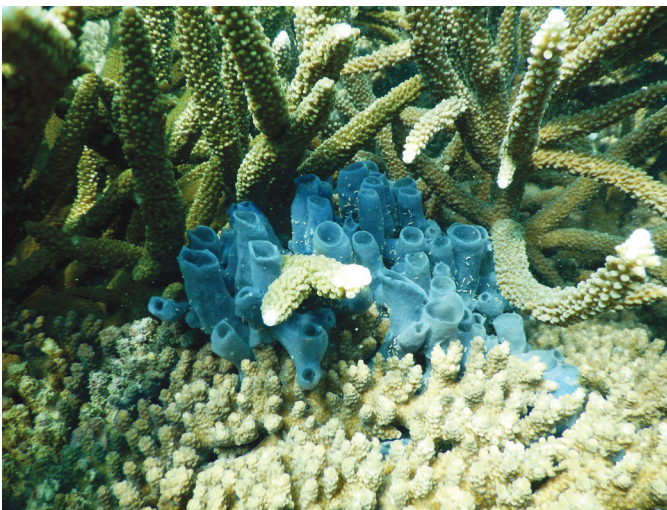




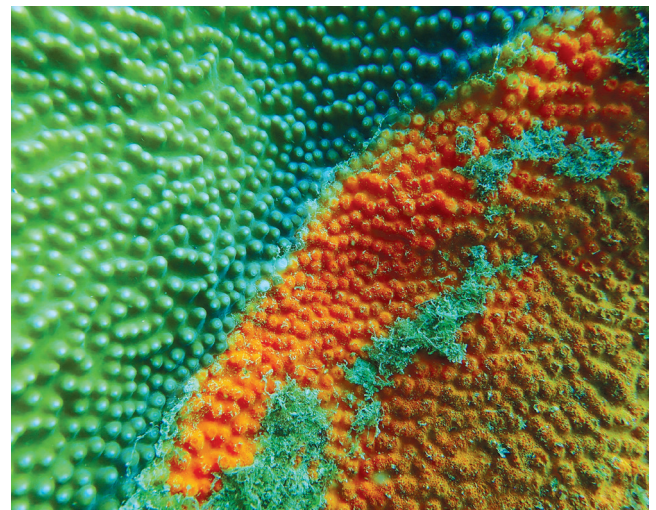
Bleached *Acropora muricata*



Bleached *Acropora muricata*



Clathria sp. sponge overgrowing *Acropora* sp.



Clathria (*Microciona*) *aceratoobtusa* sponge overgrowing *Turbinaria* sp.

of 2010 and 2016 were exceptions, with significant coral mortalities (Edward et al. 2023). Projections by Raj et al. (2021) under a high emissions scenario (RCP 8.5) indicate that the Gulf of Mannar's corals will experience annual severe bleaching before 2070, and bleaching events twice per decade are expected before 2060.

Post-bleaching, the coral reefs along the Tamil Nadu coast often face intense competition for space from rapidly growing organisms like macroalgae, sponges, and octocorals, further exacerbating the situation (Edward et al. 2023). Additionally, temperature increases during monsoons,

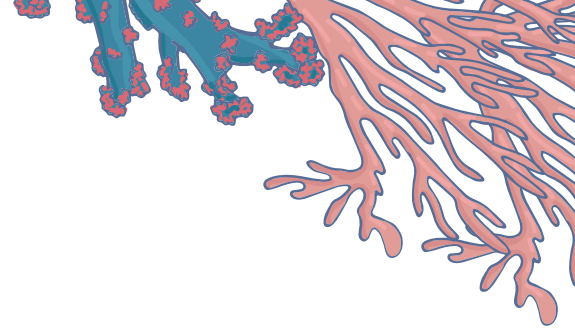
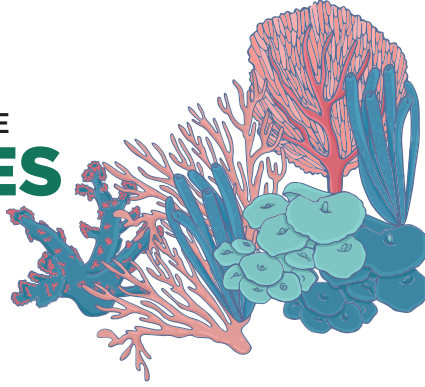
Green tide of *Noctiluca scintillans* bloom



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(Top) Macroalgae *Caulerpa* sp. overgrowing *Acropora muricata*;
(Bottom) Macroalgae *Halimeda* sp. overgrowing *Acropora cytherea*

a consequence of climate change, have been leading to annual blooms of *Noctiluca scintillans*, which result in significant coral mortality through asphyxiation (Raj et al. 2020).

The rising sea level, alongside coral mining activities, has contributed to the submergence of two coral islands in the Gulf of Mannar (Raj et al. 2015).

Furthermore, ocean acidification, another facet of climate change, is impacting Tamil Nadu's corals, though the full extent of this impact remains to be quantified. These challenges underscore the urgent need for targeted conservation strategies to protect and preserve Tamil Nadu's coral reefs amidst changing climatic conditions.

7.3 Other Threats to Tamil Nadu's Coral Ecosystems

The coral reefs of Tamil Nadu face several non-climatic challenges, exacerbating their vulnerability. Bharath (2019) highlights a significant increase in the frequency of coral disease outbreaks and other health issues over the past decade.

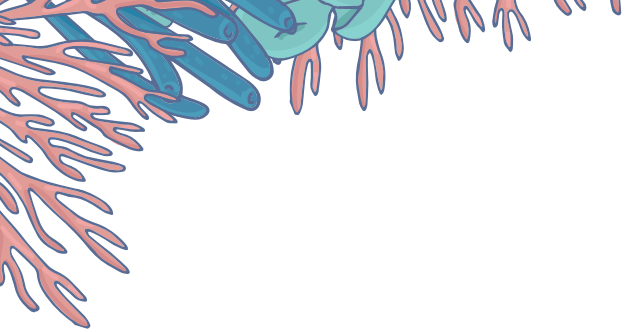
A notable concern, as pointed out by Edward et al. (2020), is the growing accumulation of marine debris and derelict fishing nets in reef areas. These materials cause substantial mechanical damage to corals and their associated organisms.

The invasive exotic alga *Kappaphycus alvarezii* has been a persistent threat to the Gulf of Mannar's coral reefs since 2005, as reported by Arasamuthu et al. (2023). This invasive species competes with native coral species, disrupting the local ecosystem balance.

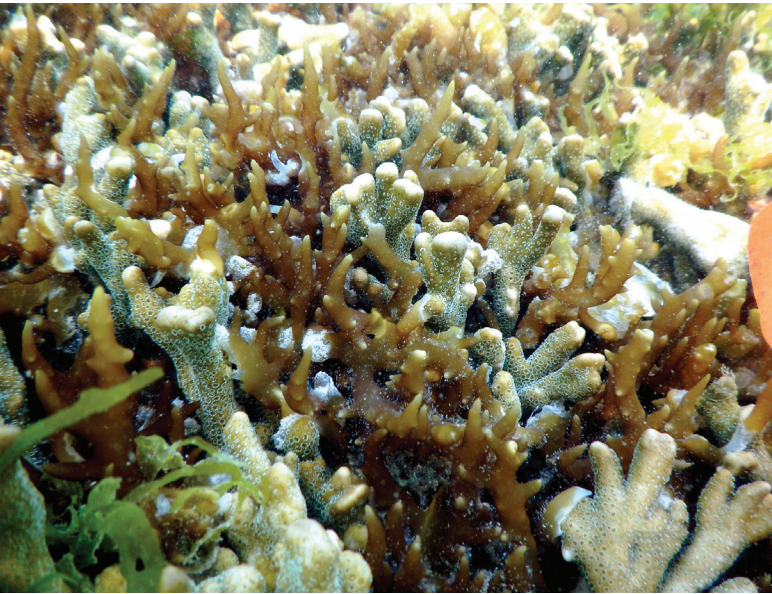
Destructive fishing practices, including bottom trawling, trap fishing, and surface-supplied diving, are also a significant concern. Edward et al. (2023) indicate that these methods cause considerable mechanical damage to the Gulf of Mannar's corals.

Further threats include pollution, development activities, tourism, and pilgrimage, which collectively contribute to the degradation of the coral ecosystems in the Gulf of Mannar (Edward et al. 2023).

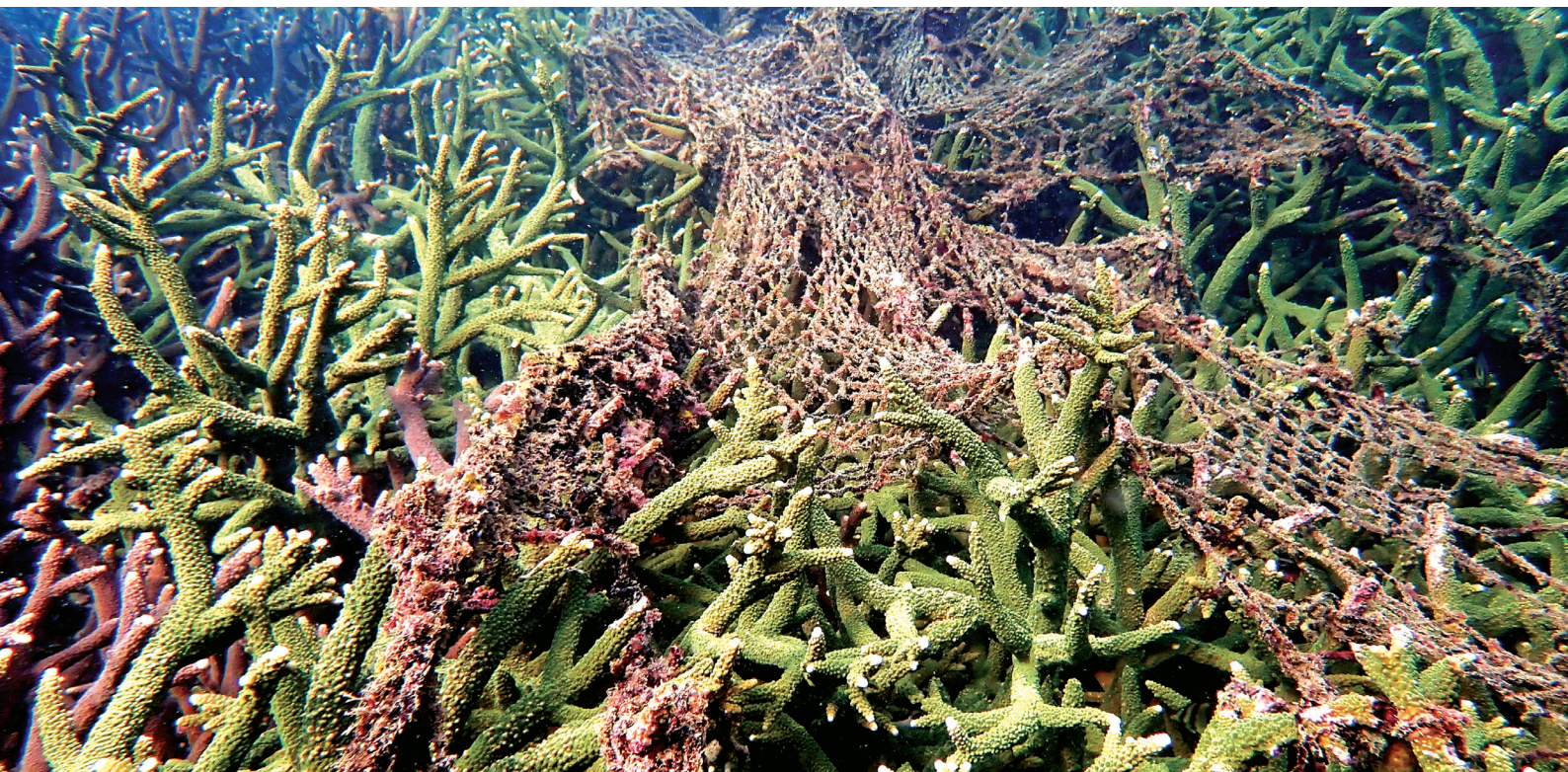
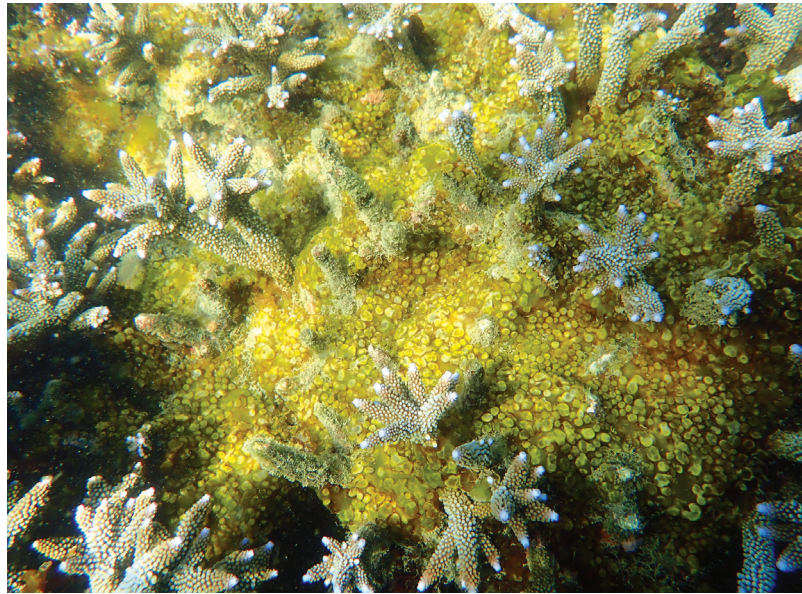
Palk Bay's coral reefs, facing similar threats,



Invasion of *Kappaphycus alvarezii* on *Montipora digitata*



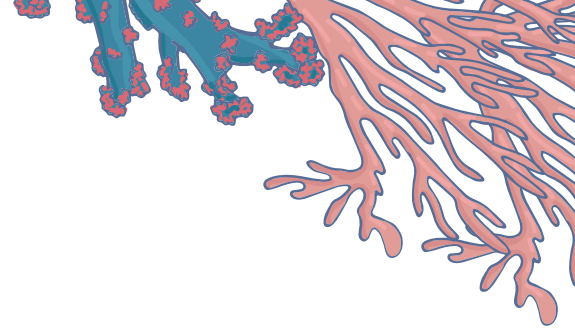
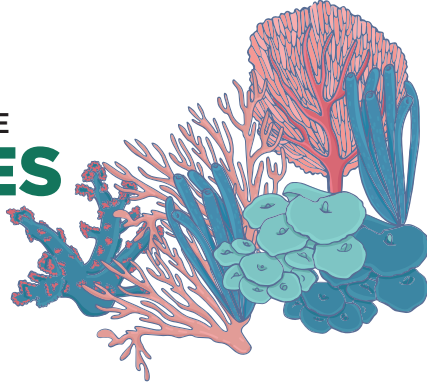
Kappaphycus alvarezii forming green mat on *Acropora robusta*



Abandoned fishing net on *Acropora* colonies

are particularly susceptible to human-induced challenges such as destructive fishing and pollution. The severity of these impacts is compounded by the lack of legal protection for the reef areas in Palk Bay, making them more vulnerable

compared to those in the Gulf of Mannar. This situation underscores the critical need for comprehensive management and protection strategies to safeguard Tamil Nadu's coral reefs against these multifaceted threats.



8

Conservation and Restoration: **Strategies and Efforts**

8.1. Legal Framework and Protective Measures

The conservation and management of coral reefs in India are governed by several legal and institutional mechanisms. Under the Wildlife Protection Act of 1972, corals are afforded protection by the Government of India. Additionally, the Gulf of Mannar Marine National Park, encompassing the 21 islands and adjacent coral reefs covering 560 sq.km, was established in 1986 by the Government of Tamil Nadu.

Further extending its protection, the entire Gulf of Mannar was declared a Marine Biosphere Reserve by the Government of India in 1989. This designation was further strengthened in 2002 when the UNESCO recognized the Gulf of Mannar Biosphere Reserve (GOMBR) under its Man and the Biosphere Programme (MAB). Moreover, GOMBR has been designated as a Ramsar Site since 2022, emphasizing its international ecological importance.

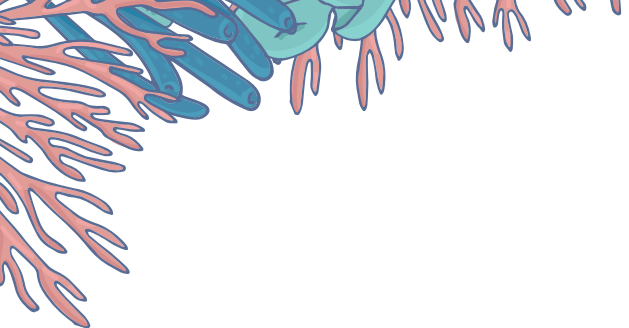
Coral restoration in India commenced in 2002 in the Gulf of Mannar. This initiative, funded by the Union Ministry

of Environment, Forest and Climate Change (MoEF&CC), was undertaken by the Suganthi Devadason Marine Research Institute (SDMRI). The project aimed at standardizing transplantation techniques. Continuing to date, this program receives primary funding from the Government of India and is implemented through the Tamil Nadu Forest Department and the Department of Environment and Climate Change.

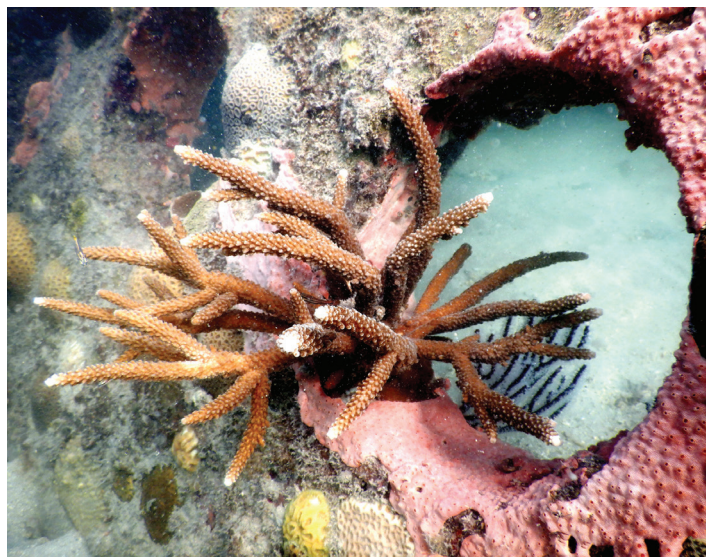
These restoration efforts have shown promising results and have become integral to coral conservation strategies. The artificial reef deployment technique for coral recovery, demonstrated successfully in these projects, has gained international recognition.

Platygyra lamellina





Natural coral recruitment on artificial reefs
- recruits of multiple coral species



Natural coral recruitment on artificial reefs -
Acropora muricata

Government-led enforcement and patrolling, coupled with awareness campaigns, alternative livelihood provision, and community development initiatives, have been pivotal in coral reef conservation. These measures are often executed in collaboration with various organizations.

Eco-development activities sponsored by the Gulf of Mannar Biosphere Reserve Trust have also played a significant role. These initiatives have empowered the local fishing communities, providing them with additional or alternative income sources. Such efforts have been instrumental in reducing the pressure on marine resources, particularly on the coral reefs, contributing significantly to their conservation and sustainability.

8.2. Restoration Initiatives and their Impact in Tamil Nadu

The Tamil Nadu Forest Department has demonstrated commendable dedication and effectiveness in enforcement and awareness campaigns. A notable achievement of their efforts was the successful cessation of coral mining activities in Tamil Nadu by 2004.

Significant financial support from the Ministry of Environment, Forest and Climate Change (MoEF&CC), allocated under the National Adaptation Fund for Climate Change, was directed through the Tamil Nadu Department of Environment and Climate Change. This funding facilitated the implementation of the artificial reef modules program, which played a crucial role in the rehabilitation of the sinking Vaan Island in the Gulf of Mannar.

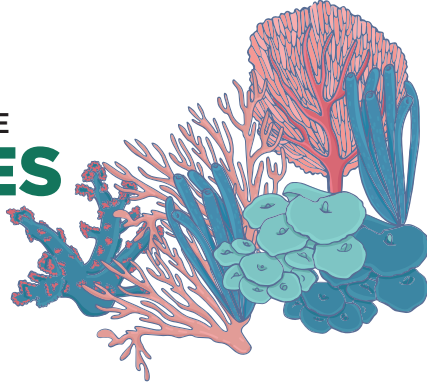
These strategically deployed artificial reef modules not only have provided habitat for a diverse range of flora and fauna, including corals, but also have significantly enriched local biodiversity and boosted fish populations. The success of these artificial reef initiatives, backed by the Government since the early 2000s, has been instrumental in the recovery of coral reefs and the enhancement of fisheries in Tamil Nadu.

Additionally, various coral restoration programs initiated by the Tamil Nadu Government since the early 2000s have contributed positively to reef recovery.

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Transplanted coral,
Acropora spp.

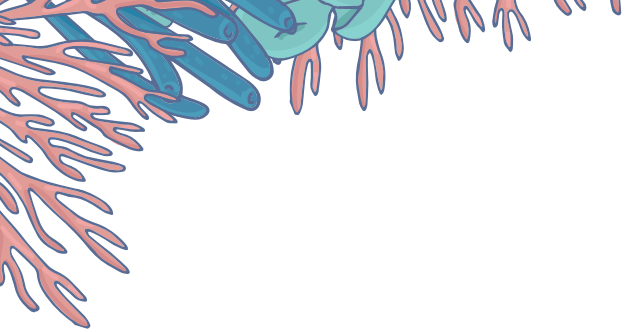


These programs have been marked by the successful survival of coral transplants, accelerated growth rates, and attainment of sexual maturity, underscoring the effectiveness of these conservation efforts in sustaining and revitalizing coral reef ecosystems.

8.3. Scientific Advancements in Reef Research in Tamil Nadu

Several institutions are involved in coral reef research in Tamil Nadu. Voluminous and continuous data is available through regular update on coral health and status with permanent monitoring sites. Advanced underwater research tools such as diver propulsion vehicles and underwater drones along with sophisticated dive

equipments are in use. The Gulf of Mannar Biosphere Reserve and the Marine National Park have a 10 year Management Plan to guide the protection, conservation and management measures. Ecological modeling incorporating a large body of satellite and field-level data has also been done to predict future coral bleaching events. Tamil Nadu was the first state in the country to implement coral restoration and this method of marine resource augmentation has been in practice for over two decades. Sexual reproduction in corals was first documented in Tamil Nadu among the Indian reef ecosystems and data is available in the Indo-Pacific coral spawning database. Molecular level works on corals have also been initiated in Tamil Nadu.



9

Responsible Tourism and Awareness

Education and Awareness: Gaining knowledge about the importance of coral reefs and spreading this awareness can amplify collective efforts towards their protection.

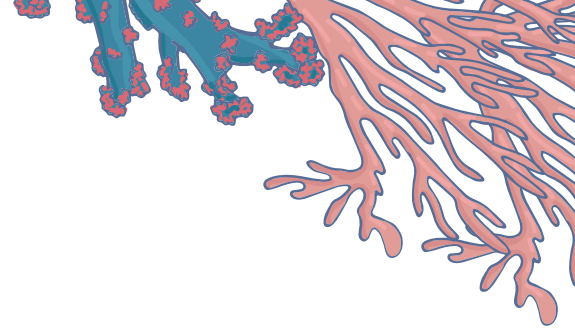
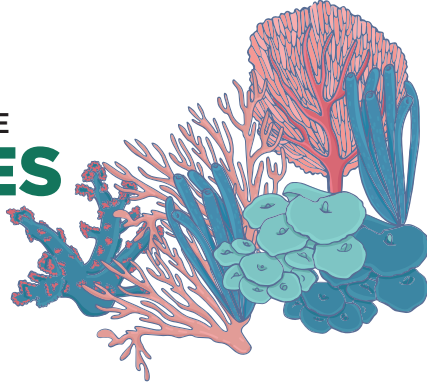
Responsible Tourism: When visiting reef areas, it is essential to conduct recreational activities responsibly, ensuring minimal damage or pollution to the fragile reef ecosystem.

Reporting Illegal Activities: If aware of any illegal poaching of coral skeletons or other reef products, promptly reporting these activities to the appropriate authorities can help in curtailing such destructive practices.

Avoiding Reef-Based Souvenirs: Refraining from purchasing souvenirs derived from coral reefs can decrease the demand that drives the exploitation of these ecosystems.

By adopting these practices, individuals can play a pivotal role in the conservation and protection of coral reefs, contributing to the preservation of these vital ecosystems for future generations.





10

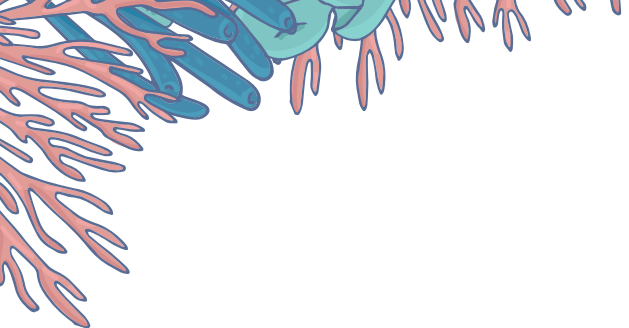
Local Voices: Insights from Coastal Communities

10.1. Testimonials and Stories

Mr. Marimuthu, Thirespuram

I am from a traditional fisherman family. We have always been dependent on the coral reefs and associated fishery resources for our livelihood. Thirty years ago there was plenty of fish in our area due to the availability of a great extent of coral reefs. As years went by, coral reefs in our area have been destroyed by mining and other destructive fishing practices, which consequently decreased the fishery resources and almost depleted our livelihood. Thanks to the Government for the deployment of artificial reefs, which helped to increase the fish abundance and we can catch fish round the year in and around these modules as there are lots of fishes. We lay nets, use hooks and lines and also traps in these artificial reefs. We also notice several corals grow on these artificial reefs.





R. Priya, South Pudukudiyiruppu, Periyapattinam

Hailing from a traditional fishing family, I spend considerable time in the coast. Fish catch nowadays is relatively small due to the loss of coral reefs. It has declined over the years. I could see the islands have decreased in size due to the loss of coral reefs. These islands were the guardians to save our lives and properties during the tsunami which killed several thousand people in other areas. If there is a continuous decline of coral reefs in our area, there is a possibility of tsunami kind of calamities affecting us in future. My husband always tells me about the importance of our precious coral reefs for good fishery resources. We have understood over the years that coral reefs are very important for the sustenance of fishery resources, our livelihood and for the protection of our coast.



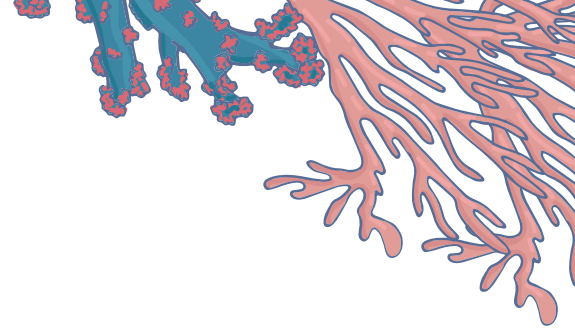
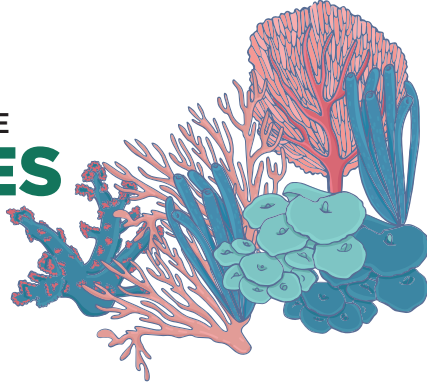
10.2. Community Involvement in Conservation Efforts

The communities living along the coast of Gulf of Mannar are aware of the importance of coral reefs particularly their importance in coastal protection and livelihood through fishery.

The Government's schemes for alternate and additional livelihood options have proved effective in reducing pressure on the marine ecosystems. The ecotourism activities are run with the involvement of local fishermen and the community gets a share of the revenue.

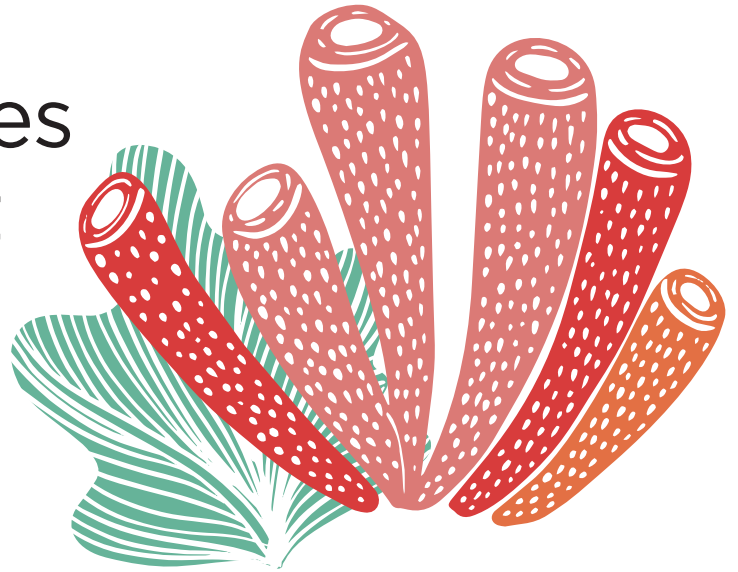
Fisher youth from several coastal villages have been appointed by Tamil Nadu Forest Department as anti-poaching watchers. The 252 Eco Development Committees under Gulf of Mannar Biosphere Reserve Trust (GOMBRT), which was formed to implement the biodiversity conservation project funded by United Nations Development Programme (UNDP) and the Global Environment Facility (GEF), are playing lead roles with the involvement of Self Help Group members in the conservation of coral reefs.





11

Further Resources and Involvement **Opportunities**



11.1. Educational and Informative Resources

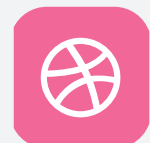


VIDEOS

<https://www.dccew.gov.au/about/news/take-a-virtual-tour-great-barrier-reef>
<https://www.youtube.com/watch?v=J2BKd5e15Jc>
https://www.youtube.com/watch?v=843Rpqza_6o

WEBSITES

<https://ocean.si.edu/ocean-life/invertebrates/corals-and-coral-reefs>
<https://coral.org/en/coral-reefs-101/>
https://oceanservice.noaa.gov/education/tutorial_corals/coral07_importance.html
<https://www.unep.org/topics/ocean-seas-and-coasts/blue-ecosystems/coral-reefs>



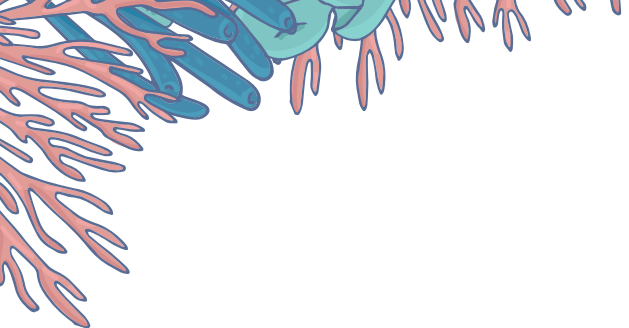
MAPS

http://www.coralsoftheworld.org/coral_geographic/interactive_map/
<https://allencoralatlas.org/>

EDUCATION AND INVOLVEMENT

<https://www.onecoralreef.org/>
<https://www.livingoceansfoundation.org/education/portal/>
<https://www.reef.org/>
<https://www.coralrestoration.org/volunteering>
<https://coralreef.noaa.gov/education/volunteer.html>
<https://www.reefcheck.org/get-involved/volunteer/>
<https://reefwatchindia.org/>





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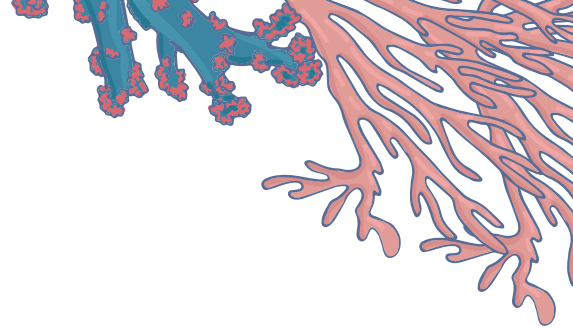
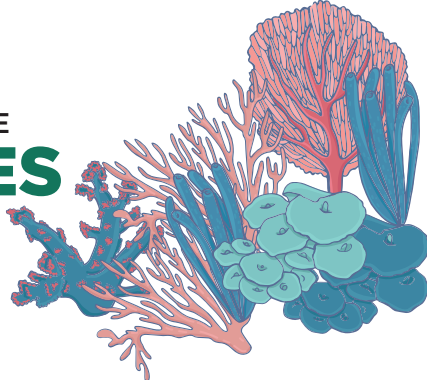
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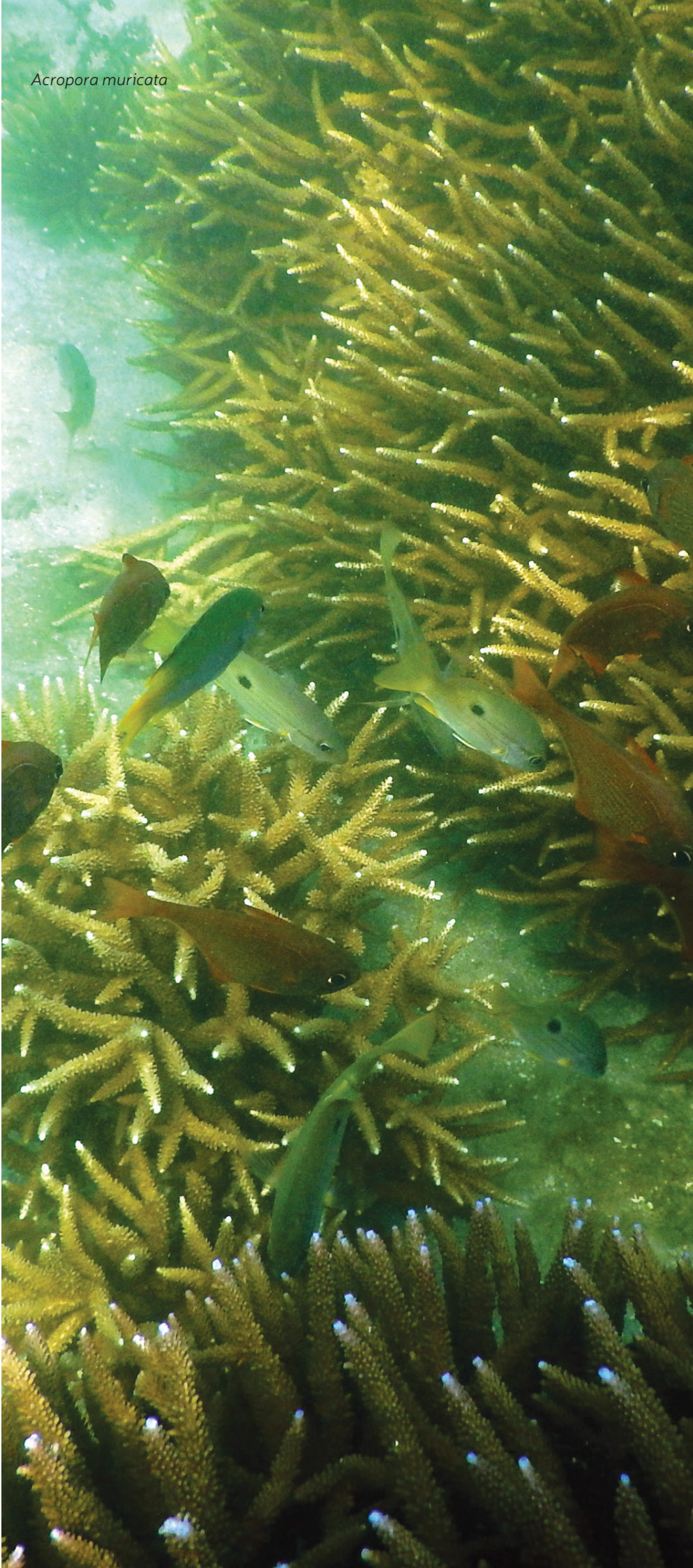
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Acropora muricata



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DEPARTMENT OF ENVIRONMENT, CLIMATE CHANGE & FOREST



Reef dominated by *Acropora* spp.