

CARE FOR THE COAST



Proceedings of the National Symposium on Coastal & Marine Habitat Restoration, Kochi, Kerala

Eds. B.C.Choudhury, Sajan John, Sandeep Kumar Tiwari
and Arinita Sandilya



The Wildlife Trust of India (WTI) is a non-profit conservation organization committed to help conserve nature, especially endangered species and threatened habitats, in partnership with communities and governments.

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Habitat Restoration, Kochi, Kerala



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2025



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PREFACE

India has a rich coastal and marine biodiversity, encompassing a wide array of habitats such as mangroves, coral reefs, seagrass beds, coastal sand dunes, coastal wetlands, oyster beds and mudflats which support a diverse range of life. These habitats play a crucial role in supporting the livelihoods of coastal communities and shielding them from natural calamities.

However, these ecosystems face numerous threats, including overfishing, destructive fishing practices, pollution, habitat destruction, and climate change. Developmental activities such as coastal development and industrial discharge also contribute to the degradation of these habitats.

The United Nations Decade on Ecosystem Restoration (2021 to 2030) is a global initiative to prevent, halt, and reverse the degradation of habitats. It aims to restore degraded ecosystems for the benefit of both people and nature by focusing on recovering biodiversity, improving human well-being and livelihoods, and mitigating climate change. The initiative emphasises the restoration of habitats in order to recover biodiversity and ecosystem integrity.

Although in India, we broadly discuss coastal and marine ecosystem restoration, most of our efforts remain largely confined to mangrove plantations, with only limited initiatives targeting other habitat types.

Restoration ecology is a science, and the recovery of coastal and marine habitats that have been degraded, damaged, or destroyed, often through human intervention, requires a scientific approach. The primary focus of restoration should be to assist the natural repair of the damage caused by human activities so that the ecosystem can return to a more natural or functional state. This involves a variety of approaches, from actively planting native species to removing stressors that hinder recovery. Restoration is often twinned with rewilding when certain species have been lost in that ecosystem and needs carefully thought out translocation programs. However, in India, restoration is often narrowly equated with mono-species plantations, which is widely practised.

The Coastal and Marine Habitat Restoration Symposium was organised with the objective of creating a platform to discuss the current

advancements in ecological restoration of coastal and marine habitats, and to provide a firm basis for dialogue and networking relating to the policy and approaches being followed both in India and globally. The two-day meet brought together a diverse group of participants, including, scientists, policymakers, restoration practitioners, academics, media representatives and corporate supporters - all united by their interest in coastal and marine restoration.

This symposium proceeding is thus unique and should offer the practitioner and researcher a glimpse into prevailing practices and possible ways forward.

A handwritten signature in black ink, appearing to read 'Vivek Menon', with a long horizontal stroke extending to the right.

Vivek Menon
Founder and Executive Director
Wildlife Trust of India

ACKNOWLEDGEMENTS

The coastal and marine habitat restoration symposium was a collective effort of many organizations and individuals. We wish to thank everyone who helped make this symposium a success. We thank SBI Foundation for their continuous support and the Kerala Forest Department and Ecological Restoration Alliance (ERA) for their partnership to make this event a success.

We are grateful to Sri. A. K. Saseendran, Hon'ble Minister for Forest, Govt. of Kerala and Sri. Pramod Krishnan, IFS, CWLW, Kerala Forest Department, for their guidance and gracing the Inaugural session. We are also thankful to the Coastal Forest Departments (Gujarat, Maharashtra, Karnataka, Kerala, Tamil nadu, Andhra Pradesh and West Bengal) for nominating the representatives to talk about the restoration efforts taken by the state.

We would also like to thank our Scientific Advisory Council (SAC) members Mr. Vivek Menon, Dr. H.S. Singh, IFS (Retd), Mr. Vasudevan, IFS (Retd), Dr. Krishna Ray, Dr. Selvan V, and Prof. Kathireshan K who advised and also attended the symposium.

We would also like to thank the Institutions and organization's participated in the symposium.

Lastly, we would like to acknowledge the efforts of our Project team to ensure that the symposium is a success: Ramith M, Vimal Lakshmanan, Bharat Kumar, Aditi Dhillon, Praveen Kumar, Naveen Edamunda, Sethu Gopinathan, Sreenanth K. and interns who were associated with the Project at that time - Arya KV, Sharanya K and Varsha P.

EXECUTIVE SUMMARY

Over the past decade, the field of marine habitat restoration in India has grown significantly. This is a result of our increased awareness of the extent of the degradation of marine ecosystems, including mangroves, coral reefs, and seagrasses, as well as our knowledge of how valuable these habitats are.

To provide a platform for practitioners and managers, and other stakeholders to discuss the effective implementation of coastal and marine habitat restoration, and to share recent developments in this field in India and abroad, a two-day symposium was organised by the Wildlife Trust of India with the support of the SBI Foundation and in collaboration with the Ecological Restoration Alliance (ERA) and the Kerala Forest Department on 14 and 15th of February 2025 at Hotel Airlink Castle, Kochi, Kerala.

This two-day symposium provided a comprehensive review of the current state of science surrounding the ecological restoration of coastal and marine habitats, and provided a firm basis for dialogue and networking pertaining to the policy and practical nuances of such restoration initiatives.

A total of 69 participants from 35 organisations/institutions and State Forest Departments participated in the symposium. It comprised five sessions (Day 1: three sessions, Day 2: two sessions) and two panel discussions. Sessions on the first day highlighted case studies on mangrove restoration initiatives led by coastal state forest departments, explored the shift from plantation to restoration and emphasised the importance of effective partnerships in supporting mangrove restoration and conservation initiatives. The second day focused on coral and seagrass restoration as well as emerging new ideas for the restoration of coastal ecosystems.

Panel discussions focused on two themes: the evaluation of mangrove restoration—charting a path for the future, and advancing the goals of the United Nations Decade of Ecosystem Restoration— for India's coastal and marine habitats.

Key takeaways and action points that emerged from the symposium included :

1) **Strengthening public-private partnerships with greater involvement** of long-term CSR commitments for biodiversity conservation by aligning the restoration goals with India's National Coastal Mission and global frameworks like REDD+;

(2) **Addressing policy & legal gaps** by strengthening community participation and related policies to ensure fair resource management, and by introducing legal mechanisms to incentivise corporate investments in conservation;

(3) **Scaling up ecosystem restoration** by expanding species-diverse mangrove restoration projects, and moving beyond monoculture plantations by using scientific methodologies to track ecosystem services and restoration effectiveness,

(4) **Enhancing community engagement** by implementing education programs to increase awareness about conservation benefits and by developing alternative livelihood programs for fishing communities to reduce reliance on unsustainable resource extraction,

(5) **Restoration of degraded coastal lands** by identifying priority restoration areas through scientific mapping and economic valuation, and by aligning the restoration efforts with India's commitment to restore 26 million hectares under UNCCD.

(6) **Policy reform and funding strategies** by modifying CSR guidelines to prioritise long-term conservation financing, and by developing carbon credit mechanisms to ensure financial sustainability in restoration projects.

The symposium concluded by underscoring the importance of multi-sectoral collaboration in ecosystem restoration. Participants agreed that public-private partnerships, policy reforms, and community-led conservation are critical for long-term success. Moving forward, integrating corporate funding, scientific research, and policy incentives will be key in achieving large-scale restoration goals. The symposium also provided general and state-specific recommendations to follow before embarking on new coastal and marine habitat restoration projects in the country.

BACKGROUND

Like its rich terrestrial biodiversity, India is equally rich in marine biodiversity. The country's coastline, which spans over 11,099 km, including the islands of the Andaman & Nicobar group and Lakshadweep, harbours unique marine habitats that support a wide variety of marine life. The diverse coastal ecosystems along the Indian coastline include estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy stretches and coral reefs. These marine habitats play a very significant role in the ecological and economic stability of the country. The coastal waters along the East and West coasts, as well as those surrounding the two island groups, are home to a plethora of marine species.



Marine diversity is primarily studied in the waters along the coast and around the islands. The coastal zone represents about 18% of the Earth's surface, providing space to approximately 60% of the global human population. It is of great bio-geochemical importance, as it buries and mineralises 89 to 90% of organic matter and acts as a sink for an estimated 50% of the global carbonate deposition. This zone also has high biological potential as it provides feeding, nursery and spawning grounds to a rich variety of marine life forms.

India's marine environment comprises a diverse range of ecosystems occurring along the coastline, which borders the Indian peninsula and encircles the two major Island groups. The mainland coastline is divided into the West Coast and the East Coast, each significantly different in its geomorphology. The West Coast is typically exposed with heavy surf, rocky shores and headlands, while the East Coast is generally shelving with beaches, lagoons, deltas and marshes.

Coastal and marine habitats across the globe have been decimated over the last few years. In India, we have lost more than 40% of our mangroves, over 25% of seagrass and around 60% of coral reefs. These habitats are essential to the health of our marine ecosystem and hold both environmental and social importance, providing valuable ecosystem services.

Over the past decade, the field of marine habitat restoration in India has grown significantly. This is a result of both our increased awareness of the extent of the degradation of marine habitats, including mangroves, coral reefs and seagrasses and our knowledge of just how valuable these habitats are.

In this UN Decade of Restoration, the number and scale of restoration efforts is increasing and now is the time to reflect on the potential of the seascape to deliver for nature and people at a large scale. The role of these critical habitats as integral components of dynamic and resilient ecosystems is beginning to be understood.

THE SYMPOSIUM

To strengthen coastal and marine conservation efforts in the country, the Wildlife Trust of India (WTI), in collaboration with the Kerala Forest and Wildlife Department and the Ecological Restoration Alliance (ERA), and with the support from the SBI Foundation organised the National Coastal and Marine Habitat Restoration Symposium in Kochi, Kerala, from 14th to 15th February 2025. This two-day symposium provided a comprehensive review of the current state of science surrounding the ecological restoration of coastal and marine habitats. It also served as a platform for discussion and networking on the policy and practical importance of this understanding.

The symposium brought together a diverse audience of scientists, policymakers, restoration practitioners, academics, and other stakeholders keen on coastal and marine restoration.

Symposium objectives focused on:

- Providing a platform for practitioners, managers and other stakeholders to discuss effective strategies for implementing coastal and marine habitat restoration,
- Sharing recent developments in coastal and marine habitat restoration in India and abroad

Benefits for the participants included:

- Providing managers and practitioners the opportunity to exchange ideas and learn from experts in coastal and marine habitat restoration,
- Gaining insights into how responsible business practices can contribute towards achieving various national and international sustainability goals through coastal and marine habitat restoration.

Inaugural Session	
Welcome Address:	Dr. Sandeep Kumar Tiwari, Vice President and Chief of Conservation, Wildlife Trust of India
Presidential Address:	Mr. Pramod G. Krishnan IFS, (CWLW, Govt of Kerala)

Special Address:	Shri. Vivek Menon, Founder & Executive Director, Wildlife Trust of India
Address:	Mr. Ritesh Sain, Program Head (CONSERW & ACE), SBI Foundation
Address by Guest of Honor:	Dr. Yash Veer Bhatnagar (Country Representative, IUCN)
Address by Chief Guest:	Mr. A. K. Saseendran, Hon'ble. Minister for Forest and Wildlife, Govt. of Kerala
Keynote Address:	Prof. BC Choudhury (Advisor, Aquatic Projects, Wildlife Trust of India). Title: Ecosystem Restoration: National Perspective in the Coastal and Marine Environment of India
Vote of Thanks:	Mr. Sajan John, Wildlife Trust of India

The Chief Guest of the symposium was the Hon'ble Forest and Wildlife Minister, Govt of Kerala, Mr. AK. Saseendran, and it was presided over by Shri. Pramod Krishnan IFS (CWLW), Kerala Forest Department.

Dr. Sandeep Kumar Tiwari, Vice President and Chief of Conservation, Wildlife Trust of India, delivered the welcome address. He stated, "With nearly 30% of India's population dependent on coastal resources, the health of marine ecosystems is crucial. Climate change, rapid industrialisation and coastal development have severely impacted these fragile ecosystems. To address this, WTI is restoring mangroves in Kannur, Kerala and coral reefs in Mithapur, Gujarat, to enhance the resilience, biodiversity and sustainability of marine habitats."



Welcome Address by Dr. Sandeep Kumar Tiwari, Wildlife Trust of India

In his presidential address, Mr. Pramod G. Krishnan (PCCF & CWLW), Kerala, stated, “A coastal and marine-based symposium is a welcome change in a conservation landscape that predominantly focuses on tigers and elephants. The rapidly evolving coastal and marine environment, shaped by shifting customs, socio-economic changes, and increasing pollution, demands urgent attention. Forest departments must seek diverse partnerships for effective conservation, integrating coastal and marine conservation into broader environmental and policy frameworks.”



Presidential Address by Mr. Pramod G. Krishnan IFS, (CWLW, Govt. of Kerala)

Mr. Vivek Menon, Founder & Executive Director, Wildlife Trust of India, delivered a special address online. In his remarks, he stated, “Coastal and marine ecosystems remain amongst the most neglected in terms of scientific understanding, as much of our ecological knowledge is derived from terrestrial ecosystems and forestry records. Multi-species restoration is emerging as a key strategy for ecosystem recovery, and the role of the private sector in this domain is becoming increasingly prominent, with both the power and willingness of private stakeholders to drive large-scale restoration efforts. It is therefore a public–private model of conservation.”



Special Address (online) by Mr. Vivek Menon, Founder & Executive Director, Wildlife Trust of India

Mr. Ritesh Sain, Programme Head (CONSERW & ACE - SBI Foundation) said, “SBI Foundation operates across eight thematic areas, with its CONSERW initiative focusing on waste management, ecosystem restoration and renewable energy solutions. Notably, SBI Foundation has undertaken large-scale plantation projects totalling 80 lakh trees, including mangroves along the Indian coastline, and plans to expand across all coastal states and UTs. Conservation initiatives also include protecting tigers, red pandas, mitigating human-wildlife conflict and supporting vulture conservation.”



Address by Mr. Ritesh Sain, Program Head (CONSERW & ACE), SBI Foundation

Mr. Yash Veer Bhatnagar, Country Representative, IUCN, said, “One of IUCN’s earliest initiatives is the ‘Mangroves for the Future’ Program, which was triggered by the 2004 tsunami, underscoring the critical role of mangroves in coastal protection and resilience. Over the years, this initiative has played a pivotal role in enabling numerous organisations to implement focused conservation efforts, contributing significantly to the restoration and sustainable management of coastal ecosystems.”



Address by Guest of Honour, Dr. Yash Veer Bhatnagar
(Country Representative, IUCN)

Hon’ble Forest Minister of Kerala, Mr. A. K. Saseendran, during his inaugural address stated, “It is heartening to see that this national symposium is focusing on the restoration of the coastal and marine habitats, which are critically important. Kerala relies heavily on its natural resources along its extensive coastline, particularly mangroves, which provide several ecosystem services. Kerala was the first state to introduce large-scale restoration in 2021, including mangrove restoration.”

Prof. BC Choudhury, Advisor, Aquatic Projects, Wildlife Trust of India, delivered the keynote address titled “Ecosystem Restoration: National Perspective in the Coastal and Marine Environment of India.” He remarked, “Restoration efforts until now have predominantly focused on terrestrial ecosystems, but the shift towards coastal and marine restoration is promising. This should align with the principles outlined in the UN Decade of Ecosystem Restoration and go beyond plantations

to true multi-species recovery. While mangroves, seagrass and corals have gained conservation priority, other crucial ecosystems such as sand dunes, salt marshes and oyster beds remain overlooked.



Inaugural address by Chief Guest, Mr. A. K. Saseendran, Hon'ble. Minister for Forest and Wildlife, Govt. of Kerala



Keynote Address by Prof. BC Choudhury, Advisor, Aquatic Projects, Wildlife Trust of India.

Mr. Sajan John, Co-PI, Marine Projects, Wildlife Trust of India, delivered the vote of thanks.

Day 1: 14-02-2025 Session 1 Case Studies on Mangrove Conservation - Experiences of the Forest Department Chair: Dr. H.S. Singh, IFS, former PCCF Gujarat, Co-chair: Dr. Sandeep K. Tiwari, WTI
Mr. Senthil Kumaran, IFS, Gujarat Forest Department
Mr. VikramYadav, UNDP Maharashtra
Mr. K V Vasantha Reddy, IFS, Karnataka Forest Department
Mr. Raju K. Francis, IFS, Kerala Forest Department
Dr. R. Murugan, IFS, Tamil Nadu Forest Department
Mr. D. Ravindranath Reddy, IFS, Andhra Pradesh Forest Department
Ms. Nisha Goswami, IFS, West Bengal Forest Department
Mr. Manoj Nair, IFS, Odisha Forest Department (Online)

Following the formal inauguration, the technical sessions commenced. Session 1, focused on Case Studies on Mangrove Conservation - Experiences of the Forest Department, and was co-chaired by Dr. H.S. Singh, IFS, former PCCF, Gujarat and Dr. Sandeep Kumar Tiwari, WTI.

The session began with introductory remarks by Dr. H.S. Singh, who emphasised that the current approach to restoration needs to evolve. He stated that the priority should be to restore ecosystems to a functional state, rather than focusing solely on increasing green cover.



Dr. Sandeep K. Tiwari, WTI and Dr. H.S. Singh, IFS, former PCCF Gujarat, chairing the session



Mr. Vikram Yadav, UNDP Maharashtra, during his session.



Mr. Senthil Kumaran, IFS, Gujarat Forest Department, giving a presentation during the session.



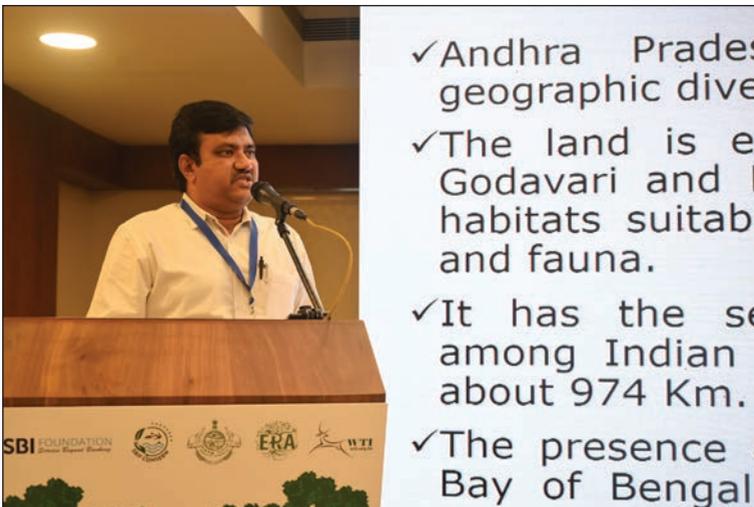
Mr. K V Vasantha Reddy, IFS, Karnataka Forest Department



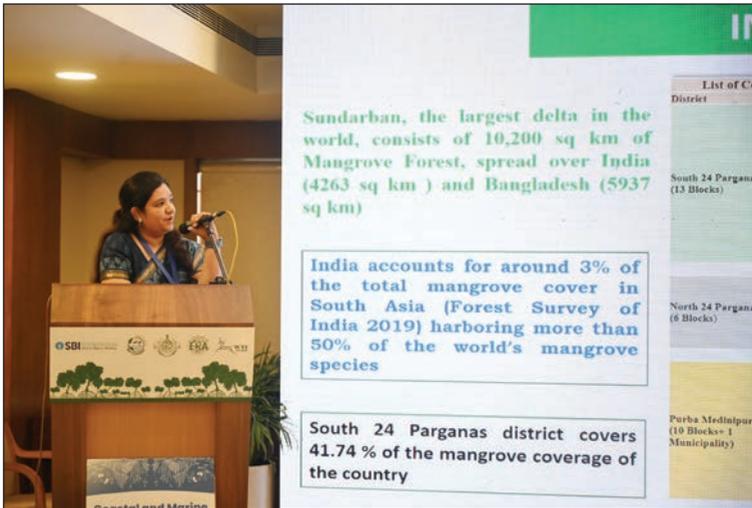
Mr. Raju K. Francis, IFS, Kerala Forest Department



Dr. R. Murugan, IFS, Tamil Nadu Forest Department, presenting his case study.



Mr. D. Ravindranath Reddy, IFS, Andhra Pradesh Forest Department



Ms. Nisha Goswami, IFS, West Bengal Forest Department

Key Takeaways & Action Points:

1. Expanding protected area coverage – Aim to bring more mangroves under conservation frameworks.
2. Community engagement – Strengthen initiatives like Mangrove Mithra and private-sector partnerships.
3. Advanced monitoring tools – Utilise GIS, remote sensing, and mobile applications like GTM Portal and MGNREGA App for real-time tracking.
4. Scientific restoration techniques – Adoption of fishbone models, direct planting, and dispersion centres to enhance success rates.
5. Multi-stakeholder approach – Collaboration between the government, the private sector, and local communities for large-scale restoration.

Closing Remarks:

The session highlighted the critical need for integrated mangrove conservation across India's coastal states. With a focus on scientific restoration, policy support, and community involvement, the discussion

paved the way for long-term sustainability and resilience of mangrove ecosystems.



Co-Chair Dr. Sandeep Tiwari delivering his closing remarks

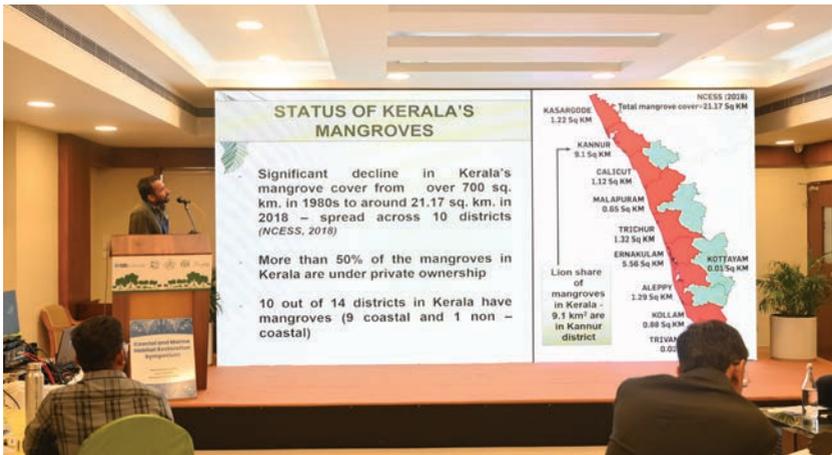
Day 1: 14-02-2025 Session 2 Mangrove Plantation to Restoration - the Way Forward (Chair Mr. N. Vasudevan, IFS, Co-chair: Dr. Mohammd Rafiq)	
Mr. Ramith M, Wildlife Trust of India	Kannur Kandal Project: A developing model for mangrove restoration in Kerala
Dr. Krishna Ray	An effort to ecologically restore degraded mangroves in the Indian Sundarbans non-protected shorelines
Dr. K. Ilangoan	Case Study: Adayar Ecopark
Prof. K. Kathiresan	Mangrove Restoration: Guiding Principles
Dr. GA Thivakaran	Challenges in Mangrove Restoration in Gujarat

This session was chaired by Mr. N. Vasudevan, IFS, former APCCF, Maharashtra, and co-chaired by Dr. Mohammd Rafiq, Scientist, MoEFCC.

In his introductory remark, Mr. N. Vasudevan noted that restoration efforts are increasingly becoming target-driven, and this corporate approach will not be very effective for conservation.



Mr. N. Vasudevan, IFS, Former APCCF, Maharashtra, and Dr. Mohammd Rafiq, Scientist, MoEFCC, chairing the session



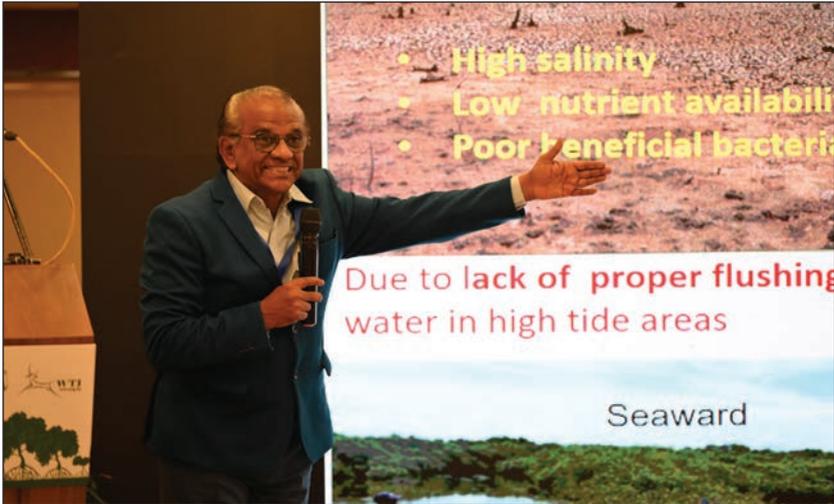
Mr. Ramith M, WTI talking about developing a new model for mangrove restoration in Kerala



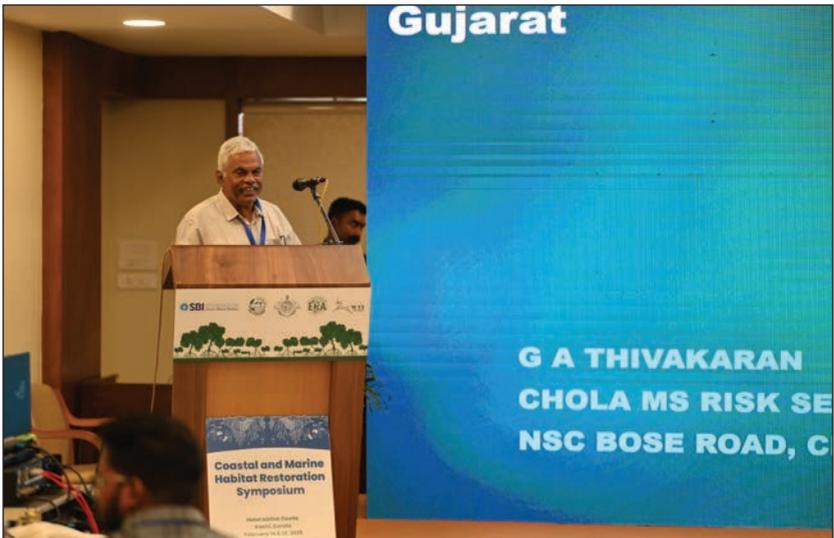
Dr. Krishna Ray talking about the efforts to ecologically restore degraded mangroves in non-protected shorelines of the Indian Sundarbans



Dr. K. Ilangovan talking about the Adayar Ecopark mangrove restoration



Prof. K. Kathiresan talking about the guiding principles of mangrove restoration



Dr. GA Thivakaran talking about the challenges in mangrove restoration in Gujarat

Key Takeaways & Action Points:

1. Strengthening Mangrove Restoration

- o Shift focus from plantation-driven approaches to holistic ecosystem restoration.
- o Diversify species composition in restoration projects.
- o Expand Blue Carbon Initiatives and community livelihood support programs.

2. Carbon Financing & Green Credit Programs

- o Develop a structured approach to carbon credit markets for mangrove restoration.
- o Launch the Green Credit Program by November 2025, aligning with national climate goals.

3. Community Participation & Multi-Stakeholder Approach

- o Implement financial incentives for local communities to engage in conservation.
- o Encourage co-management structures for community reserves.
- o Strengthen academic involvement in identifying degraded areas for restoration.

Conclusion:

The session underscored the need for a science-driven, collaborative approach to mangrove and coastal ecosystem restoration. The speakers highlighted the critical role of community engagement, legal frameworks, and sustainable funding models in ensuring long-term conservation success. The session concluded with a call for integrated policy efforts, stakeholder collaboration, and evidence-based conservation strategies to safeguard India's coastal ecosystems for future generations.



Co-chair of the session delivering their closing remarks

Day 1: 14-02-2025 Session 3 Mapping Mangroves – Restoration, Conservation and Partnerships (Chair: Dr. Krishna Ray, Co-chair: V. Karikalan, IFS)	
Dr. Ajanta Dey	Scope and Challenges of Mangrove Restoration on the Eastern Coast of India
Dr. Selvam V	Ecological basis of mangrove restoration
Dr. P. Ragavan	Mangrove restoration/afforestation success in India: A preliminary assessment (Online)
Dr. Deepak Samuel	Mapping critical coastal and marine habitats for restoration (Online)

This session was chaired by Dr. Krishna Ray and co-chaired by V. Karikalan, IFS, of the Karnataka Forest Department. In her opening remarks, Dr. Krishna Ray emphasised that mangroves with site-

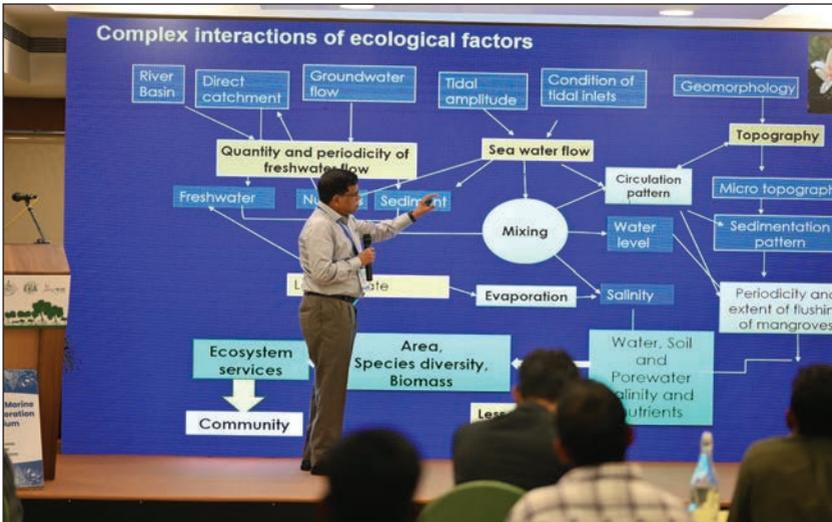
specific strategies could be scientifically experimented on, with the least disturbed reference sites. Such scientific restoration practices have a greater potential for recovery compared to the predominant monoculture-based restoration.



Dr. Krishna Ray and Mr. V. Karikalan, IFS (Karnataka FD), chairing the session



Dr. Ajanta Dey talking about the 'Scope and Challenges of Mangrove Restoration' on the Eastern Coast of India



Dr. Selvam V, talking on the ecological basis of mangrove restoration



Dr. P. Ragavan, talking on the preliminary assessment of mangrove afforestation success in India



Dr. Deepak Samuel from NCSCM, talking about the critical coastal and marine habitats mapping for restoration

Key Takeaways & Action Points:

1. Land Use & Legal Protection

- o Utilise mapping tools from NCSCM to identify potential areas for reserve forest designation.
- o Explore incentives for private landowners to engage in conservation.
- o Address political resistance to declaring protected lands through policy interventions.

2. Long-Term Conservation Planning & Funding

- o Transition from short-term funding cycles to multi-year financial commitments.
- o Engage multiple corporate sponsors through CSR-driven projects.
- o Develop a comprehensive restoration manual to guide government and private-sector initiatives.

Conclusion:

The speakers in this session emphasised that the integration of science, community and policy interfaces is key to ensuring successful mangrove restoration. To assist natural regeneration, a detailed risk mapping is needed to identify the key stressors on the ecosystem through community-stakeholder integration. In the case of critical coastal and marine habitats, mapping enables us to understand decadal changes in degradation, enhancement or even erosion or accretion along the coastal areas, and the lack of long-term scientific monitoring and records of mangrove restoration and afforestation projects is a key challenge in assessing their success. Thus, an understanding of the ecological forces acting upon and within the mangroves is a primary requisite for a successful restoration programme.

Day 2: 15-02-2025 Panel Discussion-1 An Evaluation of Mangrove Restoration - Charting a Path for the Future
Panel Moderator Dr. Sandeep Kumar Tiwari, Wildlife Trust of India
Panelists: Mr. KV Vasantha Reddy IFS, (Karnataka Forest Department) Dr. Vijai Dharmamony (Amrita Vishwa Vidyapeetham), Mr. Arjun Singh (Senior Manager ERA) Mr. Ravindra Singh (Director, Indo-German Biodiversity Programme)



Panel members deliberating on the topic (From left to right): Mr. Arjun Singh (Senior Manager ERA), Mr. Ravindra Singh (Director, Indo-German Biodiversity Programme), Dr. Sandeep Kumar Tiwari (Wildlife Trust of India), Mr. KV Vasantha Reddy, IFS, (Karnataka Forest Department) and Dr. Vijai Dharmamony (Amrita Vishwa Vidyapeetham)

Discussion Highlights

The panel discussion focused on evaluating the current state of mangrove restoration and the transition from mere plantation efforts to comprehensive ecological restoration. Key challenges identified included the lack of long-term structural support, inadequate repositories for mangrove and coral reef conservation, and limited funding resources. Mr. Vasantha Reddy, IFS, Karnataka Forest Department, emphasised the need to shift the focus from simply increasing green cover to undertaking genuine restoration efforts while improving species diversity. He also highlighted Karnataka's Blue Plastic Initiative, which integrates conservation with community-based livelihood support.

Mr. Ravindra Singh, Director, Indo-German Biodiversity Programme (GIZ) raised concerns about challenges in identifying degraded areas within marine and brackish water systems as well as the standard parameters required for assessing these regions. He underscored the importance of bringing 30% of coastal and marine areas under legal protection and setting clear benchmarks for restoration, while ensuring strong governmental commitment to conservation goals.



Mr. Ravindra Singh (Director, Indo-German Biodiversity Programme) and Prof. B C. Choudhury during the panel discussion

Prof. B.C. Choudhury suggested that outreach to external agencies could help bring a “green agenda” into mainstream conservation. He advocated for incentivising private landowners to protect mangrove habitats and exploring the potential of mapping tools from National Centre for Sustainable Coastal Management (NCSCM) to identify suitable areas for declaring reserve forests. He also proposed a collaborative effort involving various government departments to draft a long-term conservation strategy for the next decade.

Dr. Sandeep Kumar Tiwari highlighted successful conservation models, such as the Garo communities in Meghalaya, which have voluntarily dedicated their lands to conservation. He questioned how similar incentives could be extended to private mangrove landowners to encourage active participation in restoration.



Dr. Sandeep Kumar Tiwari (Wildlife Trust of India), Mr. KV Vasantha Reddy IFS, (Karnataka Forest Department), during the panel discussion

Mr. Vasantha Reddy, IFS, pointed out that declaring reserve lands for conservation remains a political challenge, as public representatives often resist such measures. He proposed utilising the Compensatory Afforestation Fund Management and Planning Authority (CAMPA) funds for land acquisition and compensatory afforestation as a potential solution. However, he raised concerns about balancing conservation with large-scale infrastructure projects, particularly under Sagarmala and Sagarmitra, which prioritise port development and coastal expansion. The discussion also touched upon the Indian government's \$5 trillion economy goal, raising the question of how restrictive environmental laws could be adapted to meet both economic and conservation objectives.

A key takeaway from the session was the role of ERA (Ecosystem Restoration Alliance) in assisting the government through evidence-based conservation strategies. The vast scientific and practical knowledge within the conservation community should be compiled into a manual or framework to guide future efforts. Dr. Sandeep Kumar Tiwari also raised the potential role of carbon financing and how community involvement could be integrated into credit mechanisms.



Mr. Arjun Singh (Senior Manager ERA) and Dr. Vijai Dharmamony (Amrita Vishwa Vidyapeetham) during the panel discussion

Dr. K. Kathiresan discussed the Green Credit Program, noting that Indian Council of Forestry Research and Education (ICFRE) is working on guidelines where 1,100 trees planted per acre could generate credits for sale in the carbon market.

Vasantha Reddy addressed concerns about government land acquisition for restoration, proposing a strategy of pre-acquiring open lands and using compensatory afforestation, similar to the tiger

conservation model. However, he noted that development agendas frequently change, making long-term conservation planning difficult. The issue of port construction and mangrove destruction was raised, highlighting the need for stringent environmental assessments.

Dr. Sandeep Kumar Tiwari questioned how ERA could support evidence-based conservation activities and how to address resource exploitation along India's large coastal landscapes. Shri. Arjun Singh emphasised the importance of taking a collective approach to developing and implementing ideas, ensuring the integration of native species diversity and using GIS-based species distribution maps for informed decision-making. He pointed out that government departments often have limited resources and data, necessitating a multi-stakeholder approach.

Dr. Vijay Dharmamony shared insights from Odisha's mangrove restoration efforts, where community participation has been successful on the east coast, but is lacking in western coastal regions like Poovar, Kerala, where seaside resorts dominate. He proposed hydrological correction techniques to restore mangroves naturally and emphasised aerial mapping and land acquisition as essential strategies. He also discussed the role of academia in identifying restoration areas and the importance of community engagement in conservation projects.



Ms. Ajanta Dey (NEWS Calcutta) and Dr. Kathireshan interacting with panel members

The discussion shifted towards carbon financing mechanisms, with Ravindra Singh addressing the hurdles of mainstreaming ecology into local development plans. He advocated for corporate engagement in ecosystem restoration through carbon offset projects and suggested

launching green credit programs by November 2024, in which one planted tree would generate one credit.

Ms. Ajanta Dey emphasised the need to localise the UN Sustainable Development Goals (SDGs) within India's 2030 agenda and recommended designing co-management structures to encourage the establishment of community reserves.

Ravindra Singh stressed the necessity of long-term funding models, as opposed to the current yearly funding system, which limits scalability. He suggested breaking conservation projects into smaller, manageable sections and engaging multiple funding agencies through an end-to-end approach.

Dr. Sandeep Kumar Tiwari reiterated the need for milestone-based changes, rather than focusing on incremental improvements. He cited examples from Bhitarkanika and Maharajia Creek (Kola Creek) as case studies demonstrating effective conservation interventions.

<p>Day 2: 15-02-2025</p> <p>Session 1</p> <p>Conserving Corals and Seagrass</p> <p>(Chair: Mr. Senthil Kumaran, IFS, Gujarat FD, Co-chair: Dr. Swati Singh, UNDP)</p>	
Mr. Praveen Kumar	Restoring a degraded coral reef: A multi-pronged conservation effort along the coast of Mithapur, Gujarat
Dr. Diraviyaraj	Restoration of corals and seagrasses along the Tamil Nadu coast, India
Dr. Manikandan	Challenges and Opportunities in the restoration of coastal coral habitats
Mr. Jeremy Josh	Coral Identification, Artificial Reefs, and Coral Transplantation at Grande Island, Goa

Dr. Sathyanarayana C	Coral Restoration efforts of ZSI and its future prospects
Dr. Erika D'Souza	Assessing the recovery potential of seagrasses following overgrazing by green sea turtles in the Lakshadweep archipelago
Ms. Nayantara Jain	Re(ef) Generate: Coral Restoration in Chidiyatapu, South Andaman Island (Online)

The session was chaired by Mr. Senthil Kumaran, IFS, (Gujarat FD) and co-chaired by Dr. Swati Singh (UNDP). In the opening remarks, Mr. Kumaran noted that the Gulf of Kutch Marine National Park is the first marine protected area in the country, and the coral reef restoration efforts undertaken by the Gujarat Forest Department have been remarkable. He emphasised that in addition to coral reefs, other subtidal critical ecosystems like seagrass meadows must also be protected and restored.



Mr. Senthil Kumaran IFS (Gujarat FD) and Dr. Swati Singh, UNDP, chairing the session



Mr. Praveen Kumar talking on multi-pronged conservation effort along the coast of Mithapur, Gujarat, to restore a degraded coral reef



Dr. Diraviyaraj talks on the restoration efforts of corals and seagrasses along the Tamil Nadu coast, India



Dr. Manikandan talks on the challenges and opportunities in the restoration of coastal coral habitats



Mr. Jeremy Josh talking on Coral Identification, Artificial Reefs, and Coral Transplantation at Grande Island, Goa



Dr. Sathyanarayana C talking on Coral Restoration efforts of ZSI and its future prospects



Dr. Erika D'Souza talking about assessing the recovery potential of seagrasses following overgrazing by green sea turtles in the Lakshadweep archipelago



Ms. Nayantara Jain talking about Coral Restoration efforts in Chidiyatapu, South Andaman Island (Online)

Key Takeaways & Action Points:

1. Enhancing Coral Restoration Strategies

- o Expand artificial reef projects using biomineralisation and birock technology.
- o Develop microfragmentation techniques to accelerate coral cover growth.
- o Address siltation issues in the Gulf of Kutch to improve restoration success.

2. Improving Seagrass Conservation

- o Reduce boating-related damage to seagrass meadows.
- o Monitor green turtle impacts on seagrass health.

3. Community Engagement & Policy Development

- o Strengthen awareness programs with educational pamphlets and training sessions.
- o Integrate carbon reduction strategies into restoration projects.
- o Advocate for long-term conservation policies addressing marine pollution, sustainable fishing, and tourism regulations.

4. Scientific Monitoring & Data Collection

- o Standardise monitoring protocols to track coral bleaching, predation, and ecosystem health.
- o Increase benthic surveys and mapping efforts for data-driven conservation planning.

Conclusion:

The session emphasised the importance of science-based, community-driven conservation strategies for coral reefs and seagrass ecosystems. Moving forward, multi-sectoral collaboration, technological advancements, and stronger policy frameworks will be essential in ensuring the long-term resilience of marine ecosystems.

Day 2: 15-02-2025 Session 2 Emerging New Ideas for Restoration of Coastal Ecosystems (Chair: Prof. BC Choudhury, Ms. Nisha Goswami, IFS, WB FD Co-chair:)	
Dr. Selvam V	Integrated Approaches to Restoration: Aquaculture and Mangroves
Dr. Thamizoli P	Community engagement for Mangrove management: A rhetoric, will it be a reality
Dr. Manoj Singh	Harnessing blue carbon: Multi-stakeholder approach
Mr. Chinmaya Thonse	Blue Carbon Finance Mechanism: Unlocking capital for Coastal conservation and restoration

This session was chaired by Prof. BC Choudhury and co-chaired by Nisha Goswami, IFS (West Bengal Forest Department). In his opening remarks, Prof. B. C. Choudhury emphasised that new problems need

new ideas and solutions. He stressed the importance of developing incentive-based approaches to attract more stakeholder participation in coastal and marine habitat restoration efforts.



Prof. BC Choudhury (WTI) and Ms. Nisha Goswami, IFS, (WB FD) chairing the session on emerging new ideas for the restoration of coastal ecosystem session on emerging new ideas for the restoration of coastal ecosystems



Dr. Selvam V talking on the integrated approaches to restoration: Aquaculture and Mangroves



Dr. Thamizoli P talking on community engagement for mangrove management

Dr. Manoj Singh talking on the multi-stakeholder approach in Harnessing blue carbon



Mr. Chinmaya Thonse talking about Unlocking capital for Coastal conservation and restoration through Blue Carbon Finance mechanism.

Key Takeaways & Action Points:

1. Integrating Mangroves into Aquaculture

- o Promote mangrove-friendly aquaculture to enhance biodiversity and economic viability.

- o Address CRZ enforcement challenges to facilitate replication of successful models.

2. Strengthening Community Participation

- o Expand awareness programs to educate diverse coastal communities on sustainable mangrove management.
- o Develop community certification programs to formalise local participation in conservation.

3. Scaling Up Blue Carbon Finance

- o Improve monitoring, verification, and validation mechanisms to attract long-term funding.
- o Establish clear distinctions between carbon projects and government initiatives.
- o Foster multi-stakeholder partnerships to ensure effective project design and implementation.

Conclusion:

The session emphasised the need for an integrated approach to coastal aquaculture, mangrove conservation, and blue carbon finance. Participants agreed that scientific, financial, and community-driven efforts must work in tandem to achieve long-term coastal ecosystem restoration.

Day 2: 15-02-2025

Panel Discussion-2

UN Decade of Ecosystem Restoration: Making it Happen in the Coastal and Marine Habitats of India

Panel Moderator:

Dr. Ishwar Narayanan (Wildlife Trust of India)

Panelists:

Dr. HS. Singh, IFS (Former PCCF-Gujarat),

Ms. Nisha D'Souza (Sea Scapes/TCL)

Ms. Swati Singh (UNDP),

Mr. Gaurav Mehta (DCB Bank),

Mr. Harpalsinh Chudasama (Aga Khan Foundation).



The panellist comprised (from left to right) Ms. Nisha D'Souza (SeaScapes/TCL); Dr. Swati Singh (UNDP); Mr. Gaurav Mehta (CSR-DCB Bank); Dr. HS. Singh, IFS (Former PCCF-Gujarat), and Mr. Harpalsinh Chudasama (Aga Khan Foundation)

The panel discussion focused on the role of public-private partnerships (PPP) in ecosystem restoration, highlighting key funding gaps, policy challenges, and opportunities for large-scale conservation efforts.

Nisha D'Souza (C-SCAPES) introduced the Tata Chemicals Society for Rural Development (TCSRDR), which has been supporting short-term conservation projects with an average duration of five years. The initiative integrates interdisciplinary research and community participation to ensure effective restoration outcomes.

From a policy perspective, Dr. Swati Singh (UNDP) emphasised the need for integrating restoration into national adaptation plans to track progress across multiple sectors. She highlighted that the Government of India's National Coastal Mission is preparing funding proposals to support large-scale coastal restoration.



Despite ongoing efforts, Mr. Gaurav Mehta highlighted a significant gap in funding, noting that out of the ₹27,000 crore total CSR fund in India, less than 7% is allocated to biodiversity conservation. He emphasised that ecosystem services should be at the core of CSR-driven conservation initiatives; however, they often face competition from large-scale infrastructure projects. Moreover, the absence of regulatory mandates for long-term CSR investments poses a major challenge, making it difficult to sustain conservation projects beyond short funding cycles.



Dr. Ishwar Narayanan and Ms. Nisha D'Souza talking during the panel discussion



Dr. Swati Singh (UNDP) and Mr. Gaurav Mehta (CSR-DCB Bank) talking during the panel discussion

Challenges and Policy Gaps in Restoration

Dr. H.S. Singh, IFS, provided a historical perspective, stating that Kutch and Pala Himalaya have been key natural areas requiring conservation attention over the past decade. He emphasised that restoration should follow natural succession processes with minimal human

intervention, allowing ecosystems to regenerate naturally. However, he pointed out that large-scale mangrove plantations often result in monocultures, which lack the species diversity essential for ecosystem stability. A significant challenge in restoration efforts, he noted, is the lack of community involvement due to inadequate policies and legal frameworks. Dr. Singh stressed the importance of integrating fisheries into conservation strategies to ensure sustainable livelihoods while protecting marine ecosystems. He also highlighted the delicate balance between working with exotic species and local communities, urging a participatory approach to ensure effective restoration.



Dr. HS. Singh, IFS (Former PCCF-Gujarat) and Mr. Harpalsinh Chudasama (Aga Khan Foundation) at the panel discussion

On a global scale, the Indian Ocean Coastal Initiative promotes community ownership and engagement in conservation. Identifying and collaborating with reliable partners is essential for successfully implementing these initiatives at the national level.

Building on this, Dr. Manoj Singh emphasised that since humans are an integral part of ecosystems, conservation programs must provide alternative livelihood opportunities to reduce anthropogenic pressures on natural resources. Similarly, Dr. Ajanta Dey noted that while various alternative livelihood programs have been introduced for

fishing communities, they remain insufficient to fully replace traditional income sources. She urged government departments to work together, ensuring that restoration efforts align with local socio-economic needs.



Dr. Manoj Singh and Dr. Thamizoli asking questions to the panellists

Dr. Thamizoli reinforced that coastal communities are diverse, with some groups unknowingly contributing to resource degradation due to a lack of awareness. He stressed the need for consultation and education programs, including community certification initiatives to encourage long-term conservation stewardship. He also pointed out that ecosystem conservation must balance environmental protection with the economic realities of local communities.

Case Study: Indus River Dolphin Conservation

Gaurav Mehta shared insights from the Indus River Dolphin Project, highlighting the challenges posed by industrial activities, sand mining, and habitat destruction. He noted that local fishing communities are directly impacted, often leading to conflicts over resource use. He emphasised that conflict resolution should be driven by education and awareness-building, ensuring that conservation goals are aligned with community interests rather than restricting their livelihoods.



Dr. Archana Chatterjee (IUCN-India) and Dr. Mohammad Rafiq (MoEFCC) asking questions to the panellists

Restoration of Degraded Coastal Lands

The discussion then shifted to the restoration of degraded coastal lands. Prof. B.C. Choudhury highlighted that coastal areas are often overlooked in national restoration programs, despite the urgent need for intervention in approximately 540 sq. km of degraded coastal land. He further pointed out that while India has committed to restoring 26 million hectares of degraded land under the UN Convention to Combat Desertification (UNCCD), significant gaps remain in identifying priority areas for restoration and aligning them with national policies and programmatic frameworks.

A key challenge highlighted was the discrepancy between the amount of degraded land and the actual area being restored, indicating that current restoration efforts are falling short. Prof. Choudhury also emphasised that the economic valuation of mangroves remains largely under recognised, limiting policy incentives for conservation.

The Way Forward – Actions Under the UN Decade of Ecosystem Restoration

When asked about the next steps under the UN Decade of Ecosystem Restoration, Dr. Ishwar Narayanan recommended leveraging sector-specific expertise to enhance the effectiveness of restoration initiatives. He emphasised that conservation efforts must yield visible results to attract long-term funding and government support.

Expanding on this, Dr. Swathy Singh proposed modifying CSR policies to increase long-term corporate investments in conservation. She recommended integrating REDD+ principles into coastal restoration, allowing projects to generate blue carbon credits and attract private sector funding.

She also emphasised the importance of breaking down restoration goals into measurable targets at both state and national levels, ensuring a unified approach that combines protection and restoration for lasting, sustainable impact.

Closing Session	
Chair:	Dr. HS. Singh, IFS (Former PCCF-Gujarat)
Concluding remarks:	Prof. BC Choudhury (Advisor, Aquatic Projects, WTI)
	Prof. Kathiresan K (Member, IUCN Mangrove Specialist Group)
	Dr. Manikandan (Scientist NIO)
Vote of Thanks:	Mr. Ramith M (Wildlife Trust of India)



Dr. HS. Singh, IFS, giving his concluding remarks



Prof. BC Choudhury giving his concluding remarks



Prof. K. Kathiresan giving his concluding remarks



Dr. Manikandan (Scientist NIO, Goa) giving his concluding remarks



Mr. Ramith M, Manager and Head, Kannur Kandal Project, Wildlife Trust of India, delivered the vote of thanks.

Key Takeaways & Action Points

1. Strengthening Public-Private Partnerships

- o Encourage long-term CSR commitments for biodiversity conservation.

- o Align restoration goals with India's National Coastal Mission and global frameworks like REDD+.

2. Addressing Policy & Legal Gaps

- o Strengthen community participation policies to ensure fair resource management.
- o Introduce legal mechanisms to incentivise corporate investments in conservation.

3. Scaling Up Ecosystem Restoration

- o Expand species-diverse mangrove restoration projects, moving beyond monoculture plantations.
- o Use scientific methodologies to track ecosystem services and restoration effectiveness.

4. Enhancing Community Engagement

- o Implement education programs to increase awareness about conservation benefits.
- o Develop alternative livelihood programs for fishing communities to reduce reliance on unsustainable resource extraction.

5. Restoration of Degraded Coastal Lands

- o Identify priority restoration areas through scientific mapping and economic valuation.
- o Align restoration efforts with India's commitment to restoring 26 million hectares under UNCCD.

6. Policy Reform & Funding Strategies

- o Modify CSR guidelines to prioritise long-term conservation financing.
- o Develop carbon credit mechanisms to ensure financial sustainability in restoration projects.

Conclusion

The symposium underscored the importance of multi-sectoral collaboration in ecosystem restoration. Participants agreed that public-private partnerships, policy reforms, and community-led conservation are critical in ensuring long-term success. Moving forward, integrating corporate funding, scientific research, and policy incentives will be key in achieving large-scale restoration goals.

GENERAL RECOMMENDATIONS

- At present, more attention is given to the recovery of coastal and marine habitats such as mangroves, corals and seagrass. In addition, sand dunes, salt marshes, mud flats, and oyster beds are also critical habitats that require assisted recovery.
- State-specific coastal and marine habitat restoration plan needs to be developed with clear goals and objectives.
- Ensure hydrological and geo-morphological restoration is done before embarking on eco-restoration activities.
- The shift from monoculture plantation to science-based eco-restoration is necessary.
- Periodic monitoring and evaluation of all restored areas should be conducted.
- Illegal aquaculture and unsustainable fishing practices are identified as one of the major threats to mangroves. These activities need to be strictly regulated.
- Transfer of technology is very essential for the assisted restoration (promote the Lab to land program).
- All the critical coastal and marine habitats need to be mapped and made available online. No restoration zone should also be marked (No mangrove plantation on mud flats/tidal flats).
- Incentivise eco-restoration to promote participation by private owners.
- Develop a structured approach to carbon credit markets for mangrove restoration.

- Like mangroves, mangrove associates are also important. So, the eco-restoration of mangrove associates should also be promoted.
- Launch the Green Credit Program by November 2025, aligning with national climate goals.
- Dovetail CSR activities to restoration projects and ensure funding cycles are multi-year financial commitments.
- New technologies need to be adopted to enhance the recovery rate (Bio Rock, Micro fragmentation, Tissue Culture etc).
- Along with coastal and marine floral restoration, faunal restoration should also be prioritised (eg. horseshoe crab, fishing cat, otters etc).

STATE-SPECIFIC RECOMMENDATIONS

- **Gujarat:** The state government has a plan to significantly enhance mangrove restoration, supported by corporate CSR commitments to undertake mangrove restoration across the coastal area. In this context, it was generally agreed that the state forest departments should prioritise and invest in professional capacity building of the forestry and non-forestry personnel involved in mangrove and other coastal habitat restoration, to ensure the success of these efforts.
- **Maharashtra:** The state of Maharashtra has made good progress in safeguarding its mangroves. The Mangrove Foundation is taking the lead by embarking on the restoration of all coastal and marine habitats. It was suggested that these restoration efforts be guided by scientific principles and carried out with the involvement of professional government and non-governmental agencies.
- **Goa:** The coastal and marine habitats of Goa are vital natural resources that support the state's tourism-based economy. The sea beaches, sand dunes, mangroves and corals are key habitats that will continue to provide economic benefits if they are properly safeguarded and restored. With the leadership of the National Institute of Oceanography (NIO) and other national organisations, it is urged that the state develop a comprehensive Coastal and Marine Conservation and Restoration Plan at the earliest.
- **Karnataka:** The state forest department has identified potential mangrove restoration areas, most of which are currently under the jurisdiction of the Government Department. Considering the importance of natural coastal resilience, these restored green spaces would provide, it is recommended that the state government facilitate the transfer of these identified areas to the forest department to enable restoration efforts to begin at the earliest.
- **Kerala:** It was noted that both healthy and degraded mangrove areas in Kerala are primarily under private ownership. It is urged that the Kerala Government initiate the process of acquiring as many of these areas as possible under the Forest Department. Additionally, it is recommended that the state government consider easing procedures for professional organisations seeking to acquire such private lands for the purpose of restoration. Furthermore, the Kerala Forest Department

is encouraged to facilitate the involvement of professional restoration organisations in undertaking mangrove restoration in degraded areas currently owned by the forest, revenue and other government departments.

- **Tamil Nadu:** With the earliest input of MSSRF, the Tamil Nadu Forest Department has made big strides in mangrove and coral restoration. It is suggested that under its coastal development initiatives supported by multilateral funding, the state government prioritise the scientific restoration of all coastal and marine habitats, in collaboration with the scientific, academic and NGO sectors
- **Andhra Pradesh:** With two of the largest river deltas, Andhra Pradesh has the natural benefit of suitable coastal and marine areas to be brought under restoration. Since the state has one of the largest coastlines with an increasing focus on the Blue Economy, it is urged to identify and safeguard coastal resilient natural green infrastructures from being altered to grey infrastructure. Preserving and restoring these natural areas will significantly contribute to carbon sequestration as well as carbon trading benefits. The Symposium further urged the state to prioritise the restoration of coastal salt marshes and sand dunes.
- **Odisha:** The state hosts the highest diversity of mangroves and associated species and has already covered most of the suitable areas for mangrove restoration. However, the state has acquired large stretches of encroached and abandoned aquaculture areas, which can be utilised for mangrove restoration. It is urged that the state government create an enabling framework to transfer such areas to the forest department for restoration activities. Furthermore, the state is encouraged to facilitate experimental work on sea grass and sand dune restoration, particularly in the Balukhand Sanctuary, which is India's only sand dune sanctuary. Collaborative efforts are also urged to help restore Balukhand to its pristine glory of indigenous flora and fauna.
- **West Bengal:** Being the custodian of a significant part of the world's largest Mangrove ecosystem in Sundarbans, West Bengal plays a leading role in coastal carbon sequestration. However, with the growing impacts of climate change and sea level rise, the state also faces one of the greatest challenges of safeguarding the coastal and marine genetic resources, including mangroves. The symposium delegates strongly urged the Government of West Bengal to establish a National Mangrove Genetic Resources centre in Sundarbans and to broaden its coastal and marine habitats restoration agenda by actively involving academic

and scientific bodies, civil society and NGOs The Sundarbans delta also holds immense potential for the restoration of various coastal and marine fauna through the development of sustainable harvesting protocols and practices that will also safeguard the livelihood opportunities of the coastal communities. Given that green coastal restoration offers a soft engineering approach, it presents a more cost-effective and ecologically sustainable alternative to traditional hard engineering methods used to prevent coastal erosion. The delegates urged the state government to take the leadership and the pole position in India on coastal and marine habitats restoration science and practice.

- **The Andaman and Nicobar Islands:** Two decades after the devastating impact of the tsunami and amid the country's ambitious development agenda, the Bay Islands are in urgent need of comprehensive efforts to safeguard their green, resilient natural infrastructures. The region's mangroves and coral reefs are only now beginning to show signs of recovery, and the symposium strongly urges the Andaman administration and the Government of India to strike a balance between ecology and economy in their development agenda. It is recommended that the protection of the islands' unique ecosystems, such as mangrove, rainforests, coral reefs, seagrass, and pristine sea turtle nesting beaches, be prioritised to prevent their conversion to grey infrastructure. Simultaneously, restoration efforts should be accelerated through the involvement of professional agencies and the adoption of global best practices.

- **Lakshadweep:** It is urged that the development agenda for the Lakshadweep Islands fully takes into account the ecological services the coastal and marine habitats have been providing for millennia, and prioritise the principle of 'no net loss' of these habitats. Additionally, the island administration is encouraged to collaborate with the country's leading scientific organisations to develop a comprehensive Coastal and Marine Habitat Conservation and Restoration Plan for the island group.

ABSTRACTS

Ecosystem Restoration: National Perspective in the Coastal and Marine Environment of India

B.C. Choudhury, Wildlife Trust of India

Terrestrial ecosystem restoration (at least bringing degraded forest ecosystems under green cover) has been practised in India for several decades. However, these efforts have often favoured commercial and/or fast-growing species that also cater to the economic and industrial needs. Forest Development Corporations and the Social Forestry sectors of various state governments have done some commendable work in plantation forestry and in helping to maintain India's Forest cover at a relatively stable level, despite huge developmental needs for conversion of forest ecosystems for other pressing uses.

However, India's growing commitment to restoring millions of hectares of degraded land to address climate change, along with its potential pledge to the United Nations Decade of Restoration, has given a giant push to this agenda. As a result, multilateral agreements and even national CSR commitments have prioritised "Restoration" as a key focus area.

India's coastal and marine ecosystems, comprising diverse habitats ranging from mangroves, coral reefs, sea grass beds, sand dunes, salt marshes etc. have not received the attention they deserve for restoration as use, overuse, and neglect have considerably degraded them. Post the Tsunami in 2004, mangroves became the focus of enhanced plantation efforts, and the Government of India's recent Mangrove Initiative for Shoreline Habitats & Tangible Incomes (MISHTI) programme has targeted 540 sq km of mangrove restoration.

However, a large gap remains in the restoration of other specialised coastal and marine habitats such as coral reefs, sea grass beds, salt marshes and sand dunes, that are our coastal resilient ecosystems. What is required is a renewed national programme focusing on the coastal and marine environment restoration, especially as India is shifting its economic development towards the Blue Economy agenda. Identifying, safeguarding and restoring both flora, fauna, and the ecological processes of our coastal and marine ecosystems will not be a large-scale shift in the Restoration paradigm of the nation.

Keywords

Plantation, Ecological restoration, faunal restoration and community participation

Power Point Presentation link: [Link](#)

Mangrove and coral conservation activities in MNP, Gujarat

R. Senthil Kumaran, IFS,

Gujarat Forest Department (GFD)

In India, mangroves are found in all coastal states, of which Gujarat state has the longest coastline in the country (>1600 km) with two gulfs. Gujarat also has the second-highest mangrove cover (23.3%) in the country, with Kutch district having the highest mangrove cover, followed by Jamnagar district. Among the various species, *Avicennia* spp. is the major mangrove species occurring on the Gujarat coast. Due to the efforts of the state government over the past 2 decades, mangrove cover has shown significant improvement from 911 sq. km in 2001 to 1164 sq.km in 2023, i.e., an increase of 253 sq.km. The Marine National Park (MNP) in the Gulf of Kutch is the first marine protected area of the country. The corals, which are considered “rainforests of the seas,” play a vital role in maintaining the marine ecosystem, and the Gujarat forest department (GFD) has taken various conservation initiatives along with scientific institutes.

This presentation highlights the various activities undertaken by GFD that have led to significant effects on the mangrove cover and the successful conservation of coral reefs.

Keywords:

Gulf of Kutch, Coral restoration, mangrove restoration and artificial reef

Power Point Presentation link: [Link](#)

**Mangrove and Marine Biodiversity Conservation Foundation of
Maharashtra (Mangrove Foundation)**

Vikram Yadav

State Project Manager, Action for Climate and Environment (ACE)
United Nations Development Programme

Mangrove and Marine Biodiversity Conservation Foundation of Maharashtra (Mangrove Foundation) is an Autonomous Body under the Revenue & Forests Department, Government of Maharashtra, set up to recruit the necessary skill sets and provide operational flexibility to implement conservation programmes across the coastal regions of Maharashtra. The Mangrove Foundation works towards the conservation and monitoring of mangroves and coastal biodiversity. The Foundation also supports the implementation of various livelihood activities under the state government's 'Mangrove Conservation and Livelihood Generation Scheme.' The mangrove forest area in the state of Maharashtra is about 31509 hectares as per the FSI report 2023, of which 24481 hectares is in possession of the Mangrove Cell, 5981 hectares is with the private sector, and about 1100 hectares is with other departments.

The Mangrove Cell has made concerted efforts to enhance the mangrove cover of the state by providing protection to mangroves which are declared as 'Reserve Forests' under the Indian Forest Act, 1927. which are under its possession. Additional measures include satellite mapping to closely monitor the status of mangroves, patrolling of mangrove forests, removal of illegal encroachments such as shanties on mangrove land, and capacity building of staff to ensure effective conservation and protection.

From the year 2012 to 2024, mangrove plantations have been completed on 2165 hectares. Maharashtra has 18 mangrove species, and *Sonneratia alba* was declared the State Mangrove Tree of Maharashtra in 2020.

The Clean Mangrove Campaign, a three-year joint initiative started in 2015 by the citizens of Mumbai and the Mangrove Cell, was included in the Limca Book of Records. In this campaign, 8,000 tonnes of garbage (mostly plastic) were cleared, covering 11.03 sq.km of mangroves across Mumbai.

Keywords:

Mangrove restoration, coastal clean-up, eco-tourism, and state mangrove tree

Power Point Presentation link: [Link](#)

Conservation and management of mangroves and marine species in the west coast of Karnataka

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Mangroves are highly productive ecosystems that provide both tangible and intangible benefits to the coastal population. The state of Karnataka, with a coastline of 320 km spread across three districts, is home to several rivers and estuaries. As per the India State of Forest Report, 2023 by Forest Survey of India, the state has 14.20 km² of Mangroves, accounting for 0.28% of the total mangrove cover in the country. The region supports 12 species of true mangroves, 32 species of mangrove associates and several birds and marine species within its estuaries. However, these mangroves face increasing anthropogenic pressures.

The Karnataka State Government has undertaken several initiatives for the conservation and management of mangroves and marine species. These include restoration of mangroves, conservation of Olive Ridley turtles, establishment of a Coastal and Marine cell, notification of the Aghanashini estuary as a Ramsar site, declaration of the Apsarakonda- Mugali shoreline as the first Marine Park in Karnataka and various eco-tourism initiatives aimed at raising awareness among local communities and students.

Keywords

Aghanashini estuary, Ramsar site, Apsarakonda- Mugali Shoreline, Marine Park, Eco-tourism, anthropogenic pressure and restoration.

Power Point Presentation link: [Link](#)

Status and conservation prospects of mangroves in Kerala

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Kerala Forest & Wildlife Department

With a coastline of 576 km, Kerala has an extensive network of backwaters and lagoons, historically supporting approximately 70,000 hectares of mangroves. A recent study conducted by the Kerala Forest Research Institute in 2024 recorded a total extent of 2,725.42 hectares across 4,799 plots in the state. Of this, 50% were privately owned. Kerala is home to 16 true mangrove species and 42 mangrove associates. Notified mangrove reserve forests are located in Kannur (236.7 hectares), Kasargod (54.5 hectares), and Thrissur (3.44 hectares). Additionally, 20.78 hectares of mangrove land is protected as Kadalundi-Vallikkunnu Community Reserve, 2.278 hectares as Ecologically Fragile Land in Azhiyur, Kozhikode, and 2 hectares as the Mangalavanam Bird Sanctuary in Ernakulam. The key laws governing mangrove protection in the state include the Kerala Promotion of Tree Growth in Non-Forest Areas Act (2005), Biological Diversity Act (2002), Environment (Protection) Act (1986), and Wetlands (Conservation & Management) Rules (2010). Major threats to mangroves include road construction, shrimp farming, pollution, and lack of awareness. For long-term conservation, it is essential to develop a business model based on ecotourism, traditional medicinal practices, and cultural heritage. Furthermore, sensitisation, research, land acquisition, incentivisation, collaborations, partnerships, and strong legislation are required.

Keywords:

Conservation, Reserve Forest, Private ownership, Threats

Power Point Presentation link: [Link](#)

Case Studies on Mangrove Conservation – Experience of the Tamil Nadu Forest Department

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Tamil Nadu's 1,076 km coastline, spanning 14 districts, hosts vital mangrove ecosystems in Pichavaram, Muthupet, Nagapattinam, and Ramanathapuram, with 44.94 sq.km of mangrove cover (1.11 sq.km very dense, 26.95 moderately dense, and 16.88 open). These habitats, which are home to 14 mangrove species, face threats from land-use changes (such as ports, salt pans), disrupted freshwater flow (due to check dams, siltation), overexploitation, invasive species, and limited community engagement. To address these challenges, the state has implemented schemes like bio-shield rehabilitation, JICA-funded biodiversity projects, CAMPA, and the World Bank-supported TN-SHORE initiative. Restoration efforts employ innovative techniques such as flooded nurseries, propagules, container seedlings, and plantation designs like modified fishbone and linear planting, alongside de-siltation. Collaborative efforts with NGOs, Village Mangrove Councils, and agencies like NABARD (National Bank for Agriculture and Rural Development) ensure convergence.

From 2021-22 to 2023-2024, 1901.4 hectares of new mangrove plantations were established, and 952 hectares of old mangroves were restored. These mangroves sequester 24.68 million tonnes of carbon, with significant contributions from both existing and newly planted areas. Best practices include the establishment of large-scale nurseries, biodiverse plantations, community-driven councils, and cultural initiatives like Tillai Vanam. Geo-referencing through the GTM portal enhances transparency, reflecting Tamil Nadu's integrated approach to conserving these ecologically and culturally significant ecosystems.

Tamil Nadu; Mangrove ecosystems; Coastal districts; Mangrove Cover; Mangrove Species; Land-use changes; Freshwater disruption; NABARD - Bio-shield rehabilitation; JICA-funded projects; TN-SHORE initiative; Carbon sequestration; Restoration techniques; Mangrove Nursery; Seedling planting; Monitoring; Village mangrove councils.

Keywords

Gulf of Mannar, Palk Bay, sea grass restoration, coral reef restoration and Tillai vanam

Power Point Presentation link: [Link](#)

Mangroves of Andhra Pradesh

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Mangroves in Andhra Pradesh are primarily found along the estuaries of the Godavari and Krishna rivers, spanning Kakinada and B.R. Ambedkar districts for the Godavari estuary, and Krishna and Bapatla districts for the Krishna estuary. In addition to these major estuarine ecosystems, smaller mangrove patches exist along the coastlines of Srikakulam, Visakhapatnam, West Godavari, Prakasam, Sri Potti Sriramulu Nellore, and Tirupati districts.

Andhra Pradesh is home to 16 true mangrove species and 18 associated species. Among them, *Avicennia marina* and *Avicennia officinalis* are the most commonly found and widely used for nursery cultivation due to their adaptability for restoring degraded areas. Additionally, *Excoecaria agallocha* and *Aegiceras corniculatum* are well-suited for rehabilitation in degraded habitats. Elements of success in mangrove restoration include continuous support for mangrove restoration (Schemes), involvement of the staff and participation of the community, trained manpower and reduction in the mangrove dependency for fuelwood, timber and grazing. However, mangrove cover is sparse in the restored areas. Continuous monitoring and desilting of canals need to improve the density of the mangrove plantations. Inclusion of mangrove-bearing non-forest areas in the prohibitory order book (POB) is essential. Such mangrove areas should be used only for reforestation /restoration and afforestation purposes. They can be brought under the protection fold by declaring them as protected forests once the respective revenue land is accepted as a Compensatory Afforestation area for mangrove restoration.

Keywords

Estuarine ecosystems, coastal vegetation, true mangrove species, associated species, afforestation, habitat rehabilitation.

Power Point Presentation link:

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Mangroves Conservation in West Bengal & Its Ecological and Social Impact

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The state of West Bengal consists of three coastal districts, namely South 24-Parganas, North 24-Parganas and Purba Medinipur district. Out of these three districts, Sundarbans falls in the South 24-Parganas and North 24-Parganas Districts. Sundarban is a vast forest in the coastal region of the Bay of Bengal and is considered one of the natural wonders of the world. This is the world's largest delta, consisting of 10200 sq.km. of mangrove forest, spread over India (4263 sq.km.) and Bangladesh (5937 sq.km). Every year, the coastal district of West Bengal is affected by more than one super cyclone, which impacts the natural habitat in the region. Apart from that, several other factors affect the mangrove forests of Sundarbans, which include developmental activities, coastal erosion, increasing salinity and formation of salt blanks, aquaculture, pollution, and tourism, to name a few. To reduce or mitigate the effects of these challenges, the Forest Department, Government of West Bengal, is undertaking several habitat restoration efforts to increase the state's mangrove cover.

Additionally, the natural influx of fresh water to the Indian Sundarbans has drastically declined, and some freshwater-loving mangrove species like *Nypa fruticans*, *Eriobotrya fones* etc. are showing less abundance in the natural forest. Considering these situations, the West Bengal Forest Department has initiated or adapted several scientific interventions like reclamation of salt pans, mangrove plantations in degraded forest areas and natural blanks as a Community Based Restoration Programme, prevention of soil erosion through nature-based solutions, etc. In the years 2021 and 2021-2022, the forest department created

massive mangrove plantations over 2500 hectares. and 2262 hectares respectively. Moreover, a modern mangrove nursery has been created to rejuvenate and protect the 11 Rare, Endangered, and Threatened (RET) mangrove species from extinction.

Keywords

Sundarbans mangrove ecosystem, initiatives for restoration of mangrove

Power Point Presentation link:

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Mangrove Afforestation: The Odisha Experience

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Mangroves play a critical role in coastal ecosystem protection, biodiversity conservation, and climate resilience. Odisha, ranking sixth in India with a mangrove cover of 259 km², harbours these vital forests across five coastal districts: Puri, Jagatsinghpur, Kendrapara, Bhadrak, and Balasore. Among these is the renowned Bhitarkanika National Park, which is globally recognised as a "Mangrove Genetic Paradise."

The state hosts a rich mangrove diversity, comprising 88 species, including 30 true mangroves, 28 mangrove associates, and 30 back mangroves. Nine are globally significant, including *Sonneratia griffithii* and *Heritiera fomes* (globally threatened under the IUCN Red List), found in Bhitarkanika. Odisha's afforestation efforts are supported by various governmental initiatives such as CAMPA, CSS-CMM, MISHTI, and MGNREGS, ensuring systematic expansion and restoration. Two key plantation methods are employed: polypot plantation, where seeds are nurtured in controlled environments before transplantation, and hypocotyl plantation, which utilises young seedlings' hypocotyls for grafting.

Illegal prawn farming and unsustainable fishing practices pose significant threats to mangrove ecosystems, and efforts have been undertaken to evict illegal prawn gherries. Additionally, mangrove meta-nurseries

and awareness programs foster long-term sustainability. Community engagement plays a pivotal role, with the 'Mangrove Mitra' initiative encouraging local participation. 42 volunteers have contributed 32.28 acres of land for afforestation under the Mangrove Forest Division, Rajnagar. Participants receive an incentive of ₹10,000 per acre for their contributions.

In short, Odisha's experience demonstrates the significance of scientific planning, local engagement, and innovative techniques in mangrove conservation. With continued efforts, mangrove afforestation can serve as a model for coastal resilience and biodiversity conservation globally.

Keywords

Bitharkanika, Sundari mangrove, community participation and fish bone method

Power Point Presentation link:

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Kannur Kandal Project: A developing model for mangrove restoration in Kerala

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Wildlife Trust of India

Mangroves in Kerala have declined from a historical range of 700 sq. km to just 21.17 sq. km, making restoration crucial. The Kannur Kandal Project focuses on scientific and community-based mangrove restoration in degraded backwaters across five locations in Kannur district, under local panchayat ownership. The project follows scientific restoration principles in site selection, species selection, planting, and monitoring. Site selection considers historical degradation causes, hydrology, tidal inundation, and soil and water parameters such as salinity, pH, nitrogen, phosphorus, potassium, soil structure, and carbon content. Species selection is based on zonation and reference site studies. Over the past two years, the project has restored 27 acres, planting at 1-metre spacing with 10 true mangrove species and one mangrove associate. A Central

Mangrove Nursery and six satellite nurseries support planting activities. Long-term conservation is ensured through MoUs with panchayats, which also engage in nursery and restoration efforts via the National Rural Employment Guarantee Scheme (NREGS). Plantation labourers, NREGS workers, and volunteers receive training in scientific mangrove restoration.

The project aims to develop a replicable mangrove restoration model for Kerala, strengthening efforts to restore and protect these vital ecosystems.

Keywords

Ecosystem, Plantation, Restoration, Panchayath, NREGS

Power Point Presentation link:

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An effort to ecologically restore degraded mangroves in the Indian Sundarbans' non-protected shorelines

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Degraded mangrove ecosystem restoration, in general, is considered to be rehabilitation with monotypic plantations, where ecological restoration principles are rarely followed. However, researchers admit that most of these initiatives have often failed. In this backdrop, an integrative framework for the ecological restoration of degraded mangroves with site-specific strategies could be scientifically experimented with, using co-located reference (least disturbed) mangroves as the target ecosystem, in a pilot scale of ~65 hectares in small, discrete degraded patches, along the river shores along the Western Sundarbans settlement regions.

This restoration intervention narrates how these small patch sites have been progressing towards gradual restoration within a period

of 4-10 years since their initiation, augmenting the natural secondary succession process at a far faster pace compared to passive restoration progression without human assistance. Our observations demonstrate the greater potential of this framework in the recovery of mangrove ecosystem functions and its self-sustainability compared to that of predominant monoculture-based restoration practices for vulnerable mangroves.

Keywords:

Ecological restoration, Degraded mangroves, Indian Sundarbans, Site-specific strategies, Mono-& multi-species assemblage, Self-sustainable mangrove ecosystem

Power Point Presentation link:

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Mangrove Restoration on a Landfill Site, A Case Study of Adyar Eco Park, Chennai, Tamil Nadu, India

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Ecological restoration is a promising strategy to reverse biodiversity loss from habitat degradation worldwide. Few attempts have been made in the past two decades to restore mangroves in densely populated cities, even though urban mangroves have received little attention in restoration initiatives. Understanding urban mangroves in the context of restoration should help create new methods for carrying out restoration projects that consider every element of urban ecosystems. The restoration procedure and recommendations are compiled in this case study, together with technical gaps and a paradigm for future urban mangrove restoration.

The Adyar Estuary, which lies in the heart of Chennai, Tamil Nadu, is one of the estuaries that has suffered the most from development in the country. 58 acres of Adyar Creek along R.A.Puram were underutilised and used as construction and sewage waste disposal sites. In 2007, the Government of Tamil Nadu launched the Adyar Poonga program to restore the landfill site on behalf of the Adyar Poonga Trust through

TUFISL. In 2008, restoration work commenced with the removal of 2.80 lakh cubic metres of accumulated sludge, enabling tidal activity, and a total of 1.25 lakh indigenous plants of 117 species, and 35,000 mangroves of 8 species were planted. In 2014, 300 acres (Phase II) of the Estuary Mouth region were undertaken for restoration, 75,000 mangroves of 9 species, and 40000 mangrove associates were planted.

As the estuary mouth remains closed for 7-8 months each year, keeping the mangroves alive in a compacted landfill and polluted waters was a challenging task. Several site-specific planting and maintenance methods were followed. A 95% success rate was achieved in mangroves, with a comparatively high growth rate. The dense mangrove patches are home to a variety of wildlife. This success model has been effectively replicated in restoring Phases III and IV of Adyar Estuary and Phases I and II of Coouam Estuary. The real success of these efforts is reflected in the nearly 9 lakh students visiting the restored area over the last 10 years.

Keywords

Urban Mangroves, Mangrove Restoration, Mangrove Associates, Adyar Estuary, Coouam Estuary, landfill

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Mangrove Restoration: Guiding Principles

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This article provides guiding principles for mangrove restoration. Hydrology and topography should be restored to ensure the free flow of tidal water for improving the natural regeneration. The hydrological connectivity of mangroves between land and sea should be considered in the restoration process. Permeable structures can be set up to trap sediment, thereby facilitating the natural regeneration, and modifying the shoreline from concave to convex, making it more resistant to waves

and winds. Excessive sediment supply should be removed manually. In the flood-depressed sites, topography should be raised to a level equal to or slightly lower than 5-10% of the maximum flood height. Mangroves should not be planted in seagrass beds or mudflats. The ideal planting site is located above mean sea level, inundated at ~30% of the time by tidal waters. Native species can be planted, with due consideration of genetic diversity and natural zonation patterns. Viviparous propagules do not require nursery development. Long-term monitoring of restored mangrove ecosystems is required. Mangrove-positive business models should be developed alongside restoration efforts to generate coastal livelihoods and the blue economy. Restoration should take into account social, ecological and economic aspects through an integrated approach. Youth, women and marginalised communities should be the key stakeholders in the process.

Keywords

Mangroves- Restoration-Principles-Planting-Hydrology

Power Point Presentation link:

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Challenges in Mangrove Restoration in Gujarat

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Restoring mangroves through plantation is a complex task that requires supportive political, social, economic, and biophysical conditions. Gujarat leads the country in mangrove plantation, with over 70,000 hectares completed by various government and non-government agencies. In addition to traditional methods of planting nursery-raised seedlings and direct seed dibbling, a unique method known as the raised bed method (locally called Otla method) has been adopted to counter fast tidal currents. Despite completing more than 70,000 hectares of plantation, mangrove restoration in Gujarat faces numerous challenges at every stage. Consequently, many plantation efforts fail due to poor survival rates. This presentation discusses the challenges and potential solutions. In many plantation efforts, the primary requirement of a technically suitable intertidal belt for plantation is often

overlooked due to various reasons, such as a poor understanding of the physical and chemical factors governing mangrove plantation. Similarly, inappropriate plantation methods often lead to poor survival. In most plantation efforts, despite a good survival rate, a lack of post-plantation care often leads to mass mortality due to issues such as algal encrustation, crab and barnacle infestations. Other issues include single-species plantation (*Avicennia marina*), poor seed selection, lack of community participation, and conflicting inter-sectoral interests, which need to be addressed through sustained effort.

Keywords

Mangrove plantation, Challenges, nursery seedlings, intertidal belt, poor survival, post-plantation

Power Point Presentation link:

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Scope and Challenges of Mangrove Restoration in Eastern Coast of India

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Working in the science, community and policy interfaces is key to ensuring successful mangrove restoration. The scientific approach should look beyond afforestation into nature-based solutions using an ecosystem-based approach for building coastal resilience imbibing the area delineation, site selection, species selection and afforestation methodology with monitoring mechanisms clearly defined in it. Community engagement should also go beyond creating contractual man-hours by apprehending the accrued ecosystem services and related opportunities to translate into a sustained impact on the livelihood of the communities.

Accordingly, beyond community participation, the afforestation mechanisms must encompass community engagement and stewardship. Policy influences through stakeholder integration are a prerequisite by which several stakeholders need to be included in the discussion, design and implementation of the afforestation process so

that the ecosystem services are understood and everyone contributes in their capacity to the risk mitigation measures. It is to be noted that to assist the natural regeneration, firstly, a detailed risk mapping is needed to identify the key stressors on the ecosystem and through community-stakeholder integration and evidence-based case studies, develop the required stewardship to sustain the afforestation impact. The presentation will share experiences from working in Sundarban, Odisha and Tamil Nadu on the eastern coast of India.

Keywords

Sundarban, Community participation, mangrove restoration

Power Point Presentation link:

[Link](#)

Ecological Basis for Mangrove Restoration

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The area, biodiversity, biomass, mangrove health, and ecosystem services of a mangrove ecosystem are determined by a) freshwater flow, b) tidal amplitude, c) topography, d) protection against wave energy, and e) local climate. Although mangroves are saline-tolerant plants, they require low saline conditions for reproduction and higher growth and productivity. For most mangroves, the optimum salinity for luxuriant growth is between 12 to 15 parts per thousand (grams/litre). Depending on the quantity and duration of the freshwater flow, a mangrove ecosystem may have different salinity zones, each creating a niche for a group of species to settle, grow and reproduce. Thus, the quantity and duration of freshwater flow play a dominant role in deciding the biodiversity and biomass of the mangroves. Tidal amplitude not only brings seawater into the mangroves but also determines the area of the mangroves in combination with the topography. For example, suppose the topography is gradual and smooth, with a high tidal amplitude, and saline water is taken far from the shoreline, creating a large area for mangrove colonisation. Mangrove propagules, which are generally found along sheltered coasts, require a low wave energy environment

to settle and grow. Thus, an understanding of the ecological forces acting upon and within mangroves is a primary requisite for a successful restoration programme.

Keywords

Freshwater flow, zonation, optimum salinity

Power Point Presentation link:

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Mapping Critical Coastal and Marine Habitats for Restoration

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Mapping transforms complex data into visual representations, making it easier to interpret and analyse. It plays a crucial role in decision-making by providing clear, structured insights across various domains, from geography and urban planning to data management and logistics. By simplifying intricate information, maps enhance communication, improve efficiency, and enable informed strategic planning. In the case of critical coastal and marine habitats, mapping allows us to understand decadal changes in degradation, enhancement or even erosion or accretion along the coastal areas.

The Coastal Regulation Zone (CRZ Notification in 2011 issued by the Ministry of Environment, Forest and Climate Change (MoEF&CC) has classified ecologically sensitive areas (ESA and geomorphological features as CRZ-IA due to their significant role in maintaining the integrity of the coast. CRZ-IA area includes:

(i) Mangroves (in case mangrove area is more than 1000 sq.m., a buffer of 50 m along the mangroves shall be provided and such area shall also constitute CRZ-I A); (ii) Corals and coral reefs; (iii) Sand dunes; (iv) Biologically active mudflats; (v) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of

1972), Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 Of 1986), including Biosphere Reserves; (vi) Salt marshes; (vii) Turtle nesting grounds; (viii) Horse shoe crab habitats; (ix) Sea grass beds; (x) Nesting grounds of birds; (xi) Areas or structures of archaeological importance and heritage sites

An OM released by MoEF&CC (F.No.12-I/2019-IA III) on the guidelines for updates of the Coastal Zone Management Plan (CZMP), CRZ 2011, mapped ESA and CVCA were to be aligned with 2019.

Keywords

Hazard line, sediment cells, Participatory Coastal Rural Appraisal (PCRA)

Power Point Presentation link: [Link](#)

Mangrove restoration/afforestation success in India: A preliminary assessment

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The lack of long-term scientific monitoring and records of mangrove restoration and afforestation projects poses a significant challenge in assessing their success. A straightforward approach to address this issue involves comparing changes in the country's mangrove cover with the total land area used for restoration efforts at decadal intervals. This can help evaluate the success of mangrove restoration initiatives and establish a baseline for future efforts. In this study, data on the land area used for mangrove restoration and plantation in India from 2000 to 2021 were collected and compared with biennial mangrove cover assessments from the State of Forest Report. The results show that between 2000 and 2021, mangrove cover increased by 510 km², while 1268.75 km² of land was used for restoration efforts. If the entire 510 km² increase is attributed solely to restoration efforts, the success rate would be approximately 41%. However, natural regeneration also significantly contributes to the increase in mangrove cover. For

example, in the states of Andhra Pradesh, Kerala, Goa, Diu & Daman, and Maharashtra, mangrove cover increased more than the land area used for plantations.

In Maharashtra, only 20.99 km² was used for plantations, but mangrove cover increased by 206 km², highlighting the substantial role of natural regeneration supported by protective measures. In contrast, in states such as Gujarat, Karnataka, Odisha, Tamil Nadu, and West Bengal, the land area used for plantations was much greater than the increase in mangrove cover. For instance, in Gujarat, 795.72 km² was utilised for mangrove plantations, yet the increase in mangrove cover was only 264 km². Despite harsh environmental conditions, Gujarat has achieved notable mangrove cover growth over the last two decades, with significant efforts dedicated to restoration and afforestation. This analysis underscores the need to distinguish the contributions of natural regeneration and plantation efforts when evaluating increases in mangrove cover. Incorporating these findings into India's biennial State of Forest Report will help streamline restoration efforts and improve the monitoring of programs like the ambitious MISHTI initiative.

Keywords:

Afforestation, India, Mangroves, Restoration, Success

Power Point Presentation link:

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Restoring a degraded coral reef: A multi-pronged conservation effort along the coast of Mithapur, Gujarat

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Wildlife Trust of India

The coral reefs of Gujarat's Gulf of Kutch Marine National Park (GoKMNP) are relatively less diverse, comprising eight families and 20 genera. These patchy fringing reefs, often exposed to low tides and impacted by anthropogenic and natural stressors such as sand mining, destructive fishing, eutrophication, sedimentation, and climate-induced bleaching, are particularly vulnerable. Of the 36 recorded hard coral

species, 28 are found in Mithapur. In 2008-09, with live coral cover at just 12%, Wildlife Trust of India (WTI) launched the Mithapur Coral Reef Recovery Project in collaboration with the Gujarat Forest Department, Tata Chemicals Ltd., and the local fishing community under a Public-Private-Partnership (PPP) model.

To date, 2,110 artificial reefs have been created at 5-9m depths, adding 5359.4 sq. m of settlement area for corals. Additionally, 57 coral nurseries, populated with 1,040 boulder corals (mainly *Favia* spp.), have demonstrated a survival rate of over 97%.

Demarcation of no-take zones for fishing (1,50,000 sq.m with community support has improved fish diversity from 55 species (2008-09 to 64 species (2016-17, leading to a nine-fold increase in fish stock. Noteworthy records include two black coral species (*Antipathareans*), two soft corals (*Gorgonia* & *Dendronephthya*, five seahorse species, and an uncommon starry puffer fish (*Arothron stellatus*).

After 17 years of conservation efforts, live coral cover increased to 18% (2023-24), with 90% of the reef showing resilience to minor bleaching. To further enhance reef recovery, advanced restoration techniques such as biorock technology and micro-fragmentation are now being implemented along Mithapur's coast.

Keywords

Coral restoration, Artificial Reef, Bio rock, No-take zones, and community participation

Power Point Presentation link:

[Link](#)

Restoration of corals and seagrasses along the Tamil Nadu coast, India

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Degradation of coral reefs and seagrass meadows has been severe globally due to several climatic and non-climatic issues, and the coast of Tamil Nadu is no exception. Hence, restoration of these critical habitats using regionally feasible technologies is paramount to sustain their ecological and economic benefits. Coral restoration through direct transplantation on artificial substrates has been a successful initiative carried out along the Tamil Nadu coast with support from various state, national and international agencies. Suganthi Devadason Marine Research Institute (SDMRI) pioneered this effort in the country and standardised the protocols. Since its introduction in the early 2000s, the restoration technique has been improved based on lessons learnt during the past two decades. Coral restoration in the Gulf of Mannar and Palk Bay using these standardised low-tech and low-cost protocols has yielded significant outcomes. Furthermore, deployment of specially engineered artificial reef structures by SDMRI has also helped in reef recovery by providing the much-needed substratum for juvenile corals. In 2008, SDMRI also perfected the protocols for restoring seagrass beds with a low-tech and low-cost method called manual transplantation of seagrass sprigs. Using this method, several acres of degraded seagrasses have been restored in the Gulf of Mannar and Palk Bay on the Tamil Nadu coast.

Keywords

Tamil Nadu, Gulf of Mannar, Palk Bay, Coral restoration, Seagrass restoration

Power Point Presentation link:

[Link](#)

Challenges and opportunities in the restoration of coastal coral habitats

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Coral reefs are highly productive biodiversity hotspots with immense ecological and economic value. However, they are declining at an alarming rate due to human-induced climate change. The increasing frequency of climate stress, exacerbated by anthropogenic pressures, is pushing the coral reefs towards extinction risk. Restoration of coral reefs is envisaged as an effective tool to mitigate the impacts of climate change by reintroducing the coral population from the distant healthy reefs to the degraded reefs. However, the success of restoration measures depends on various environmental factors that could limit the continued growth of corals in the restoration sites. The coastline of Maharashtra is predominantly rocky with distinct geomorphological features such as rocky terraces, sheltered embayment's and rocky mounds that are both submerged and elevated above the sea level. A baseline study was conducted along the Maharashtra coast to assess the feasibility of coral restoration to enhance the climate resilience of coastal communities. The study revealed that the distribution of coral communities is spatially restricted between 15°44'N and 17°01'N along the southern coast of Maharashtra. In contrast, a high level of suspended sediments in the northern part of the state limits the distribution of coral communities to the intertidal zones and tide pools. Live corals in the study sites were represented by 20 species of 15 genera, with live coral cover ranging from 0.2 to 22%. Besides corals, other macrobenthic invertebrates, including Zoanthids, Ascidiens, and Sponges, were highly prevalent across all sites, competing for space with corals alongside macro and turf algae. In most cases, these spatial competitors overgrow corals, leading to mortality and permanent loss. Their rapid growth rate and ability to outcompete corals pose a significant challenge for restoration efforts, potentially reducing their success. Site-specific proactive restoration strategies are essential to ensure the long-term survival of coral colonies and enhance restoration success. The findings of this study emphasise the need for collective restoration activities that are aimed at reducing the environmental stressors, restoring the ecosystem function and promoting coral recovery, which can be further supported through targeted restoration efforts.

Keywords:

Corals, Maharashtra, Restoration, Climate change, spatial competitors

Power Point Presentation link:

Link

Coral Identification, Artificial Reefs, and Coral Transplantation at Grande Island, Goa

Jeremy Josh and Venkatesh Charloo

Coastal Impact, Goa

Coastal Impact is a small but dedicated team working at the intersection of awareness, research, and conservation. Founded in 2009, the organisation has been conducting educational programs, cleanups, and reef restoration efforts. In collaboration with the Habitats Trust (THT), Coastal Impact initiated a coral micro-fragmentation project at Grand Island, Goa, where corals grow in a unique, high-sedimentation, urban marine environment. Using ceramic tiles and metal frames, the team successfully cultivated over 500 coral fragments, observing significant growth in genera like *Turbinaria* and *Cyphastrea*.

Building on this success, the HPCL-sponsored artificial reef project introduced three-dimensional structures to enhance marine biodiversity. These structures attracted a variety of fish, invertebrates, and even egg-laying species, demonstrating their ecological value. Additionally, the team transitioned from manual growth measurement to photographic analysis, improving efficiency and accuracy.

Coastal Impact also conducts benthic surveys and is developing automated analysis tools to support marine researchers. Goa's corals demonstrate remarkable resilience in challenging conditions, offering insights into climate adaptation. By studying these species, we aim to contribute to broader coral conservation strategies. This presentation highlights our key findings, emphasising the importance of protecting and understanding India's unique coral ecosystems.

Keywords:

Coral nursery, coral growth, micro fragmentation, artificial reefs, coral restoration

Power Point Presentation link:

[Link](#)

Coral Reef Restoration and Translocation Efforts of the Zoological Survey of India and Future Prospects of Restoration

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Earth's ecosystems are in peril, degrading fast primarily due to Global warming, prompting the United Nations to call for the UN Decade of Ocean Science for Sustainable Development and Ecosystem Restoration (2021-31). Coral reefs, often referred to as 'paradise underwater', harbour diverse biodiversity and are highly productive in the coastal zones, however, they are more severely threatened than any other ecosystem. India, which ranks tenth in the world for its extensive reef area, is a victim of both anthropogenic activities and natural habitats. Coral reefs, which have existed on Earth for more than 250 million years, are now at risk of vanishing in another 25 years.

The Zoological Survey of India, a century-old organisation with the largest scientific diving team, pioneered the restoration of coral reefs and the translocation of corals with its world-class efforts in the Gulf of Kutch. They boast the first world-record effort of reinstating extirpated branching corals using established methods in an area of 1050 sq. m with a survival rate of more than 75 percent after 10,000 years of their disappearance from the study. With the foresight to sustain the successful efforts, the Gujarat Forest Department, supported by funding, implemented the second successful effort using Biorock, an innovative restoration technology which can grow corals 6 to 20 times faster than normal. Two biorocks were installed and are being maintained. The two successful efforts led to the acceptance and execution of the ongoing

largest translocation effort in India involving more than 16,522 corals with the invitation of Indian Oil Corporation Limited at Narara, Gujarat.

Keywords:

Ecosystem degradation, Restoration and Translocation, Restoration of Extirpated species and Birock

Power Point Presentation link:

[Link](#)

Assessing the recovery potential of seagrasses following overgrazing by green sea turtles in the Lakshadweep archipelago

Al Badush Gafoor, Rohan Arthur, Mayuresh Gangal, Erika D'Souza, & Teresa Alcoverro

Nature Conservation Foundation

Sequential overgrazing by large aggregations of green sea turtles was recorded in the western lagoons of several islands of the Lakshadweep archipelago between 2005 and 2020. At each lagoon, within 2-6 years of turtle persistence, drastic reduction in biomass, shifts in seagrass composition, loss of function and eventually bare sand were observed. By 2019, all large meadows had declined, and in 2020, green turtles were distributed at low densities in every meadow. These were limited to small patches of early successional species, maintained in a state of protracted recovery by constant, low-level herbivory. In 2021, we set up seagrass exclosures in a few seagrass meadows to understand the process of recovery. Within a year, the seagrass cover had recovered to 100 % within the exclosures. The resultant structure supported a diverse fish community. Over the years, seagrass species succession was observed with shifts from *Halophila*-dominated to *Cymodocea*-dominated areas, all of which still represent a fast-growing early successional seagrass community. These exclosures have demonstrated proof of concept for the recovery trajectory in the absence of turtle herbivory. While these exclosures may help restore some of the functions of seagrass ecosystems in the lagoons, the effectiveness lies in the scale at which this needs to be done, which for heavily used lagoons such as those in the Lakshadweep. However, these exclosures

serve as a refugia for recovery, supporting both vegetative propagation and seeds for recovery in the event that herbivory pressures reduce.

Keywords:

Green sea turtles, overgrazing, succession, assisted recovery

Power Point Presentation link:

[Link](#)

Re(ef)Generate: Coral Restoration in Chidiyatapu, South Andaman Island

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ReefWatch Marine Conservation

The Andaman & Nicobar Islands have some of the most extensive and biodiverse reefs in India, but like coral reefs across the world, they have been impacted by severe stressors in the form of heightened temperatures and El Nino events, increased tourism and degradation of water quality. This has led to significant declines in live coral cover.

In 2018, ReefWatch Marine Conservation, with funding from The Habitats Trust under the Lesser Known Habitats Grant, launched Re(ef)Generate, a project aimed at augmenting coral reef conservation in the Andaman Islands through artificial reefs and mineral accretion technology. In this project, we use only already broken coral fragments from natural reefs no further than 200m away. There is no coral species bias, as any broken fragments of hard, reef-building corals are used. These fragments are attached to submerged metal structures, and the mineral accretion is powered by floating solar panels.

The objectives of this project are to refine mineral accretion and artificial reef methodology to best suit the Andaman Islands' ground realities, assist with capacity building by publicising our learnings through manuals and workshops and to have an emergency response plan in case of large-scale coral destruction.

Keywords:

Coral, Coral Reef Restoration, Conservation, Artificial Reefs, Mineral Accretion Technology

Power Point Presentation link:

[Link](#)

Integrated Approaches to Restoration: Aquaculture and Mangroves

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Brackish water fish farming, or coastal aquaculture, is key to securing livelihoods for fishing families, under dwindling fishery resources and extreme climatic stress. India has about 46,000 coastal aquafarms covering an area of about 70000 ha. Nearly 94% of the farms are owned by small aquafarmers (less than 2.0 hectares). Coastal aquaculture faces setbacks due to monoculture, poor environmental management and increased input costs. Integrated Mangrove Fishery Farming System (IMFFS), wherein mangrove cultivation and fish culture are integrated, is a system that provides tangible solutions to make coastal aquaculture sustainable and also strengthen coastal communities' resilience to climate change.

The IMFFS is designed to allocate 60 to 70% of the area for fish culture, whereas 30-40% is for growing mangroves. The space for growing mangroves is created by providing additional earthen bunds or mounds. The IMFFS is environmentally friendly and energy-efficient. IMFFS is designed to be tidal-fed, meaning that water moves in and out of the farm through gravitational force during high and low tides. No artificial feed or chemicals are used in IMFFS. The mangrove leaves decomposing in the farm water provide enough organic food for shrimp, fish and crabs. These reduce input costs and prevent negative environmental impact, resulting in economic and ecological sustainability. In addition, the farm protects the inland environment from rising sea levels and increasing frequency and intensity of cyclones. The IMFFS has the potential to

rehabilitate abandoned shrimp and pokkali farms. The GTZ, UNEP, UNFCCC, and NABARD consider IMMFS a Blue Solution to increase coastal communities' resilience in the climate change era.

Keywords:

Coastal aquaculture, mangroves, resilience, Blue solution

Power Point Presentation link:

[Link](#)

Community engagement for Mangrove management: A rhetoric, will it be a reality?

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Community participation and engagement are often treated as one of the 'tick-box' items in the checklist of Conservation and Management of Natural Resource Management programmes. In seminars, workshops, and meetings, 'community engagement' is discussed as an add-on topic and approach, and included in the plan. An interdisciplinary approach is vital to understand and internalise the concepts and methods of social science disciplines like Anthropology and Sociology, particularly in relation to community structures and dynamics— similar to learning about the concepts and methods of biological and physical sciences.

Concept/practice of 'participation' means sharing platforms, responsibility and empowering the community through devolving power with the community, but in most cases, participation is restricted at the manipulation level, which is the bottom rung of the participation ladder. The first step to achieve real participation and engagement of the communities is bringing about a change in the mindsets of the administrators, forest managers, academics, practitioners etc. They must begin to think/believe that communities have a stake, rooted in long-standing historical relationships, traditional rights, time-tested knowledge and sustainable practices. This shift in mindset is not simply about learning or unlearning but about 'deep learning'.

Keywords:

Engagement, Participation, Community, Learning

Power Point Presentation link:

[Link](#)

Harnessing blue carbon - a multi-stakeholder approach

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Blue carbon represents one of the nature-based solutions for wetland restoration and conservation, promoting a sustainable future for coastal and marine ecosystems. The Nature Conservancy (TNC) collaborates with multiple partners to advance the blue carbon economy using science, tools, and various projects. Despite India's extensive coastline and the presence of coastal marine ecosystems like mangroves, seagrasses, and salt marshes, the country's full potential to harness blue carbon remains in its infancy. It requires concerted efforts from all key stakeholders to promote nature-based climate solutions. Nature Conservancy India Solutions (NCIS) employs a multi-stakeholder approach to work with the Government, research institutions, corporates, non-government organisations, etc, for "mangrove restoration and blue carbon opportunities in India." This approach involves creating enabling conditions for blue carbon projects, exploring various financial mechanisms and risk models, facilitating discussions to address key barriers, and ensuring the sustainability of India's blue carbon economy.

Keywords:

Blue carbon, below ground biomass, Triple-Benefit Investment and Sustainability

Power Point Presentation link:

[Link](#)

Blue Carbon Finance Mechanism: Unlocking Capital for Coastal Conservation and Restoration

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Coastal ecosystems, particularly mangroves, play a crucial role in carbon sequestration, biodiversity conservation, and climate resilience. However, restoring and protecting these ecosystems requires substantial financial investment and long-term commitment. The Blue Carbon Finance Mechanism aims to bridge this gap by connecting businesses with high-quality, nature-based solutions that generate verified carbon credits while delivering social and environmental co-benefits. This presentation explores the challenges of financing mangrove restoration, such as high costs, land ownership complexities, and the need for effective monitoring. It outlines how voluntary carbon markets (VCMs) can provide upfront financing through forward sales of credits and structured project validation and certification processes. Additionally, successful case studies from India, Pakistan, Colombia, Kenya, and Myanmar highlight the effectiveness of community-led conservation efforts. By fostering partnerships that go beyond financial transactions toward community ownership, this mechanism ensures equitable benefit-sharing and sustainable impact. The future of blue carbon finance will see an increased emphasis on biodiversity, resilience-building, and fair carbon offset mechanisms.

Keywords:

Blue Carbon, Carbon Finance, Mangrove Restoration, Voluntary Carbon Market, Coastal Conservation, Climate Resilience

Power Point Presentation link:

[Link](#)

Indian Ocean Coastal Regeneration Initiative

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India's mangrove cover, spanning nearly 5,000 sq.km is facing rapid degradation due to deforestation, habitat loss, water and soil pollution, rapid urbanisation, industrial growth, and land reclamation projects. Rising temperatures, variability in rainfall, and extreme weather events contribute to lower groundwater levels, water shortages, coastal flooding, and decreased agricultural land and productivity. Meanwhile, fishing, aquaculture, coastal agriculture, and tourism are becoming increasingly vulnerable due to environmental degradation, which impacts the local coastal communities relying on coastal ecosystems, fisheries, aquaculture, and agriculture for their livelihoods. Coastal habitats also have the potential to provide alternative livelihood sources for local communities through mangrove restoration and sustainable livelihood activities. The Indian Ocean Coastal Regeneration initiative, led by the Aga Khan Rural Support Programme (India) and the Aga Khan Foundation, aims to restore and protect 500 hectares of mangrove habitat during the project's first phase (2024–2026). AKRSP(I) has identified several coastal districts in Gujarat and Maharashtra based on their vulnerability to climate change, the ecological regeneration potential of coastal ecosystems, community engagement strength, and local socioeconomic context. The project adopts a multi-stakeholder approach involving local communities, government agencies, research institutions, and private sector partners to ensure evidence-based implementation for environmental restoration and to address the socioeconomic vulnerabilities of coastal communities and build climate resilience. Key activities include mangrove reforestation, aquaculture-based livelihoods, rainwater harvesting and water management, regenerative agriculture practices, safe and nutritious food systems, clean energy solutions, and skill development and entrepreneurship. This initiative contributes to India's commitments under global climate frameworks, reinforcing the importance of nature-based solutions in addressing coastal degradation and climate change impacts.

Keywords:

Mangrove restoration, coastal regeneration, nature-based solutions, community-led conservation, sustainable livelihoods, and climate resilience



Coastal and Marine Habitat Restoration Symposium

Hotel Airlink Castle, Kochi, Kerala
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Emergency Relief Network Digest 2006 – 2007

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National Bear Conservation and Welfare Action Plan 2012

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This report highlights the key outcomes of a two-day symposium organised by the Wildlife Trust of India in February 2025, focusing on coastal and marine habitat restoration. Bringing together 69 participants from 35 organisations, the event showcased progress in mangrove, coral, and seagrass restoration and emphasised the importance of public-private partnerships, community engagement, and policy reforms. The symposium underscored multi-sector collaboration as essential to achieving India's restoration goals and provided strategic guidance for future coastal and marine habitat conservation initiatives.



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