2026

GLOBAL MANGROVE ALLIANCE



THE STATE OF THE WORLD'S MANGROVES

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The Global Mangrove Alliance
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1 Introduction



Community members Dulcie Egu and her father, Koivi Egu, who are participants in the Mangoro Market Meri program at KariKari nursery, Papua New Guinea. © Annette Ruzicka

1.1 Foreword

Dr David Obura Chair, Intergovernmental Platform on Biodiversity and Ecosystem Services and Director, CORDIO East Africa

Mangroves are one of those 'magic ecosystems' of deep wonder for their diversity, character and beauty. Flourishing where saltwater meets freshwater and the land, they provide shelter and food for countless species, from early life-stages to adults. For people, they protect coastal settlements, provide myriad resources, and as we now understand, are master-regulators of climate through carbon sequestration.

Sadly over-use, settlement and development have also undermined these precious ecosystems and for many decades, perhaps centuries, mangrove area has been declining. But for the first time, as this latest State of the World's Mangroves (SOWM) reports, a positive trend is emerging: the area of mangroves is now increasing globally.

This Fourth edition of the SOWM demonstrates just how important good quality, representative, spatially explicit and up-to-date data is, for understanding how nature is faring, and interpreting the findings for policy and action. It includes voices from over 190 contributors from 30 countries – including government sources, communities, NGOs and scientists – many of whom come from the rapidly growing consortium of the Global Mangrove Alliance (GMA). The emerging dataset provides unparalleled authority, not only for informing action, but for building accurate, actionable, and positive messages that can inspire people and investment.

The report clearly lays out the critical nuances that are essential for effective action. The growth in overall area of mangroves is due to rapid mangrove colonization in locations where previously there were none, masking losses in established mangroves elsewhere. Most of this expansion is occurring on new sediments, eroded from land and delivered by rivers – good for mangroves, but a worrying sign of impacts to other systems upstream. Apparent 'net gain' from these new mangroves is also not a sufficient replacement for ongoing loss of mature mangroves. It takes decades to grow or restore fully mature mangrove stands that replicate the many services that were lost. Substitution of new for old cannot be allowed to cover for loss.

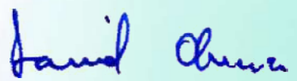
The report recommends pathways to actions that are locally and regionally nuanced and contextualized. A particular call-out in the report are the 15 "National Chapters" of the GMA, reflecting the broad umbrella of this alliance, bringing together NGOs and community groups with governments and scientists, each party empowering and strengthening the others.



Dr David Obura, Chair, Intergovernmental Platform on Biodiversity and Ecosystem Services and Director, CORDIO East Africa

The GMA has set 2030 targets to halt loss, restore half, and double protection of mangroves; far more ambitious than the global targets of the Global Biodiversity Framework (GBF). These are fitting targets, in fact, for an ecosystem of such "particular importance for biodiversity and ecosystem functions and services" (GBF words). But we must be careful to not just focus on telling big stories and demanding big targets. Conservation and restoration play out on the ground, or in the water. What is needed is for the information and support to to reach the people who can make a difference. Headlines are made by new efforts to plant the most mangroves in a single day, but most of these put the wrong mangroves in the wrong places. Seedlings die, or even strangle the former healthy ecosystems they were planted on top of! Conservation and restoration need to be locally owned, appropriate and followed through.

We still have a way to go, but, as this report shows so clearly, we can achieve incredible progress by working together.



1.2 Executive summary

In 2022 the Global Mangrove Alliance first promoted it's three broad goals for 2030 – to halt mangrove loss, restore half of recent loss, and double the extent of protection.

2026 represents the half-way point to this milestone year and there is much to consider. There are reasons for optimism and reasons for concern. The State of the World's Mangrove 2026 presents a powerful summation, with contributions from partners around the world alongside the very latest science from the world's leading experts. All told, **over 190 people have contributed to this report, from over 30 countries**.

THE STATE OF MANGROVES

A remarkable advance in mapping in 2026 has highlighted a dramatic turning point. Separately, two teams have generated annual maps of mangrove cover globally, while also pushing back the earliest of these maps over ten years. We now have estimates of mangrove cover from 1985 to 2025. Both studies reach the same broad conclusion – **mangrove cover is no longer in retreat, and is, in many areas, increasing**.

Such headlines hide details. Overall mangrove change, year-on-year is a combination of losses and gains. **Some 65% of mangrove gains are in new places where mangroves have not grown before**, often expanding onto areas of new sediments. Some of these sediments are, unfortunately, the product of inland deforestation and intense erosion. Nonetheless these gains, which are substantial in countries such as India and the Philippines, are important in boosting mangrove cover. Elsewhere in Southeast Asia and in East Africa gains so far make little impact on the vast losses that have preceded them.

Improvements in technology have helped enhance our mangrove maps, and such improvements, including geospatial AI, are likely to accelerate in the near future, supporting finer-scale and locally-driven mapping. Improved technology has also assisted the release of a **new and better map of mangrove canopy heights, with a six-fold improvement in resolution**. The new maps once again highlight remarkable forests such as those of Colombia and Gabon with nearly 60m canopies.

As our knowledge of mangroves improves, the importance of understanding the interactions and inter-dependencies between mangroves and adjacent ecosystems such as seagrass, saltmarsh and coral reefs is also highlighted. **Future efforts to restore and manage mangroves should consider the importance of taking a wider seascape approach** rather than targeting mangroves as a single ecosystem.

> Some 65% of mangrove gains **are in new places where mangroves have not grown before**, often expanding onto areas of new sediments

THREATS TO MANGROVES

Mangrove losses are continuing, averaging almost 500km^2 per year since the mid-1980s. **Where losses are original mangrove cover, the new forests that are developing cannot be seen as a simple replacement** – they lack the diversity and many of the ecosystem benefits provided by older forests. Promising new work is also helping to quantify and map mangrove degradation, although this is not yet being fully factored into global scale models and targets.

The threat of plastic pollution in mangroves is addressed for the first time in our reports. A new review highlights **average plastic concentrations of 24 items of macroplastics per m^{-2} in mangrove forests**, with concentrations of 3000 microplastic items per kg of sediments.

Sea level rise is another wide cause for concern. Current work suggests that many **mangroves may keep up with 5mm per year of relative sea level rise, while 7mm may overwhelm many areas**. In turn this depends on whether we are able to keep global temperature rises to 2 degrees Celsius or lower.

HALFWAY TO 2030

At the halfway point to 2030, we revisit the three main goals of the GMA and, drawing on a forthcoming paper, explore what these goals might look like on the ground.

Halting loss has always focused on direct, human-induced loss. It is different from halting "net loss". This nuance is important given the newly reported gains. **We still must halt any losses of original mangrove cover** – newly established mangroves cannot be seen as replacements.

Doubling protection, requires deeper consideration. The sharpened goal calls for doubling where appropriate, but adds a minimum target of 30% protection, and a challenge to reach 90% protection where current protection is already above 45%. Attention is also drawn to other forms of protection, noting that in many countries, regulations at the national level often offer at least partial protection to all mangroves.

Restoring half of recently lost mangroves remains a clear target, although tracking progress is likely to remain a considerable challenge. Restoration takes time. Quick-fix mass plantings are rarely the solution. The report highlights restoration stories from around the world, from Brazil to Indonesia, Qatar to Tanzania.

Successful outcomes for all of the goals must be tracked. The headline targets are not enough. **Efforts must be effective and equitable, community engagement is a critical component**. This report provides case studies highlighting the designation of new protection and community led restoration efforts from Ghana, Brazil, Mexico, Qatar, Tanzania, and The Philippines.

Certain countries are "too big to ignore". **Indonesia, Brazil, Mexico and Nigeria are critical if we are to achieve any of these goals**. At the same time, it is critical to see the value in nations of all sizes, and, in prioritizing actions, to ensure we are maximizing benefits, to biodiversity and to people.



Sunrise over the mangroves in Gumbanan, Australia. © Lewis Burnett / Ocean Image Bank

BENEFITS OF MANGROVES

More consideration is needed on the origins, stability and fate of blue carbon in and around mangroves. While policy instruments often look at averaged carbon stock values, **carbon concentrations, as well as rates of loss are highly variable spatially and through time** and need to be given more attention. Likewise, the origins of carbon in the mangroves, and the fate of carbon leaving mangroves needs more research attention.

The imminent release of a new study provides the basis for re-considering the role of mangroves in flood reduction. Coastal wetlands reduce overall flood extents by 5% - a smaller number than previous studies, but nonetheless **reducing impacts for almost half a million people and some $2 billion in damages every year**. This study only considers tide and storm impacts, however a side-study confirms that wind-driven waves only make a very limited addition to flooding in mangrove areas.

The role of mangroves in enhancing resilience for coastal communities is the subject of a new resilience credit tool. Like existing carbon credits, these financing mechanisms will greatly benefit from ongoing research to reduce uncertainty, incrementally enhancing our ability to more reliably build mangroves into policy and action around natural climate solutions.

THE WAY AHEAD

For mangrove ecosystems, global interests are increasingly moving "from ambition to action". Under the UNFCCC, **15 countries have referenced mangroves in their Nationally Determined Contributions**, with some, such as Kenya, Panama and Jamaica making large commitments for protection and restoration. Further commitments are seen through National Biodiversity Strategies and Action Plans (NBSAPs) under the Convention on Biological Diversity, and under the prioritization of the Ramsar Convention on Wetlands.

There are growing numbers of financial tools and approaches supporting conservation and restoration initiatives. **Seven broad categories of financial instruments are presented, each of which are already being used in mangrove settings**. These range from insurance-centred risk-transfer agreements to debt restructuring, to market-based tools such as credits and the restructuring of tax and public financing mechanisms. All have considerable potential for wider adoption.

Many tools are helping to support decision-making and the wider monitoring and evaluation of progress in mangrove restoration and conservation. At the international level these include Global Mangrove Watch, the Mangrove Restoration Tracker Tool, and the High-Quality Blue Carbon Practitioner's Guide.

The Mangrove Breakthrough, launched by the UN High Level Climate Champions in 2022, has now been **endorsed by 29 countries, plus several states and cities**. It tracks the same goals as the GMA, but adds its own – to **mobilize US$4 billion by 2030** in order to reach these goals. This is not a case of fundraising, but of building the investment architecture, across multiple financial approaches, in collaboration with governments, financial institutions and the private sector to ensure that opportunities can be made to support mangrove conservation at all levels from international initiatives down to individual communities.

BUILDING PARTNERSHIPS

Among the most significant developments within the GMA has been the advance of its National Chapters. Fifteen of these, from around the world, are highlighted. Each Chapter is unique, but all represent collaborations between partners, ranging from just a few members in Indonesia and the Bahamas to 68 in Mexico, **typically led by civil society partners, but often including government, industry and academic institutions**. The Northeast Brazil Chapter was only established in 2026, but has 40 members, including fishing communities and educational organizations.

The work of the Chapters is also highly varied, but **they each have the opportunity to connect the big vision of the GMA to local settings**, to know, more deeply, how the challenges of mangrove conservation can be met within local contexts. For example, the Belize Mangrove Alliance updated a national land tenure analysis and found that most mangroves are located on private lands, and so it has pivoted attention towards engagement with private landowners. **Connection to the governments is a critical element**. In the case of both Senegal and Guinea Bissau, GMA Chapters operate under the supervision of the respective environment Ministry (although maintaining clear and independent multi-partner membership). **Connection to local communities is also very strong**: the Malaysia Chapter's Jelak Bakau initiative is working with two local community and fisher groups, while it can also carry concerns over the challenges they face up to decision-makers in government.

Partnership, then, is one of the most important components. Where past efforts at mangrove conservation and restoration have been piecemeal, **the National Chapters work together in setting priorities and are generating opportunities for influence, investment and action far greater than could be achieved alone**. Some are also seeking to bring in new voices, exemplified by India's investment in the Youth Changemakers for Mangroves Initiative in the Sundarbans, and by many of the Chapters to work closely with the private sector.



Ecotourism is providing important alternative livelihoods in many mangroves world-wide. © Mark Spalding / TNC

1.3 Setting the scene

The Global Mangrove Alliance Steering Committee

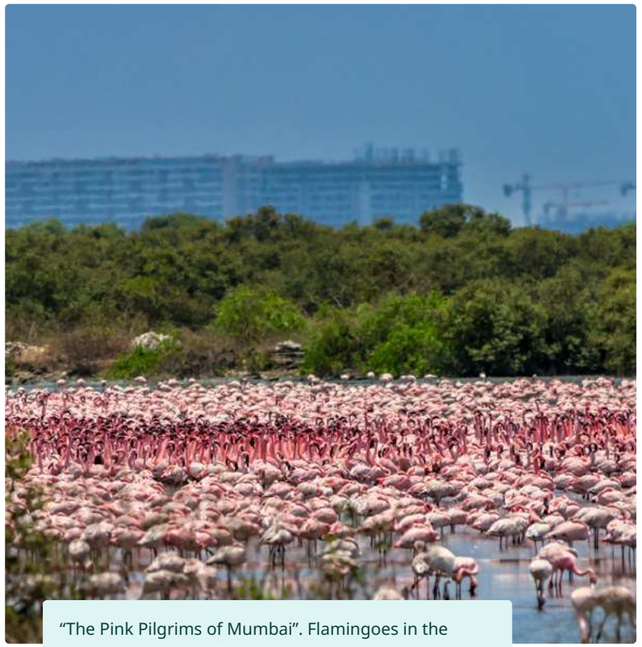
In 2017, representatives from the mangrove conservation community came together united by one challenge: mangroves are being lost at an incredibly rapid pace… what can we do to bring these unique ecosystems back from the brink?

The answer to that question was not simple. Mangroves had been gravely undervalued and received less attention from funders, policymakers, and the land-use sectors compared to, for example, rainforests and coral reefs. Conflicts around land tenure and resource rights and overlaps in jurisdictions make mangroves notoriously hard to govern, and in remote locations law enforcement struggled to act on illegal encroachments, pollution, and overexploitation. While the global mangrove community—including the local communities who steward, restore, and depend on these ecosystems—had achieved remarkable successes in conserving and restoring mangroves at the local level, it had not yet been able to develop a shared strategy and coordinate collective action at the scale needed.

> We have grown the alliance from 5 to **over 100 members**

This is how the Global Mangrove Alliance was born. We were united by the belief that these compounding barriers to effective conservation can only be addressed if we bring together complementary skillsets and knowledge across diverse organizations. We aligned our missions to build a powerful collective vision and accelerate a comprehensive, coordinated, global approach to mangrove conservation and restoration at a scale that matters.

With generous contributions from members and funding from equally generous donors, we have grown the alliance from 5 to over 100 members and built a collaborative structure that involves global working groups aligning science and developing knowledge, strengthening capacities, informing policies and enhanced governance, as well as coordinating communication and outreach. After our success uniting so many members on a global scale, our mission grew to address more specific regional, national, and local needs and contexts. Over the last few years, the GMA formed National Chapters that bring together GMA members in a country, as well as other local groups involved or interested in supporting mangrove conservation and restoration. Today there are 15 active chapters with another 2 in development. Each chapter is tasked with developing a joint vision and a coordinated action plan that the chapter members commit to co-execute to drive action on the ground together.



"The Pink Pilgrims of Mumbai". Flamingoes in the urban mangroves of Mumbai. © Vidyasagar Hariharan / Ocean Image Bank / Mangrove Photography Awards

We have also brought dozens of government and private sector partners into the mix by co-founding the Mangrove Breakthrough, a large global commitment to mobilize $4 Billion of investment into mangroves through mangrove positive businesses, financial mechanisms, and government commitments.

Looking back, we are proud of what we've achieved: the Global Mangrove Watch (GMW) platform and the previous State of the World's Mangroves reports have boosted global attention for mangroves. Near-real time information through the mangrove disturbance alerts enables fast action to mitigate illegal and unsustainable activities. While the Mangrove Restoration Tracker Tool (MRTT) allows restoration practitioners to track their work, and the GMA's overall restoration impact. Alliance members have supported dozens of countries in integrating mangroves into their climate, biodiversity, and sustainable development plans in line with the global targets and commitments. The Chapters supported the development or implementation of national mangrove strategies. We mapped priorities for mangrove action in different regions and developed a project pipeline for future investment, including a series of large-scale multi-partner country propositions. Through the Mangrove Breakthrough, we are working with the private sector, financial institutions, and governments ready to scale solutions. And our members have created a network of local mangrove Champions providing peer-to-peer learning and support within their community and national environment.



Pere women use poles to manage a boat full of firewood gathered from the mangroves, on Manus Island, Papua New Guinea. © Justine E. Hausheer / TNC

But our work is not done. Thanks to recent mangrove gains, spatial data would seem to imply that net mangrove loss has been halted, and increased commitments by government and private sector partners seem promising. However, the ecosystem services that disappear from ongoing losses of older mangrove forests in places like Mozambique and Myanmar cannot be offset by new gains. And indeed, some of these gains come at the expense of terrestrial forests being destroyed and the resulting sediment accumulation making ideal new ground that mangroves colonize (see section 2.2). It's a nuance most groups and news outlets fail to recognize. While restoration efforts are on the rise, many projects follow outdated single-species mass planting approaches that often fail

and cause devastating impacts to critical saltmarsh and mudflat habitats. Coastal development land use planning continues to undervalue the ecosystem services provided by mangroves. At a time when the triple planetary crisis of pollution, biodiversity loss and climate change all affect mangroves, we need to unite and accelerate action more than ever to halt loss, increase protection and restore in areas where it makes sense.

The Global Mangrove Alliance stands ready to join funders, government and private sector counterparts to ensure we do the right things at the right scales to achieve our targets. This fourth State of the World's Mangroves report provides a detailed account of why mangroves are important, summarizes how they are faring and most importantly provides a snapshot of our collaborative work. A rich pallet of case studies and photo stories introduce the Alliance's complementary skills and experiences and illustrates our progress towards our global goals.

We thank all local mangrove community guardians, our members, Chapters, partners and donors to date who have enabled the progress shared in this report and we hope it inspires other readers to become mangrove advocates and to join our movement to drive change and develop more resilient coasts where mangroves and communities thrive. **Together we can!**



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Latin America and the Caribbean
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Pieter van Eijk
Programme Head,
Coasts and Deltas
(Wetlands International)

Strengthening Global Collaboration

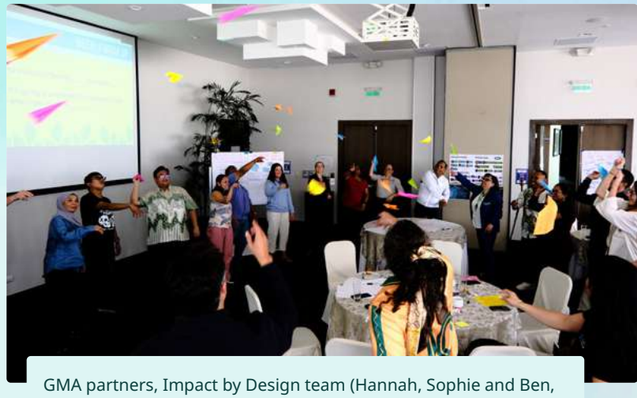
Benjamin Christ, Sophie Nazeri,
and **Hannah Pickard** (Impact by Design)

As a global partnership of more than 100 organizations, achieving the ambitious goals of the Global Mangrove Alliance requires more than scientific expertise and financial investment: it demands effective, expert coordination across a diverse and growing network of invaluable partners.

Impact by Design's (IbD) relationship with the GMA began in 2019, when we facilitated the Alliance's first strategic planning workshop. Through this and other convenings, we developed trusted relationships with the Alliance and gained a deep understanding of the opportunities and challenges inherent in managing a global partnership. In 2022, we assumed the role of the Alliance's neutral program management partner, providing the dedicated coordination capacity needed to help translate strategy into collective action.

Today, IbD continues to serve as the connective tissue of the Alliance. We support governance, facilitate leadership and working group convenings, coordinate strategic planning, strengthen communication and knowledge sharing, manage information systems, and help align activities across working groups, National Chapters, and member organizations. By remaining an impartial program manager, we facilitate the conditions necessary for productive collaboration, shared accountability, and informed decision-making.





GMA partners, Impact by Design team (Hannah, Sophie and Ben, upper image), have led and facilitated meetings around the world. © Benjamin Christ, IbD (upper), Dominic Wodehouse, MAP (lower)

While the Alliance's conservation achievements are driven by the expertise and commitment of its members, our role is to ensure those contributions are strategically connected, mutually reinforcing, and focused on shared outcomes. As the Alliance continues to grow, dedicated backbone management has become an essential ingredient for sustaining momentum and accelerating progress toward our shared global mangrove conservation goals.

2 The state of mangroves

2.1 Mangrove extent in 2025

Pete Bunting (Aberystwyth University),
Lammert Hilarides (Wetlands International), and
Ake Rosenqvist (solo Earth Observation)

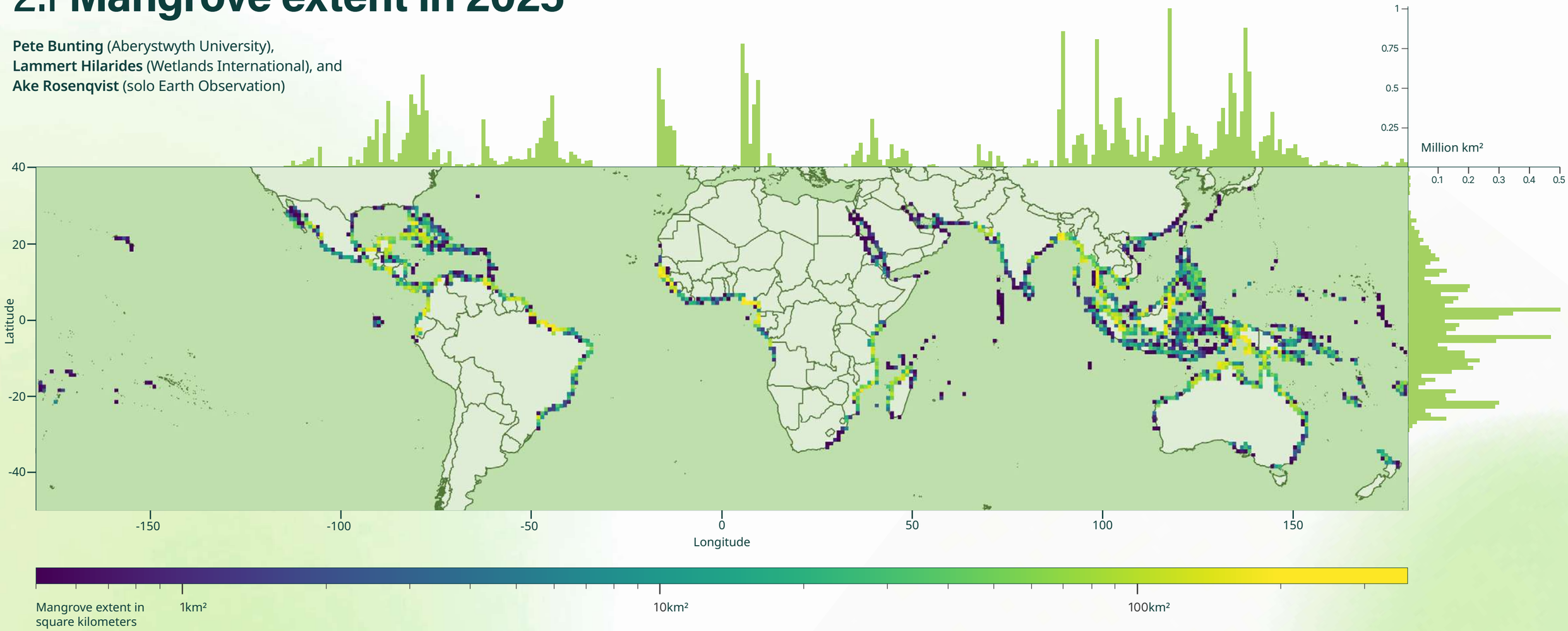


Figure 1. The distribution of mangroves in 2025. The map shows total extent (km²) in 1 degree grid cells world-wide. The bar charts show the total extent in each one-degree strip of latitude (y-axis) and longitude (x-axis).

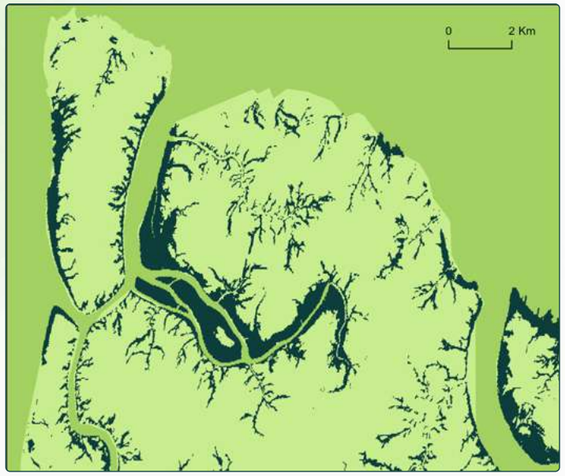


Figure 2. Fine details of coastal and estuarine mangroves in the Joseph Bonaparte Gulf, in northern Australia.

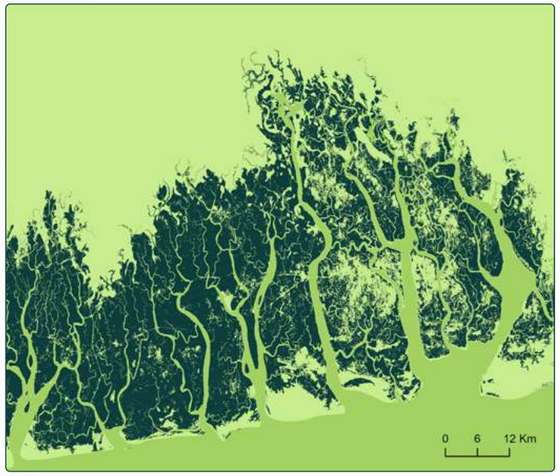


Figure 3. Mangroves in Rivers State, Nigeria. The more open coverage in the eastern half is linked to compounded oil spills over many years[3].

In 2026, two new global maps of mangroves were released[1,2] documenting mangrove extent and change through time (**Section 2.2**). Both maps have incorporated considerable advances by including the full Landsat time series and have enabled an extension in our understanding of historic cover. The maps are largely similar, but in this first section we focus on the Global Mangrove Watch data for 2025, as this is the most recent layer that can be explored online **www.globalmangrovewatch.org**.

With the release of the new Global Mangrove Watch (GMW) dataset (v4.1.12)[2], the main focus was on the enhancement and improvements to the time series providing annual mangrove extent from 1985 to the present.

In 2025, mangroves accounted for approximately **1% of tropical forest area** and **3.6% of tropical wetland area**

1 Bunting, P., Hilarides, L., Rosenqvist, A., Oakes, G., Castro Brandão Vaz dos Santos, P., Worthington, T. *et al.* Global Mangrove Watch: Timeseries of Mangrove Extent (Version 4.1.12) [Dataset]. *Zenodo*, (2026).

2 Zhang, Z., Murray, N. J., Song, X.-P., Bunting, P., Worthington, T. A., Fatoyinbo, L. *et al.* Unexpected expansion and regrowth in Earth's mangrove forests over the past four decades. *Science* **392**, 1082-1087, (2026).

3 O'Farrell, J., O'Fionnagáin, D., Babatunde, A. O., Geever, M., Codyre, P., Murphy, P. C. et al. *Quantifying the Impact of Crude Oil Spills on the Mangrove Ecosystem in the Niger Delta Using AI and Earth Observation*. Remote Sensing 17, 358, (2025).



Mangrove forests grow along creek lines on the tidal flats of Kakadu National Park, Australia. © Stuart Chape / Ocean Image Bank / Mangrove Photography Awards

The most recent map is from 2025 (Figure 1) and estimates a mangrove extent of 147,289 km^2 (Table 1), aligning with previous GMW estimates; estimated at 147,256 km^2 for 2020 (GMW v4.0.19). In 2025, mangroves accounted for approximately 1% of tropical forest area and 3.6% of tropical wetland area.

Within the new map, the global range limits (38°54'24.35"S Australia and 34°38'06.50"N Japan) are the same as the previous GMW map. However, at the local level, the extent of mangroves has been increasing at their range limits[4]. For example, in Florida[5], mangroves were mapped a further 2 km along the Gulf coastline compared to the previous 2020 mapping, while expansion is also observed in locations in the northern Persian Gulf.

The focus of the GMW v4.1.12 product was to create a consistent time series of mangrove extent maps from the mid-1980's to present. To achieve this, the spatial resolution needed to be consistent through the time series. As the Landsat archive was used throughout, alongside the JAXA L-band radar archive, the GMW v4.1.12 product has a spatial resolution of 30 m. The previous GMW v4.0.19 layer had a resolution of 10 m but has only been produced for 2020. Future developments are expected to develop a 10 m resolution timeseries from 2020 using Copernicus Sentinel-2 imagery, but further consideration is needed to ensure consistency with the historical 30 m resolution timeseries.

4 Doughty, C. L., Cavanaugh, K. C., Chapman, S. & Fatoyinbo, L. Uncovering mangrove range limits using very high resolution satellite imagery to detect fine-scale mangrove and saltmarsh habitats in dynamic coastal ecotones. *Remote Sensing in Ecology and Conservation* **10**, 686-701, (2024).

5 Duff, P. M., Wellnman, E. H. & Braswell, A. E. Factors Driving Mangrove Range Expansion: FOR415/FR486, 12/2025. *EDIS* 2026, (2026).

Top 10 countries

There are 129 mangrove countries and territories. Over half of the world's mangroves are found in the top 6 countries (Table 1), and the top 27 countries contain 90% of the world's mangroves. This illustrates the uneven distribution of mangroves and critical role that just a few countries have to play in the global effort to conserve mangroves.

The many nations with small mangrove areas, some less than 1 km^2, remain critical, however. These include some that are home to mangrove patches at the local range limits (e.g., Kuwait) or are in geographically isolated areas (e.g., Chagos Archipelago), but perhaps more importantly, in almost all cases they host biodiversity, provide important seed sources, and generate ecosystem services of essential value to coastal communities.

> Mangroves host biodiversity, provide important seed sources, and generate ecosystem services of **essential value** to coastal communities

	Country	2025 (km^2)	Proportion of global	Cumulative Area (km^2)	Cumulative %
1	**Indonesia**	31,465.4	21.4%	31,465	21.4
2	**Brazil**	10,770.6	7.3%	42,236	28.7
3	**Australia**	10,691.0	7.3%	52,927	35.9
4	**Nigeria**	7,925.4	5.4%	60,852	41.3
5	**Mexico**	7,901.5	5.4%	68,754	46.7
6	**Malaysia**	5,597.3	3.8%	74,351	50.5
7	**Myanmar**	5,583.6	3.8%	79,935	54.3
8	**Papua New Guinea**	4,877.7	3.3%	84,813	57.6
9	**India**	4,670.7	3.2%	89,483	60.8
10	**Bangladesh**	4,281.0	2.9%	93,764	63.7

Table 1. Top 10 mangrove countries by extent in 2025 GMW v4.1.12 mapping.

Regional Extents



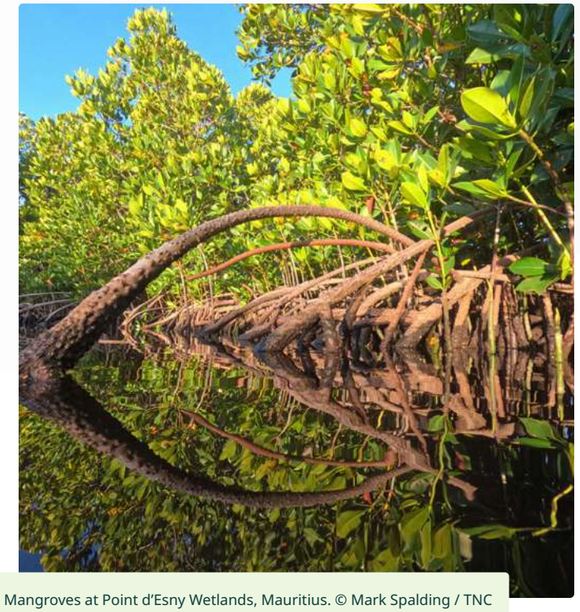
Bengal tiger in the Indian Sundarbans. © Santanu Majumdar / Ocean Image Bank

Asia

Southeast Asia has the largest area of mangroves with 50,396 km^2 (34.21% of the global total). This region's long coast, with extensive archipelagos, high ambient sea-surface temperatures, and extensive deltaic systems, provides optimal biophysical conditions for expansive, structurally complex mangrove ecosystems. When coupled with South Asia (9,917 km^2, 6.73%), which is dominated by macro-tidal systems, such as the Sundarbans delta, the broader Asian continent accounts for over 40% of the global mangrove area.

Africa

In total, Africa has almost 20% of the world's mangrove forests split between the west and east coastlines. These coastlines have different drivers of change and pressures. West & Central Africa holds 21,703 km^2 (14.74%), making it the second-largest region of mangroves. The distribution is highly concentrated within major riverine networks and active deltaic plains, such as the Niger Delta. Pressures in West Africa are primarily anthropogenic, with pollution in the Niger Delta causing extensive mangrove loss and degradation, while in countries further north, such as Guinea-Bissau, mangroves are being removed for agriculture. Eastern Africa contains 7,381 km^2 (5.01%), with distribution primarily confined to estuarine channels and deltas along the Western Indian Ocean rim.



Mangroves at Point d'Esny Wetlands, Mauritius. © Mark Spalding / TNC

Americas & Caribbean

The Americas and the Caribbean account for about 26% of the global mangrove total. North & Central America & Caribbean comprises 20,099 km^2 (13.65%), displaying wide structural variations from the extensive carbonate-fringe configurations of the Caribbean basin to the dense riverine and estuarine blocks of Central America and the Gulf of Mexico. South America has 19,645 km^2 (13.34%). There are significant mangrove stands along the northern equatorial Atlantic coast, where macrotidal mudflats support wide, continuous bands of high-stature mangrove forests, yet the system is highly dynamic, captured in our maps as regularly changing patterns of mangrove extent. There are also significant mangrove stands along Colombia's Pacific coastline, with some of the tallest mangroves in the world found there (Section 2.4).



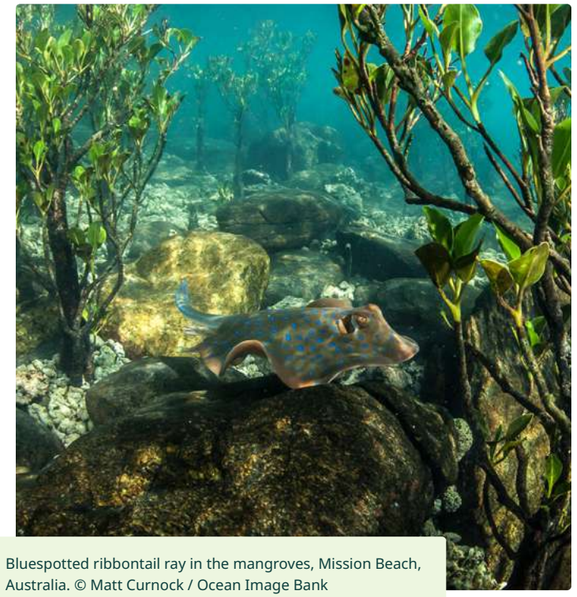
Lemon shark, the Bahamas. © Anita Kainrath / Ocean Image Bank / Mangrove Photography Awards



Mangroves and Modernity, United Arab Emirates. © Ahmed Badwan / Ocean Image Bank / Mangrove Photography Awards (Winner)

High-Latitude and Hyper-Arid Margins

The Middle East (385 km^2, 0.26%) and East Asia (268 km^2, 0.18%) regions represent two different extremes at the extreme latitudinal and physiological tolerances of mangroves. In the Middle East this includes hyperaridity, and high-salinity regimes, while in East Asia challenges arise from low winter thermal thresholds. In both regions mangrove occurrence is restricted to isolated, low-canopy structural configurations. However, these regions have both also witnessed significant gains in mangrove extent over the last 40 years.



Bluespotted ribbontail ray in the mangroves, Mission Beach, Australia. © Matt Curnock / Ocean Image Bank

Oceania, Australia and New Zealand

Ecosystems across Oceania, Australia & New Zealand display distinct distributional patterns shaped by varying geomorphological constraints. Australia & New Zealand combined have 10,987 km^2 (7.46%). This region encompasses a broad latitudinal gradient, transitioning from complex, species-rich tropical communities in northern Australia to low-stature, monospecific temperate populations *(Avicennia marina)* at its southern limits. The Pacific Islands account for 6,508 km^2 (4.42%) of global mangroves. These numbers are dominated by Papua New Guinea and particularly the very large stands in the Fly River Delta. Elsewhere, Pacific mangroves are characterized by fragmented patches localized within volcanic islands and low-lying coral atolls.

Country	2025 km^2	95th Lower Confidence Interval	95th Upper Confidence Interval
Pacific Islands	6,508	6,070	7,132
Australia & New Zealand	10,987	10,248	12,042
East Asia	268	250	294
Southeast Asia	50,396	47,004	55,234
South Asia	9,917	9,250	10,869
Middle East	385	359	422
Eastern Africa	7,381	6,884	8,089
West & Central Africa	21,703	20,243	23,787
North & Central America & Caribbean	20,099	18,746	22,028
South America	19,645	18,322	21,530
Total	**147,289**	**137,376**	**161,429**

Table 2. Mangrove Extent (GMW v4.1.12) for 2025.

2.2 Change and expansion in the world's mangroves

Daniel Friess and **Zhen Zhang** (Tulane University), and **Pete Bunting** (Aberystwyth University)

Bending the curve on mangrove loss

In the early 2000s mangroves were considered one of the world's most threatened ecosystems, with predictions that they could be functionally extinct by the end of the 21st Century. Estimates in the 1990s and early 2000s put global mangrove loss at more than 1% per year[6], though more recent remote sensing surveys mapping the last ~20 years of mangrove change have since shown that rates of mangrove loss were markedly lower, at 0.14[7]-0.17%[8] per year.

While this slowdown of mangrove loss was good news, the most recent comprehensive remote sensing surveys of mangrove change show an even better trajectory: rates of mangrove loss have reduced substantially from the 1980s to today, and we are now experiencing a net global gain of mangrove area. Zhang *et al.* 2026[8] showed a relatively small overall loss of 848 km^2 in net global mangrove area between 1984 and 2023 (an overall loss rate of ~0.01% per year), with global mangrove area shifting from a net loss to a net gain from 2010 onwards, as rates of mangrove deforestation continue to decline and areas of mangrove regeneration and expansion increase. Global Mangrove Watch 4.1 suggests an even more positive trend, showing a net gain of 477 km^2 between 1985 and 2025[9].

> Rates of mangrove loss have reduced substantially from the 1980s and we are now experiencing a net global gain of mangrove area

6 FAO. *The world's mangroves 1980-2005*. A thematic study prepared in the framework of the Global Forest Resources Assessment 2005. Report No. 153, (Forestry Department, *Food and Agriculture Organization of the United Nations* (FAO), Rome, 2007).

7 Hamilton, S. E. & Presotto, A. A Global Database to Monitor Annual Mangrove Forest Change, 2000-2020: GMC-21. *International Journal of Applied Geospatial Research* **15**, 361727 (2024).

8 Zhang, Z., Murray, N. J., Song, X.-P., Bunting, P., Worthington, T. A., Fatoyinbo, L. *et al.* Unexpected expansion and regrowth in Earth's mangrove forests over the past four decades. *Science* **392**, 1082-1087, (2026).

9 Bunting, P., Hilarides, L., Rosenqvist, A., Oakes, G., Castro Brandão Vaz dos Santos, P., Worthington, T. *et al.* Global Mangrove Watch: Timeseries of Mangrove Extent (Version 4.1.12) [Dataset]. *Zenodo*, (2026).

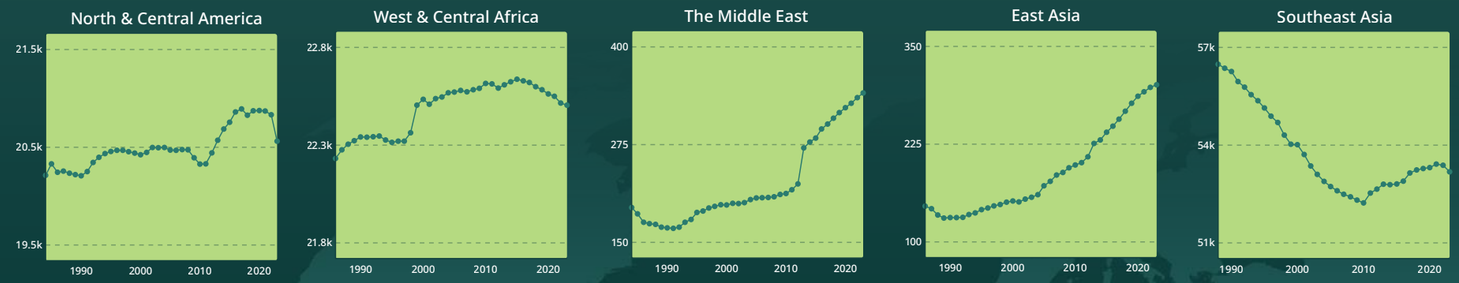


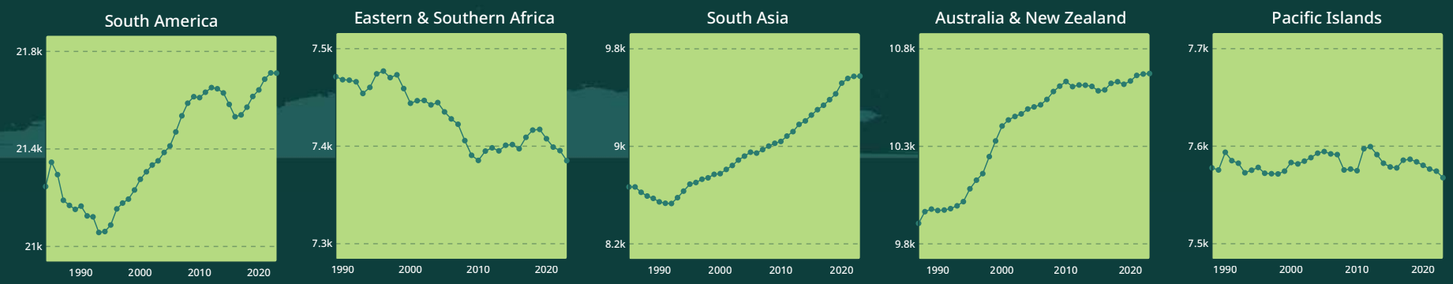
Figure 4. Losses and gains in mangrove cover from the mid-1980s to 2025. The map highlights overall percentage change into coastal hexagons (note that the overall mangrove extent in each hexagon is highly varied)[1]. The graphics track the change over time in km² across this 40-year period for ten regions around the world[2].

Patterns of Change

While net gains in mangrove coverage have rightly received considerable attention, overall trends show a mixed array of gains and losses (Figure 4, map). On a region-by-region basis the story of change over time is highly variable, with net gains in many regions, but with the extensive losses in Eastern and Southern Africa and in Southeast Asia highlighting the extensive impacts in those regions.

% Change 1985 - 2025

- 100% Loss
- 50 - 99% Loss
- 10 - 49% Loss
- 2 - 9% Loss
- .1 - 1.9% Loss
- Minimal Change
- .1 - 1.9% Gain
- 2-9% Gain
- 10 - 49% Gain
- 50 - 99% Gain
- ≥100% Gain





Mangroves are quick to colonize new ground, here in low-lying grassland behind mangrove areas in Ngezi Forest Reserve, Tanzania, possibly as a result of rising sea levels. © Mark Spalding / TNC

A positive trend in net global mangrove area hides a lot of complex and nuanced dynamics, and it's important to acknowledge that at local scales mangrove loss is still happening around the world, even if it appears to be balanced by mangrove gains elsewhere. Myanmar, Malaysia and Nigeria in particular continue to experience mangrove loss[9]. However, rates of deforestation have continued to reduce over time, and the state of the world's mangroves is now much more positive than that suggested by shorter-term remote sensing inventories. Our new understanding of mangrove dynamics is a reflection of improvements in long-term mapping technologies (**Section 2.3**), alongside natural regeneration and expansion of mangroves, and the successful implementation of conservation, restoration, and policy initiatives around the world.

> Myanmar, Malaysia, and Nigeria continue to **experience mangrove loss**

But it's not just the quantity of mangrove that counts, we need to consider habitat quality too. Using fractional canopy cover as a proxy for habitat quality, we've shown that rates of mangrove degradation are higher than rates of mangrove loss, but these rates of degradation have also shown a reduction since the 1980s[8]. From a global perspective, the state of the world's mangroves is looking better on balance than we assumed before.

8 Zhang, Z., Murray, N. J., Song, X.-P., Bunting, P., Worthington, T. A., Fatoyinbo, L. *et al.* Unexpected expansion and regrowth in Earth's mangrove forests over the past four decades. *Science* **392**, 1082-1087, (2026).

9 Bunting, P., Hilarides, L., Rosenqvist, A., Oakes, G., Castro Brandão Vaz dos Santos, P., Worthington, T. *et al.* Global Mangrove Watch: Timeseries of Mangrove Extent (Version 4.1.12) [Dataset]. *Zenodo*, (2026).

Areas of expansion

The recent net gain we've seen in global mangrove extent is in part because extensive areas of new mangroves are replacing continuing losses elsewhere. Between the early 1980s and 2023, there were 18,083-20,340 km^2 of new mangroves created globally, while losses of 18,932-19,863 km^2 were recorded[8,9]. Mangrove gains have been observed over much of the world's mangroves, with only Southeast Asia and Eastern and Southern Africa showing a consistent net loss of mangroves over the past 40 years. Several countries account for particularly large mangrove gains in recent decades, including Australia, India, and the Philippines.

> The state of the world's mangroves is **looking better** on balance than we assumed before

A number of reasons explain the mangrove gains observed around the world. Approximately 35% of new mangroves since 2010 have re-established in areas where mangroves were present before, either through human-assisted restoration or natural regeneration. This includes large parts of the Mahakam Delta in Indonesia (Figure 5), where over half of its mangroves were developed into aquaculture ponds[10], but many of these operations have since been abandoned, allowing mangroves to grow back.



Comparison of site conditions before the implementation of Ecological Mangrove Restoration (EMR) in 2023 (upper) and two years after restoration activities began (lower).

10 Aslan, A., Rahman, A. F., Robeson, S. M. & Ilman, M. Land-use dynamics associated with mangrove deforestation for aquaculture and the subsequent abandonment of ponds. *Science of The Total Environment* **791**, 148320, (2021).



Figure 5. Extensive mangrove regeneration in the Mahakam Delta, Indonesia.

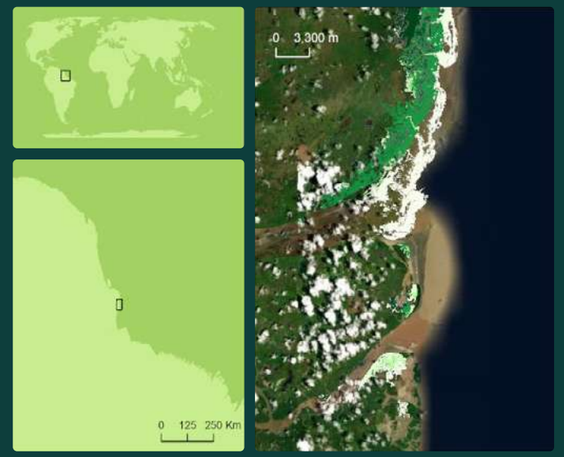


Figure 6. Araguari River, Brazil , showing mangrove progradation (north) and river bank/infilling (south)

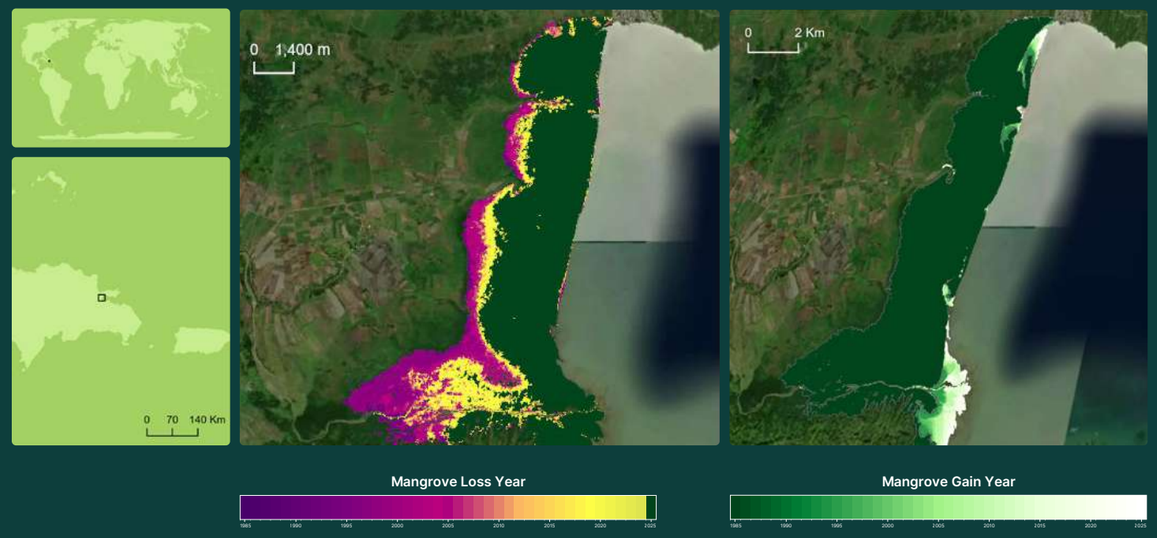


Figure 7. Since 1980 there have been progressive losses of mangrove cover on the landwards margins of Bahía de Samaná (above, left), Dominican Republic, but also considerable gains on the seaward margins (above, right).

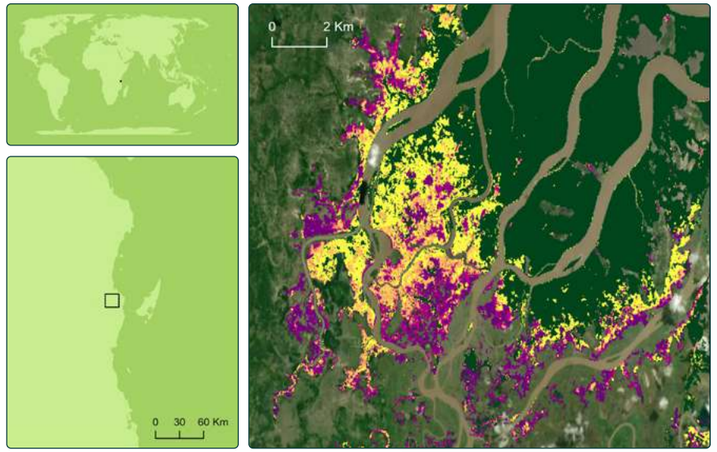


Figure 8. Steady year-on-year losses of mangroves on the landwards margins of the Rufiji Delta in Tanzania. (Legend on facing page.)

However, 65% of mangroves newly established since 2010 expanded into new areas. Mangroves commonly expand in sediment-rich coastal environments through a few different mechanisms. Mangroves can undergo seaward shoreline progradation when the surface elevation of mudflats fronting the mangrove becomes suitable for mangrove seedling colonization. This is seen extensively on the west coast of Peninsular Malaysia, such as Matang Mangrove Forest Preserve. Here, turbid waters deposit sediment onto the mudflat, which is later colonized by the mangrove pioneer species *Avicennia alba*.

In estuarine settings, large areas of expansion occur where new mudbanks form from deposited sediments in river mouths, that are then colonized by mangroves. This is seen in locations as diverse as the Thanlyin estuary in Myanmar and the mouth of the Araguari River in Brazil (Figure 6). The formation of mudbanks in many estuaries correlates with general global observations of an overall increase in suspended sediment concentrations in the coast over the last 20 years[11], particularly from terrestrial sources. But what is good news for mangroves may not be such good news for other terrestrial ecosystems in the watershed, as sediment delivery into rivers can be caused by terrestrial deforestation and mining activities, with eroded sediments washed downstream.

> **What is good news for mangroves** may not be such good news for other terrestrial ecosystems … as sediment delivery into rivers can be caused by terrestrial deforestation and mining activities

11 Hou, X., Xie, D., Feng, L., Shen, F. & Nienhuis, J. H. Sustained increase in suspended sediments near global river deltas over the past two decades. *Nature Communications* **15**, 3319, (2024).

Confirming Global Trends: Mangroves in the Mesoamerican Reef

Suvarna Punalekar, Steven W.J. Canty, and **Grant Connette** (Smithsonian Institution)

The Mesoamerican Reef (MAR) region in the Caribbean is home to critical coastal and marine ecosystems, including extensive mangrove forests. Spanning the coastlines of Mexico, Belize, Guatemala, and Honduras, MAR is one of the few tropical regions with active transboundary policy frameworks supporting conservation and restoration of these fragile ecosystems. Yet these efforts face mounting pressure from rapid socioeconomic development and climate-related stress.

To understand how mangroves have changed, we analyzed 25 years of Landsat satellite data, tracking shifts in both the extent and condition of mangroves across all four countries. The results are encouraging - despite escalating threats, mangroves across the MAR region show an overall positive trend, with recovery and expansion occurring along much of the coastline. Some local hotspots of loss persist, concentrated around urban centers, and areas where shifting hydrology has caused permanent damage. These regional findings align closely with global patterns, which similarly show a net increase in mangrove cover over the past two decades in many areas.

While this reflects the success of local, national, and global efforts to protect and restore mangroves, our analysis also revealed that nearly 25% of existing mangrove cover is experiencing some form of disturbance or degradation. In other words, while outright loss has slowed, deeper challenges remain to improve the health of these ecosystems and ensure they are resilient in the face of future change.

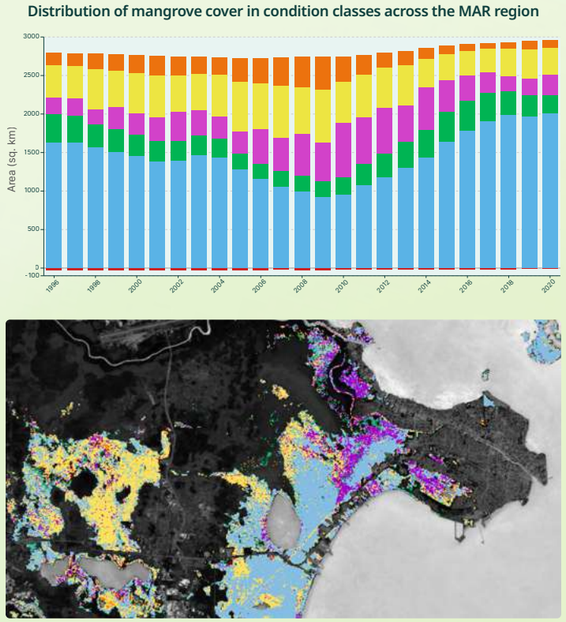


Figure 9. Changing patterns of mangrove cover and condition across the Mesoamerican reef region (upper graphic) and showing the detailed condition of mangroves around Belize City (below map).

Drivers of mangrove change

While mangroves are showing net gains globally, many are still being lost, and rates of loss can be high in certain landscapes. Human-driven land use change continues to be the leading cause of mangrove loss around the world, with commodity production (particularly aquaculture, oil palm and rice production) dominating in Southeast Asia. Indeed, export of commodities to Europe, North America and East Asia account for one fifth of global mangrove blue carbon losses in the 21st Century[12].



Vast areas of mangrove in Southeast Asia have been cleared for aquaculture, then abandoned when they become unproductive. © Mark Spalding

Environmental drivers such as shoreline erosion and extreme weather events accounted for 38% of global mangrove loss between 2000 and 2016, and the importance of these drivers is increasing through time[13]. These will become even more important for mangrove dynamics in the future, as climate change becomes increasingly felt along our shorelines. Mangroves are on the frontline of climate change impacts, particularly increased inundation from sea-level rise (see Section 3.1). On top of this, mangroves will face increased damage from more frequent and intense cyclones in parts of the world, higher rates of erosion as wave energy increases along many shorelines, and large areas of mangrove dieback become apparent as climatic oscillations such as the El Niño-Southern Oscillation become more variable and severe. Substantial management and policy attention is required so that today's positive mangrove trajectories remain this way in the future.

> Export of commodities to Europe, North America and East Asia account for **one fifth of global mangrove blue carbon losses** in the 21st Century

12 Ge, N., Xin, Y., Tian, P., Yu, Y., Zhang, Z., Zhong, H. & Feng, K. Mapping mangrove deforestation and blue carbon loss in global supply chains between 2000 and 2019. *One Earth* **8**, (2025).

13 Goldberg, L., Lagomasino, D., Thomas, N. & Fatoyinbo, T. Global declines in human-driven mangrove loss. *Global Change Biology* **26**, 5844–5855, (2020).

2.3 Long-term monitoring of mangrove extent and change

Zhen Zhang (Tulane University) and **Pete Bunting** (Aberystwyth University)

Existing global mangrove maps have provided an unprecedented understanding of the recent distribution and changes of mangroves.

However, most map products either begin in the mid-1990s or provide observations only at multi-year intervals. The earlier GMW maps did both, leaving major knowledge gaps in both the historical baseline and the temporal dynamics of global mangroves. As a result, our understanding of mangrove decline before the mid-1990s remained limited, despite evidence that extensive deforestation occurred with rapid expansion of aquaculture and coastal development in the 1980s and early 1990s[14]. Likewise, coarse temporal resolution makes it difficult to quantify annual trends, identify abrupt disturbances such as cyclones or extreme events, or separate long-term directional changes from interannual variability.

Recent advances in time-series remote sensing and cloud computing have made global monitoring using the complete Landsat archive feasible. Rather than relying on a small number of independent snapshots, these studies have begun to exploit the full Landsat record spanning 1984-2025 to reconstruct continuous histories of mangrove dynamics[15],[16]. This approach substantially improves the ability to identify the timing of mangrove loss and gain, while providing a consistent historical perspective over four decades.

One of the primary challenges of using the full Landsat archive is the highly uneven temporal availability of observations across space. Historical Landsat imagery varies considerably among regions due to cloud cover, acquisition frequency and the distribution of ground receiving stations during the Landsat 5 era. In regions with abundant observations, such as Australia or the Sundarbans, annual mapping can often be performed directly because at least one cloud-free image is available for almost every year after Landsat observations began. In contrast, persistently cloudy tropical regions such as the Niger Delta may lack usable imagery for many years, particularly during the 1980s and 1990s. Addressing these spatially heterogeneous data gaps has therefore become a central challenge for long-term global mangrove monitoring.

> Landsat is a practical solution for reconstructing a consistent historical baseline while **maximizing spatial coverage**

Recent studies have addressed this problem by treating change detection as the central step rather than directly classifying every annual image. Pixel-wise algorithms first identify the most likely year of land-cover transition using the complete temporal trajectory. Once the timing of change has been determined, image segments before and after the transition can be labelled as mangrove or non-mangrove depending on whether the change represents loss or gain. This strategy substantially reduces the dependence on complete annual observations.

Another practical consideration is that the earliest usable Landsat imagery differs among regions, making it difficult to define a single global baseline year. Rather than adopting a fixed starting date, a recent global study has generated an “1980s baseline” by compositing the earliest cloud-free Landsat observations available for each location[16]. The study indicates that the clear Landsat observations are available before 1990 for approximately 97% of global mangroves, which provides a practical solution for reconstructing a consistent historical baseline while maximizing spatial coverage.



Jordan Mitchell pilots a quad copter drone collecting environmental information over seagrass, reef and mangrove habitats in Haiti. © Tim Calver

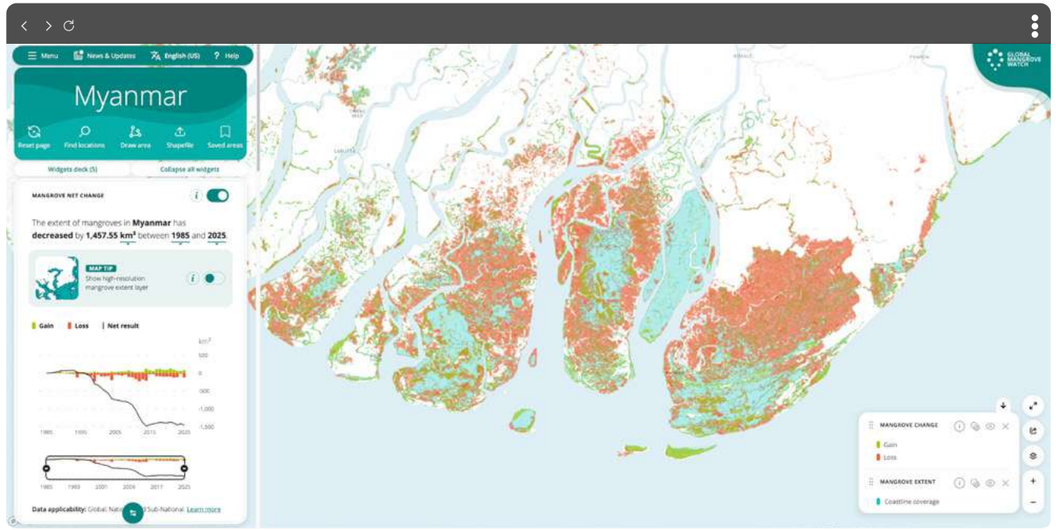


Figure 10. A screen shot of Global Mangrove Watch platform focused on the central Ayeyarawady Delta, Myanmar, an area of extensive mangrove losses over the last 30 years. The dashboard on the left shows the timeline of changing mangrove cover for all of Myanmar and users can adjust the view to focus in on change during different periods.

14 Friess, D. A., Rogers, K., Lovelock, C. E., Krauss, K. W., Hamilton, S. E., Lee, S. Y. *et al.* The State of the World’s Mangrove Forests: Past, Present, and Future. *Annual Review of Environment and Resources*, (2019).

15 Bunting, P., Hilarides, L., Rosenqvist, A., Oakes, G., Castro Brandão Vaz dos Santos, P., Worthington, T. *et al.* Global Mangrove Watch: Timeseries of Mangrove Extent (Version 4.1.12) [Dataset]. *Zenodo,* (2026).

16 Zhang, Z., Murray, N. J., Song, X.-P., Bunting, P., Worthington, T. A., Fatoyinbo, L. *et al.* Unexpected expansion and regrowth in Earth’s mangrove forests over the past four decades. *Science* **392**, 1082-1087, (2026).



The Sundarbans Biological Observatory Time Series

Anwesha Ghosh and **Punyasloke Bhadury** (Indian Institute of Science Education and Research- Kolkata)

The Sundarbans Biological Observatory Time Series (**SBOTS**) is a long-term monthly monitoring program established in 2010 to track environmental change in the Indian Sundarbans. Conducted across three fixed stations, SBOTS records hydrological parameters including temperature, pH, dissolved oxygen, water transparency, dissolved nutrients (nitrate, nitrite, ammonium, phosphate, and silicate), and biological communities. These continuous observations have revealed increasing nitrogen availability, shifts in phytoplankton and bacterioplankton communities, and ecosystem responses to cyclones, altered river discharge, and human activities. By capturing long-term variability rather than isolated snapshots, SBOTS provides critical insights into mangrove ecosystem health, biogeochemical cycling, resilience, and climate-driven change.

Photo: The team at IISER Kolkata drawing 1 m sediment cores using the SedX corer. © Anwesha Ghosh

Future directions for local mangrove mapping

The increasing availability of global mangrove products does not eliminate the need for local mapping. Global datasets are designed to achieve consistent performance across diverse environmental conditions and therefore inevitably sacrifice some local accuracy.

Over 8 years of mapping, the GMW global maps have increasingly improved such accuracy through the development of improved training and validation datasets along with extensive user feedback, enabling more local knowledge to be included in the mapping. Today, the GMW has a reference database of over 5 million reference points[17] for 2020 and over 30,000 validation points extending back to the mid-1980s.

Nonetheless, for many management applications, including restoration planning, ecological monitoring, and conservation assessments, locally optimized maps remain essential. Global products act as benchmarks that provide consistent reference information, while regional studies continue to refine local mapping using higher-quality imagery, local training data, and site-specific knowledge.

> Rapid developments in geospatial artificial intelligence (GeoAI) are likely to **transform local mangrove mapping** over the coming years

17 Bunting, P., Hilarides, L., & Rosenqvist, A. Global Mangrove Watch v4 Reference Samples (Version 20250113) [Dataset]. *Zenodo*, (2025).

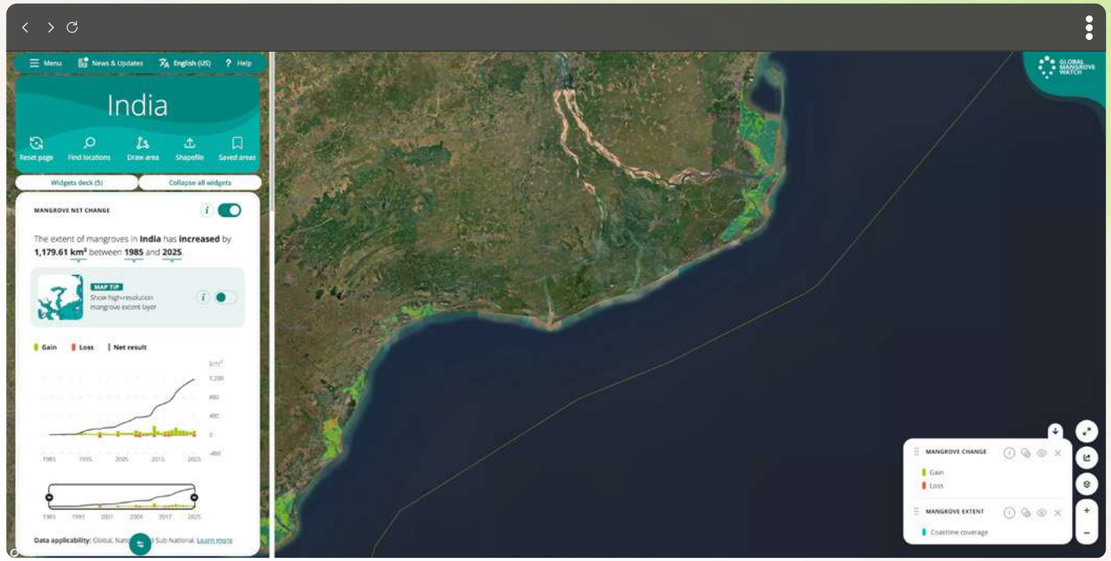


Figure 11. In contrast to Myanmar (previous page), India has shown steady gains in mangrove extent, year on year, as shown on the dashboard, and in the map, focused on the Godavari and Krishna Deltas (here a satellite background has been selected).

Rapid developments in geospatial artificial intelligence (GeoAI) are likely to transform local mangrove mapping over the coming years. Recently developed geospatial foundation models, including Tessera, OlmoEarth, and AlphaEarth Foundations, provide dense satellite "embeddings" that integrate large volumes of spatial, spectral and environmental information into high-dimensional feature representations, although the spatial resolution of such maps remains relatively low (10–30 m).

Future local mapping will also benefit from integrating higher-resolution and more specialised sensors. Commercial constellations such as PlanetScope provide near-daily imagery capable of resolving fine-scale (3 m) processes that remain beyond the reach of current global products, such as determining mangrove range limits[18]. At the same time, hyperspectral sensors offer new opportunities to distinguish mangrove species rather than simply separating mangrove from non-mangrove vegetation[19]. The combination of global benchmark datasets, geospatial foundation models and emerging high-resolution observations is therefore expected to shift mangrove mapping from producing increasingly accurate global extent maps towards delivering locally optimized products capable of addressing ecological processes, species composition and ecosystem function.

18 Doughty, C. L., Cavanaugh, K. C., Chapman, S. & Fatoyinbo, L. Uncovering mangrove range limits using very high resolution satellite imagery to detect fine-scale mangrove and saltmarsh habitats in dynamic coastal ecotones. *Remote Sensing in Ecology and Conservation* **10**, 686-701, (2024).

19 Banerjee, S., Santra, A., Bhadra, T., Mukherjee, K. & Mitra, S. S. Decoding mangrove diversity through species classification in the Indian Sundarbans using PRISMA hyperspectral data. *International Journal of Remote Sensing* **47**, 574-602, (2026).

2.4 Mangrove canopy height

Nathan Thomas (Edge Hill University), **Marc Simard** (California Institute of Technology), **Lola Fatoyinbo** (Massachusetts Institute of Technology), **Adriana Parra** (Commonwealth Scientific and Industrial Research Organisation), **Atticus Stovall and Abigail Barenblitt** (University of Maryland), **Pete Bunting** (Aberystwyth University), and **Irena Hajnsek** (German Aerospace Center)

Many mangrove tree species are highly versatile: rapidly colonizing new sediments, and managing to grow across a range of conditions.

In places where conditions are colder, receive limited tidal flushing or sufficient freshwater inputs and are subject to frequent high-energy storms, mangrove trees may have a sparse distribution and tree heights of just 1-2 m can be common. By contrast, the tallest stands in the world are found close to the equator, on the western coastlines of continents where storm activity is limited. In these areas, stands close to 60 m tall can be found, hosting levels of aboveground biomass comparable to the highest levels of any tropical forests[20].

An earlier global map of mangrove heights, released in 2019, utilised the Shuttle Radar Topography Mission (SRTM) 30 m resolution data, and was used to assess forest biomass[21]. In 2025 a new 12 m TanDEM-X canopy height map was released, with 6.25 times higher resolution, greater vertical accuracy, and a wider range of heights than existing estimates (Fig 11.)[20].



High canopy mangrove forest in Gabon. © Lola Fatoyinbo

> Stands close to 60 m tall can be found, hosting levels of biomass comparable to the **highest levels of any tropical forests**

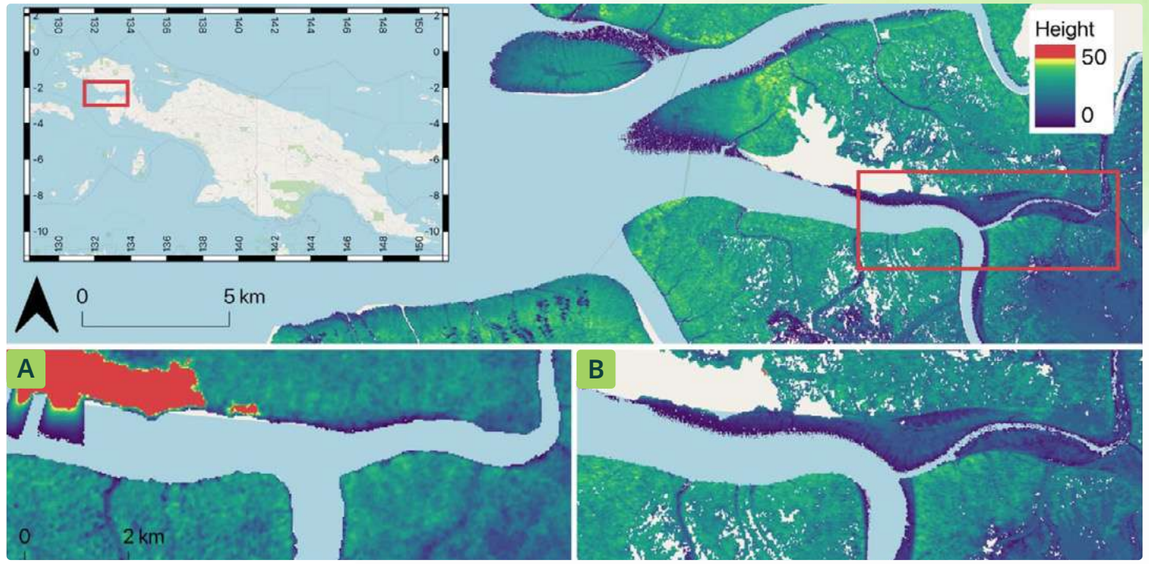


Figure 12: Mangrove canopy height for Bintuni Bay, West Papua. Insets show heights in previous SRTM-derived (A) and current TanDEM-X derived (B) products. There are notable improvements in the data reflected by the removal of anomalous regions (including a hill, in red) and inclusion of contemporary mangrove gain. The increased resolution provides more detail of canopy structure in the interior of the mangrove and along channel edges. The increased spatial resolution also enables a greater range of heights as individual canopies are better represented at 12 m than at 30 m[20].

The new map once again highlights Gabon, Colombia, and Equatorial Guinea as having the tallest stands, based on the 99th percentile height. The median of the tallest 100 height estimates (md100) exceeds 59 m in both Colombia (59.6 m) and Gabon (59.1 m), with 99th percentile (perc99) values of 46.1 m and 43.5 m, respectively.

Other notable countries in the top 20 include Ecuador (8th, perc99: 37.2, md100: 57.4 m), French Guiana (11th, perc99: 35.2 m, md100: 57.4 m), Papua New Guinea (14th, perc99: 32.3 m, md100: 57.8 m) and Brazil (20th, perc99: 31.3 m, md100: 58.7 m).

Compared with globally distributed Airborne Lidar Survey (ALS) data the global RMSE (Root Mean Square Error) is 2.4 m, reflecting a 35% increase in vertical accuracy over previous models. For the tallest stands this represents a height error of less than 5%. Uncertainties associated with fusing multiple global datasets can lead to unrealistic height measurements caused by the inclusion of hills and mountains, particularly within igneous island nations and archipelagos. The mangrove extent for these regions need to be carefully validated before the height estimates are used, but the value of the new map, at higher resolution and fitted to more recent base-maps of mangroves positions it as the most detailed and accurate map of global mangrove structure ever created.

20 Simard, M., L. Fatoyinbo, N. M. Thomas, A. E. Stovall, A. Parra, A. Barenblitt, P. Bunting, and I. Hajnsek. 2025. *A New Global Mangrove Height Map with a 12 meter spatial resolution*. **Scientific Data 12**:15.

21 Simard, M., L. Fatoyinbo, C. Smetanka, V. H. Rivera-Monroy, E. Castañeda-Moya, N. Thomas, and T. Van der Stocken. 2019. Mangrove canopy height globally related to precipitation, temperature and cyclone frequency. *Nature Geoscience* **12**:40-45.

2.5 Mangroves and associated coastal ecosystems

Sevvandi Jayakody (Wayamba University of Sri Lanka), **Philine S.E. zu Ermgassen** (University of Edinburgh), and **Thomas A. Worthington** (University of Cambridge)

Mangrove ecosystems do not function in isolation; they are vital components within dynamic, interconnected coastal seascapes.

Alongside habitats such as seagrass beds, coral reefs, saltmarshes, and tidal mudflats, mangroves form networks of ecosystems where connectivity directly supports biodiversity and ecosystem services such as coastal protection and carbon storage. Within the seascape, habitats are connected by the transfer of energy, nutrients, and organisms through the water[22]. The strength of these connections are strongly influenced by structural elements, such as the closeness, size, and configuration of habitat patches, which in turn confers functional connectivity or how organisms and materials move in response to this physical structure.

Connectivity between terrestrial, coastal, and marine ecosystems across the seascape has a significant impact on the species present. At the contact zones between ecosystems, known as "ecotones", species richness is often at its highest with conditions suitable for communities from both habitats and species adapted to the edge conditions. Many marine fish use different habitats at different times in their life history, and at finer daily or seasonal temporal scales for feeding, refuge, or reproduction.

> A combination of mangrove, seagrass, and coral reef **reduces wave and storm impacts** far more effectively than any single habitat could alone

There is also a growing appreciation of the importance of connected habitats in terms of the delivery of ecosystem services, with a greater diversity of habitats on the whole providing a corresponding diversity of benefits[22]. As an example, areas of combined mangrove, seagrass, and coral reef reduce wave and storm impacts far more effectively than any single habitat could alone[23]. The connectivity between these habitats is especially evident in their role as blue carbon sinks, with mangroves exporting carbon and nutrients to adjacent estuaries and conversely adjacent seagrass meadows actively enhancing the carbon stocks of mangrove forests and unvegetated mudflats[24]. By reducing water velocity and turbulence, dense seagrasses increase the deposition of both local and imported organic carbon, substantially raising sediment carbon densities across the continuum.

Understanding these interactions and interdependencies should be a critical component of conservation efforts, including the establishment of protected areas. Likewise, for restoration: while focusing efforts on a single ecosystem remains important, the connectivity between ecosystems should also be considered. As well as benefitting species whose life-history and habitat use isn't tied to a single ecosystem, restoring the seascape may promote facilitative benefits through processes such as wave attenuation, sediment dynamics and nutrient processing[25], and may result in elevated outcomes for biodiversity.



Coral, seagrass and mangrove roots in Jardines de la Reina National Park, Cuba. © Mark Spalding

22 Preston, J., Debney, A., Gamble, C., Hardy, M. J., Underwood, G. J. C., Garbutt, A. *et al.* Seascape connectivity: evidence, knowledge gaps and implications for temperate coastal ecosystem restoration practice and policy. *npj Ocean Sustainability* **4**, 33, (2025).

23 Guannel, G., Arkema, K., Ruggiero, P. & Verutes, G. The Power of Three: Coral Reefs, Seagrasses and Mangroves Protect Coastal Regions and Increase Their Resilience. *PLoS ONE* **11**, e0158094, (2016).

24 Guo, X., Song, S., Chen, L., Zhang, C., Ye, S., Ding, Y. *et al.* Ecological connectivity between mangroves and seagrasses increases sediment blue carbon storage. *Estuarine, Coastal and Shelf Science* **318**, 109231, (2025).

25 Vozzo, M. L., Buelow, C. A., Sievers, M., Adame, M. F., Branson, P., Brown, M. *et al.* Achieving at-scale seascape restoration by optimising cross-habitat facilitative processes. *npj Ocean Sustainability* **3**, 57, (2024).



Rezoning the Coast: Community Governance Shapes Kubu Raya's Marine Conservation Area

Tess de Jongh (Planet Indonesia)

In coastal Kubu Raya, community leaders and fisherfolk drove the rezoning of the 134,409ha Regional Marine Conservation Area (KKPD). With Planet Indonesia's support, communities held participatory mapping sessions and reviewed larval connectivity studies tracing how mangrove crabs, shrimp, grouper, and pomfret connect offshore and coastal habitats. Drawing on this evidence, communities agreed on revised core no-take, utilization, and other-use zones to sustain stable fish stocks, maintain livelihood viability, and secure at least 10% core zone protection. The resulting area zonation plan, endorsed by multi-level government, anchors mangrove stewardship in community governance.

Aerial view of Kubu Raya, West Kalimantan, where community-led re-zoning is securing mangrove ecosystems and the livelihoods that depend on them. © Planet Indonesia

2.5.1 Mangroves and seagrasses

Jimena Samper-Villarreal (Universidad de Costa Rica) and **Megan I. Saunders** (CSIRO Environment)

Seagrass meadows, like mangrove forests, are formed by flowering plants, although unlike mangroves, seagrass species can thrive fully submerged. They are found in calm marine and brackish waters, extending from tropical and subtropical (mangroves, seagrasses) into subarctic (seagrasses) climates.



Temperate mangrove and seagrass in Ku-Ring-Gai Chase National Park, Australia. © Mark Spalding/TNC

Mangroves and seagrasses are often found in close proximity. The boundaries between these two habitats can merge into a continuum, with mangrove seedlings and isolated trees found growing within shallow seagrass meadows and seagrasses growing among mangrove roots in clear waters. This natural ecotone is ecologically important, however it presents a challenge for habitat delimitation in mapping initiatives, as seagrass extent may be underestimated. Future mapping efforts could avoid this problem by delineating a combined habitat transitional zone.

There has been recent renewed interest in the positive interactions between seagrasses and mangroves[26],[27]. Mangroves can facilitate seagrass presence and condition by retaining sediment and nutrients from the catchment, leading to improved water clarity and therefore light penetration for seagrasses. Meanwhile, seagrasses can facilitate sediment consolidation for mangroves to establish, extend nursery habitat towards the sea, and slow down water flow into the mangrove promoting deposition and decreasing resuspension of carbon rich sediment[26]. In India for instance, in seagrass meadows with nearby mangroves there is higher seagrass leaf shoot density; and increased horizontal extension, amount and production of vegetative tissue, and sediment silt and carbon content[27]. Meanwhile, in Kenya, fish and crustacean composition is influenced not just by mangrove and seagrass presence, but by forest structural complexity and area of extent and continuity of seagrasses[26]. Further studies on the benefits provided by these habitats in different spatial and structural combinations, beyond mere presence or absence, will provide greater insight into their positive interactions.

Mangroves and seagrasses provide increased habitat for mobile animals such as fish and invertebrates, greater biomass productivity, higher biodiversity and nutrient cycling, reduced water energy and increased shoreline protection, and greater carbon sequestration[27], potentially increasing resilience to climate change. As our understanding of these positive interactions improves, it is increasingly clear that conservation and restoration efforts may benefit from a wider seascape approach, considering mangroves and seagrasses as a combined ecotone with positive interactions rather than independent habitats[28].

> Conservation and restoration efforts may **benefit from a wider seascape approach**, considering mangroves and seagrasses as a combined ecotone

PHOTO STORY



Coastal wetland ecosystems are linked ecologically and biogeochemically. *Pioneering research* in northern Cambodia found mangrove-derived organic matter contributes substantially to seagrass carbon storage, highlighting the need for integrated management of interconnected blue carbon habitats. © Daniel Bayley, Fauna & Flora

26 Narayanan, B., Mavilavalappil, S. P. & Raj, B. Synergistic roles of mangrove and seagrass ecosystem connectivity: a systematic review of ecosystem services. *Hydrobiologia*, (2026).

27 Mao, W., Geng, X., Huai, Z., Huang, W., Chen, G., Gonzalez, E. B. *et al.* Synergistic effects of interconnectivity among coral reefs, seagrass beds, and mangroves under climate change. *The Innovation Geoscience* **4**, 100189, (2026).

28 Vozzo, M. L., Buelow, C. A., Sievers, M., Adame, M. F., Branson, P., Brown, M. *et al.* Achieving at-scale seascape restoration by optimising cross-habitat facilitative processes. *npj Ocean Sustainability* **3**, 57, (2024).

2.5.2 Mangroves and coral reefs

Mark Spalding (The Nature Conservancy)

Coral reefs are physical structures formed over centuries to millennia by the compounding growth of hard corals, often with coralline algae. They thrive in clear, warm tropical waters and are often found in close proximity to mangroves. Interactions between the two communities can be tight.



Juvenile grunts in the shelter of the mangroves in Lac Bay, Bonaire. © Lorenzo Mittiga / Ocean Image Bank

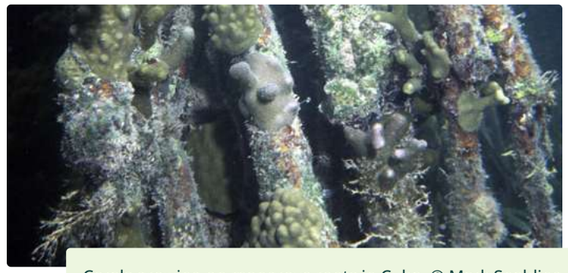
Mangrove ecosystems have long been noted as nursery grounds, providing a disproportionate contribution to the recruitment of adult fish into adjacent waters. Early quantification of the inter-dependence between mangroves and coral reefs highlighted benefits of mangrove-proximity to reef fish, with the enhancement of fish biomass on mangrove-adjacent reefs, and even species-specific inter-dependence. Juvenile fish benefit from both the protection and the productivity of mangroves, migrating out to coral reef habitats with age. While many species appear to be making opportunistic use of nearby mangroves, for others, including some commercially important coral reef species, this dependence may be more absolute[29]. More recent research has shown that the influence of coral reefs on mangrove fish communities is strongly influenced by factors including distance and tidal range.

> Juvenile fish benefit from both the **protection and the productivity of mangroves**, migrating out to coral reef habitats with age

In mangroves less than 100m from reefs, reef fish tend to dominate and replace other coastal and estuarine species. Meanwhile, the importance of mangroves for juvenile reef fish is particularly high in microtidal regimes[30].

Others have highlighted the potential importance of mangroves as refugia for corals. Unlike seagrass and saltmarsh ecosystems, the boundary between mangroves and actively growing coral reef zones, is usually clear. Nonetheless individual corals are sometimes found, and may even be abundant, close to mangroves. With their high sensitivity to ocean warming and acidification, the cooler shaded waters of mangroves, often with higher alkanlinity, may represent an important stronghold and refuge where a considerable diversity of hard coral species may survive[31].

The interactions are not solely linked to biodiversity. Coral reefs thrive in high energy coastal areas, rapidly diminishing incoming wave energy and often creating calm water settings on reef flat and lagoonal shores. These conditions can be ideal for the growth of coastal mangroves. This co-occurrence is also of critical importance for coastal societies – while coral reefs provide a highly effective barrier to wave energy, they can do little in the face of storm surges. By contrast mangroves, in sufficient densities, can greatly reduce the impacts of larger surges, and the combined action of reefs and mangroves will generate considerable benefits in terms of protected lives and economies (**Section 5.3**).



Corals growing on mangrove roots in Cuba. © Mark Spalding

29 Mumby, P. J., Edwards, A. J., Arias-González, J. E., Lindeman, K. C., Blackwell, P. G., Gall, A. *et al.* Mangroves enhance the biomass of coral reef fish communities in the Caribbean. *Nature* **427**, 533-536, (2004).

30 Bradley, M., Dubuc, A., Piggott, C. V., Sambrook, K., Hoey, A. S., Depczynski, M. *et al.* The fish–mangrove link is context dependent: Tidal regime and reef proximity determine the ecological role of tropical mangroves. *Fish and Fisheries* **25**, 523-541 (2024).

31 Stewart, H. A., Wright, J. L., Carrigan, M., Altieri, A. H., Kline, D. I. & Araújo, R. J. Novel coexisting mangrove-coral habitats: Extensive coral communities located deep within mangrove canopies of Panama, a global classification system and predicted distributions. *PLoS ONE* **17**, e0269181, (2022).



Mangroves as refugia for terrestrial wildlife

Frida Rebeca Castillo Infante, Gonzalo David Sansón Vera, Alejandro Corona Salto, María Fernanda Olivares Martínez, Roberto Rentería, David Thau, Nicole Chabaneix, and the **ManglarIA Team** (World Wildlife Fund (WWF))

Mangrove forests regulate local thermal environments by buffering temperature extremes, creating microclimatic refuges that support a wide diversity of wildlife. While they are well recognized as critical habitat for aquatic fauna and birds, their ecological importance for terrestrial mammals remains largely unexplored. Through the ManglarIA project, WWF have documented the use of mangroves in the Yucatán Peninsula and Nayarit, México by a wide range of species, including mammals such as jaguar, ocelot, margay, and jaguarundi. By integrating camera trap records, environmental sensors, and using AI to analyze data, we characterize activity patterns and the environmental conditions associated with species occurrence. Thermal distributions reveal differences in the temperature ranges used by mammals, birds, and reptiles across different sites. These patterns provide insight into the microclimatic conditions experienced by wildlife and help explain how habitat condition may shape species activity and resilience under future climate change scenarios.

A camera trap captures a jaguar walking through the mangroves in the Yucatán, México" © WWF

2.5.3 Mangrove and saltmarshes

Sevvandi Jayakody (Wayamba University of Sri Lanka)

While connectivity is beneficial, it can also blur ecological boundaries. In some regions like in arid coastal regions of Sri Lanka, mangrove and saltmarsh ecosystems physically merge.



Dwarf *Avicennia marina* consociations with saltmarshes in Achchankulum Forest Reserve, Sri Lanka. © Sevvandi Jayakody

Mangrove species like Avicennia marina and Pemphis acidula can have stunted growth forms, sharing the exact height profile as adjacent saltmarsh species like Suaeda maritima, Salicornia brachiata and Tecticornia indica. Recognition of these unique combined/associated ecosystems and of the abiotic factors that enable such consociations is important for natural resource inventory, conservation planning, and for effectively understanding the biodiversity and the many values of both mangroves and saltmarshes.

Elsewhere, mangroves and saltmarshes are more commonly found as adjacent rather than fully combined, with saltmarsh species sometimes growing almost as a pioneer species on the seaward margin of mangroves, but also commonly growing behind the mangroves, particularly in arid conditions. In all cases the boundary may still be a dynamic and somewhat mixed community, while the connections between the two extend far beyond the physical extent of the plants themselves.

All associations of mangroves with saltmarshes provide mixed seascapes supporting and enhancing populations of juvenile fish and crustaceans[32]. Additionally, soil microbiota link these ecosystems by facilitating the movement of dissolved inorganic carbon, while fringing wetlands actively filter land-derived nitrogen to protect delicate seagrasses. Habitat connectivity, especially in mangrove-saltmarsh continua, actively raises total sediment carbon capture across the landscape[33].



Adjacent mudflats in Negombo, Sri Lanka enabling the pioneer fauna such as *Terebralia palustris* to reach mangroves under restoration, where the nutrients released by these organisms fuel the plant growth. © Sevvandi Jayakody

Understanding the role of associated ecosystems is also crucial for coastal ecosystem restoration. Hydrological and landscape connectivity positively dictates the success of habitat recovery. In Sri Lanka, for example, abandoned shrimp aquaculture ponds are known to recover significantly faster when situated adjacent to intact saltmarshes and mudflats. This connectivity allows for the rapid, natural settlement of pioneer plants and fauna compared to isolated land plots.

The belowground connections of mangroves and saltmarshes remain poorly documented. However, in mangrove saltmarsh ecotone, root systems of mangroves extend well into saltmarsh proper. As such, depending on how the prevailing environment and human disturbances facilitate the spread, the edge remains highly dynamic. The unscientific planting of mangroves in mangrove-saltmarshes could therefore have negative consequences for both ecosystems.

In tropical regions, the boundaries between mangroves, seagrasses, and coral reefs represent zones of extraordinary "conservation efficiency." At least six synergistic benefits have been identified when these ecosystems are jointly managed: increased resistance to environmental disturbances; highly concentrated biodiversity; the creation of climate refugia; strengthened ecosystem services; movement corridors for allochthonous inputs including dissolved inorganic carbon; and acting as nursing grounds for degraded ecosystems by supplementation of both biotic and abiotic inputs for rapid recovery[34].



The continuum from mangrove to saltmarsh to salt pans in the desert margins of Baja California, Mexico. © Mark Spalding / TNC

32 Lefcheck, J. S., Hughes, B. B., Johnson, A. J., Pfirrmann, B. W., Rasher, D. B., Smyth, A. R. et al. Are coastal habitats important nurseries? A meta-analysis. Conservation Letters 12, e12645, (2019).

33 Adame, M. F. & Lovelock, C. E. Carbon and nutrient exchange of mangrove forests with the coastal ocean. Hydrobiologia 663, 23-50, (2011).

34 Adapted from: Carlson, R. R., Evans, L. J., Foo, S. A., Grady, B. W., Li, J., Seeley, M. et al. Synergistic benefits of conserving land-sea ecosystems. Global Ecology and Conservation 28, e01684, (2021).



"Human Hunger" - urban encroachment on mangroves in India. © Star Udyawar / Ocean Image Bank / Mangrove Photography Awards

3 Threats to mangroves

3.1 Losses and drivers of loss

Pete Bunting (Aberystwyth University) and **Lammert Hilarides** (Wetlands International)

While the recent mangrove time series maps have demonstrated that globally there have been significant mangrove gains over the last 40 years (Section 2.2), they also show losses, and many mangroves are still under threat from anthropogenic change.

The newly released IUCN Red List of Ecosystems for mangroves, presented in our last report (**SoWM, 2024**, **Section 2.3**), highlights that around half of the mangrove provinces worldwide are at risk from collapse, threatened by sea level rise and storms, with overharvesting and pollution also having impacts in many areas[1]. Using the new GMW time series[2], we know that, since the mid-1980s, losses have amounted to 19,863 km^2, resulting in a rate of loss of 497 km^2 per year.

It is important to note that the widespread reported gains of mangroves cannot be treated as a simple form of rebalancing or offsetting these losses. Older mangrove forests are of critical importance in terms of biodiversity and a host of ecosystem service benefits – they host rich carbon reserves, higher diversity, and are far more effective at coastal protection. To this end, it is critical that we understand where such forests are being lost and that we try to build an understanding of the drivers of such loss. In particular, we need to understand where losses are driven by direct anthropogenic impacts – activities that can be managed and prevented, such as engineering, pollution, or land conversion. The more indirect impacts of storms or even rising seas are also driving some losses, but these remain beyond the grasp of governments and natural resource managers. A more detailed assessment of patterns and drivers of mangrove loss is currently being undertaken using the GMW v4.1 timeseries, but to highlight the approach, on the following page we present a case study from Malaysia.

In addition to straightforward gains and losses, new studies are beginning to look at degradation, which is in some cases extensive, with degradation rates exceeding loss rates across 65% of global mangrove area in an average year[3].



Not all mangrove loss is a result of direct human impact - a flamingo in a mangrove forest hit by a hurricane in Mexico. © Miguel Diaz / TNC Photo Contest 2023

1 Macintosh, D. J., Suárez, E. L., McGregor, S. G., Ellison, J. C., Botts, E. & Valderrábano, M. *Global risks to mangrove ecosystems: Red List of Ecosystems of intertidal forests and shrublands*. (IUCN, Gland, Switzerland, 2026).

2 Bunting, P., Hilarides, L., Rosenqvist, A., Oakes, G., Castro Brandão Vaz dos Santos, P., Worthington, T. *et al.* Global Mangrove Watch: Timeseries of Mangrove Extent (Version 4.1.12) [Dataset]. *Zenodo*, (2026).

3 Zhang, Z., Murray, N. J., Song, X.-P., Bunting, P., Worthington, T. A., Fatoyinbo, L. *et al.* Unexpected expansion and regrowth in Earth's mangrove forests over the past four decades. *Science* **392**, 1082-1087, (2026).

Forty years of mangrove losses in Malaysia

Figure 13 illustrates the proportion of mangrove loss attributable to direct anthropogenic activities in Malaysia. These numbers were estimated through visual interpretation, which digitized regions identified as mangrove losses due to direct anthropogenic activities. These regions were intersected with the GMW v4.1 time series to assess how much direct anthropogenic loss has occurred through the timeseries. From 1985 to 2000, over 60% of losses were attributable to direct anthropogenic causes, but extending the assessment period by 25 years (1985-2025), this number fell to just over 50%. This illustrates that, while losses continued, the proportion attributable to direct anthropogenic impacts reduced considerably.

A major challenge with this work is that it is only possible to detect obvious direct impacts such as clear felling and land conversion. Other anthropogenic change, including local impacts such as pollution as well as indirect impacts such as sea level rise, subsidence linked to mining or groundwater abstraction and hydrological disturbances in the upstream catchment, would not be taken into account by this analysis. Further work is needed to understand these wider anthropogenic changes, which are not identifiable in the satellite imagery, especially the impact changes in the catchment have on mangrove ecosystems.

Malaysia: Mangrove Losses from a Baseline (1986-2025)

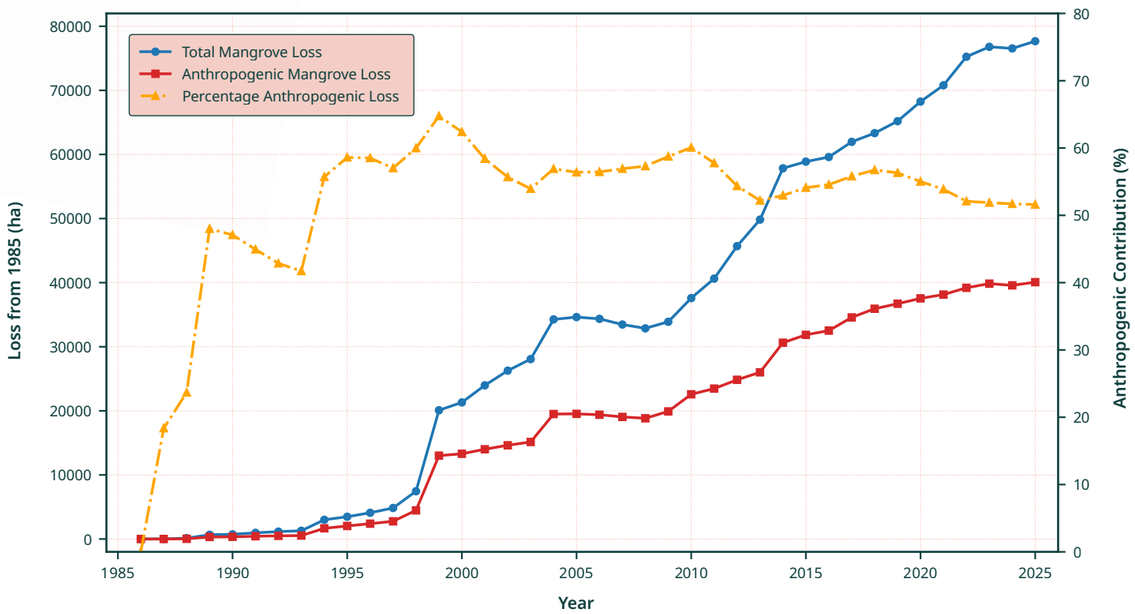


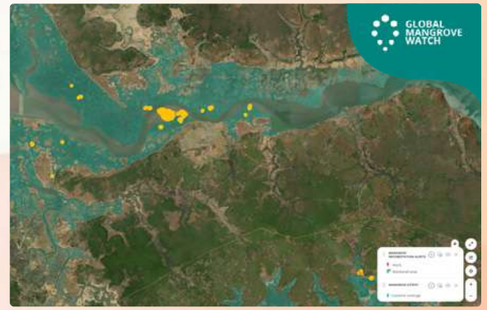
Figure 13. From GMW v4.1.12 the mangrove losses in Malaysia have been split into two categories, direct anthropogenic losses and total losses. This plot shows the total, direct anthropogenic losses and the cumulative percentage of those mangrove losses with a direct anthropogenic cause.

GMW Disturbance alerts

The GMW mangrove disturbance alerts are updated monthly and highlight locations of mangrove losses, with a minimum size of loss visible at 20 x 20 m resolution (SoWM 2024 Section 6.2)[4]. Currently, the alerts cover 50% of the global mangrove extent and about a third of mangrove coastlines, but these will be expanded to provide global coverage from 2027. The following pages contain two examples of recent losses detected by the mangrove loss alerts: Sand mining in Mozambique and Urban encroachment in Guinea.

Paradise Buried: a waste dump encroaching on mangroves in Bali, Indonesia. © Tom Quinney / Ocean Image Bank / Mangrove Photography Awards

4 Bunting, P., Hilarides, L., Rosenqvist, A., Lucas, R. M., Kuto, E., Gueye, Y. & Ndiaye, L. Global Mangrove Watch: Monthly Alerts of Mangrove Loss for Africa. *Remote Sensing* **15**, 2050, (2023).



From mangrove disturbance alerts to mangrove action in Senegal's Casamance

Susanna Tol (Wetlands International)

Global Mangrove Watch's near-real-time mangrove loss alerts are helping conservation practitioners in Senegal's Casamance region rapidly detect and respond to threats across extensive and difficult-to-access mangrove landscapes. Through training delivered under Wetlands International's Rooted Resilience project, protected area managers and local communities used alerts to identify mangrove loss caused by aquaculture dikes, coastal dune movement, and illegal cutting. Field verification enabled targeted management responses, including restoration planning, increased monitoring, and stakeholder engagement. The case demonstrates how satellite-based monitoring can strengthen local stewardship by turning timely data into effective conservation action.

Photo: A screenshot from the Global Mangrove Watch platform showing mangrove loss alerts from Casamance, Senegal.

Heavy Sand Mining: Zambezi River Delta, Mozambique

The Zambezi Delta features some of East Africa's most extensive mangrove forests, which have historically relied on the natural exchange between Indian Ocean tides and freshwater river flow to thrive.

However, recently, extensive heavy sand mining along Mozambique's beaches, fuelled by global demand for titanium and zirconium ores, has physically closed off an estuary mouth. This obstruction severs the critical hydrological balance and blocks tidal flushing, resulting in extensive mangrove dieback, identified through the GMW loss alerts.

Satellite imagery (Figure 14) reveals the immediate fallout of this obstruction. Where the "before" image shows lush green canopies bordering the estuary, the "after" image exposes extensive swaths of brown mangrove die-back trapped behind the blocked inlet.

This rapid forest mortality was entirely unnecessary; incorporating basic hydrological assessments into coastal infrastructure planning could have maintained tidal flows and prevented the die-back. Instead, this practice decimates estuarine biodiversity and strips the Mozambican shoreline of its primary defence against storm surges.

See case study at **www.globalmangrovewatch.org**



Figure 14. Illustrates the impact of the hydrological disturbance from sand mining, which blocked off the river channel and caused significant mangrove dieback. A) Planet NICFI Imagery from May 2022, before the disturbance; B) Planet NICFI imagery from February 2026, showing the impact of the sand mining. The red rectangle illustrates the location of the channel blockage. C) A very high resolution satellite image from Google Earth of the channel blockage showing the machinery and sand excavations.

Urban Encroachment: Conakry, Guinea

Historically, the dense mangrove forests fringing Conakry provided a vital buffer against Atlantic storm surges and supported rich artisanal fisheries that fed the local population. However, rapid population growth and unregulated urban expansion have driven intensive land reclamation. Mangrove stands are being systematically clear-cut and filled to create cheap, albeit highly vulnerable, real estate.

The stark contrast between the before and after imagery (Figure 15) illustrates the ongoing conversion. The once-continuous green coastal ribbon is being fragmented, replaced by sprawling informal settlements that push the urban edge directly into the tidal zone.

This localized deforestation not only decimates crucial nursery habitats for coastal fisheries but leaves these new coastal settlements acutely exposed to rising sea levels and flooding.

See case study at **www.globalmangrovewatch.org**

This localized deforestation not only **decimates crucial nursery habitats for coastal fisheries** but leaves these new coastal settlements acutely exposed to rising sea levels and flooding



Figure 15. Illustrates an area of on going urban expansion in Conakry, Guinea. A) Planet NICFI Imagery from October 2020; B) Planet NICFI imagery from June 2026. C) A very high resolution satellite image from Google Earth.

3.2 Plastic pollution in mangroves: scale, impacts, and solutions

Ceri Lewis and **Katie Deakin** (University of Exeter)

Plastic pollution is in many ways emblematic of the interconnected anthropogenic pressures of climate change, biodiversity loss, and pollution in marine ecosystems.

Plastics are accumulating in natural environments leading to habitat degradation and associated impacts for wildlife. Without significant intervention, the global burden of plastic pollution is predicted to nearly triple, reaching over one billion tonnes of waste annually by 2060[5]. Mangrove ecosystems are critical hotspots of plastic accumulation, where the convergence of hydrodynamic processes and complex root structures facilitates the retention and concentration of plastic debris.

> Mangrove ecosystems are **critical hotspots** of plastic accumulation

The complex root systems of mangroves function as effective traps for plastic debris, physically intercepting and retaining items such as ropes, fishing gear and plastic sheeting, but also slowing water flow and promoting the deposition of sediments and suspended smaller particles. This combination of hydrodynamic and structural features results in the retention of both macroplastic (items larger than 5 mm) and microplastic (smaller than 5 mm) debris within the seawater and sediments of mangrove habitats at levels often much higher than that of surrounding water bodies or shorelines.

Macroplastic abundance within mangroves is highly variable geographically, spanning several orders of magnitude between sites, reflecting differences in local inputs, proximity to urban areas, and hydrodynamic conditions. Although sediment contamination is relatively well documented, fewer studies have assessed seawater and even fewer have simultaneously measured across environmental compartments, limiting the ability to fully understand plastic dynamics within these ecosystems. The global average for larger plastic litter items (macroplastic) in mangroves was approximately 24 items per square metre, with some sites recording levels comparable to the most heavily polluted beaches globally[6]. Significant geographical regions remain poorly studied for plastic pollution, particularly in Africa, Australasia, and parts of the Americas.

5 OECD. *Global Plastics Outlook Policy Scenarios to 2060*. (Paris, 2022).

6 Deakin, K., Porter, A., Baquero, A. O. & Lewis, C. Plastic pollution in mangrove ecosystems: A global meta-analysis. *Marine Pollution Bulletin* **218**, (2025).

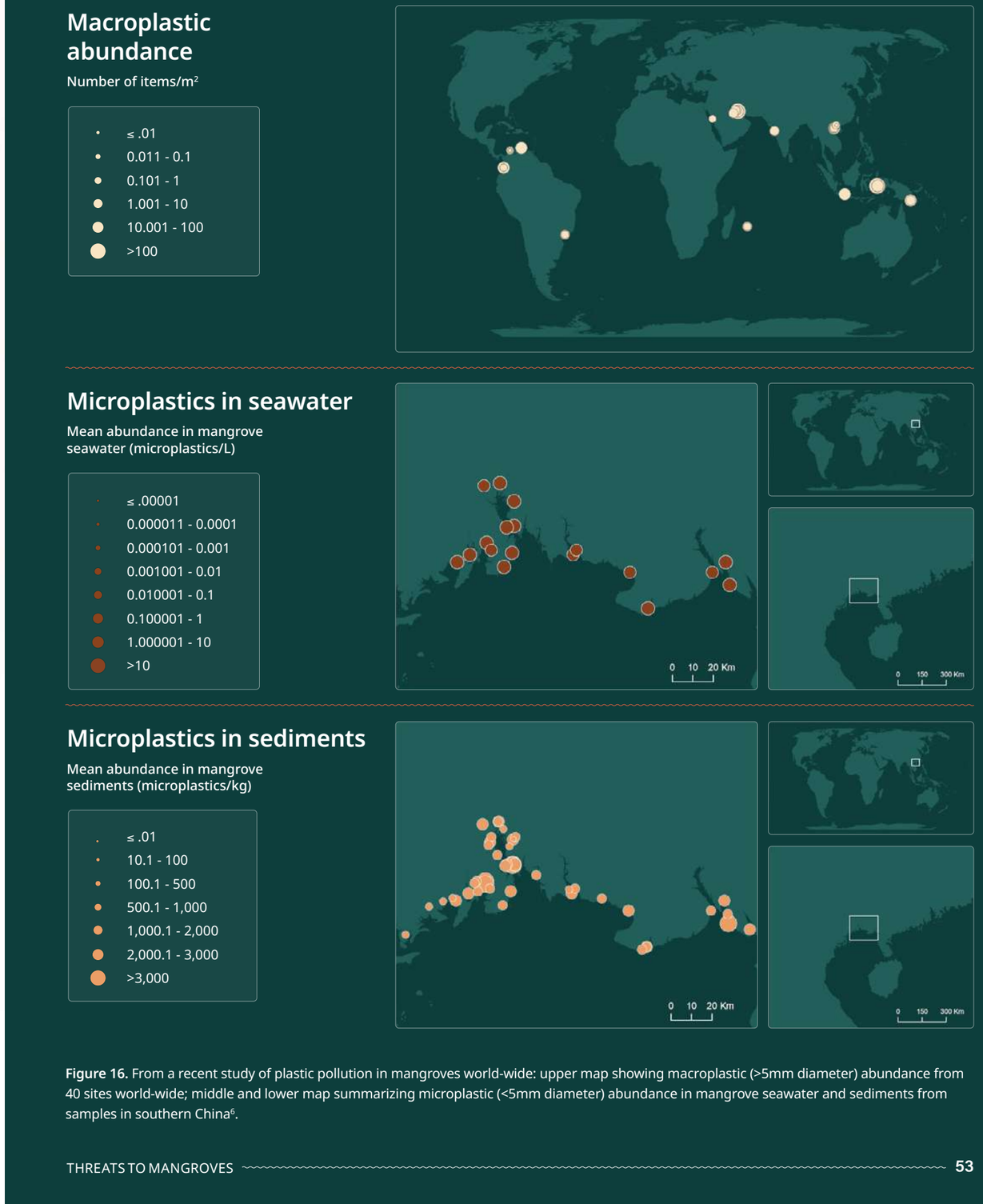


Figure 16. From a recent study of plastic pollution in mangroves world-wide: upper map showing macroplastic (>5mm diameter) abundance from 40 sites world-wide; middle and lower map summarizing microplastic (<5mm diameter) abundance in mangrove seawater and sediments from samples in southern China[6].

A recent global meta-analysis[6] found global average levels of microplastics in mangrove sediments of around 1,100 particles per kilogram of sediment, while seawater concentrations averaged approximately 16 particles per litre. These are around double the 'safe' thresholds for avoiding harm to wildlife.

Plastic pollution extends beyond the physical environment. Microplastics have been detected in the majority of mangrove-associated species that have been studied (see side bar).

Despite clear evidence of widespread plastic contamination, there is limited understanding of how this plastic pollution affects mangrove ecosystem functioning. Some experimental evidence research suggests potential impacts on sediment structure, microbial communities, and biogeochemical cycling, with accumulated macroplastic smothering mangrove sediments, creating prolonged anoxic conditions around root zones, stimulating stress-induced pneumatophore growth and reducing mangrove survival when plastic cover becomes extensive[7]. However, empirical evidence linking plastic pollution to changes in key ecosystem services such as carbon sequestration or fisheries production remains scarce. This represents a critical knowledge gap, particularly given the increasing focus on mangroves in climate mitigation and adaptation strategies.

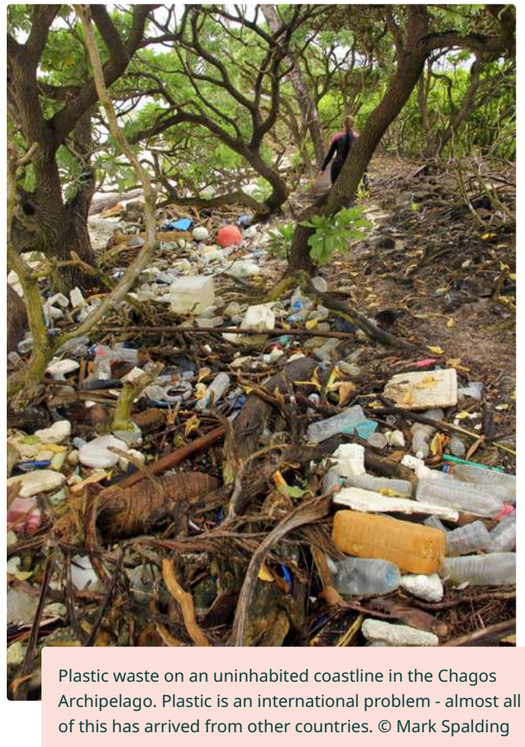
> Microplastics have been detected in the **majority of mangrove-**associated species that have been studied

Plastic pollution appears to be lower within Marine Protected Areas than their surrounding areas, possibly due to better clean up and management within MPAs although other factors like location may also influence this[6]. Unfortunately, MPAs cannot address the wider, transboundary drivers of pollution, particularly microplastics carried by rivers, runoff, and coastal activity. Tackling this issue therefore requires action beyond MPA boundaries, including improved waste management and riverine controls in urban and coastal catchments, targeted clean-up efforts, and stronger community engagement. A global reduction in plastic production is ultimately required to effectively reduce environmental plastic pollution. Standardized monitoring and further research are also needed to track trends and understand ecological impacts. Active removal of macroplastics may be the only means to clean existing plastic pollution within mangroves, and to prevent further breakdown of such plastic into microplastics which cannot be removed. Ultimately, however, effective mangrove conservation depends on reducing plastic pollution at its source.

PHOTO STORY



Can mangrove microbes help solve the plastic crisis? Work at the Indian Institute of Science Education and Research (IISER) in Kolkata reveals that the Indian Sundarbans harbours diverse plastic-degrading bacteria, but many also carry antibiotic and metal resistance genes, underscoring the need for safe, responsible bioremediation strategies. © Yash



Plastic waste on an uninhabited coastline in the Chagos Archipelago. Plastic is an international problem - almost all of this has arrived from other countries. © Mark Spalding

Mangroves as Hotspots for Microplastic Pollution

Audrey Primus, Tony Hadibarata, and **Muhammad Noor Hazwan Bin Jusoh**
(Curtin University Malaysia)

Evidence from studies around the world shows that microplastics are now widespread in mangrove waters, sediments and fauna, originating both from *in situ* breakdown of macroplastics and from direct inputs such as urban runoff and wastewater discharge, with sources including tire wear and personal care products.

In a review of ten key studies, reported microplastic polymers included polyethylene, polypropylene, PET, nylon, polyurethane, EVA, latex, and PVC, each providing clues about local pollution sources. Combining information on polymer type with particle shape, colour, and local environmental context improves source identification. Fibers were the most common form of microplastics in many locations, often linked to textile fibers, and fishing activities. Fragments, including small black particles, were associated with degraded packaging, aquaculture materials, and shoreline litter. Films reflected inputs from aquaculture and packaging waste.

Microplastics are also widespread in numerous mangrove inhabitants, but feeding mode is a clear driver. Filter-feeding bivalves and planktivorous fish often show high levels of microplastic exposure, while benthic grazers and detritivores also often show high levels of ingestion. Patterns are more mixed among omnivores and mixed feeders. However, potential transfer and accumulation through food webs raise concerns for wider biodiversity and human food security.

Reference

Primus, A., Hadibarata, T. & Jusoh, M.N.H. Accumulation of microplastics in mangrove ecosystem: source, properties, and impacts for conservation. *Environmental Sustainability* 9, 711–728 (2026).

7 van Bijsterveldt, C. E. J. *et al.* Does plastic waste kill mangroves? A field experiment to assess the impact of macro plastics on mangrove growth, stress response and survival. *Science of the Total Environment* **756**, (2021).

3.3 The fate of mangroves under rising seas

Neil Saintilan (Macquarie University) and **Kerrylee Rogers** (University of Sydney)

Rising sea levels pose a threat to mangroves, however, evidence of mangrove shoreline retreat is largely limited to locations where sea-level rise is additional to local factors which together drive hydrological stress or shoreline erosion.



SLR is rarely the sole driver of mangrove loss. This dieback event on the seaward edge of the Myall River, New South Wales, Australia was linked to several weeks of elevated baseflows of the Myall River following extreme rainfall, but it was likely exacerbated by pre-existing vulnerability linked to higher sea levels. © Neil Saintilan

These may include prolonged flooding resulting from hydrological constraints such as barriers blocking water flow; increasing exposure to waves; and land subsidence resulting from geologic adjustment or groundwater extraction. To date, the mean rate of global ocean surface increase (3-4 mm per year) poses little immediate threat to mangrove survival, and so mangroves can retain their position while expanding landward.

Various biogeomorphic mechanisms can help mangroves to build up the substrate as sea levels rise. These include the trapping of sediment by the complex morphology of mangrove root systems, and the capture and burial of atmospheric carbon ("blue carbon") within below-ground biomass[8]. Studies of mangrove elevation change in the palaeo-records show that mangrove substrates can maintain an optimal tidal position when rates of relative sea-level rise are modest and are effectively compensated by vertical accretion over millennial timescales[9]. However, there are limits to the rate of mangrove surface elevation gain, and there are few records of continued long-term mangrove forest development where the rate of relative sea-level rise increases above 7 mm per year[9].

8 Krauss, K. W., McKee, K. L., Lovelock, C. E., Cahoon, D. R., Saintilan, N., Reef, R. & Chen, L. How mangrove forests adjust to rising sea level. *New Phytologist* **202**, 19-34, (2014).

9 Saintilan, N., Khan, N. S., Ashe, E., Kelleway, J. J., Rogers, K., Woodroffe, C. D. & Horton, B. P. Thresholds of mangrove survival under rapid sea level rise. *Science* **368**, 1118-1121, (2020).

Mangroves and sea level rise in Indonesia

Frida Sidik and **Tubagus Solihuddin** (National Research and Innovation Agency (BRIN))

Indonesia holds the world's largest area of mangrove ecosystems. Its mangroves exist under widely different environmental, oceanographic, and geomorphic settings. Rod surface elevation table and marker horizon (RSET-MH) records from Indonesian mangroves show variable rates of soil surface elevation change across the sites that can influence mangrove responses to rising sea-levels[10,11].

Most Indonesian mangroves are deltaic and estuarine, characterized by high sediment supply and high vertical accretion. In many of these settings, mangrove substrates can gain elevation through mineral sedimentation, in some cases exceeding local relative sea-level rise, with rapid organic matter deposition[11]. This rapid mineral accumulation offsets natural soil compaction and shallow subsidence[12]. In addition to sediment supply and organic matter production, Indonesian mangrove response to sea-level rise is influenced by available accommodation space and their geological preconditioning. The Holocene palaeo-records from Belitung Islands showed that mangroves benefitted from relative sea level fall during Late Holocene, however geomorphological conditions limited the accommodation space for their landward expansion as coastal elevation increased dramatically due to the presence of rock outcrops in the form of granite[12]. Both observations and Holocene records of vertical accretion under modest rates of relative sea-level rise are consistent with evidence from the Indo-Pacific.



Surface elevation change measurement using RSET in Pari Island, Indonesia. (see Figure 17) © Frida Sidik

Together, these records indicate that Indonesian mangrove persistence depends on sediment delivery, organic accumulation and substrate stability offsetting accommodation creation; this is best achieved when vertical substrate development coincides with modest rates of relative sea-level rise.

10 Sidik, F., Neil, D. & Lovelock, C. E. Effect of high sedimentation rates on surface sediment dynamics and mangrove growth in the Porong River, Indonesia. *Marine Pollution Bulletin* **107**, 355-363, (2016).

11 Sidik, F., Fernanda Adame, M. & Lovelock, C. E. Carbon sequestration and fluxes of restored mangroves in abandoned aquaculture ponds. *Journal of the Indian Ocean Region* **15**, 177-192, (2019).

12 Solihuddin, T., de Gelder, G., Utami, D. A., Sidik, F., Rachmayani, R., Hendrizan, M. *et al.* Coral reef and mangrove interplay during Holocene sea level changes, Belitung Island, Indonesia. *Earth Surface Processes and Landforms*, **51**, e70354, (2026).

PHOTO STORY



When mangroves suffer, women bear the burden. Sundarbans fisherwomen in India depend on mangrove ecosystems for survival, yet intensifying cyclones, salinization, and degradation place the greatest burden on women's health, livelihoods, and resilience.
© Jayati Chourey, SaciWATERs

The surface elevation table-marker horizon (SET-MH) network is a globally distributed array of benchmark monitoring stations for surveying mangrove and tidal marsh substrate elevation changes and deciphering the contribution of tidally borne sediment and autocompaction to surface building processes. For mangroves this consists of 593 monitoring stations across 20 countries. Thus far, these studies suggest the ability of mangroves to adjust to rising seas will be compromised above 5 mm per year of relative sea-level rise in areas of low sediment supply, and above 7 mm per year of relative sea-level rise in high sediment settings[13].

In reality, most mangrove monitoring stations are already transitioning towards lower tidal positions, but the effect on condition is yet to appear.

Overall, however, the implications may not be dire for mangroves. If the challenge posed by the Paris Agreement is met, and temperatures are kept below 2 degrees of warming by 2100, it is unlikely that the rate of sea-level rise will increase above 7 mm per year, and biogeomorphic feedbacks may largely sustain mangrove substrate adjustments and prevent widespread loss before 2100, in all but low-sediment settings. Seaward expansion may continue where sediment supply is

13 Saintilan, N., Horton, B., Törnqvist, T. E., Ashe, E. L., Khan, N. S., Schuerch, M. *et al.* Widespread retreat of coastal habitat is likely at warming levels above 1.5 °C. *Nature* **621**, 112-119, (2023).

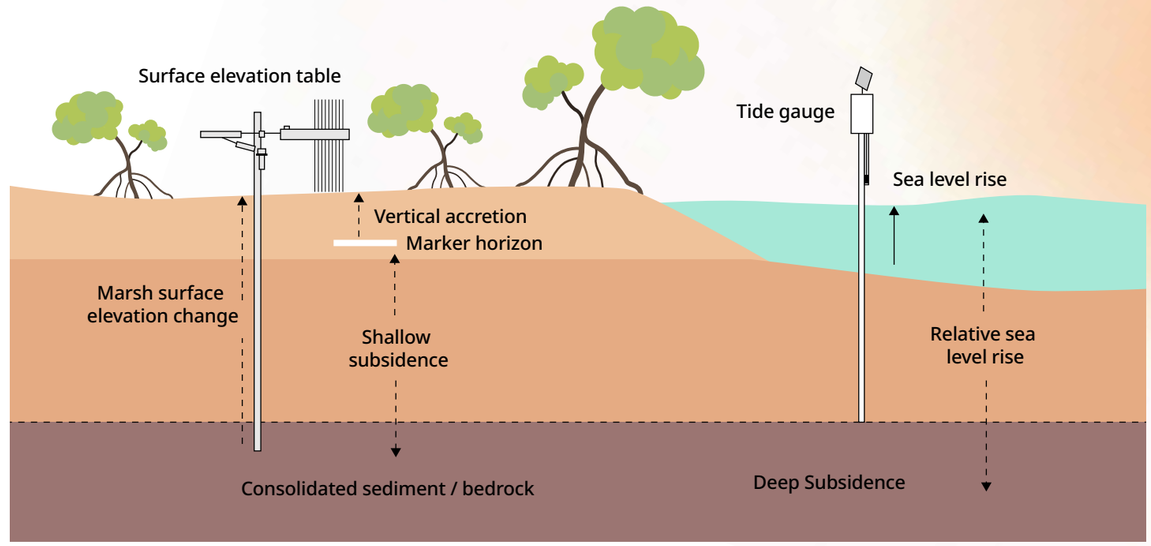


Figure 17: Elements of the Surface Elevation Tables (SET). The benchmark rod is driven into the sediment, to a depth of up to 25 metres. Repeat measurements are then made using a detachable arm with pins descending to the mangrove sediment surface. At the time of installation, a horizon of feldspar powder is laid down on the surface against which fresh sediment accretion is measured. The difference between accretion and elevation gain is attributed to subsidence below the feldspar horizon. Elevation gain can be compared to local water level changes.

high (see Chapter 2) and landward extension across coastal floodplains will occur where tidal impediments are absent. Overall, the prognosis for mangroves over the coming decades is more likely one of continued expansion where this is permitted.

Long-term, the future of mangroves is in our hands. The rate of sea-level rise will climb above 7 mm per year as temperature rise approaches 3 degrees Celsius[13] and widespread loss would be inevitable. In common with all other coastal ecosystems, the fate of the world's existing mangroves forests depends on the willingness of humanity to control global warming.

> The fate of the world's existing mangroves forests depends on the **willingness of humanity** to control global warming

3.4 Updating the conservation status of the world's mangrove plant species

Clare Duncan and **Jurgenne H. Primavera** (Zoological Society of London), **Norman C. Duke** (James Cook University), **Shing Yip Lee** (Chinese University of Hong Kong), **Kandasamy Kathiresan** (Annamalai University), and **Martin Zimmer** (Leibniz-Centre for Tropical Marine Research)[14]

The global IUCN Red List of Threatened Species (RLS) extinction risk assessment for mangrove plant species was last conducted in 2007-2010 by the IUCN/SSC/Conservation International Global Marine Species Assessment and the IUCN/SSC Mangrove Specialist Group (MSG) (Polidoro *et al.* 2010).



Flower and fruit of *Pelliciera rhizophorae* (Vulnerable, 2022) in Parque Nacional Natural Utría, Colombia. © Mark Spalding / TNC

Based on historical best-available data, 16% of the mangrove species in the previous global assessment (out of a list of 70 species) were found to be at elevated threat of extinction. The assessment identified a global extinction risk hotspot in Central America where five species (40%) were at elevated extinction risk: *Rhizophora samoensis*, *Avicennia bicolor*, *Mora oleifera*, *Peliciera rhizophorae*, *Tabebuia palustris*. It also recognized greater extinction risk for upper intertidal and upstream mangrove species (44%), for which threats from development and hydrological alteration are acute[15]. The threatened and near-threatened species from these earlier listings are shared in Table 3.

14 The authors are all members of the IUCN Mangrove Specialist group. In this group, SYL holds the Chair, and NCD is the Red List Authority

15 Polidoro, B. A., Carpenter, K. E., Collins, L., Duke, N. C., Ellison, A. M., Ellison, J. C. et al. *The Loss of Species: Mangrove Extinction Risk and Geographic Areas of Global Concern*. PLoS ONE 5, e10095, (2010).

Mangrove Species	Species Name Authority & Year	Nominal Intermediate / Hybrid	Family Name	Growth Form	Global Sub Region	2020 RLS Status
Aegialitis rotundifolia	Roxburgh 1824	Species	Plumbaginaceae	Shrub	IWP	NT
Aegiceras floridum	Roemer & Schultes 1819	Species	Primulaceae	Shrub	IWP	NT
Avicennia bicolor	Standley 1923	Species	Acanthacaeae	Tree/ Shrub	IWP	VU
Avicennia integra	N.C. Duke 1988	Species	Acanthacaeae	Tree/ Shrub	IWP	VU
Avicennia rumphiana	Hallier f. 1918	Species	Acanthacaeae	Tree/ Shrub	IWP	VU
Brownlowia tersa	(L.) Kosterm. 1959	Species	Malvaceae	Tree/ Shrub	IWP	NT
Bruguiera hainesii	C.G. Rogers 1919	Intermediate/ Hybrid	Rhizophoraceae	Tree/ Shrub	IWP	CR
Camptostemon philippinense	(Vidal) Becc. 1898	Species	Malvaceae	Tree/ Shrub	IWP	EN
Ceriops decandra	(Griff.) Ding Hou 1958	Species	Rhizophoraceae	Tree/ Shrub	IWP	NT
Heritiera fomes	Buch.-Ham. 1800	Species	Malvaceae	Tree/ Shrub	IWP/AEP*	EN
Mora oleifera	(Triana) Ducke 1925	Species	Fabaceae	Tree/ Shrub	AEP	VU
Pelliciera benthamii	Cornejo 2020 (also Duke 2020)	Species	Tetrameristaceae	Tree/ Shrub	AEP	EN (2022)
Pelliciera rhizophorae	Triana & Planchon 1862 (also Duke 2020)	Species	Tetrameristaceae	Tree/ Shrub	AEP	VU (2022)
Rhizophora samoensis	(Hochr.) Salvoza 1936	Species	Rhizophoraceae	Tree/ Shrub	IWP/ AEP	NT
Sonneratia griffithii	Kurz 1871	Species	Lythraceae	Tree/ Shrub	IWP	CR
Sonneratia hainanensis	Ko 1985	Hybrid	Lythraceae	Tree/ Shrub	IWP	CR (1998)
Sonneratia ovata	Backer 1929	Species	Lythraceae	Tree/ Shrub	IWP	NT
Tabebuia palustris	Hemsl. 1882	Species	Bignoniaceae	Shrub	AEP	VU

**Introduced into AEP*

Table 3: Globally threatened and near-threatened mangrove species from the most recent IUCN RLS assessments. Acronyms: IWP - Indo West Pacific, AEP - Atlantic Eastern Pacific, NT - Near Threatened, VU - Vulnerable, EN - Endangered, CR - Critically Endangered

> 16% of the mangrove species in the previous global assessment (out of a list of 70 species) were found to be at **elevated threat of extinction**

Led by this core group of authors, the IUCN/SSC MSG are now conducting an IUCN RLS reassessment of global mangrove species' extinction risk. This critical update will enable a stocktake of the potential negative impacts of further coastal development and other threats and potential positive impacts of restoration and conservation actions on the status of the world's mangrove species and biodiversity since 2010. The reassessment approach is two-fold: first, the IUCN/SSC MSG have now reached a consensus on a definition of what characteristics constitute a mangrove species to improve taxonomic inclusion[16]; second, an updated assessment process for mangrove species will be adopted, such that rigorous re-assessment will be based on the best-available global datasets following advances in satellite remote sensing in recent decades.

> A stocktake of the potential negative impacts of further coastal development and other threats and potential positive impacts of restoration and conservation actions on **the status of the world's mangrove species**

The IUCN/SSC MSG's definition of mangrove plant species is contained in Box 1. Following application of this definition to the previous global assessment mangrove species list, (1) three species previously considered mangroves have been reclassified as associate species (*Aglaia cucullata, Brownlowia argentata, Heritiera globosa*); (2) four mangrove species have been added (*Crenea patentinervis, Muellera moniliformis, Pavonia rhizophorae, Peliciera benthamii*); and (3) fertile hybrid/intermediate mangroves are to be considered as separate conservation units (*Bruguiera dungarra, Bruguiera rhynchopetala*). The authoritative global mangrove species list thus now contains 73 mangrove species/hydrids/intermediates for reassessment, and a further 10 non-fertile hybrids/intermediates. This list is very close to the list of full species and hybrids provided in the **2024 report** with the sole addition of *Acanthus volubilis*.



Roots of *Mora oleifera* in Parque Nacional Natural Utría, Colombia. this species was classified as Vulnerable in 2010. © Mark Spalding / TNC

Updating the RLS assessment process for mangrove plant species includes two major steps. First, we are updating species distribution range maps from expert-elicited occurrence data (IUCN/SSC MSG)[17], species life histories and tolerance ranges, and spatial hydrogeomorphological units[18].

16 Duke, N. C., Duncan, C., Kandasamy, K., Primavera, J. H., Zimmer, M. & et.al. What is a mangrove? An authoritative decision by the IUCN Mangrove Specialist Group on what defines a mangrove plant, and the list of plants in the world that fit that definition. (in review).

17 Duke, N.C. 2025. World Mangrove iD-2: expert ID for the World's mangrove plants. Currumbin, MangroveWatch App Publication. ISBN: 978-0-9923659-2-9.

18 Worthington, T. A., Ermgassen, P. S. E. z., Friess, D. A., Krauss, K. W., Lovelock, C. E., Thorley, J. et al. *A global biophysical typology of mangroves and its relevance for ecosystem structure and deforestation*. Scientific Reports 10, 14652, (2020).

Box 1.



The diversity of mangroves. © Mark Spalding / TNC

Authoritative definition of a mangrove plant (Duke *et al.* in review).

"Mangrove plant species or intermediate taxa, generally exceeding one half-meter in height at maturity, are those plants naturally rooted in intertidal sediments of predominantly (but not always) fine, soft-sediment shorelines of mostly tropical and subtropical marine coastal and estuarine environments. Mangrove plants occasionally occur also on intertidal rocky shorelines and reef rampart margins. In each occurrence, mangrove plants are mostly restricted to the upper intertidal zone between mean sea level and the highest astronomical tide level. While mangroves are dominated by flowering plants (angiosperms), with growth forms varying considerably from trees and shrubs to palms, they also comprise species of ground ferns. A number of mangrove species are naturally restricted to seasonally brackish, fluctuating tidal conditions of occasionally freshwater dominated riverine estuaries."

This will enable us to more accurately determine range-based IUCN RLS variables and criteria for mangrove plant species. Second, we will quantify distribution (and estimated abundance) change in IUCN RLS variables from net ecosystem gain and loss within globally standardized satellite-derived datasets (**Section 2.1**), moving mangrove plant species from qualitative records-based to quantitative, robust IUCN RLS assessments. This will enable us to more accurately model changes in range and abundance-based IUCN RLS variables and criteria for mangrove plant species. The IUCN/SSC MSG expects to complete all new assessments and re-assessments by mid-2027.



Mariamo, a fisherwoman in Ilha de Moçambique walks through the mangroves. © Esther Mbabazi / Rare

4 Halfway to 2030

4.1 The 2030 Goals Revisited

Mark Spalding (The Nature Conservancy) and **Lanie Esch** (World Wildlife Fund)

In 2022, the Global Mangrove Alliance released a new plan to reverse the decline of mangrove forests at the global scale and place these critical ecosystems on a pathway to recovery by 2030. This plan centered on three goals to guide efforts over the remainder of the decade:

1 Halt loss

An imperative to reduce direct human-induced losses to mangroves world-wide

2 Double protection

Recognizing their importance to both biodiversity and people, the aim is double the area of mangroves within conservation-focused protected areas

3 Restore half

Effective restoration techniques to be applied to at least half of recently lost mangrove areas

In formulating these basic goals, it was clear that, while they might be achievable, they would also be challenging. The same three goals have also been adopted by the Mangrove Breakthrough, who added a fourth Goal of sustainable finance, as part of its ambitious plan to leverage US$4 Billion for mangrove conservation and restoration.

A new paper currently in press has taken the broad goals of the GMA and applied a rigorous science-driven assessment of these goals, utilizing the latest available global datasets to set achievable, area-based targets at national levels for Goals 1-3. All told, 109 scientists, from 35 countries, have been the driving force behind this work. This level of collaboration alone highlights the unity of purpose and the enthusiasm by which these goals are being endorsed.

Critical to these goals, like the many other goals and targets being encouraged for biodiversity conservation, is that they follow the SMART criteria. They must be: **Specific**, **Measurable**, **Achievable**, **Relevant** and **Time-bound**.

In writing this paper it became increasingly clear that, while useful as guidelines, the application of these broad goals would require more detailed considerations. Assigning such a global scale vision would, in fact, need to touch down in the real world, and would have to take into account different conditions – ecological, social, and economic – in many different places.

The challenge of taking on such goals requires engagement and support at national levels, while implementation will typically require local-scale involvement. Policy, and the course of action that follows, will often fall to national or local governments. Their engagement can be encouraged by experts, industry and civil society, and such engagement may benefit from the powerful arguments that can and are being made about the immense value of mangroves to people.

> It will take the **entire mangrove community globally** to support the recovery of mangrove forests

Since the launch of the 2030 goals, the GMA has continued to grow in both size and influence. The Alliance now comprises more than 100 members from across the global mangrove community. Collectively, GMA members contribute to a wide range of expertise, resources, and on-the-ground experience that supports progress toward the Alliance's shared ambitions. This growth has also been reflected at the national level, with the formation, to date, of 15 GMA National Chapters (Chapter 7), creating platforms for members within countries to coordinate their efforts, align priorities, and strengthen collective action. While the GMA, its members and National Chapters, serves as a catalyst for collective action, the Alliance is not intended to be the sole implementer of these Goals. It will take the entire mangrove community globally to support the recovery of mangrove forests.

The sections that follow examine Goals 1-3 in greater detail, presenting the targets, evaluating current progress, and exploring the actions needed to achieve each goal by 2030.

Ambitious goals for global mangrove conservation and restoration

At the time of release of this report, a new paper was in press in the journal, Ambio, explaining and justifying the goals, as laid out in this chapter. Peer reviewed publication gives extra academic weight to the importance of these goals, while the combination of 109 authors from 88 different University departments, NGO offices and other groups across 35 countries gives a strong sense of the unity of vision and purpose they represent. The full citation of this work, listing all authors, is:

Spalding, MD; Canty, SWJ; Brown, CJ; Achete, F; Agblonon, G; Ahmed Mohammed, KH; Ali Mohamed, S; Alzahlawi, N; Arifanti, VB; Ashtamoorthy, SK; Astra, AS; Austin, WEN; Bandeira, SO; Bayley, DTI; Beeston, MA; Beguin Billecocq, I; Benbow, SLP; Beneby, JN; Bera, N; Berzina-Rodrigo, A; Bhadury, P; Biancardi Aleu, R; Bood, ND; Borrero Avellaneda, WJ; Bunting, P; Cabanban, AS; Cañedo-Argüelles, M; Castellanos-Galindo, GA; Christ, B; Dabalà, A; Dahlgren, C; Dey, A; Diazgranados, M; Diazgranados, MC; Doughty, CL; Duncan, C; Ebua, V; Esch, MM; Fatoyinbo, L; Fraiz-Toma, Andrés; Friess, DA; Gandhi, SR; Gevaña, DT; Ghosh, Anwesha ; Govale, AR; Hapsari, KA; Harisam, RT; Herrera-Silveira, Jorge A.; Hersant, A; Hilarides, L; Howard, JF; Ilman, M; Ingraham, RT; Jones, LA; Kozhapalli, V; Landis, EC; Leal, M; Li, M; Longley-Wood, KE; Lovelock, C E.; Maina, GW; McCarthy, OS; Michie, LA; Moity, N; Montes de Oca, J; Moreira-Ramírez, JF; Morrissette, HK; Oberle, B; Ofori, SA; Okalo, FA; Pangilinan, MJM; Parihar, S; Polania, J; Ramírez-Aguilera, FT; Robalino, JJ; Rodriguez, KL; Rog, SM; Rosli,FN; Roy, C; Rozaimi, M; Saini , N; Salmo, SG; Samuelson, JI; Satyanarayana, B; Shah, DG; Shah, N; Shepard, CC; Sheridan, C; Sherman, KD; Sidik, Frida; Sievers, M; Simonjan, J; Simpson, S; Stewart, HA; Suárez, L; Tabola, J; Thomas, N; Thorn, JPR; Tol, S; Uddin, MM; Valla, AAE; van Eijk, P; Venkatraman, A; Villarreal-Rosas, J; Williams, JL; Wodehouse, DCJ; Wong, L; Zimmer, M; Worthington, TA. Ambitious goals for global mangrove conservation and restoration. Ambio (2026, in press).



Guatemala South Coast Restoration Network

José F. Moreira Ramírez (WCS Guatemala)

The Guatemala South Coast Restoration Network is an inter-institutional platform with the aim of promoting the restoration of forest landscapes and the conservation of degraded ecosystems on the country's Pacific slope.

The Network has led the planting of mangrove seedlings in the community of San Francisco Madre Vieja (Tiquisate, Escuintla), strengthening the National Forestry Institute's 'Sembrando Huella' program. We have restored mangrove areas within the Manchón-Guamuchal Conservation Area within Sipacate-Naranjo National Park supporting the National Council of Protected Areas.

The Network has also led the protection of red mangroves in Tecojate, as part of the actions of the Mangrove Technical Committee.

Together, we are working towards sustainable development of Guatemala's mangroves!

Photo: Implementing restoration and protection initiatives in the Hawaii Multiple-Use Protected Area, in partnership with the South Coast Restoration Network of Guatemala, engaging the government, co-administrator of the area, and local partners to protect more than 2,000 hectares of mangroves. © Jefferson Duarte / WCS Guatemala



Regenerative Seascapes for People, Climate and Nature (ReSea)

Christopher Roy and **Busolo Bonface** (International Union for Conservation of Nature)

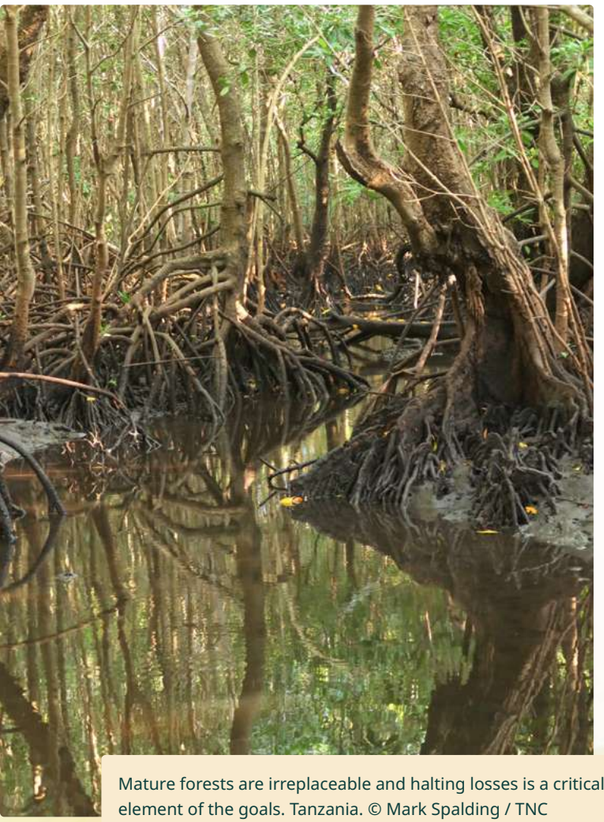
Across Comoros, Kenya, Madagascar, Mozambique and Tanzania, **ReSea Project** is applying mangrove restoration and conservation as a gender-responsive Nature-based Solution for adaptation, contributing to 2030 mangrove goals through seven demonstration sites in the Western Indian Ocean. At Prawns Lake, Kenya, co-management agreements between five Beach Management Units and local government have created the foundation to restore 121 hectares and conserve 1,697 more – working with 300 community members to rebuild fish nursery habitats and sustainable livelihoods. Community-run ecotourism enterprises, including an eco-restaurant and kayaking, provide income linked to ecosystem health – a replicable model spreading across the **Great Blue Wall** network.

Photo: Community members and Beach Management Unit partners review progress at Prawns Lake. © IUCN

4.2 Halt Loss

Mark Spalding (The Nature Conservancy)

For decades, authors have written about mangrove losses. No-one has ever been able to reliably determine an estimate of "original" mangrove cover, although it seems highly likely that it was over 200,000 km^2.[1]



Mature forests are irreplaceable and halting losses is a critical element of the goals. Tanzania. © Mark Spalding / TNC

Throughout the twentieth century, losses were heavily driven by clearance and conversion to aquaculture and agriculture. Smaller losses are linked to impacts on drainage and sediment supply; from conversion to industrial and urban space; and through clear-felling for timber or fuelwood. However, many losses occurred well before the advent of remote sensing, when accurate maps of mangrove cover were relatively rare, so our accounting remains poor.

Early statistics from FAO suggested loss rates of 2% of global cover annually in the 1980s, dropping dramatically in subsequent decades. The very latest statistics (Chapter 2) suggest some of these earlier loss estimates may have been exaggerated, but also point to a dramatic reversal of fate for estimates of global mangrove cover.

> Achieving this goal will **reduce global mangrove losses** over 2020–2030 by an estimated 1,500 km^2

Among the many challenges of understanding cover and change is that mangrove cover has always been highly dynamic, with mangroves frequently colonizing new sediments, even as they may be lost to human or natural processes elsewhere.

The goal to "halt loss" over a period of only a decade is clearly ambitious, but with declining rates of loss already apparent, it is feasible. There are two critical provisos:

- The target focuses on avoidable losses only. These are losses from direct human impacts such as land claim and clear-felling. We estimate that such losses are about 60% of total losses. Other losses, which may include sea level rise and storm impacts cannot be prevented by any reduction of local human impacts and are not considered.
- The target refers to halting all losses of existing mangroves. The natural expansion of mangroves to new sediments, while welcomed, cannot be used to assess progress or considered as "offsetting" losses of existing mangroves. This is important as mature mangroves host the highest levels of biodiversity and generate many of the most important ecosystem services.



Urban encroachment and land claim has led to massive losses of original mangrove cover in the Persian Gulf. © Mark Spalding / TNC

> Over the period 2010–2020 Myanmar had, by some margin, the **highest proportion of human-induced losses**

Closer scrutiny of this goal reveals variation in the scope of this challenge: loss rates vary around the world, often linked to governmental policies which may support mangrove conversion, or promote conservation. Social perceptions are also important – many communities and societies now recognize the considerable benefits that mangroves bring in terms of coastal protection, fisheries and even tourism (Chapter 5), but elsewhere mangroves are not so highly valued and seen as potential locations for development, agriculture or aquaculture.

Halting loss may be particularly challenging in countries where loss rates are currently high. Over the period 2010-2020 Myanmar had, by some margin, the highest proportion of human-induced losses, losing 6% of its 2010 cover in ten years. Several other countries, including Guinea, Sierra Leone, the USA and the Philippines also lost over 3% of their mangroves in this period.

Success with this goal will, in effect, achieve what can be termed "avoided loss" – areas where mangroves would have been lost without such a change in human impact. Although it cannot be accurately predicted, we used the loss rates from 2010-2020 to generate a baseline from which to estimate the avoided loss accrued from a successful halting of mangrove loss by 2030. Using this, we estimate that achieving this goal will reduce global losses over the 2020-2030 period of some 1,500 km^2. Some unavoidable losses will continue, but the continued expansion of mangrove to new sediments may to some degree counter the impacts of these losses for people and biodiversity.

1 Spalding, M. D., Kainuma, M. & Collins, L. *World Atlas of Mangroves*. 319 (Earthscan, with International Society for Mangrove Ecosystems, Food and Agriculture Organization of the United Nations, The Nature Conservancy, UNEP World Conservation Monitoring Centre, United Nations Scientific and Cultural Organisation, United Nations University, 2010).

4.3 Double Protection

Mark Spalding (The Nature Conservancy)

One of the most effective ways to secure mangroves in the long term, and to safeguard the many benefits they generate for people, is to utilize existing conservation approaches.



Coral reefs and mangroves in Southeast Misool Locally Managed Marine Area, Indonesia. © Alex Mustard / Ocean Image Bank

Although many conservation-centric forms of protection exist such as Other Effective Area-Based Conservation Measures (OECMs), or even generic national legal frameworks (**Section 4.6**) (see **SOWM 2024** Section 6.1), traditional protected areas are, by a large margin, still the most widely adopted form of protection, providing long-term security for natural resources.

Overlaying the latest GMW maps and protected areas data[2], some 44.5% of mangroves fall within protected areas. This is considerably more than mean global protection statistics (17% of terrestrial areas and nearly 10% of marine areas). Given their importance, however, the GMA has stressed that this is not enough for an ecosystem that plays such a critical role both for biodiversity and for people. Drawing inspiration from the call under the Conservation on Biological Diversity (CBD) for conservation attention to be focused on "areas of particular importance for biodiversity and ecosystem functions and services" the GMA is seeking to ensure the best possible levels of protection for mangroves worldwide.

As a broad goal the concept of doubling protection provides a powerful headline, however reality demands a more nuanced response. Current levels of mangrove protection vary enormously, from zero to near total protection across the range of mangrove nations. **Under a more detailed review, therefore, the authors on the revized paper recommend three broad classes of action under this goal:**

Double Protection

the headline statistic, is recommended for all countries where current protection falls above 15% but below 45%. For these countries, the goal would generate protection at levels from 30-90% world-wide.

Target 90%

for countries already protecting 45% or more of their mangroves. Twelve countries have already achieved this goal and protected over 90% of their mangroves, and so this aim, while ambitious, should be achievable.

Minimum 30%

has been recommended for all countries with protection currently below 15%. This represents more than doubling, but would enable those countries to meet the minimum standard also set under the CBD.

> It is critical that **conservation measures for mangroves are equitable**, and that they are effective



Ghana Establishes its First Marine Protected Area

Samuel Appiah Ofori (One Tree Planted) and **Stephen Kankam** (Hen Mpoano)

Along Ghana's western coast, decades of overfishing, mangrove loss, and habitat degradation threatened mangrove ecosystems and communities that depend on them. The Greater Cape Three Points Marine Protected Area was established in an historic effort to enhance mangrove protection alongside critical fish spawning grounds, rocky reefs, estuaries, and coastal forests. A key lesson? The critical role of community participation in conservation and management. Looking ahead, the MPA offers a model for restoring mangrove-linked ecosystems, strengthening climate resilience, supporting sustainable livelihoods, and securing long-term benefits for coastal communities and marine biodiversity.

Photo: © Hen Mpoano

2 IUCN & UNEP-WCMC. The World Database on Protected and Conserved Areas (WDPCA). July 2026. Available on *www.protectedplanet.net*. (International Union for Conservation of Nature (IUCN) and United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), Cambridge, UK, 2026).

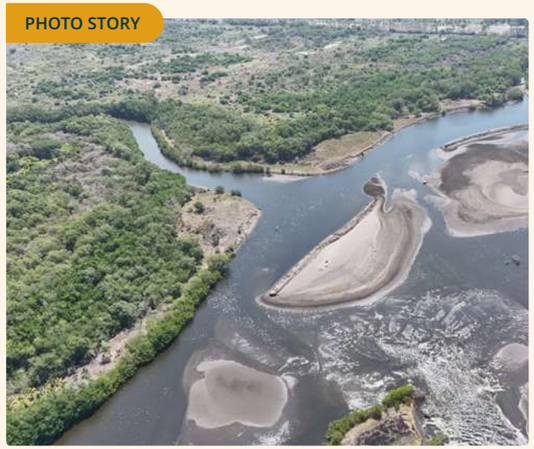
If these targets were met by each country, a combined total of 97,000 km^2 mangroves would be protected equating to roughly two-thirds of mangroves globally.

It is clearly not the place of the GMA to attempt to force policy, however it is hoped that, through reasoned argument and the on-the-ground engagement of GMA partners, other NGOs, and local communities, such targets will be viewed positively and embraced at all levels.

In Indonesia, the largest mangrove country in the world, some 25% of mangroves are currently in protected areas, and so the target to double protection would hold, leading to a recommendation of protecting 50% of remaining mangroves by 2030.

By contrast, three other critical mangrove countries – Brazil, Australia, and Mexico –already have protected areas covering 60 to almost 90% of their total mangrove extent. In these cases, doubling protection is not possible, but the ambitious target to reach 90% protection would be promoted.

PHOTO STORY



Designation of an area important for mangrove protection and nature-based tourism on Guatemala's Pacific coast, in collaboration with Nueva Concepción City Council, the private sector, and institutions responsible for protected areas and forests in Guatemala. © Jefferson Duarte/WCS Guatemala



Urban protected areas provide excellent opportunities for public access. Here in Brisbane, Australia. © Mark Spalding / TNC

A number of important mangrove countries fall far below the average levels of protected areas coverage, including Myanmar (3% protected), Papua New Guinea (5%), Nigeria (6%), and Thailand (6%). For these and other poorly covered countries it is argued that doubling protection would be insufficient and while the resources for higher ambitions may be limited, a base level of 30% protection is recommended. This degree of protection would also bring them in line with the minimum standards of the CBD with 30% protection by 2030.

> It is hoped that, through reasoned argument and the on-the-ground engagement, such targets **will be viewed positively and embraced at all levels**

Caution must be declared around understanding protection. It is critical that conservation measures for mangroves are equitable, and that they are effective. While we can use the current protected areas coverage as a general guide for future effort, in many cases existing protection falls short and direct human impacts may still occur. Efforts to document management effectiveness are being encouraged, however rolling out such assessments at the global scale are still far from reality.

In contrast to this risk of over-estimating protection, other effective forms of protection may go uncounted which could mean that some countries are actually doing better than estimated from protected areas statistics alone. The only solution to these challenges in the short term is likely to be independent national level assessments. GMA partners may be among the best placed organizations to do this work, with local knowledge combined with connection to the international partnership of other GMA members and Chapters.



PHOTO STORY

Bangladesh Environment and Development Society (BEDS) and Global Nature Fund (GNF) are constructing the Mangrove Museum and Learning Centre by the name of BADAPATH in Dacope, Khulna, near the single largest mangrove forest in the World. This center will be a cultural, educational, and research hub focused on coastal education, mangrove conservation, and climate resilience. BADAPATH aims to empower local communities through training while serving as a space for researchers, students, and nature enthusiasts. Its design offers a storytelling experience of the Sundarbans, showcasing the region's fauna, flora, and culture. Visitors will engage with the ecosystem through immersive sensory experiences, inspired by a mythical boat journey. Its design is led by architect Ricardo de Ostos and NaJa & deOstos. © Maksud / BEDS



Children fishing with a nylon thread and hook in an *Avicennia marina* mangrove creeklet in Gazi Bay, Kenya. © Farid Dahdouh-Guebas

Traditional ecological knowledge at risk

Farid Dahdouh-Guebas (Université libre de Bruxelles) and **Behara Satyanarayana** (Universiti Malaysia Terengganu)

Local and Traditional Ecological Knowledge (LEK and TEK) are fundamental to our understanding of mangrove ecosystems. A new study* in Gazi Bay, Kenya, drawing on 262 semi-structured interviews conducted in 2003, 2014 and 2021 analyses mangrove knowledge, utilisation, fisheries and community perceptions of environmental change.

Results reveal that a locally grounded ecological taxonomy remains, although mangrove use has declined. Reduced species knowledge and shifting gender roles were also reported. These trends indicate an ongoing erosion of TEK, linked to socio-economic transitions, conservation policies and changing livelihoods.

Many conservation interventions pay limited attention to the cultural dimensions of mangroves. The gradual decline of traditional practices in places like Gazi Bay reflects a gap in conservation attention. Younger generations are increasingly disconnected from these environments. Strengthening the integration of TEK and cultural ecosystem services into conservation planning and flagship programs like the UNESCO World Heritage evaluations would support more holistic approaches combining ecological integrity and the continuity of knowledge, practices and identities associated with mangrove landscapes.

* Dahdouh-Guebas, F., Rumba, S., Van Tendeloo, A., Munga, C. N., Koedam, N. & Hugé, J. What if Traditional Ecological Mangrove Knowledge Eroded over Decadal Time Scales? *Ethnobotany and Economic Botany* **80**, 227-257, (2026).

4.4 Restoration

Lanie Esch, Dominic Andradi-Brown, and **Maria Prebble** (World Wildlife Fund), **Thomas A. Worthington** (University of Cambridge), and **Magdalena Precoma** (World Wildlife Fund-Mexico)

PHOTO STORY



After years of unsuccessful planting, Rassam Mansur embraced community-based ecological restoration, reopening blocked waterways and enabling natural regeneration. Today, he inspires science-based and locally led restoration and stewardship under GMA's Mangrove Champions Initiative across Kenya. © The Good Picture

Where we stand

The GMA's goal for restoration, to "restore half" or 4,000 square kilometers by 2030, is based on a study that estimates the biophysical restoration potential of the world's mangroves[3]. The study used the Global Mangrove Watch extent layers to provide a footprint of losses between 1996 and 2020. It then identified restorable areas by excluding those patches where loss was likely to be attributed to human settlements and, the cost of restoration may be too high; as well as areas of open water, lost to erosion, in some cases driven by natural processes, but again too challenging to restore (**SoWM 2021**, Section 2.5). As with all such global studies, this analysis is primarily applicable at broad scales, being unable to capture site-scale characteristics. Further it focuses strictly on the biophysical determinants of restoration potential, thereby overlooking socio-economic, political, and operational constraints.

Tracking progress towards achieving the global restoration goal is challenging due to a lack of reporting by practitioners and a lag in the ability of remote sensing to detect successful restoration. The GMA-developed Mangrove Restoration Tracker Tool (MRTT) helps address these challenges (see **Section 6.3**).

Despite the area-based target of the GMA restoration goal, we need to be careful not to view restoration success just as a change in mangrove area. For many projects, funding for monitoring is limited to the first few years, if it is available at all. This is problematic because ecosystem structure and processes can take far longer to achieve equivalence to undisturbed mangroves. Satellite remote sensing can monitor elements of restoration projects, such as changes in extent or vegetation structure, and can be regularly carried out at broad scales. However, satellite remote sensing is limited in its ability to detect changes in many other aspects of a restoration project that we care about, such as changes in biodiversity or benefits to local communities.

> We need to be careful not to view restoration success just as a change in mangrove area

3 Worthington, T. & Spalding, M. Mangrove Restoration Potential. A global map highlighting a critical opportunity. 36 (The Nature Conservancy, IUCN, University of Cambridge, 2018).

The Mangrove Restoration Tracker Tool (see also Section 6.3) helps improve the visibility of restoration efforts worldwide. To date, the MRTT captures:

35
Organizations
supporting mangrove restoration efforts

21
Countries
implementing mangrove restoration

385
Restoration sites

84km²
of mangroves
under restoration

> As adoption of the MRTT grows, the tool will provide an increasingly **accurate picture of global mangrove restoration** progress and impact.

Restoration at scale

Although mangrove restoration has gained significant global attention since 2020, many implementation efforts remain relatively small in scale. More than 30% of the restoration projects stored in the MRTT cover less than 1 hectare, highlighting the need to scale up restoration efforts to achieve global restoration goals.

Growing policy commitments present an opportunity to scale up restoration. Mangrove restoration is increasingly being included in countries' Nationally Determined Contributions, creating a framework for scaling restoration through stronger policy, financing, and coordination. As many of these commitments are recent, their implementation and associated impact is expected over the second half of the decade and beyond.

Mexico showcases how GMA National Chapters (see Chapter 7) can align with national priorities to scale restoration. The Mexican Alliance for Restoration of Ecosystems (AMERE) is a national, multi-stakeholder platform to coordinate efforts, share knowledge, and drive restoration efforts across terrestrial and marine ecosystems and sectors in Mexico aligned with Target 2 ('30% restoration') of the Global Biodiversity Framework. The GMA Chapter in Mexico has worked with AMERE to fully align and integrate the Chapter's activities. Through this collaboration, AMERE and the Government of Mexico have identified mangroves as a priority ecosystem, highlighting how GMA Chapters can elevate mangroves within national restoration agendas.

What is needed to reach the 2030 restoration goal?

Achieving the 2030 restoration target will require more comprehensive and consistent reporting. Unlike protected areas which are often formally designated sites, recognized by national and regional governments, restoration sites are typically implemented at the local scale and are defined by project-specific boundaries. Therefore, reporting is largely dependent on local practitioners, many of which have limited capacity and resources to do so.

When restoration reporting does occur, site boundaries are often drawn imprecisely and can extend beyond ecologically suitable mangrove habitat (e.g. over the ocean). This leads to inflated estimates of restored areas and reduces the accuracy of reported restoration progress.

> Sustained monitoring of restoration will provide a clearer understanding of the long-term outcomes of **achieving global restoration targets**

Wider adoption of the MRTT and accurate delineation of restoration boundaries reported would improve data quality, reduce double counting, and enable more reliable monitoring of restoration efforts.

Long-term monitoring is equally important to understand the outcomes of restoration and the benefits associated with achieving the global goal. However, long-term monitoring of restored mangroves remains limited, constraining our understanding of ecosystem recovery over decadal timescales. While restoration delivers clear ecological gains, studies show that restored mangroves generally do not reach the functionality of intact forests within the timescales measured[4,5]. Sustained monitoring of restoration will strengthen this existing body of evidence and provide a clearer understanding of the long-term outcomes of achieving global restoration targets.

PHOTO STORY



In an effort to reduce plastic waste, our mangrove restoration partner NEWS has replaced 50% of conventional plastic nursery bags with biodegradable jute alternatives, reducing pollution and supporting more sustainable restoration practices for nature and communities. © Samadrita Roy, One Tree Planted

4 Su, J., Friess, D. A. & Gasparatos, A. A meta-analysis of the ecological and economic outcomes of mangrove restoration. *Nature Communications* **12**, 5050, (2021).

5 Bourgeois, C. F. *et al.* Four decades of data indicate that planted mangroves stored up to 75% of the carbon stocks found in intact mature stands. *Science Advances* **10**, eadk5430, (2024).



Beyond Replanting: Reimagining Mangrove Conservation in Indonesia

A Yoseph Wihartono (Yayasan Konservasi Alam Nusantara)

Between 1990 and 2019, Bengkalis Island lost over 1,207 hectares of mangroves to severe abrasion and illegal logging. To ensure long-term protection, YKAN implemented Community-Based Ecological Mangrove Restoration (CBEMR) rather than planting alone. This science-backed approach focuses on restoring natural hydrology to accelerate ecosystem recovery.

Crucially, this initiative secured formal legalities by embedding community management into institutional structures. YKAN facilitated the enactment of binding village regulations to establish clear zoning laws and usage rights. These frameworks empower the Village Forest Management Board to conduct regular patrols for mangrove protection purpose.

The results in Teluk Pambang deliver measurable change. The annual mangrove degradation rate plummeted by 96 percent, from 27 hectares per year during 2016–2021 to just 1 hectare in 2022 - 2024. Concurrently, active community participation expanded from five individuals to 170 members legally organized to guard their 950-hectare forest.

Photo: The vast majority of the remote indigenous community on Bengkalis Island relies on mangrove logging (*Rhizophora*) for a local charcoal factory. Conservation strategies must address these critical realities of local livelihoods. © A Yoseph Wihartono/YKAN



RE3CO proves success of community-led restoration

Yoali López, Mitzi García, and **Mariana Hernández** (WRI México)

During RE3CO I (Restauración y conservación de humedales costeros y desarrollo comunitario), coastal communities in southeastern Mexico restored 1,144 hectares of mangroves, conserved 2,532 hectares, rehabilitated 82 km of tidal channels, and planted 58,000 native seedlings. The project strengthened community-based conservation through sustainable livelihoods such as ecotourism, mangrove beekeeping, and responsible fisheries, all while promoting women's leadership in environmental management. In addition, it supported community-based monitoring, climate resilience, and local governance by establishing fish refuges and restoration networks. **The RE3CO initiative** demonstrated that community-led mangrove restoration delivers lasting biodiversity, coastal protection, and socioeconomic benefits.

Photo: Aerial view of the mangroves of southern Mexico, a success story part of the RE3CO initiative. © CGAIA Studio-WRI Méx-PPD



Community-Led Mangrove Restoration in Maranhão

Laura Lucas Trujillo (One Tree Planted)

Planting partner Samaúma led a community-based mangrove restoration project in Primeira Cruz, Maranhão, Brazil. Through One Tree Planted's support, the initiative successfully planted 855,840 mangroves across 103 hectares of degraded tidal areas. In this landscape, mangroves provide critical nursery habitat for fish and crustaceans, stabilize sediments, reduce coastal erosion, and protect local communities from flooding and storm impacts. These restored ecosystems also directly support artisanal fishing, crab harvesting, and other vital livelihoods that are central to food security and household incomes in the region.

Photo: Community members restore degraded mangroves in Maranhão, Brazil, planting red mangrove *Rhizophora mangle* propagules by hand in tidal mudflats to reinforce coastlines, supporting biodiversity. © Samaúma



Restoring mangroves in Qatar's extreme environments

Sara Abdul Majid (Earthna)

Qatar's National Mangrove Restoration Project (2023–2028), led by Earthna in partnership with the Ministry of Environment and Climate Change, Qatar University, and supported by MSC Foundation, aims to restore 40 hectares of *Avicennia marina*. Guided by the GMA Best Practice Guidelines, the project is advancing restoration in one of the world's most extreme environments through nature-inspired innovations that mimic ecological processes, including tidal flooding land nursery systems, wave-attenuating coastal nurseries, and radial transplantation techniques. These approaches are improving restoration success while generating practical lessons and best practices for mangrove restoration in hot and arid environments that can inform similar initiatives globally.

Photo: Planting native *Avicennia marina* seedling at Earthna's restoration site under Qatar's National Mangrove Restoration Project. © Tony Zgheib



ZanzAdapt Tanzania Advancing gender equality and climate adaptation

Dominic Wodehouse
(Mangrove Action Project)

ZanzAdapt is a multi-year, Global Affairs Canada-funded project implemented by **Community Forests International** and Community Forests Pemba in Zanzibar, Tanzania. This project is advancing gender equality and nature-based climate adaptation in coastal communities on Pemba and Unguja Islands. The project targets 4,000+ direct beneficiaries, 80% women & 40% youth, by providing climate-smart agroforestry training, conservation income opportunities, and legal land rights through 'community forest management agreements', to create a broader enabling environment for women's leadership in environmental governance. A central pillar of ZanzAdapt is the protection and restoration of mangrove forests, with training provided by Mangrove Action Project.

Photo: The women of Uzi Village, Unguja, Zanzibar's main island, tending to their mangrove nursery. © Mangrove Action Project / Community Forests



A pathway for fishpond restoration in the Philippines

Dennis Calvan and **Jamie Tabing** (Rare)

Decades ago, vast stretches of the Philippines' mangroves were leased and cleared for the development of fishponds. Managing these areas has been complicated by overlapping government mandates, making their legal status and future use difficult to determine.

That coordination gap is starting to close. With the support of the Asian Development Bank & Rare, the Department of Environment and Natural Resources and the Bureau of Fisheries and Aquatic Resources have signed a Memorandum of Agreement to jointly assess the condition and tenure of these areas and identify the most appropriate future use, including mangrove rehabilitation.

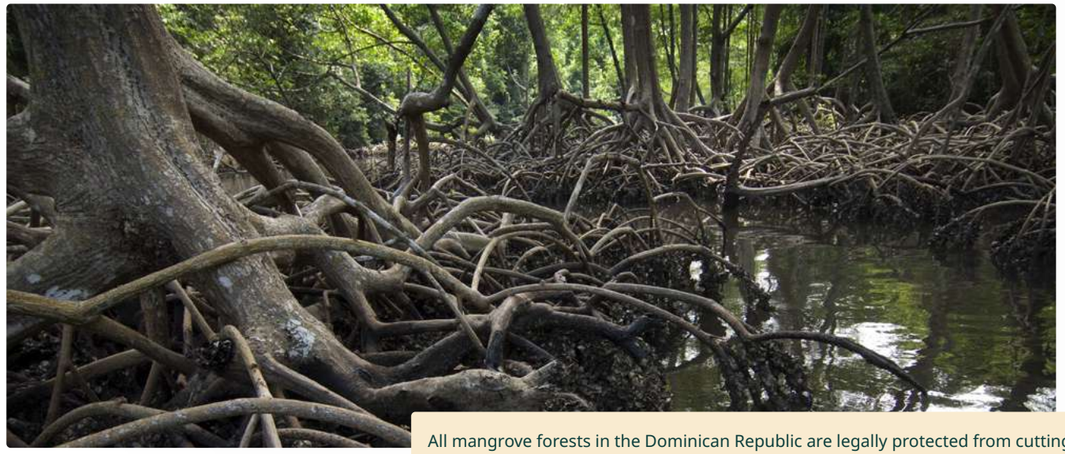
The agreement is part of Marine Ecosystems for Blue Economy Development (MEBED), an ADB policy-based loan program with the Philippine government. By linking national financing with policy reform, it creates a pathway to return eligible fishponds to living mangrove forest.

Photo: Mangroves in Del Carmen, Siargao Islands, Philippines. © Ferdz Decena / Rare

4.5 Legal protection of mangroves at the national level

Lydia Slobodian (Georgetown University), **Dominic Andradi-Brown** (World Wildlife Fund), and **Christopher Brown** (University of Tasmania)

While there has been considerable focus on spatial conservation measures for mangrove protection, it has been apparent for many years that generic and holistic protection of all mangroves under national or regional policy or legal framework may offer an alternative, or a strengthening framework, for such efforts.



All mangrove forests in the Dominican Republic are legally protected from cutting and clearance under national law. Here in Samana Bay. © Mark Godfrey / TNC

In reality, over 80% of the world's mangroves are explicitly targeted for protection under some form of national law[6]. These laws exist in 65 countries and territories, and range from restrictions on cutting and clearing (covering 60% of the world's mangroves) to integration into planning and environmental impact assessment processes (75%) to community management frameworks applicable to mangrove areas (83%). Some jurisdictions have more restrictive laws than others.

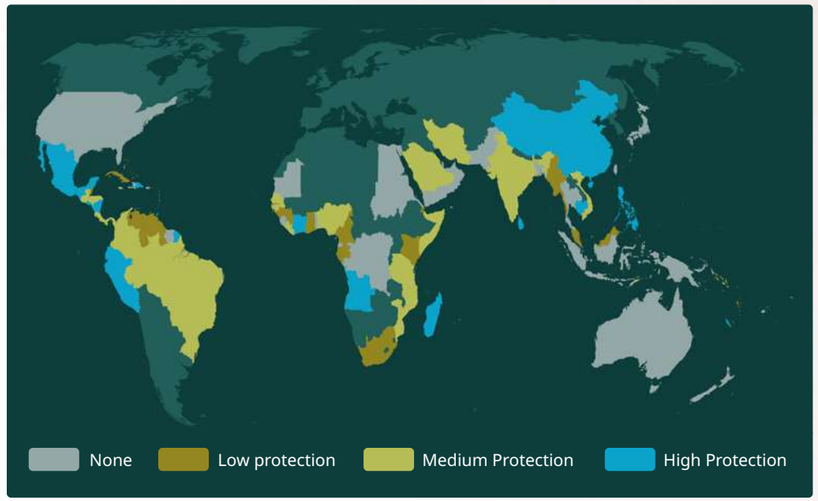
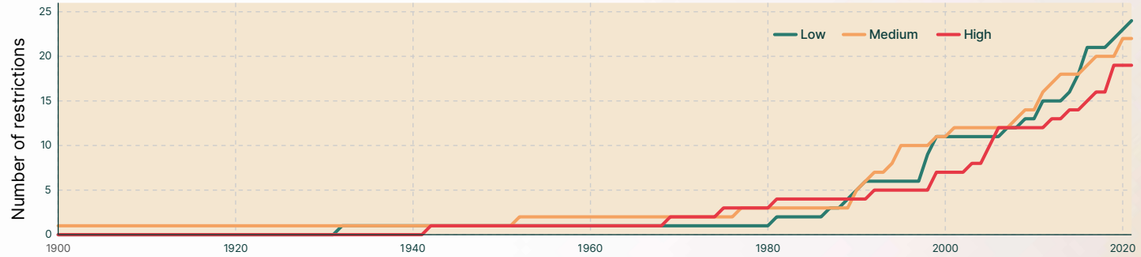


Figure 18: Explicit restrictions on mangrove cutting and level of protection provided. Map showing the distribution of national restrictions, with a graphic (below) showing the cumulative number of jurisdictions with cutting restrictions through time.

"High" protection indicates all cutting and clearing of mangroves is prohibited. "Medium" protection indicates that cutting, clearing, or conversion is prohibited for some but not all uses, species, tree heights or diameters, or sizes of mangrove areas. "Low" protection indicates that cutting, clearing, or conversion of mangroves requires a permit for some or all uses.



In jurisdictions with cutting restrictions, 'high' level protection prohibits all cutting or clearing of mangroves (14% of mangroves), 'medium' protection bans some uses but not others (27%) and 'low' protection requires a permit for some or all activities (18%).

National laws play a clear role in preventing mangrove loss. Analysis of mangrove forest area from satellites shows that countries with national laws protecting mangrove have lost less forests than they otherwise would have[7].

Over 80% of the world's mangroves are **explicitly targeted for protection** under some form of national law

6 Slobodian, L., C. A. Buelow, S. C. Baker, S. Alvarez, K. C. Wood, J. Villarreal-Rosas, et al. Quantifying the presence and potential of national legal frameworks for global mangrove protection. *Cell Reports Sustainability*. 2026.

7 Brown, C. J., L. Slobodian, A. A. Amir, M. F. Adame, S. Baker, J. Bell-James, et al. *Impact of national policies and laws on global mangrove deforestation*. SSRN Preprint. 2025.



Legal restrictions on mangrove cutting in Kenya only offer limited protection, however mangroves are specifically integrated into coastal zone planning regulations and given special protection. Here in Lamu, Kenya. © Mwangi Kirubi

Among the range of types of protection offered under such laws, cutting and clearing restrictions have proven to be the most effective for preventing loss of mangroves.

The existence, type, and level of protection that different countries use depends on political, economic, geographical, and ecological factors. Jurisdictions benefiting from high value mangrove-related ecosystem services like fisheries and carbon stocks are more likely to have explicit mangrove policies, environmental impact assessment requirements for mangroves, and inter-agency coordination mechanisms. Countries and territories where mangroves play an important part in coastal protection are more likely to integrate mangroves in coastal planning frameworks. Countries with lower per capita GDP are more likely to have laws providing for community management, indicating a possible opportunity to invest in community-led mangrove protection using existing legal frameworks.

> Cutting and clearing restrictions have proven to be the **most effective** for preventing loss of mangroves

As we approach 2030 and attempt to assess progress towards conservation targets it will be critically important to make a full appraisal of all forms of protection. Furthermore, it will be valuable to build a more comprehensive understanding of both the concepts and practicalities of using national-scale legal and policy frameworks for mangrove conservation, assessing best practice to ensure measures are effective, equitable, and secure over the long term.

4.6 Prioritizing progress

Steven W.J. Canty (Smithsonian Institution), **Mark Beeston** (Conservation International), **Christopher Brown** (University of Tasmania), **Elizabeth Francis** (University of Colorado), **Ixchel Lopez** (World Wildlife Fund- Mexico), **Francis Okalo** (International Union for Conservation of Nature- Kenya), **Apri Susanto Astra** (Wetlands International- Indonesia), **Jessica Wandscheer** (Rare- Brazil), and **Thomas A. Worthington** (University of Cambridge)

It is important to highlight and celebrate the successes to date: not only have mangrove loss rates significantly declined, but there are signs of recovery and expansion in several countries.

PHOTO STORY



Local wetland monitoring entered the digital age with **WETSAPP**, empowering practitioners and local people to collect accurate, GPS-tagged biodiversity data offline. It strengthens local research capacity, improves data quality, and supports evidence-based wetland conservation across Seychelles. © Liz Mwambui, Nature Seychelles

However, human driven losses continue to occur, and as a global community, we need to think of how and where mangrove conservation can make meaningful gains to safeguard mangroves and improve the well-being of coastal communities that depend on them.

> Successful actions in Indonesia alone would contribute to around **20% of the GMA goals**

Too Big to Ignore

There are some countries that cannot be ignored when looking to achieve the three GMA goals; Indonesia, Brazil, Mexico, and Nigeria are home to globally significant portions of the world's mangroves. Successful actions in Indonesia alone would contribute to around 20% of the GMA goals. Understanding how to implement conservation actions within these countries will be important in the safeguarding and restoration of the world's mangroves and the communities that depend on them.



Fishing boat in Aceh Province. Indonesia alone could contribute to 20% of GMA goals. © Junaidi Hanafiah/TNC Photo Contest 2019

Political Will

The recognition of the importance of mangroves to coastal resilience and local livelihoods has increased, with governments around the world identifying ways to better protect and restore their mangroves. Not all countries have large areas of mangrove, but all actions are important. Nearly all countries have adopted the Paris Agreement, and some such as Belize, Kenya, and Mexico, have included ambitious mangrove protection and/or restoration targets within their Nationally Determined Contributions. As described earlier (**Section 4.3**), the global mangrove goals set a higher ambition than the 30x30 target under the Convention on Biological Diversity. Assisting just Indonesia, Nigeria, and Malaysia to reach the proposed goals for mangrove protection, would safeguard a combined additional area of over 10,000 km^2 of mangroves. Combining political will with local actions will be key to successfully achieving national priorities and GMA goals. A key conduit for these local actions are the GMA National Chapters (Chapter 7), which have been shown to be important hubs for the coordination of mangrove positive activities.

High Risk, High Reward

There are countries where implementing conservation interventions can be more difficult than others. But that does not mean we should shy away from action in these geographies, as significant gains can be made with considerable benefits to coastal communities, in addition to the contributions to the GMA goals. For example, Myanmar could contribute up to 12.7% of Goal 1 - Halt loss, and 7.5% of Goal 2 - Restore half. In 2024, the GMA funded a project in Myanmar, which aims to increase the area of mangroves under protection and strengthen local livelihoods. Teams on the ground are making great progress, highlighting that action can be achieved despite more difficult enabling conditions.

> Assisting just Indonesia, Nigeria, and Malaysia to reach the proposed goals for mangrove protection would **safeguard an additional 10,000 km^2 of mangroves**

Importance of Locally Led Actions

Area-based targets are an important first step, but overlook the ultimate objectives of management, restoration, and protection. It is critical to keep in mind and assess the social priorities, including sustaining food security, livelihoods, coastal protection, and other ecosystem services that support communities, and ecological priorities, including conserving biodiversity hotspots, protecting rare and threatened species, and maintaining older, established forests. There will be tradeoffs between these priorities to ensure the long-term future of mangroves and the well-being of coastal communities.

> **It is critical** to assess social priorities, including food security, livelihoods, coastal protection… and ecological priorities including biodiversity hotspots and maintaining older, established forests

Making significant and successful advances towards the goals needs to be driven by locally led actions, with GMA National Chapters and national wetland or mangrove committees being critical parts of the conversations, national capacity, and implementation.

As we move forward, we need to identify how and where we can have impact. Enabling conditions are the foundation for success. Therefore the key to making transformational change is ensuring political will is combined with long-term financing and effective governance, supported by local mangrove heroes and champions who can help lead the way for interventions that build resilience in the coastal communities that live within and around mangroves.



Participatory mangrove conservation in Colombia

Danilo Torres Gómez and **Pablo Imbach**
(Tropical Agricultural Research and Higher Education Center (CATIE))

Between 2024 and 2025, The Tropical Agricultural Research and Higher Education Center (CATIE) implemented the project Sustainable Cuerval: Participatory mangrove conservation, restoration and monitoring strategies of the Cuerval Community Council for adaptation and mitigation, with a focus on integrating peace in climate action on the Colombian Pacific Coast. The project was supported by the Cauca Regional Autonomous Corporation and Colombia's Ministry of Environment and Sustainable Development and funded by the CTCN (Climate Technology Centre and Network).

The project analyzed the state of degradation and vulnerability of mangroves and developed a strategy for the conservation and ecological restoration of approximately 2,700 hectares of mangroves, as well as a community monitoring strategy to ensure the sustainability of the restoration actions.

Photo: Community members actively managing the mangrove areas that they steward. © Danilo Torres / CATIE



Fishing in Godavari mangrove forest, India. © Srikanth Mannepuri / Ocean Image Bank

5 Benefits of mangroves

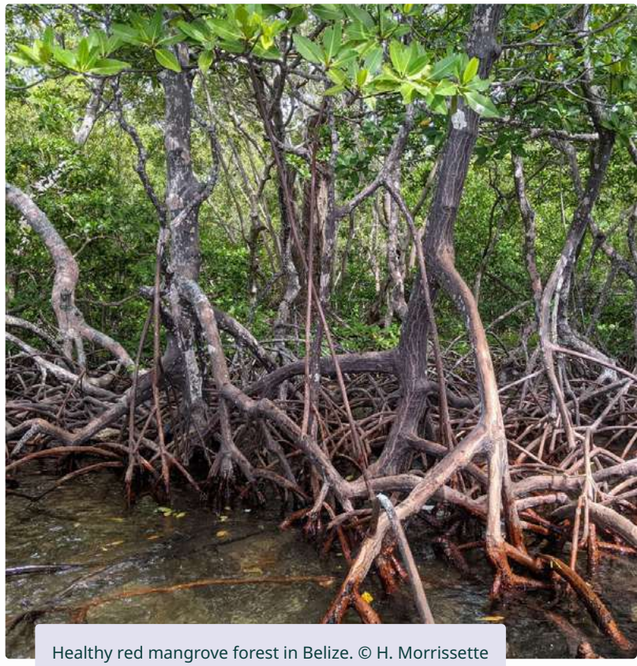
5.1 Impact of ecosystem change on carbon loss

Hannah Morrissette and **Annie Tamalavage** (Smithsonian Environmental Research Center)

Mangrove resilience is determined by their ability to persist in the face of direct threats and indirect change, allowing for sustained ecosystem services such as coastal protection, biodiversity, and livelihoods support.

One such service - the ability for mangroves to pull carbon dioxide from the atmosphere and store it underground better than almost any other ecosystem on Earth - has led to their recognition of being important ecosystems for reduced and avoided greenhouse gas emissions[1]. The preservation of these pathways for carbon storage and avoided loss back to the atmosphere is identified as a nature-based solution, and included in national policy and reporting, i.e. Nationally Determined Contributions (NDCs) and Greenhouse Gas Inventories (GHGIs)[2].

A carbon stock inventory of any ecosystem involves the quantification of carbon both in the living biomass and the soil. In reporting and tracking these carbon reserves, changes to the natural balance must be taken into consideration. As the majority of carbon is typically stored in the soil, carbon reporting needs to consider how the impacts of mangrove loss and disturbance will affect the soil. Disturbances can range from wholescale change to the ecosystem, such as completely clearing plants and sediment for infrastructure development, to more minimal impacts of harvesting parts of plants themselves while leaving soils or other components of the ecosystem intact.



Healthy red mangrove forest in Belize. © H. Morrissette

1 Adame, M. F., Connolly, R. M., Turschwell, M. P., Lovelock, C. E., Fatoyinbo, T., Lagomasino, D. *et al.* Future carbon emissions from global mangrove forest loss. *Global Change Biology* **27**, 2856-2866, (2021).

2 IPCC. 2013 *Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*. (Intergovernmental Panel on Climate Change, Switzerland, 2014).

Previous guidance recommended adopting an assumption that any disturbance will cause a loss of soil carbon to about 1m depth. In reality, different types of disturbances, varying environmental conditions, and variable levels of existing organic carbon will all have an impact on the amount and rate of organic carbon lost. It is now generally agreed that the application of global standards will miss such place- and case-specific variability.

Recent studies have begun to quantify local scale variation in carbon vulnerability, and are encouraging the use of emissions rates that capture common variabilities and nuance in various mangrove environments[3]. Evaluating differences in carbon stock and disturbance type is the best way to reduce uncertainty in policy and inventories moving forward.

Such work suggests that carbon loss from mangrove degradation or conversion ranges from 1-70% of total ecosystem carbon, based on activity type. Activities such as harvesting, that affect plants, but not the underlying soil, do not remove sediment and result in negligible loss. Extreme climatic events such as cyclones, can disturb up to 30 cm of the stored soil and release over 30% of its carbon. More impactful activities, for example the active conversion of mangroves to agriculture, can alter soil to a depth of 2 m, and, while these processes may take decades, they may eventually result in 70% loss of carbon. Some of these losses may also, in effect, be irreversible, at minimum taking decades to recover even after ecosystem restoration. However, since not all carbon loss is instantaneous, for more sustained effects from events such as consistent agricultural runoff, delayed regeneration post-storm, etc., addressing root issues early, like nutrient imbalances or tidal flow restriction, can be a way to prevent reaching the maximum projected loss.

> Carbon loss from mangrove degradation or conversion ranges from 1-70% of total ecosystem carbon, based on activity type



Degraded and dead mangrove in Belize, likely linked to nearby development and sea level rise. © H Morrissette

With the impacts of disturbance to upper soil storage in mind, a global 1 m soil depth standard for carbon stock, loss, and emissions estimation is understood to be inaccurate. Realistic estimates, adapted for specific environmental conditions and diverse impacts, are needed to evaluate the carbon benefits or consequences that come from healthy or damaged mangrove ecosystems. Such information will be important for protection, restoration, and monitoring efforts as we work to achieve collective environmental targets at national and global scales.

3 Fu, C., Klein, S. G., Breavington, J., Lim, K. K., Steckbauer, A. & Duarte, C. M. Nonuniform organic carbon stock loss in soils across disturbed blue carbon ecosystems. *Nature Communications* **16**, 4370, (2025).



Building Belize's Blue Carbon Future: Science, Communities, and Sustainable Development

Florencia Guerra and **Minerva Gonzalez** (Belize Forest Department)**, Nadia Bood** and **Juliet Neal** (WWF Mesoamerica)

Belize, through its mandated entity for mangrove management and for reporting land use and land-use change, the Belize Forest Department, has advanced mangrove carbon research by establishing 28 Permanent Sample Plots to measure and monitor biomass accumulation and quantify carbon sequestration. Translating this science into practical information for communities, local governments, decision-makers, and national forest inventories is essential for developing effective Blue Carbon monitoring and reporting frameworks.

The Belize Chapter of the Global Mangrove Alliance is fostering sustainable development by integrating such science into community-based action, promoting greener development pathways, and supporting fair and equitable benefits through future environmental market-based instruments.

Photo: Mangrove carbon sample collection in Belize. © Belize Forest Department



From Science to Decision-Making: Mangrove Monitoring and Blue Carbon Assessment in São Paulo, Brazil

Laís Coutinho Zayas Jimenez, Beatriz Eiko Kitagami, and **Julia Lima Monteiro de Carvalho** (Fundação Florestal)

Since 2024, São Paulo State has been advancing public mangrove management by translating scientific knowledge into practical decision-making tools. Continuous monitoring programs have been established across the state's mangroves, focusing on birds, crabs, vegetation, and soils. The resulting data are incorporated into an online platform used by managers to support evidence-based conservation and territorial planning.

In partnership with the University of São Paulo (USP), the state is also implementing an ecosystem-scale blue carbon inventory integrating aboveground biomass, soil carbon stocks, and potentially toxic elements. Based on extensive field sampling, this initiative provides an unprecedented level of detail for both science and public management. Preliminary results indicate that São Paulo's mangroves stand out nationally for their carbon storage capacity, while generating the most comprehensive characterization of the state's mangrove ecosystems to date.

Photo: Researchers undergo Mangrove Monitoring and a Blue Carbon Assessment in São Paulo, Brazil. © Bruno Leonelle Garrote

5.2 The dynamics of mangrove carbon

Annie Tamalavage and **Hannah Morrissette**
(Smithsonian Environmental Research Center)

Mangroves are highly productive ecosystems, producing a lot of plant material and eventually storing a significant proportion of it in the soil.

The sequestration of this material, alongside carbon from other sources, in the mangrove ecosystem is increasingly being factored in to national-level climate policy and management through the development of carbon inventories. In turn this requires increasingly accurate carbon accounting.

Carbon stocks in mangroves are either derived from production in situ (autochthonous) or generated from external sources (allochthonous) that end up being captured by the mangrove ecosystem. This incoming carbon flux can be a major contributor to carbon stocks. Disaggregating autochthonous and allochthonous carbon is considered important in order to develop robust carbon inventories, however, it is challenging. Geochemical measurements of soil and models can help to uncover this variation.



Coastal mangroves at Ría Celestún, Mexico. The brown coloring of the water is a clear indication of the carbon species that are abundant in mangrove settings. © Annie Tamalavage

> **Carbon stocks in mangroves** are either derived from production in situ (autochthonous) or generated from external sources (allochthonous) that end up being captured by the mangrove ecosystem

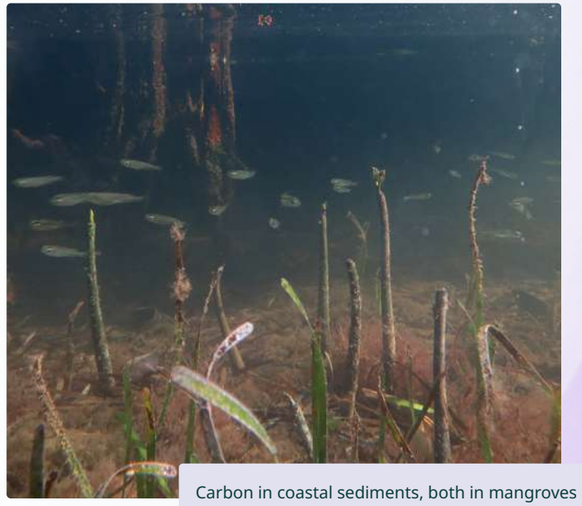
Mangrove ecosystems also export considerable volumes of carbon. Research has suggested that in some locations the net export of carbon outwelled to the coastal ocean might be greater than in situ sequestration baselines[4]. Some components of this exported carbon, notably particulate organic carbon (POC), may become sequestered into other shallow blue carbon ecosystems or into the deep ocean (below 200 m). However, tracking the export and eventual storage of that carbon remains difficult, requiring complex or costly sampling, and further challenged by regional variability in tides and oceanic biogeochemical processes.

Carbon captured in mangroves is broken down along various microbial pathways by fungi, bacteria, and other microbes. It can be stored within soil or released in other forms through these breakdown processes. These processes cause the release of carbon dioxide gas, but also methane, to the atmosphere. Additionally, some other mineral carbon forms (dissolved inorganic carbon) can move from the mangrove soil and porewater through hydrologic processes, like tides or riverine flows, to enter coastal waters[5]. For example, estimated export of the dissolved phase of inorganic carbon can range from 0-46 metric tonnes of carbon per hectare per year[6].

Carbon stock measurements provide important baselines for national policy, regional management, and local inventories, but the movement of carbon into and out of mangrove ecosystems needs to be quantified to reduce uncertainty. Although work continues, a full picture of the variations of these processes that promote or limit total sequestration is currently not included in coastal carbon inventories.

Improved accounting of sequestration and the fluxes of carbon would enable countries to scale up their "tier reporting" of carbon set by the Intergovernmental Panel on Climate Change. This allows for a strengthening between science and policy, a reduction of uncertainty, and improved valuation of a proposed natural climate solution (NCS).

Understanding carbon sources and fluxes is critical to avoid double counting of carbon that may accrue in mangrove from adjacent ecosystems, but also importantly, understanding the export of organic carbon into offshore ecosystems may help to highlight additional links of the coastal carbon cycle to other benefits of mangroves such as fisheries food web dynamics for mutually beneficial social and environmental outcomes.

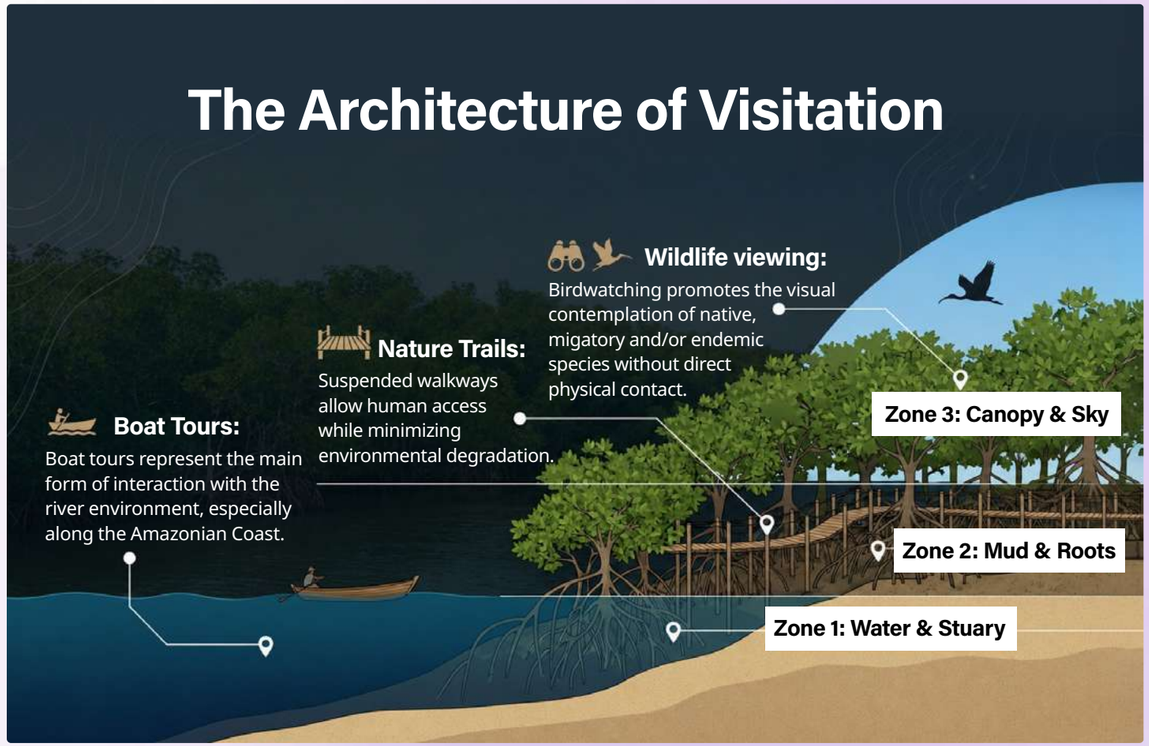


Carbon in coastal sediments, both in mangroves and adjacent ecosystems, can come from multiple sources. © Mark Spalding / TNC

4 Santos, I. R. *et al.* The renaissance of Odum's outwelling hypothesis in 'Blue Carbon' science. *Estuarine, Coastal and Shelf Science* **255**, 107361, (2021).

5 Alongi, D. M. Global Meta-Analysis of Mangrove Primary Production: Implications for Carbon Cycling in Mangrove and Other Coastal Ecosystems. Forests **16**, 747 (2025).

6 Reithmaier, G. M. S. *et al.* Carbonate chemistry and carbon sequestration driven by inorganic carbon outwelling from mangroves and saltmarshes. *Nature Communications* **14**, 8196, (2023).



Mangrove Tourism in Brazil

Letícia Teixeira Cordeiro, Francisco José Reyes Sánchez, and **Marília Cunha-Lignon** (São Paulo State University (UNESP))

In addition to supporting biodiversity and multiple provisioning and regulating services, mangroves also provide cultural ecosystem services related to leisure, traditional practices, and tourism. A **recent study** assessed mangrove tourism activities in 52 Brazilian federal protected areas (PA) across 15 states, using online questionnaires completed by PA managers and available management plans. Data were organized and analyzed using descriptive and inferential statistics, including regional comparisons. Most activities were recorded from Sustainable Use PAs (71%), particularly Extractive Reserves (44%).

The most frequent tourism activities were boat tours, recorded in 60% of the protected areas, followed by trails in 40%, and wildlife watching in 29%. Additional activities included environmental education, research, artisanal and recreational fishing, cultural tourism, community-based experiences, diving, and landscape contemplation. These findings highlight mangrove tourism as an important cultural ecosystem service supporting conservation, public use planning, and traditional coastal communities in Brazil.

5.3 Coastal protection by mangroves

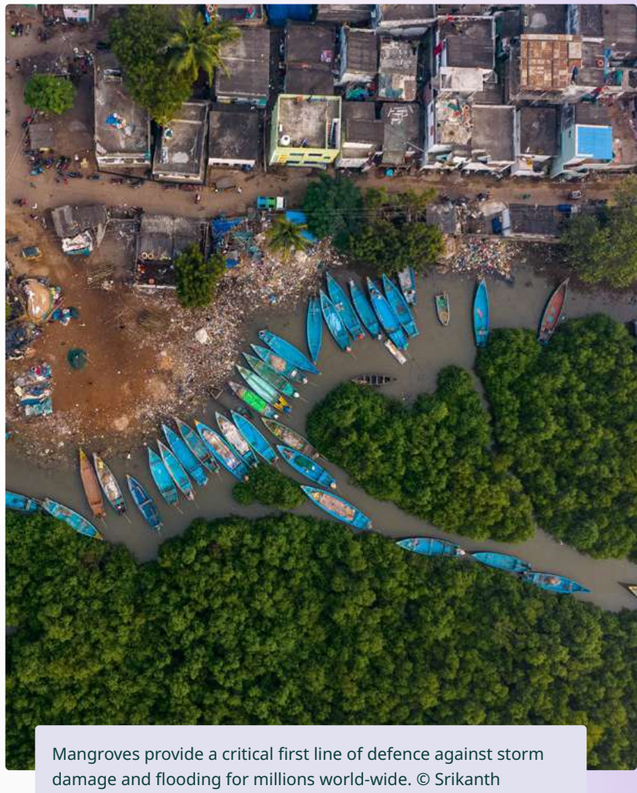
Vincent van Zelst, Bregje van Wesenbeeck, and Arjen Luijendijk (TU Delft; Deltares)
Timothy Tiggeloven (VU Amsterdam; CMCC), **José A. A. Antolínez** (TU Delft), **Robyn Gwee** (National University of Singapore), and **Ignace Pelckmans** (University of Antwerp)

From green belt width to landscape scale modeling

Mangroves as buffer against coastal flooding

Coastal flood risk is increasing due to increased storm frequency, sea-level rise and land subsidence, and exacerbated by population growth increasing vulnerability. Flooding in coastal areas is driven by several components: astronomical tide, storm surge, and waves. Their relative importance varies by location. While wave-vegetation interaction has received considerable attention in literature, the sheltered nature of most mangrove forests means that surges and tides are the dominant drivers of extreme water levels.

Traditionally, governments relied on engineered hard structures, such as dikes and sea walls, as protection against flooding. A growing body of evidence shows the ability of mangroves to reduce flood impacts. Mangroves exert resistance to the flow of water and thereby slow down and redistribute incoming storm waters. This leads to lower flood depths and can reduce the total landward area that is



Mangroves provide a critical first line of defence against storm damage and flooding for millions world-wide. © Srikanth Mannepuri / Ocean Image Bank / Mangrove Photography Awards

flooded. In addition to these functions of slowing and redistributing water flow, mangroves attenuate waves – reducing their energy as they pass through the complex structures of the ecosystem.

> Mangroves exert resistance to the flow of water and thereby **slow down and redistribute incoming storm waters**

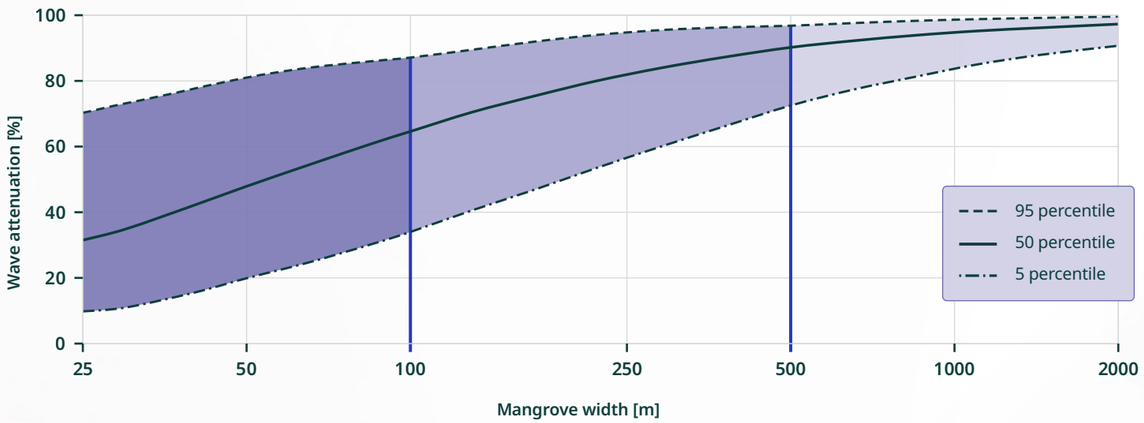


Figure 19: Wave attenuation percentage versus green belt width

Green belt policies for wind-wave dampening

Legislation for the protection of mangrove green belts are in place in several countries. A new study found that where green belts are narrower than 500 m, the dissipation of wind-waves is largely determined by local water levels, incoming wave height and forest characteristics[7]. A 25 to 100 m wide green belt can reduce waves on average by 30 to 65%, whereas greenbelts that extend over a distance of 500 m reduce waves by 75-95% dependent on local hydrodynamic and forest characteristics (Figure 19). Thus, while even relatively narrow belts may be important, green belts of 500 m wide or more should be maintained wherever they occur.



In many areas, such as parts of south Florida shown here, a wide swathe of dense mangroves greatly reduces flood risk on adjacent land. © Mark Spalding / TNC

> A 25 to 100-meter-wide green belt **can reduce waves on average by 30 to 65%**, whereas greenbelts that extend over 500 meters reduce waves by 75-95%

7 van Wesenbeeck, B. K., van Zelst, V. T. M., Antolinez, J. A. A. & de Boer, W. P. Quantifying uncertainty in wave attenuation by mangroves to inform coastal green belt policies. *Communications Earth & Environment* **6**, 258, (2025).



A simple sea defense behind extensive mangroves in southern China. © Mark Spalding / TNC

Hybrid shorelines

In absence of extensive mangrove belts to fully reduce flood levels, a combination of mangroves with engineered water retaining structures can be considered. Extensive areas of coastal wetlands are already backed by seawalls or other coastal defenses. These range from bespoke engineered structures to simple hand-built barriers. A recent study underlines the cost-effectiveness of integrating mangrove restoration into these so-called hybrid solutions[8]. Although incorporating mangrove restoration with engineered protection structures can optimize flood mitigation strategies, it can limit landward migration potential under future sea-level rise. The study highlights that mangrove restoration should be economically viable for about half of the subnational regions assessed with greatest benefits estimated for parts of Asia and West-Africa.

8 Tiggeloven, T., van Zelst, V., Mortensen, E., van Wesenbeeck, B. K., Worthington, T. A., Spalding, M. *et al.* Mangrove restoration and coastal flood adaptation: A global perspective on the potential for hybrid coastal defenses. *Proceedings of the National Academy of Sciences* **123**, e2510980123, (2026).

The need for landscape-scale flood modeling

Extreme coastal flood events are often the result of a combination of surges, tides and waves. More extensive greenbelts, spanning several kilometres, are typically needed to substantially reduce flood extent and water level of storm surges. Global estimates of the flood protection benefits of mangroves tend to be based on simplified models, neglecting 2D patterns of water movements, such as flows bypassing forests or the funnelling of storm waters. For instance, a common underlying modelling assumption is that storm waters propagate through a green belt along straight lines perpendicular to the coast (1D modelling). This bears little resemblance to reality in which water flows both through and around mangroves, propagating through creeks and spreading unevenly across the landscape. This is especially the case for floods caused by tides and surges[9].



2D flow models provide a more realistic picture of the patterns of flooding through coastal embayments and mangrove channels. Bootless Bay, Papua New Guinea. © Annette Ruzicka

A new modeling framework for global overview and local support

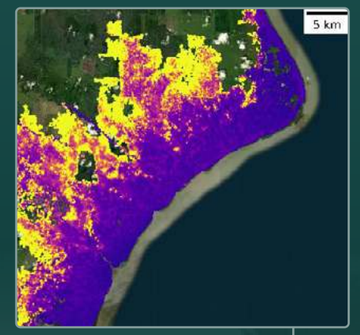
A finalized model of the global flood protection model described in **2024** is now under review. This work led by Delft University of Technology, Deltares and the Institute of Environmental Studies (IVM) Amsterdam, in collaboration with The Nature Conservancy (TNC) and the University of Cambridge, uses two-dimensional models to simulate water movement across entire coastal landscapes. While previous modeling studies typically decoupled flow within wetlands and overland flooding, the new approach combined both processes within a unified hydrodynamic model. The modeling effort considers both mangroves and tidal marshes, although the former have the most dramatic impacts on flood reduction. By linking these model outputs to maps of human population and infrastructure, while also accounting for engineered protection, the model derives estimates of annual protection provided by mangroves[10] (Figure 20). In addition to a ready-to-use global dataset, the modeling framework has been downscaled to bridge the gap from global to local scale and support local initiatives.

> **Water flows both through and around mangroves**, propagating through creeks and spreading unevenly across the landscape

9 Pelckmans, I., Belliard, J.-P., Gourgue, O., Dominguez-Granda, L. E. & Temmerman, S. Mangrove Vegetation Density and Channel Drainage Density Have Trade-Off Effects on Nature-Based Flood Risk Mitigation in Estuaries. *Journal of Geophysical Research: Oceans* **130**, e2025JC022398, (2025).

10 Van Zelst, V., Tiggeloven, T., Luijendijk, A., Spalding, M., Worthington, T. & Van Wesenbeeck, B. Adding a new dimension to the global flood protection value of mangroves and tidal marshes. (in rev).

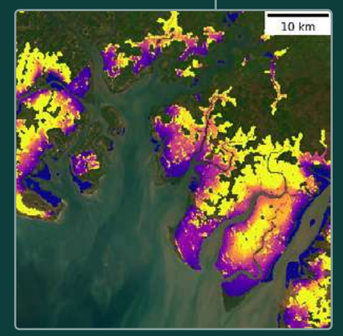
Figure 20: Relative patterns of protection from storm surge and tidal flooding, highlighting people protected. Inset maps show flood depth reduction in three diverse coastal settings: estuarine, open coast and coastal lagoon.



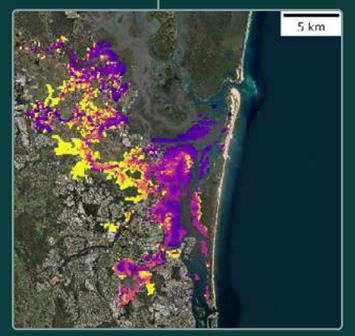
South Sumatra, Indonesia

People Protected
Low
Medium
High

Flood depth reduction by mangroves [%]
50
40
30
20
10
0



Kanfarande, Guinea



Gold Coast, Australia

Mangrove flood protection concentrated in Asia and Africa

The research shows that coastal wetlands reduce overall flood extents by over 5%, equating to reduced impacts for almost half a million people and some $2 billion in reduced damages every year. These present-day coastal protection benefits are concentrated in Asia and Africa, which together account for over 85% of the global flood protection benefits (Table 4). Importantly, protection by mangroves relative to the exposed buildings and people is 20 times larger for low-income countries compared to high income countries. A factor driving this is the higher flood protection level provided by engineered structures in higher income countries which is accounted for in our analysis.

> Coastal wetlands reduce overall flood extents by over 5%, equating to **reduced impacts for almost half a million people** and some $2 billion in reduced damages every year

Future coastal protection benefits depend on the changing patterns of mangrove extent, which is challenging to predict over the long-term. Our model generates future scenarios which indicate that the relative benefits of mangroves will increase considerably if they are able to maintain their current extents, however if they are unable to keep up with rising seas such benefits will be greatly reduced. In ongoing work with the National University of Singapore, future flood protection benefits are being assessed using the new model framework under several future scenarios of sea-level rise and land-use change. In the near term, land-use change is likely to remain the main cause of mangrove loss (see **Section 3.1**), although sea-level rise is widely recognized as a long-term threat (**Section 3.3**).

Country	Share of global population benefits	Share of global avoided damages
Asia	82,9%	83,9%
Africa	12,7%	6,2%
North America	2,3%	6,6%
South America	1,5%	2,2%
Europe	0,4%	0,7%
Australia	0,1%	0,3%
Oceania	0,1%	0,1%

Table 4: Distribution of global coastal protection benefits across continents, expressed as the share of total people benefiting from coastal protection and the share of total avoided damages attributable to mangrove ecosystems.

The role of wind waves on extreme water levels

Locally, flood levels can be aggravated by wave-setup, which is an increase of the water level due to large breaking waves pushing water shoreward. However, such flooding can be limited if the water is not piling up at the shore, but is redistributed by currents. Such redistribution is likely where broad water bodies exist between the breaker zone and flood prone areas, such as lagoons and the areas between offshore reefs and the shoreline. Thus, in sheltered locations, wind waves are typically strongly attenuated through interactions with the sea floor, particularly via wave breaking and bed friction induced by shallow bathymetry and coastal geomorphology well before reaching the shore. This is the case for many mangrove areas around the world. Most mangroves are found in already sheltered locations: less than 20% of the open coast mangroves world-wide occur in cyclone-prone regions, and, of these, 70% are sheltered by wave-breaking coral reefs. In a test, we trialled the modeling of wave impacts on top of our tide and surge model for different coastal systems in Belize, Jamaica and Gabon. Jamaica and Belize are both located within the Atlantic hurricane belt. In Belize, the coastline is largely protected from direct wave attack by offshore reefs, while mangroves are typically situated within sheltered lagoonal environments. As a result, wave-induced flood levels were found to be generally low, as wave setup cannot be sustained. In Jamaica, offshore wave conditions can be highly energetic during storm events, generating significant wave setup along exposed headlands and open coasts. However, in those areas where mangroves occur, wave heights and associated wave setup are again typically much lower. Consequently, flood levels in these areas are predominantly driven by storm surge rather than wave processes, and as a result the role of mangroves in flood reduction is largely based on their role in reducing such surges. By contrast, Gabon is not exposed to tropical hurricanes and therefore experiences considerably milder storm conditions than Belize and Jamaica. Mangroves are generally found within estuaries, although some occur in relatively more exposed coastal settings around Port-Gentil. Even in these locations, wave energy remains limited, and wave-induced flood levels in the vicinity of mangrove ecosystems are typically negligible.

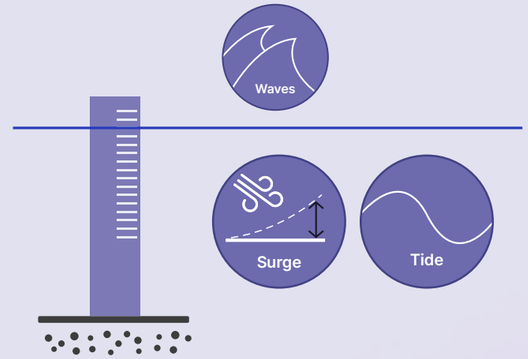


Figure 21: Schematic of the three elements of coastal flooding - tide, surge, and waves. Typically waves only play a very minor role in flooding in mangrove areas.

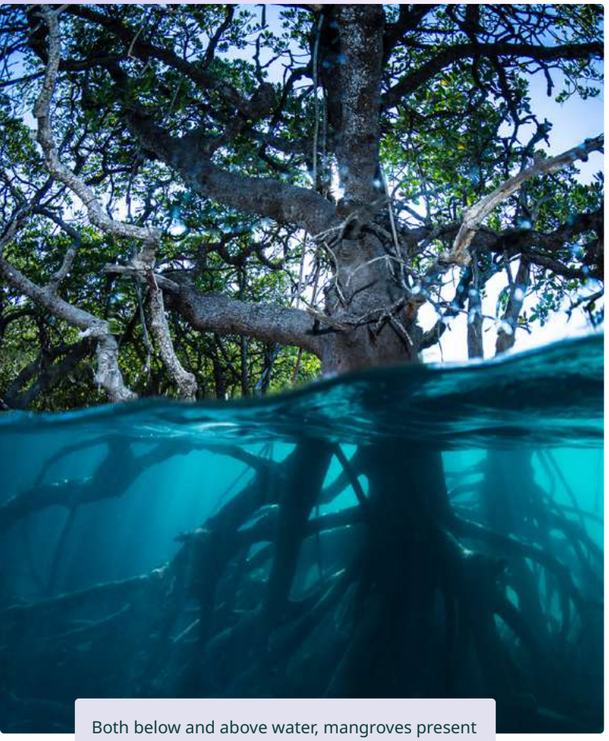
> The contribution of wind waves to flooding is typically limited in **sheltered coastal settings** where the majority of mangroves are found

These results highlight the overwhelming role of storm surges and tides in flooding in mangrove regions. Although they do indicate the role of mangroves in wind-wave attenuation, they clearly show that even where offshore waves are energetic, most wave energy is dissipated before reaching the mangrove edge. Although wave setup can be a notable contribution to flood levels along coastlines exposed to high-energy waves, the contribution of such waves is typically limited in sheltered coastal settings where the majority of mangroves are found.

5.4 Resilience credits

Lindsey Smart and **Stefanie Simpson** (The Nature Conservancy)

Healthy intact coastal ecosystems offer a powerful nature-based solution to growing flood risks driven by climate change and sea-level rise. By absorbing wave energy and reducing storm impacts, these ecosystems can provide substantial protection, often at lower cost than traditional infrastructure such as seawalls and levees.

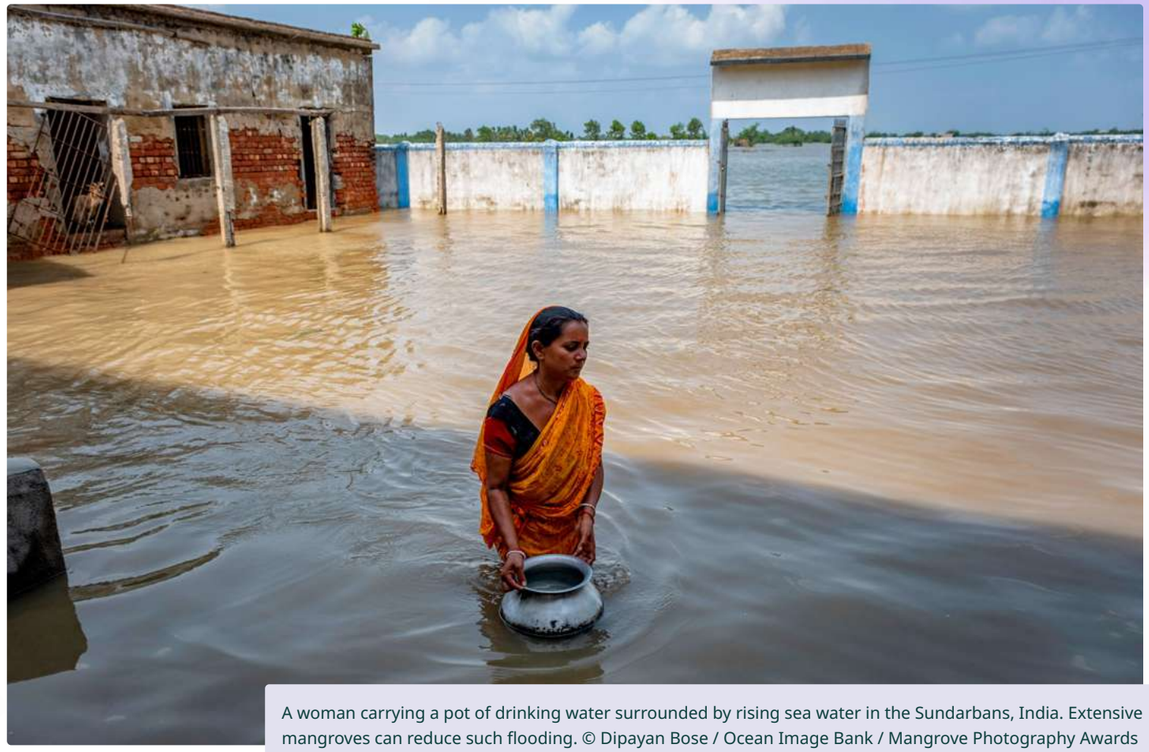


Both below and above water, mangroves present a high friction barrier to water movements. © Matt Curnock / Ocean Image Bank

Recognizing this value as a potential pathway to unlock new sources of climate finance beyond carbon markets, a new approach for quantifying and verifying these benefits has now been developed. Verra, a leading nonprofit in developing global standards for achieving climate and sustainability goals, has teamed up with The Nature Conservancy and other partners, developing a new methodology for assessing and quantifying coastal resilience benefits from mangroves and tidal wetlands[11].

> The methodology provides a standardized framework for **quantifying the annual flood risk reduction benefits** provided by coastal ecosystems

The methodology provides a standardized framework for quantifying the annual flood risk reduction benefits provided by coastal ecosystems. These benefits can be issued as Coastal Resilience Assets, either independently or alongside blue carbon credits, creating a new mechanism to fund coastal conservation and restoration while advancing UN Sustainable Development Goals.



A woman carrying a pot of drinking water surrounded by rising sea water in the Sundarbans, India. Extensive mangroves can reduce such flooding. © Dipayan Bose / Ocean Image Bank / Mangrove Photography Awards

These assets measure the number of people and avoided damages (in USD) to property at reduced risk from flooding due to coastal restoration or conservation activities. They can be quantified using one of two approaches. The Scenario Method uses hydrodynamic modeling to estimate annual expected flood risk reduction benefits to property and people and must be used in project areas if local data or modeled outputs are available. Where local models and data are absent, the Deemed Estimate Method can be used, which relies on publicly available global datasets that meet methodology criteria[12]. As new datasets become available, the methodology requires that any Deemed Estimate Method assessments use the dataset that results in the most conservative estimate of expected annual benefits.

This methodology can help fill critical gaps in flood risk reduction financing by generating verified, transactable flood risk reduction outcomes that can be used for results-based payments, financial risk assessments, and risk-transfer structures. By investing in Coastal Resilience Assets, entities are investing in the well-being of countless individuals, critical infrastructure, and the preservation of our planet's essential coastal ecosystems.

11 Narayan, S., Beck, M. W., Reguero, B. G., Settelmyer, S., Menendez, P. & Simpson, S. Coastal Resilience Benefits from Restoration and Protection of Mangroves and Tidal Marshes. (Sustainable Develop Verified Impact Standard (SD VISta), Verra, 2026).

12 For mangroves, the following has been approved: Menéndez, P., Losada, I. J., Torres-Ortega, S., Narayan, S. & Beck, M. W. The Global Flood Protection Benefits of Mangroves. *Scientific Reports* **10**, 4404, (2020). It is likely that the models described in the previous section will provide an alternative, once they have been published.



Mazzella Maniwavie, Papua New Guinea's first female mangrove scientist, in Bautama near Port Moresby. © Annette Ruzicka

6 The way ahead

6.1 Progress in policy

Alice Taberner and **Adriana Vidal** (International Union for Conservation of Nature), **Kristina Rodriguez** (Climate Champions Team), **Susanna Tol** (Wetlands International), **Luz Gil** (The Nature Conservancy), **Anelise Zimmer** (The Pew Charitable Trusts), and **Jill Hamilton** (Conservation International)

From Commitments to Implementation

Since the 2024 *State of the World's Mangroves*, the global policy landscape for mangroves has shifted from ambition to action, with countries now focused on translating existing commitments for mangroves to implementation on the ground. Global governance of mangroves continues to span multiple UN Conventions, including the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands, and the United Nations Framework Convention on Climate Change (UNFCCC), each of which provides opportunities for enhanced mangrove protection, conservation and restoration through its own thematic priorities. Under the UNFCCC, attention is centered on delivering and implementing Nationally Determined Contributions (NDCs); under the CBD, the Kunming-Montreal Global Biodiversity Framework (KMGBF) has entered its implementation phase; and the Ramsar Convention continues to promote wetland conservation and wise use, including mangroves[1].

1 Ramsar. *Protecting wetlands for our common future*. Conference Report. 15th meeting of the Conference of the Contracting Parties to the Convention on Wetlands. Victoria Falls, Zimbabwe, 23-31 July 2025.



Indonesia mangrove management plan and TEK

Katharina Kerlfeld (NABU)

Burung Indonesia and NABU supported the participatory development of a mangrove management plan (2025–2030) for Gorontalo province (Sulawesi), now to be integrated into other regional planning and policies. Local stakeholders like Pak Umar, a widely respected champion for mangrove conservation and member of the Regional Mangrove Working Group (KKMD), contributed traditional knowledge and community perspectives, hence increasing quality, scope and acceptance of the plan. It provides a comprehensive framework for protection, sustainable use, and restoration of nearly 23,000 ha of mangrove area in Gorontalo province, and includes numerous measures to enhance governance, strengthen local ownership, increase public funding, and overcome fragmented approaches, for a more effective and inclusive management of mangrove ecosystems.

Photo: A Joint Effort for Sustainable Mangrove Management in Gorontalo. © NABU/ Valentin Giebel

Mangroves in National Climate Commitments

Mangroves are one of three coastal wetland ecosystems, alongside seagrass meadows and tidal salt marshes, for which the Intergovernmental Panel on Climate Change (IPCC) has developed dedicated greenhouse-gas accounting guidance. When degraded or lost, mangroves release stored carbon into the atmosphere; when conserved, they can store carbon for millennia. As a result, the conservation and restoration of mangroves can support measurable mitigation and adaptation outcomes, helping countries advance their national climate goals and incorporate blue carbon actions into their NDCs[2]. Mitigation-related targets typically include quantitative emissions reduction metrics supported by area-based conservation or restoration goals and following the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Adaptation-related targets often recognize mangrove contributions to resilience, biodiversity, livelihoods, fisheries, and other ecosystem services.

Mangroves have become more visible within national climate planning, not simply through broader references to nature-based solutions (NbS), but through countries' establishment of specific commitments for mangrove restoration, conservation, and blue carbon. Analysis by the Mangrove Breakthrough NDC Task Force found that 15 of the 49 endorsing governments with mangrove extent referenced mangroves in their updated NDCs, with 13 including mangrove-specific targets.

These commitments reflect a shift from broad political recognition to implementation policies, with countries establishing quantified restoration targets, and incorporating mangroves within protected areas, coastal management, or ecosystem resilience strategies.

Particularly notable is the growing integration of mangroves into blue carbon governance and monitoring systems: Costa Rica, Indonesia, Jamaica, Mexico, Colombia, and the United Arab Emirates all include commitments related to blue carbon inventories, carbon accounting, MRV (Measurement, Reporting, and Verification) systems, or national greenhouse gas reporting[2].

> 15 of the 49 endorsing governments with mangrove extent referenced mangroves in their updated NDCs, with 13 **including mangrove-specific targets**

The June 2026 Ocean and Climate Change Dialogue, convened under the sixty-fourth session of the UNFCCC's Subsidiary Body for Scientific and Technological Advice, reinforced this implementation focus, highlighting both the growing incorporation of ocean-based solutions into NDCs and the challenges of finance, institutional coordination, technical capacity, and monitoring[3]. Mangroves also feature within discussions on the Global Goal on Adaptation (GGA) (Target 9d), where they are recognized as NbS that support coastal resilience. Adopted GGA indicators draw on ecosystem extent, restoration area, and protected area coverage[4].

Examples of NDC 3.0 Targets & Implementation Commitments[5]

Costa Rica
Restore 2000 hectares of mangroves by 2030; establish a permanent financing mechanism for blue carbon ecosystems; integrate blue carbon measurement, reporting, and verification into the national greenhouse gas inventory.

Honduras
Increase marine and coastal areas under conservation by 5% by 2035; establish a seagrass baseline; restore at least 10% of mangrove forests; maintain or improve ecological integrity across at least 65% of wetland conservation areas.

Jamaica
Complete national seagrass mapping and carbon stock assessment by 2030; include mangroves in the national greenhouse gas inventory; restore 2200 hectares of mangroves and conserve all seagrass ecosystems within protected areas by 2035.

Kenya
Conserve all existing mangroves, restore 75% of degraded mangroves, and protect at least 22,000 hectares of mangroves through implementation of its Blue Carbon Ecosystems NDC Implementation and Investment Plan[6].

Panama
Restore and conserve 100,000 hectares of ecosystems, including 2500 hectares of mangroves by 2035; expand protected areas to 40% of land and 60% of marine and inland water.

2 *IPCC 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* (Hirashi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M., & Troxler, T.G., Eds.) Intergovernmental Panel on Climate Change. (2014).

3 Tol, S. and Zimmer, A. "*From Dialogue to Delivery: Reflections from the Ocean and Climate Change Dialogue at UNFCCC SBSTA 64*". Global Mangrove Alliance (2026).

4 Proposed mangrove-relevant indicators include area under restoration (KM-GBF Target 2 headline indicator), coverage of protected areas (KM-GBF Target 3 headline indicator), and extent of natural ecosystems. ; FEBA, the Global Mangrove Alliance, and the *Mangrove NDC Task Force* (2025)

5 *"Mangrove Law and Policy in Practice: 2026 Case Studies". Global Mangrove Alliance (2026).*

6 *Kenya Launches National Plan to Protect Blue Carbon Ecosystems*. K. Jensen and T. Hickey. (2026). The Pew Charitable Trusts.



Where Money Meets Mangroves: Seychelles Pioneers a New Model for Private Sector Stewardship

Nirmal Shah, Liz Mwambui, Esthel Didon, and **Corinne Julie** (Nature Seychelles)

For years, wetland conservation has depended largely on government and donor funding. Through its EU-funded Wetlands of Hope project, Nature Seychelles has pioneered a new approach that introduces the private sector as mangrove stewards. Eight companies, including five-star hotels, Absa Bank and Air Seychelles, signed the Wetlands of Hope Pledge, committing to manage adopted sites. The project delivered baseline ecological assessments and maps, a wetland management plan template, training programs, awareness materials, and Memorandums of Understanding with the Ministry responsible for Environment. The project also delivered a new National Wetlands Policy. The result is a sustainable model where conservation responsibility and action are shared.

Please see this **link** to read more.

Photo: Wetlands of Hope closing ceremony celebrating people, partnerships and collective action for wetlands. © Liz Mwambui, Nature Seychelles

Mangroves in Biodiversity Policy Implementation

Since the adoption of the KMGBF, biodiversity policy has likewise shifted from establishing global targets to implementing them through National Biodiversity Strategies and Action Plans (NBSAPs). For mangroves, principal entry points are Targets 2 (ecosystem restoration), 3 (protected and conserved areas, including Other Effective Area-Based Conservation Measures (OECMs)), 8 (climate change impacts on biodiversity, including through NbS and ecosystem-based approaches), and 11 (ecosystem services and NbS).

National and regional examples illustrate how these commitments are being translated into practice: Kenya adopted its National Mangrove Ecosystem Restoration Guidelines in 2024, making Community-Based Ecological Mangrove Restoration (CBEMR) the national standard for restoration, institutional coordination, community participation, and monitoring[7]; Colombia has strengthened mangrove governance through its updated National Program for the Sustainable Use, Management and Conservation of Mangrove Ecosystems (2023), providing a national framework for mangrove planning, restoration and monitoring[8]. At the regional level, the Caribbean Biological Corridor Initiative aligns mangrove restoration and coastal conservation in Haiti and Cuba with KMGBF Target 2[8].

7 GMA PWG 2026 Case Studies *Mangrove Law and Policy In Practice: 2026 Case Studies.pdf*

8 *State of Biodiversity Action: Global Report on Collective Progress in the Implementation of the Kunming-Montreal Global Biodiversity Framework (page 336)*

Ramsar Convention on Wetlands

The Convention on Wetlands is a highly relevant treaty for mangroves as it explicitly addresses the conservation and sustainable use of wetlands, including mangroves, many of which are designated as Ramsar sites. The fifth Strategic Plan of the Convention on Wetlands (2025-2034) encourages the development and strengthening of national wetland inventories as a basis for monitoring and management, and guides on reporting for Ramsar Sites, particularly in relation to changes in ecological character and wetland extent. It also reinforces wetlands as critical ecosystems for biodiversity, ecosystem services, and climate adaptation, and encourages greater integration with related multilateral environmental agreements[9].



Mangroves, coastal forest and wetlands in Sian Ka'an Biosphere Reserve, a World Heritage Site and a Ramsar Site. © Camilo Felipe Santander Endell / Ocean Image Bank / Mangrove Photography Awards

Monitoring, Data Systems, Cross-Convention Coherence

Efforts to improve coherence in mangrove monitoring and reporting across the CBD, UNFCCC, and Convention on Wetlands build on existing datasets, indicator frameworks, and coordination mechanisms. **Global Mangrove Watch[10] has become a shared technical resource for mangrove monitoring, supporting countries in reporting under all three conventions.** The UNFCCC's Belém Adaptation Indicators[11] draw upon KMGBF metrics, and the Convention on Wetlands' fifth Strategic Plan (2025-2034) aligns parts of its indicator framework with the KMGBF. Together, these developments provide foundations for more integrated reporting and a "collect once, use many times" approach. Ongoing efforts from Parties to strengthen their national wetland inventories and greenhouse gas reporting for mangroves will further strengthen interoperability between biodiversity, climate, and wetland monitoring initiatives[12].

Despite these advances, implementation remains challenging. In many countries, mangrove governance remains divided across multiple ministries and levels of government, while competing pressures from aquaculture and other coastal activities further undermine coherent management[13]. Strengthening national coordination and shared monitoring frameworks will, therefore, be essential for improving policy coherence, reducing reporting burdens, and supporting access to climate and biodiversity finance.

9 The Strategic Plan of the Convention on Wetlands 2025-2034 *https://www.ramsar.org/sites/default/files/2025-09/xv.3_fifth_strategic_plan_e.pdf*

10 *https://www.globalmangrovewatch.org/*

11 *https://unfccc.int/sites/default/files/resource/9%28d%29_Ecosystems_and_biodiversity.pdf*

12 Ramsar Convention Secretariat (forthcoming). Technical Report: Guidance on using National Wetland Inventories in national GHG reporting -> cited in the PMG Policy Brief on Coherence

13 Lorber, M,Cappa, P. (2026). *Defragmenting Mangrove Law towards Coherent Global Governance* . Ecology and Evolution 16(6).

Mangroves in National Policy

A recent study conducted found that 82.2% of global mangroves are in jurisdictions with some form of national legal protection (see **section 4.5**). Around 51% of mangroves occur in countries with policies specifically aimed at protecting or managing them. Most mangroves fall within Environmental Impact Assessments and planning systems (75%), and community management frameworks (83%), while approximately 60% are covered by laws restricting cutting or clearing[14]. High nominal coverage, however, does not translate into effective protection: the existence of a law is not assurance that it is enforced, adequately resourced, or whether it is backed by clear jurisdiction and secure tenure. Most of the world's mangroves are already covered by some form of national legal protection, but these protections are fragmented, unevenly implemented, and underutilized[15]. Strengthening implementation will require clearer governance mandates, resolution of jurisdictional and land tenure uncertainties, stronger integration of safeguards to prevent mangrove degradation and overexploitation, and improved coordination among stakeholders. Building capacity and translating scientific and local knowledge into implementation is also critical[16].

> **The defining challenge** for mangroves is no longer securing commitments but delivering them

Ocean-Climate Integration

More broadly, ocean-climate integration is likewise being operationalized through coordinated global initiatives. The Ocean Breakthroughs[17] provides a 2030 roadmap for aligning ocean action with the Paris Agreement, the Global Biodiversity Framework, and SDGs. The Plan to Accelerate Ocean-based Climate Solutions ("Blue Package") provides an implementation-oriented roadmap that consolidates marine conservation, blue carbon ecosystems, ocean renewable energy, and aquatic food systems[18].

Collectively, these processes demonstrate growing alignment between ocean governance and climate policy. These developments signal that the defining challenge for mangroves is no longer securing commitments but delivering them—through coordinated governance, sustained finance, and implementation that matches the ambition now on record.

PHOTO STORY



At the Keta Lagoon Complex Ramsar Site in Ghana, locals have created mangrove plantations, harvesting the mangrove wood to sell in Ghana and other neighbouring countries like Togo and Benin. © One Tree Planted

14 Slobodian et al. (2025). *Quantifying the Presence and Potential of National Legal Frameworks for Global Mangrove Protection*. Cells Reports Sustainability 2(8).

15 Rahman, M.S. (2025). *Implications of National Legal Frameworks for Global Mangrove Protection*. Cell Reports Sustainability 2(8).

16 *The Mobilizing the Mangrove Breakthrough reports identify recurring barriers and enablers across regions and countries to support more effective mangrove governance and action*.

17 *Ocean Breakthroughs*

18 *Plan to Accelerate Ocean-based Climate Solutions: A Blue Package*



Building the Enabling Conditions to Achieve the Global Mangrove Alliance's 2030 Goals in Fiji

Francis Areki and **Margaret Vakalalabure** (WWF-Pacific), and **Dominic A. Andradi-Brown** (World Wildlife Fund)

Fiji's approximate 50,000 ha of mangrove forests protect coastlines from storms, sustain fisheries and livelihoods, and hold deep cultural importance.

Since 2021, WWF-Pacific has partnered with Fiji's Ministry of Environment and Climate Change to strengthen the enabling conditions for long-term mangrove conservation. Key milestones include Fiji's first dedicated Mangrove Regulation — endorsed by the National Environment Council in 2025 — which will establish a national committee to coordinate mangrove governance across agencies once adopted. WWF-Pacific also supported new Environmental Impact Assessment guidance, strengthening safeguards for developments affecting mangroves. To guide restoration, WWF-Pacific and the Ministry of Forestry established a National Mangrove Restoration Working Group to develop a national mangrove baseline, restoration priorities, and a national restoration plan. Together, these actions provide the governance framework needed to halt mangrove loss, scale restoration, and strengthen climate resilience, inching Fiji closer to achieving the GMA's 2030 Goals.

Photo: Launch of Sectoral Guidelines for Environmental Impact Assessment Screening, including mangroves Left to Right- IUCN Oceania Director- Susana Waqainabete, WWF Fiji Conservation Director- Duncan Williams, Vanessa Dirking- GIZ Pacific- Advisor and Dr Michael Sivendra- Permanent Secretary for the Ministry of Environment and Climate Change. © WWF-Pacific



How mangrove science helped to shape climate policy in Jamaica

Loúreene Jones and **Steve Schill** (The Nature Conservancy)

The Nature Conservancy, with funding from the Pew Charitable Trust, conducted island-wide assessments and produced Jamaica's first national scale mangrove habitat map. Field campaigns were conducted across priority mangrove sites identified in collaboration with local expert stakeholders. The 4m resolution habitat map is complemented by carbon stock estimates developed by the Centre for Marine Sciences of the University of the West Indies – Mona Campus; also a first for Jamaica. The mangrove extent and carbon estimates were used in 2025 to inform the targets in Jamaica's NDC 3.0. The habitat map is now actively informing national planning processes and guiding sustainable development decisions.

Photo: Demonstrating the collection of mangrove core samples in the Port Royal Protected Area. © Peter Edwards / The Pew Charitable Trusts

6.2 Financing for mangroves

Alina Bill-Weilandt (Potsdam Institute for Climate Impact Research (PIK), Member of the Leibniz Association)

The Mangrove Breakthrough, co-designed with the Global Mangrove Alliance, aims to mobilize USD 4 billion to protect and restore 15 million hectares of mangroves by 2030.

Financing at this scale will require a diverse range of financial instruments, which may enable or fund actions through processes ranging from philanthropic donations to insurance mechanisms to debt relief.

A recent systematic review identified 33 nature-positive climate risk transfer and financing instrument types across seven categories[19]. Drawing on this work, a considerable number of these approaches have been, or could be, highly applicable for mangrove protection and restoration and are presented here:



Boardwalk in the mangroves of Del Carmen, Siargao Islands, Philippines. © Ferdz Decena / Rare

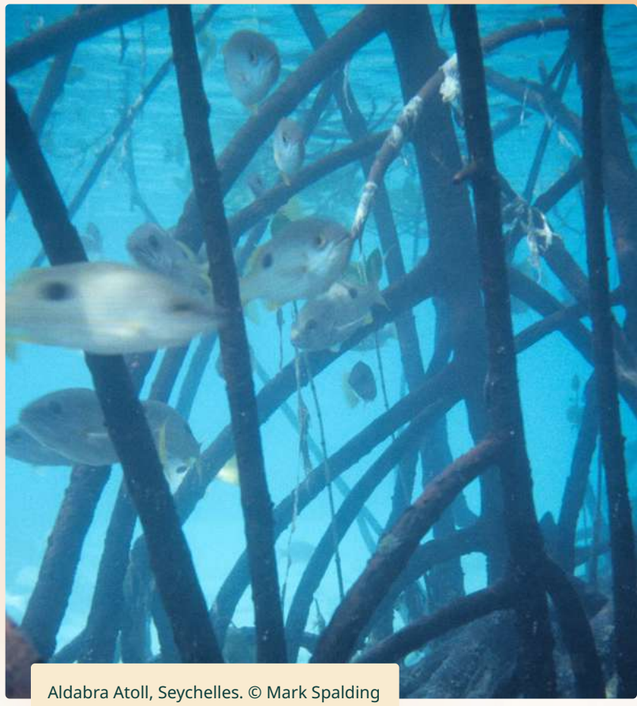
19 Bill-Weilandt, A., Lallemant, D., Chan Khim Sun, V., Patel, M. R. & Hamel, P. A systematic review of nature-positive climate risk transfer and financing instruments. *Communications Earth & Environment* 7, (2026).

1. Risk transfer instruments

Risk transfer instruments such as insurance schemes shift the financial consequences of an extreme event from one party to another in exchange for predictable payments (e.g., insurance premiums) or other agreed compensations[19].

Nature-positive resilience insurance schemes grant policyholders a premium discount in return for mangrove protection commitments, since mangroves attenuate waves and reduce expected annual losses in coastal areas. The Restoration Insurance Service Company (RISCO) was a pioneer in exploring nature-positive resilience insurance in the Philippines.

Parametric ecosystem insurance provides a payout to restore a mangrove forest after a pre-defined extreme event. While such products have been launched for reefs and a national wetland park, the first mangrove insurance product is still under development by AXA Climate, AXA México, and Climate Seed for San Crisanto in Yucatán, Mexico.



Aldabra Atoll, Seychelles. © Mark Spalding

2. Debt instruments

Debt instruments are mechanisms through which one party provides funds to another party that agrees to repay them later, usually with interest[19].

Loans can be tied to mangrove conservation conditions. When Zephyr Power Limited built a wind power plant in Pakistan, it conserved and restored a 1,028 ha mangrove forest to meet environmental standards of international investors. The project enhanced flood protection, increased shrimp yields, and created jobs in mangrove management[20].

Debt-for-nature swaps are instruments that enable the exchange of debt for nature conservation commitments. TNC's Bahamas Debt Conversion Project for Marine Conservation, launched in 2024, is expected to mobilize USD 124 million for conservation, including a National Mangrove Management Plan, by 2039.

> A recent review identified **33 nature-positive climate risk transfer and financing instrument types**

20 Earth Security. The Investment Value of Nature: The Case of Zephyr Power Limited. *Online report* (2020).

3. Credit enhancement instruments

Credit enhancement instruments strengthen a borrower's creditworthiness by reducing the likelihood that the borrower fails to repay[19].

The catastrophe wrapper for the Belize Blue Bond (which finances mangrove conservation) is a parametric insurance policy covering the government's bond repayment default following a hurricane. Payments are triggered based on predefined hurricane intensities, locations, and rainfall thresholds during hurricanes[21].



Mangrove planting in the Philippines. © Rare



Traditional crab harvesting in the Sabana Grande community in Guayaquil, Ecuador. Harvesters are allowed to collect red mangrove crabs in exchange for helping to conserve the 6,500 hectares of mangrove-forest. © Juan de Dios Morales / Ocean Image Bank / Mangrove Photography Awards

4. Performance-based instruments

Performance-based instruments tie funding to verifiable social and environmental outcomes and associated financial rewards and/or penalties[19].

Environmental cash-for-work programs in the Philippines create financial incentives for community members to plant mangroves by compensating them per day, per area, or per seedling[22].

> **Success depends on** locally appropriate species selection and long-term community-led mangrove forest management

21 TNC. Case Study: Belize Blue Bonds for Ocean Conservation. *Online report*. (2022)

22 Altenburg, T. et al. Managing Coastal Ecosystems in the Philippines: What Cash for Work Programmes Can Contribute. (*Deutsches Institut für Entwicklungspolitik (DIE)*, Bonn, Germany, 2017).

5. Market instruments

Market instruments encompass carbon credits, resilience credits, and biodiversity credits.

Carbon credits are issued by carbon certification standard registry organizations. Once certified, mangrove conservation and restoration projects can generate carbon credits corresponding to CO_2 sequestration resulting from the project. Carbon credit buyers use credits to offset their emissions. Three well-known mangrove-based blue carbon projects are the Mikoko Pamoja in Kenya, Delta Blue Carbon in Pakistan, and the Vida Manglar in Colombia[23].

> Global mangrove-based climate mitigation potential is estimated at **26 million tons of CO^2 equivalent per year**

The project in Colombia alone is expected to sequester about one million tons of CO_2 over 30 years. The global mangrove-based climate mitigation potential is estimated at 26 million tons of CO_2 equivalent per year, with Indonesia, Myanmar, and Vietnam hosting a major share of the global financially viable mangrove blue carbon budget[24].

23 Montenegro, J. F. et al. Mangrove-based carbon market projects: Current trends and future perspectives. *Forest Policy and Economics* 181, (2025).

24 Zeng, Y., Friess, D. A., Sarira, T. V., Siman, K. & Koh, L. P. Global potential and limits of mangrove blue carbon for climate change mitigation. *Current Biology* 31, 1737-1743.e3 (2021).



Outcome-based Finance for Mangrove Conservation

Lisa Schindler Murray and **Carlos Arango** (Rare)

Outcome-based financing (OBF) is at an innovative moment, using the trusted approach in the health and education sectors now for mangrove conservation. It links funding to verified environmental, governance, and community results, helping attract investment while strengthening accountability. Rare is at the forefront of demonstrating results:

In Indonesia, Rare is expanding its Small-Scale Fisheries Impact Bond across North Sulawesi, Maluku, and North Maluku and will now include mangrove protection alongside fisheries and community outcomes.

In Colombia, Rare is developing a unique OBF approach to protect up to 100,000 hectares of mangroves. In Tumaco, the model Rare and the UN are designing supports mangrove protection and sustainable livelihoods. In Buenaventura, Rare and WWF Colombia are developing an OBF model to finance new and expanded Other Effective Area-Based Conservation Measures (OECMs) and Marine Protected Areas in mangrove areas.

Photo: Salman, a mangrove crab fisher, setting up his traps in the mangroves during low tide. © Rare



From Logging to Livelihoods: Supporting Sustainable Fishing Economies in Mangrove Communities

Siddharth Samal (Global Mangrove Trust)

Global Mangrove Trust, together with implementation partner YAGASU, led an alternative livelihoods program in North Sumatra, Indonesia, to reduce pressure on mangrove forests by supporting former mangrove loggers in transitioning to sustainable fisheries and mud crab aquaculture. Made possible through financial support from Marex, with program expansion to 12 villages supported by the UBS Optimus Climate Collective, the initiative has enabled 126 former mangrove loggers and 42 women across four villages to establish sustainable income sources through fishing equipment, training, technical support, market linkages, and women-led enterprises producing value-added fishery products. The program demonstrates how strengthening livelihoods can address the drivers of mangrove degradation while building more resilient mangrove-dependent communities.

To read more about this project, **click here**.

Photo: Program participants with the YAGASU field team and representatives from Marex during a community livelihood workshop in Halaban, North Sumatra. © Yayasan Gajah Sumatera (YAGASU)



Protecting Japan's unique mangroves

Seiichiro Okada (ManGlobal)

Japan hosts the most northerly mangroves in the world. Near these northern limits, Japan's first mangrove-derived "J-Blue Credit" certification was achieved in Amami Oshima in 2025. Planting efforts use the cold-tolerant *Kandelia obovata* (right image, above). Mangrove distribution survey data collected by ManGlobal® in Okinawa and Kagoshima also supported mangrove-related carbon accounting in Japan's national greenhouse gas inventory submitted to the UNFCCC in 2023.

Even in these northern mangrove environments, a rich diversity of tree species continues to thrive. The pneumatophores of *Sonneratia alba* (left image, above) resemble Japanese "kokeshi" dolls, showcasing the species' remarkable adaptation to its environment.

Photo: © Seiichiro Okada / ManGlobal



Financing Invasive Species Control Through Payment for Ecosystem Services

Laís Coutinho Zayas Jimenez, Beatriz Eiko Kitagami, and **Julia Lima Monteiro de Carvalho** (Fundação Florestal)

Biological invasions can threaten native biodiversity and disrupt entire mangrove food webs. However, some of their most severe impacts occur when they affect local livelihoods and the economic sustainability of value chains linked to these ecosystems. This is the case in southern São Paulo State, Brazil, where the invasive oyster *Saccostrea cucullata* threatens native *Crassostrea* spp. and directly affects traditional oyster harvesters whose livelihoods depend on this resource.

To address this challenge, the Fundação Florestal—the state agency responsible for managing protected areas in São Paulo—is developing a Payment for Ecosystem Services (PES) scheme that remunerates oyster harvesters for the removal of the invasive species. Because the invasive oyster currently has little or no market value, the PES mechanism creates an economic incentive for its removal while helping maintain native oyster production. The initiative seeks to align invasive species control, biodiversity conservation, and the financial sustainability of traditional coastal communities.

Photo: Removal of the invasive oyster species *Saccostrea cucullata*. © Beatriz Eiko Kitagami



Blue Catalyst Fund

Juliette Baralon
(Fair Carbon/Blue Catalyst Fund)

Delivered by Fair Carbon and Finance Earth, the Blue Catalyst Fund (BCF) is an end-to-end accelerator that combines early-stage funding with technical expertise and transaction advisory to de-risk blue carbon projects and help them reach investment readiness. The BCF support is only repayable if projects successfully secure follow-on investment.

The North Bank Restoration Trust project in The Gambia, led by Great Green Wall Frontline (GGWF), is one of the first two projects supported by the BCF. Over the next 16 months, GGWF will work with the BCF and Silvestrum to prioritize restoration sites, prepare its Project Design Document (PDD), and secure implementation finance.

Photo: The Blue Catalyst Fund team and technical partner Silvestrum visited the North Bank project site in June 2026 to see its restoration potential firsthand. © Juliette Baralon

6. Actively managed funds

Actively managed funds, capitalized by high-income economies, private investors, or philanthropic donors, fund mangrove projects in low- and middle-income economies.

Funds provide grants to support mangrove conservation, restoration, and blue carbon project design. Examples include the Blue Action Fund (capitalized by Germany, Sweden, France, and Norway), the Blue Carbon Accelerator Fund (capitalized by Australia), and PROBLUE (a Multi-Donor Trust Fund, housed at the World Bank).

7. Fiscal and tax policies and public financing mechanisms

Fiscal and tax policies can mobilize government revenues to support mangrove conservation and restoration.

Tax policies to fund nature conservation can take different forms. In Bali, Indonesia, tourism tax revenues fund cultural and environmental protection programs. Costa Rica's National Fund for Forest Finance, established in the 1990s, finances Payments for Ecosystem Services through revenues from fossil fuel taxes and water fees; although initially focused on forests, an expansion to mangroves has been proposed[25].

> **In Bali, Indonesia, tourism tax revenues** fund cultural and environmental protection programs

Public financing mechanisms such as the Mangrove Initiative for Shoreline Habitats & Tangible Incomes in India provide funding for local mangrove plantation projects and awareness campaigns on ecosystem services provided by mangroves.

Integrating multiple ecosystem services into financial instruments enables the channeling of resources from multiple beneficiaries into mangrove conservation. For example, home owners benefit from property price stability, a factory benefits from mangrove-based coastal protection, a service provider purchases carbon credits to comply with emission regulations, and a municipality raises a tourist tax capitalizing on the mangroves' aesthetic value.

Scientific advances in valuing the multiple benefits of mangroves provide a foundation for innovative financing. The design and scaling of effective financial instruments for mangroves require cross-sectoral collaboration, financial inclusion, locally driven design processes, equity-sensitive economic analyses, and community-led management to ensure lasting impacts.

25 Hernández-Blanco, M., Costanza, R. & Moritsch, M. Payment for Ecosystem Services 2.0: The Natural Capital Trust of Costa Rica. *Ecosystem Services* 76, 101787 (2025).

6.3 Tools and resources

Lanie Esch and **Dominic Andradi-Brown** (World Wildlife Fund), **Lindsey Smart** (The Nature Conservancy), **Mark Beeston** (Conservation International), and **Lammert Hilarides** (Wetlands International)

Achieving global mangrove conservation and restoration goals requires accessible, science-based tools that enable informed decision-making, consistent monitoring, and transparent reporting. Here, we highlight several tools and resources:

1. Global Mangrove Watch

The **Global Mangrove Watch** (GMW) remains a foundational resource for tracking and accelerating our collective progress toward the 2030 goals by providing open-access spatial data to map mangrove extent and change, to monitor threats, and to identify prime areas for recovery. Central to this is GMW version 4.1 (1985–2025), the most long-term and up-to-date global dataset on mangrove extent and change, which underpins key layers including blue carbon, restoration potential, and monthly disturbance alerts (see **section 3.1**).

GMW supports the operationalization of high-level commitments like the Mangrove Breakthrough and overarching GMA goals and equips national governments with robust baselines to integrate blue carbon into their NDCs and similar climate commitments. GMW translates satellite data into actionable insights, enabling policy makers and local leaders to develop targeted conservation and restoration strategies. The GMW is a powerful tool that ensures global conservation efforts are transparent, evidence-based, and measurable.

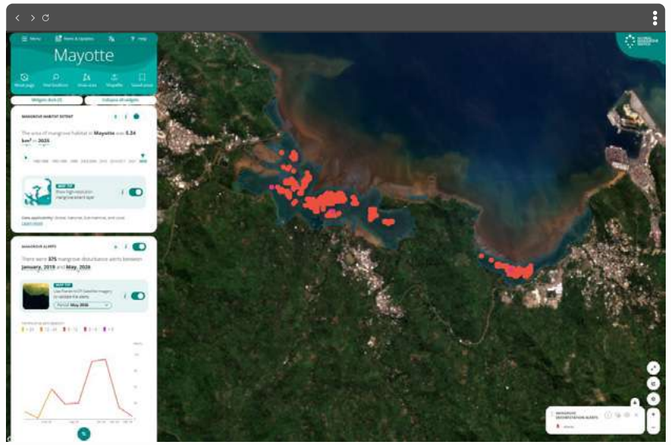


Figure 22: An example of loss alerts displayed on the GMW platform. Further examples and case studies can be found in Section 3.1

2. Mangrove Restoration Tracker Tool

What is the Mangrove Restoration Tracker Tool?

The **Mangrove Restoration Tracker Tool** (MRTT) is an open-access platform for monitoring and reporting mangrove restoration projects. The MRTT aids the mangrove conservation community in quantifying how specific conservation actions lead to outcomes for biodiversity, mangrove resilience, management effectiveness, communities, and governance. In turn, the tool supports more effective mangrove restoration projects by supporting information sharing. The MRTT is the official restoration reporting tool of the GMA and is a key mechanism for tracking progress towards global mangrove restoration goals (see **section 4.4**).

How does it work?

Restoration projects with all types of approaches, covering single or multiple outcomes across the full array of ecological and socio-economic benefits of mangroves can be added to the MRTT. The tool has a flexible structure designed to capture field and desk-based data on mangrove restoration projects in a standardized format. Users are guided to record key variables using common language and definitions, improving data coverage and consistency across restoration efforts worldwide. The MRTT provides a secure location to store information across restoration planning, intervention, and monitoring.

The MRTT application and project database are hosted on the GMW platform. A map of sites submitted on the MRTT is available on the GMW, providing a global view of mangrove restoration projects and promoting a learning exchange among practitioners to maximize impact and success of future restoration efforts.

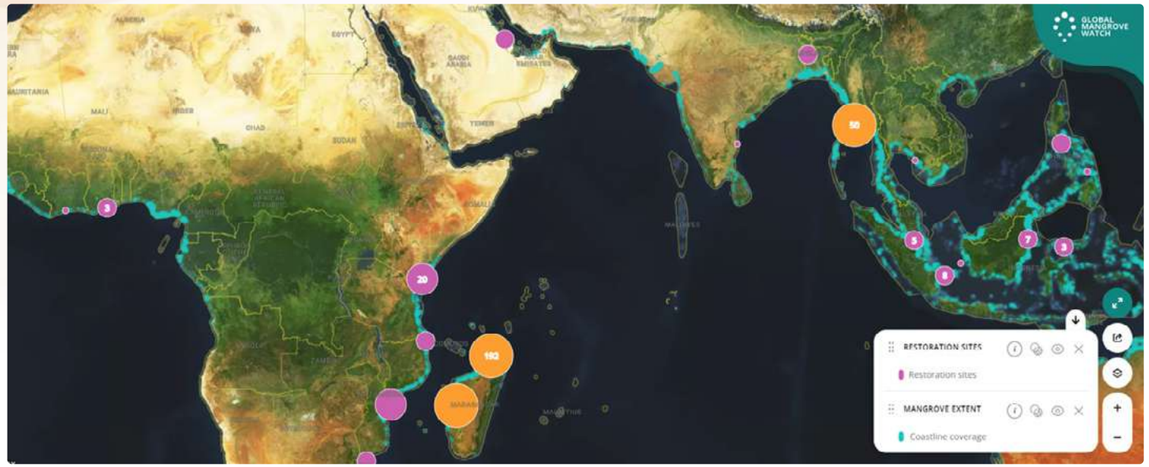


Figure 23: Screenshot from Global Mangrove Watch showing the distribution of MRTT reported restoration sites across Africa and Asia

3. Restor

Restor is an online platform that hosts nature stewardship projects focused on conservation, restoration, and sustainable land management across diverse landscapes. The platform supports these projects by showcasing their impact, connecting them with a community of conservation practitioners, and increasing their visibility with potential funders. Restor also provides an effective mechanism for locally recognized protected areas to be submitted, assessed, and tracked for their contribution to global mangrove protection goals (see **section 4.3**).

4. Climate-Smart Mangrove Tool

The **Climate-Smart Mangrove Tool** is a science-based decision support tool available in English and Spanish that helps conservation practitioners integrate climate-smart approaches into mangrove management and restoration. Developed by WWF and the University of Queensland, it combines a step-by-step guidance manual with an Excel-based workbook to assess climate vulnerability, identify key risks, and prioritize climate-smart management actions. The tool supports collaborative, evidence-based decision-making using global datasets alongside local knowledge. Applicable to protected area planning, management, and restoration, the Climate-Smart Mangrove Tool supports user decisions that strengthen mangrove resilience and improve long-term conservation outcomes.



Sandra Cárdenas is a Rare partner and Regional Coordinator for El Centro de Estudios Marinos (CEM) in Omoa and Puerto Cortés, Honduras. Born and raised in Omoa, she now works to strengthen Omoa's fisher association and make science accessible to community members of all ages. © Lorena Velasco / Rare

> The Climate-Smart Mangrove Tool supports **collaborative, evidence-based decision-making** using global datasets alongside local knowledge

5. Blue Carbon Cost Tool

The **Blue Carbon Cost Tool** (BCCT) is an online platform that assesses the feasibility of blue carbon projects by centralizing data on costs, potential revenues, and key social and legal factors. Use of this tool can empower developers, investors, researchers, government bodies, regulatory agencies, and practitioners to make informed decisions on blue carbon[26].

By aligning financial incentives with environmental impact, BCCT unlocks a pathway to accelerate conservation, attract investment, and drive meaningful, scalable climate action. For more information on the methodology underpinning the tool and an overview of projects already assessed go to **www.bcct.naturebase.org/** [29].

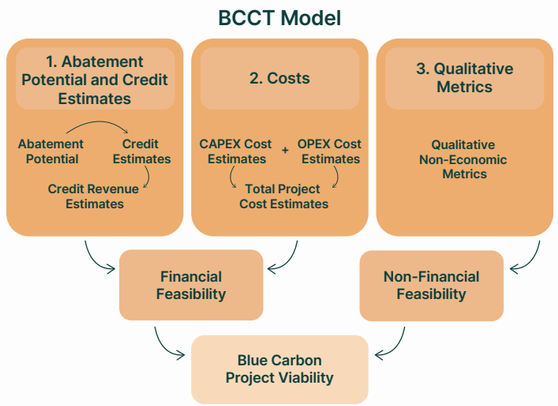


Figure 24: The three core components that make up the Blue Carbon Cost Tool

6. HQBC Practitioners Guide 2026

The second edition of the High Quality Blue Carbon (HQBC) **Practitioners Guide** compiles more than 400 resources for proponents of restoration, conservation, and carbon crediting projects to align their project design with the GMA and Mangrove Breakthrough Principles and the **High-Quality Blue Carbon Principles and Guidance**. A multiple-choice framework based on the Society for Ecological Restoration Recovery Wheel supports project progress tracking, and the visual output can be inserted in project profiles on Restor or included in funding applications or annual reporting. Linking readers to everything from risk assessments to conservation finance reports, the Practitioners Guide strongly complements the GMA **Best Practice Guidelines for Mangrove Restoration**.

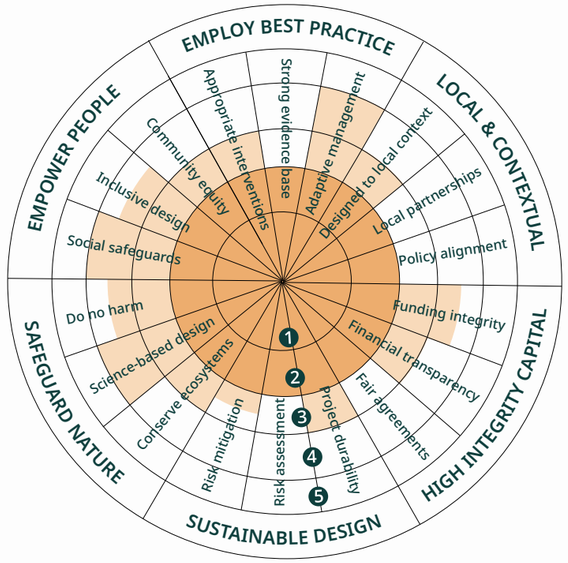


Figure 25: The Society for Ecological Restoration (SER) Recovery Wheel

7. Other tools and resources to support practitioners:

Mangrove Best Practices: Stakeholder Collaboration through Mangrove Platforms, Wetlands International, 2026

Mangrove Best Practices: Savings and Loans Groups, Wetlands International, 2025

Mangrove Best Practice: Mangrove School Clubs, Wetlands International, 2025

Mangrove Best Practices: Energy Efficient Cookstoves, Wetlands International, 2025

High-Quality Blue Carbon: Guidance for Benefit-Sharing Agreements, Conservation International / CrossBoundary / Blue Carbon Action Partnership 2026. Reviewed and endorsed by the GMA SC.

Mobilizing the Mangrove Breakthrough Regional Reports

Naturebase

Coastal Resilience



In Thailand, spatial monitoring proves community-focused policies lead to success

Juan Robalino and **Matteo Bonetto** (Landesa)

In coastal Thailand, Landesa evaluated mangrove forest dynamics across eight Community Forests (CFs) using remote sensing data from Global Mangrove Watch and Restor, comparing them to sub-district trends from 2001 to 2024. Despite extreme climatic shocks, including the 2004 Tsunami and the 2015–2016 El Niño, these CFs demonstrated superior management, with loss rates approximately half of those in surrounding areas (0.44% versus 0.86%). Landesa has demonstrated that legal anchors like the 2015 Marine and Coastal Management Act and the 2019 Community Forest Act protect mangrove ecosystems, providing the necessary evidence to strengthen community-led tenure as a foundational step toward sustainability.

Photo: Coastal mangrove landscape in the Thap Put District of Phang Nga Province, Thailand. © Landesa

26 Simpson, S., Smart, L. S., Landis, E., Van Laere, S., Kibria, A. S. M. G., Albot, O. et al. The Blue Carbon Cost Tool – understanding market potential and investment requirements for high-quality coastal wetland projects. *Frontiers in Marine Science* **Volume 12 - 2025**, (2025).

6.4 The Mangrove Breakthrough

Kristina Rodriguez, **Pauline Fernandez**, **Sam Goodman**, and **Victoria Paz** (The Mangrove Breakthrough)

Protecting mangroves at the scale required will only be possible by transforming how they are valued, financed, and managed

The **Mangrove Breakthrough** (MB) is a global initiative bringing together governments, investors, NGOs, and local communities to mobilize the partnerships, policies, and capital needed to secure the future of 15 million hectares of mangroves by 2030. Through cross-sector collaboration, science-based decision-making, and investment in local leadership, the MB is helping transform mangrove conservation and restoration at scale.

Launched by the United Nations' High-Level Climate Champions and the GMA in 2022, the initiative aims to mobilize USD 4 billion by 2030 to protect and restore 15 million hectares of mangroves.

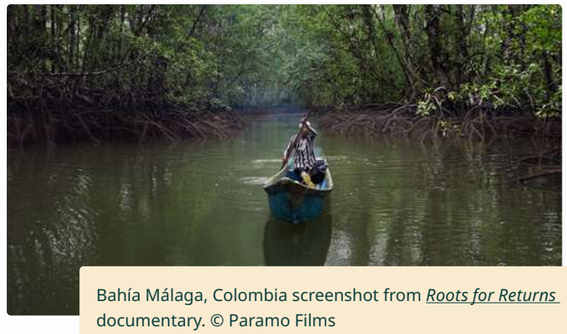
The goals of the Breakthrough align with those of the GMA (Chapter 4), along with ensuring long-term finance for the sustainable management of the world's mangrove cover. The work follows a set of Guiding Principles that prioritize sustainability, biodiversity, equity, and effective science-based conservation and restoration.

In partnership with the GMA, the Mangrove Breakthrough has developed a shared definition of a mangrove-positive business contributor, together with a set of indicative KPIs to help assess and measure contributions to mangrove conservation and sustainable management. This represents an important step in mainstreaming mangroves within the financial sector, providing financial institutions with a common language and practical framework to identify, evaluate, and finance businesses that positively contribute to mangrove ecosystems.

With its partners, the MB is building the investment architecture needed to unlock finance at scale by presenting mangroves as high-performance infrastructure that protect coastal economies while generating revenues for communities and investors. The MB is working with financial institutions to build shared valuation frameworks, risk definitions, and a transparent pipeline of investment-ready opportunities. Ultimately, the objective is to see active, replicable transactions integrating the value of mangroves in sectors such as coastal agriculture, aquatic food production, coastal infrastructures, and carbon markets.

At the project level, a development finance institution can provide a first-loss guarantee that unlocks local commercial bank lending to smallholder shrimp or rice farmers converting to mangrove-positive practices. At the corporate level, a port developer can issue a green bond to finance mangrove-positive port expansions, with mangrove restoration embedded as a covenant rather than an offset. A fishery cooperative can access a sustainability-linked loan tied to verified catch data from mangrove ecosystems.

> Protecting mangroves at the scale required will only be possible by **transforming how they are valued, financed, and managed**



Bahía Málaga, Colombia screenshot from *Roots for Returns* documentary. © Paramo Films

Parametric insurance products can price coastal infrastructure risk lower where mangrove buffers are in place, channeling premium savings back into restoration. These established financial instruments are just missing the project pipeline, frameworks, and coordination to integrate mangrove value. The MB's work is building all three, to develop the systematic approach needed.

To stimulate transactions, the MB is developing the Mangrove Catalytic Facility, a dedicated financing mechanism that funds the development of key market enablers (national regulations, local investment, and project development capacity), provides concessional capital to de-risk first transactions, and coordinates across financial institutions, project developers, and public instruments to get deals done.

The initiative has secured endorsements from 49 national and subnational governments, representing more than 60% of the world's remaining mangrove extent. It supports governments in mobilizing resources for mangroves to deliver on their climate mitigation and resilience strategies.

The Mangrove Projects Portfolio, developed with Restor and building on Global Mangrove Watch, has mapped more than 350 mangrove conservation and restoration projects worldwide. Following screening and transparency assessments, investment-ready projects are referred to Capital for Climate's NbS Investment Platform, and other investment partners, ensuring a consistent and robust pipeline is visible to investors globally.



Biodiversity bonds leading the way for systemic change

The Mangrove Breakthrough

In 2024, Banco Davivienda issued a groundbreaking biodiversity bond, backed by up to $50 million from the International Finance Corporation (IFC), to expand lending to businesses that meet biodiversity performance criteria. As part of the initiative, Davivienda committed 10% of bond proceeds ($5 million) to loans supporting mangrove restoration outcomes. The bond demonstrates how financial institutions can help redefine how ecosystems are valued, financed, and protected, creating pathways for systemic change. Building on its flagship mangrove restoration projects in El Salvador's Barra de Santiago and Panama, Davivienda has leveraged its operational experience to strengthen investor confidence in its ability to deliver measurable impact.

Photo: Aerial picture of Bahia Malaga in Colombia. © Paramo Films

Governments that have endorsed the MB:

Countries (29)

Australia, Belgium, Brazil, Burundi, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Gambia, Germany, Guinea-Bissau, Indonesia, Jamaica, Liberia, Mexico, Mozambique, Norway, Pakistan, Palau, Panama, Papua New Guinea, Philippines, Senegal, Sierra Leone, South Korea, Spain, United Arab Emirates, United Kingdom.

States/Provinces/Departments (16)

Amapá (Brazil), Atlántico (Colombia), Bahia (Brazil), Bolívar (Colombia), Campeche (Mexico), Cesar (Colombia), Córdoba (Colombia), Pará (Brazil), Pernambuco (Brazil), Quintana Roo (Mexico), Rio de Janeiro (Brazil), Rio Grande do Norte (Brazil), Sergipe (Brazil), Sucre (Colombia), Yucatán (Mexico).

Cities (4)

Aracaju (Brazil), Barra de São Miguel (Brazil), Barranquilla (Colombia), Cartagena (Colombia).

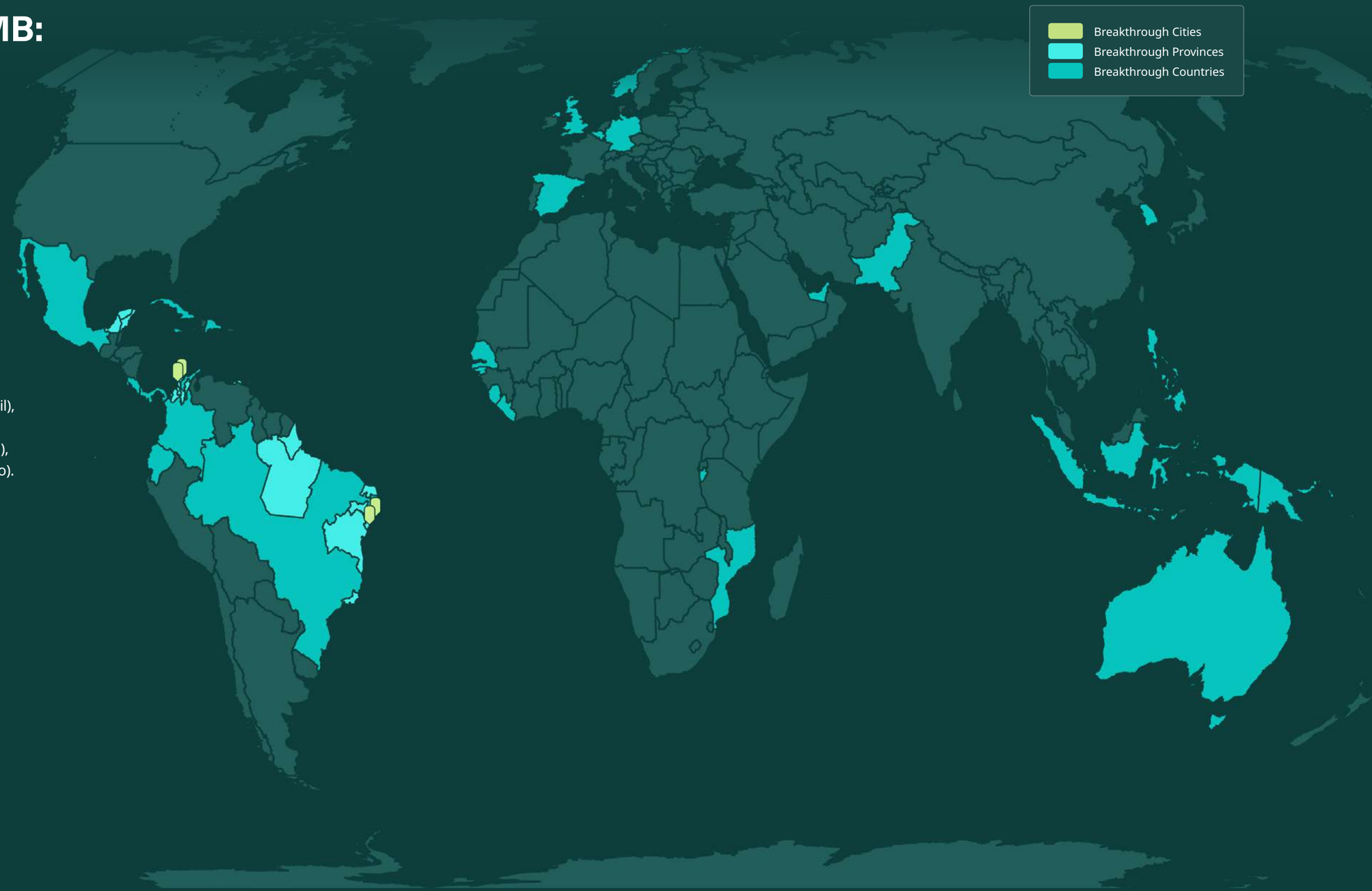


Figure 25: The countries, states, regions and cities that have endorsed the Mangrove Breakthrough



Esha Sizi (left) and Shakila Shebwana (right) from the Mtangawanda Women's Association in Lamu County, Kenya, moving seedlings from their nursery to a restoration site. © Sarah Waiswa

7

Building Partnerships

7.1 Leading the way

Emily Goodwin (Rare)

Mangrove conservation and restoration ultimately succeeds or fails at the local level. Global commitments, national policies, and international finance are essential, but the decisions that determine whether mangroves are protected, restored, and sustainably managed are made by local governments, communities, and coastal resource users.

These are the people who depend on mangroves for livelihoods, food security, cultural identity, and climate impacts - and who are the first to experience the consequences of mangrove degradation.

Evidence increasingly shows that conservation action is most effective when it is locally owned, politically supported, and integrated into local development and coastal governance priorities.

Sustainable mangrove management requires local decision-making

A growing body of evidence demonstrates that conservation outcomes improve when **local communities and institutions**[1] have meaningful roles in governance and management. Participation builds legitimacy, local capacity, and stewardship, and ensures that conservation actions fit local conditions. For mangroves, where ecological, economic, and social interests intersect in complex coastal landscapes, local leadership is particularly important.

PHOTO STORY



Conserving mangroves also strengthens communities. Women and men in Campeche, México promote agroecological beekeeping and Melipona beekeeping to conserve biodiversity, strengthen their Maya cultural heritage, and create sustainable economic opportunities. © CGAIA-WRI Méx-PPD

1 Dawson NM, Coolsaet B, Bhardwaj A, Brown D, Lliso B, Loos J, et al Reviewing the science on 50 years of conservation: Knowledge production biases and lessons for practice. *Ambio*. 53, 1395–1413 (2024).

Community ownership improves restoration outcomes

Active engagement of communities and local stakeholders in the design, implementation, and stewardship of mangrove initiatives is critical for long-term success. Sustainable mangrove management depends not only on ecological expertise, but also on local and traditional knowledge, trusted institutions, and shared commitment. When communities help shape conservation decisions, projects are more likely to reflect local needs, address underlying drivers of degradation, and earn lasting support.

Sustainable mangrove management depends not only on ecological expertise, but also on local and traditional knowledge, trusted institutions, and shared commitment

Sustainability depends on local decision-making and governance

Local governments are often the critical drivers of lasting progress. Mayors, district heads, environmental authorities, village leaders, and other local decision-makers shape mangrove futures through coastal development planning, fisheries management, enforcement, budget allocation, disaster preparedness, and public engagement. Even where strong national policies exist (see **section 6.1**), local policy and political will is often a decisive factor in implementation. Local leaders can translate ambitious global commitments into action, mobilize constituencies, align conservation with wider development priorities, and ensure that conservation is pursued by communities rather than imposed upon them.



Luis Antonio Silva Craveiro, a crab fisher from Soure, harvesting crabs in the mangroves. Luis starts his day at 6am and travels through the mangrove channels early in the morning to catch crabs. He only catches male crabs and can track them based on the crab's footprints in the mud. Resex Soure, Pará, Brazil. © Enrico Marone for Rare

National Chapters Gather in Ecuador

In June 2026, the GMA's National Chapters and Global team convened in Guayaquil for a week of learning, collaboration, and exchange.

The gathering focused on strengthening coordination across the Alliance by sharing successes, addressing common challenges, and identifying opportunities for greater collaboration. National Chapters exchanged practical lessons from their work, while the Global team shared new resources and discussed ways to better support country-led action. Conversations sparked new ideas, uncovered shared priorities, and opened the door to stronger collaboration across Chapters.

A highlight of the meeting was a visit to the Puerto Hondo Mangrove Site, where participants learned firsthand from community-led conservation efforts in Guayaquil and took home practical insights to inform their own national work. The meeting strengthened relationships across the Alliance and reaffirmed a shared commitment: empowering coastal communities is essential to a healthy future for the world's mangroves.



Participants of the GMA annual National Chapter's meeting visited a community-led nursery, learning from the local leaders that manage the Puerto Hondo Mangrove Site. © Laura Lozano / Conservation International Ecuador



The Global Mangrove Alliance's National Chapters

Despite growing global investment in mangrove conservation, resources and authority for decision-making often fail to reach the communities and institutions responsible for implementation on the ground.

Recognizing this gap, the Global Mangrove Alliance has prioritized devolving decision-making power through a network of National Chapters.

These Chapters unite civil society, governments, and academia to translate global and national goals into coordinated action. Grounded in country contexts, they work with local governments, Indigenous Peoples, local communities and other coastal stakeholders essential for success.

By connecting global knowledge, finance, advocacy, and technical resources with local expertise and leadership, the GMA's National Chapters bridge the gap between global ambition and the local action needed to secure the future of the world's mangroves.

The following pages introduce the work of the GMA's 15 National Chapters.

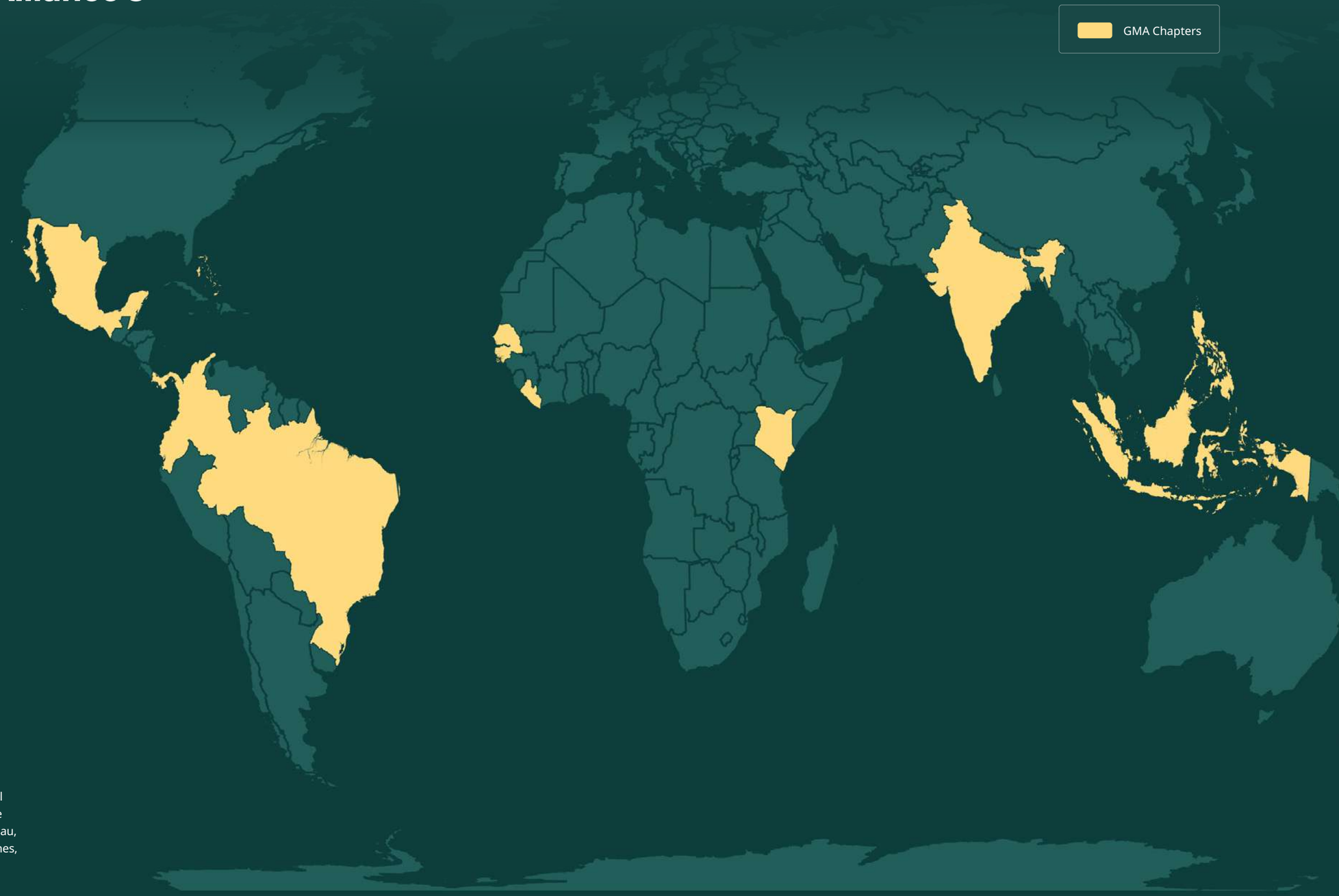


Figure 26: The Global Mangrove Alliance has established 15 National Chapters spanning Africa, Asia, and the Americas. GMA Chapters are active in the Bahamas, Belize, Brazil, Colombia, Ecuador, Guinea-Bissau, India, Indonesia, Kenya, Liberia, Malaysia, Mexico, Panama, Philippines, and Senegal, with 2 more in the pipeline!

1 | BAHAMAS

The Bahamas Mangrove Alliance

Rashema Ingraham (Bonefish and Tarpon Trust) and **Ranique Forbes** (Bahamas Mangrove Alliance)

# of members
6

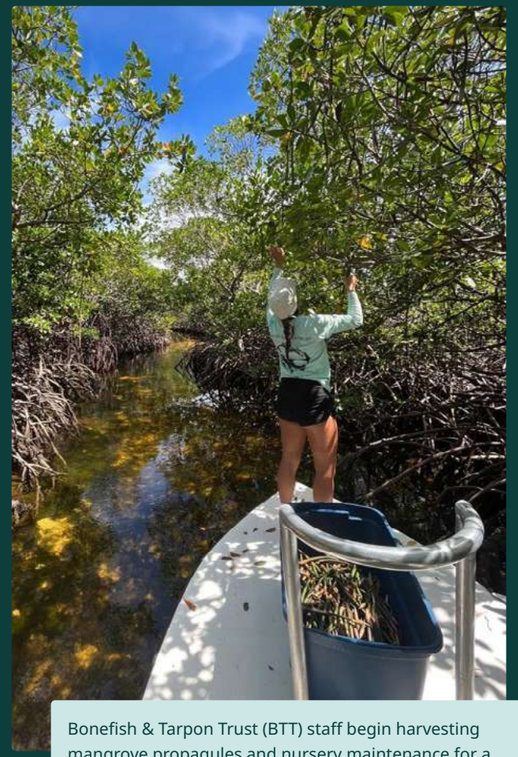
Chapter inception
March, 2024

Type of Chapter members
NGOs and Academia

Overview of Chapter structure

Operating as the Bahamas Mangrove Alliance (BMA).

Co-founded on Earth Day 2023 by Bonefish & Tarpon Trust, Perry Institute for Marine Science, and Waterkeepers Bahamas, the Bahamas Mangrove Alliance (BMA) was established to unite organizations committed to mangrove conservation and restoration throughout The Bahamas.



Bonefish & Tarpon Trust (BTT) staff begin harvesting mangrove propagules and nursery maintenance for a new mangrove season. © Bonefish & Tarpon Trust

Structure

The Bahamas Mangrove Alliance (BMA) operates under a two-tier chapter model: Contributing Members and General Members.

- Contributing Members actively support the Alliance's work through collaboration, expertise, funding, resources, or participation in mangrove conservation initiatives. This tier includes:
  - Council Members: Core organizations that help guide the Alliance's priorities and participate in coordination, planning, and collaborative initiatives.
  - Affiliate Members: Partner organizations that contribute to projects, research, restoration, education, outreach, or other aligned activities.
  - Supporting Members: Organizations that strengthen the Alliance through financial, technical, in-kind, communications, or network support.

General Members are individuals and organizations interested in staying connected to the Alliance and receiving updates, opportunities, and information on mangrove conservation activities.

The Bahamas Mangrove Alliance (BMA) was established on Earth Day 2023 and formally joined the GMA as the Bahamas National Chapter almost a year later. The BMA has made meaningful progress in strengthening collaboration around mangrove conservation, restoration, and long-term stewardship in The Bahamas. As a network, BMA has supported collective action among partners while helping to engage government agencies, technical partners, researchers, community groups, and private-sector stakeholders through projects, workshops, restoration activities, and public awareness initiatives. This collaborative approach supports a shared commitment to protecting and restoring mangrove ecosystems, recognizing their importance to climate resilience, biodiversity, fisheries, coastal protection, and the well-being of Bahamian communities.

One of BMA's major successes has been its support for coordinated mangrove restoration efforts, particularly in priority areas such as Grand Bahama and Abaco, where mangrove ecosystems were severely impacted by Hurricane Dorian. Through partner-led restoration initiatives, more than 600,000 mangroves have already been planted, with continued work underway toward the project's target of one million mangroves by the end of 2026. These efforts have advanced ecological restoration while also strengthening local participation, site monitoring, volunteer engagement, and public understanding of the importance of mangroves to coastal protection and community resilience.

BMA has also contributed to improved coordination among organizations working in mangrove conservation and restoration. Through partner meetings, technical discussions, restoration site identification, annual workshops, and collaborative planning, the Alliance has helped create a stronger foundation for aligning activities, sharing lessons learned, tracking progress, and ensuring that partner efforts support one another. BMA has also supported public education and visibility around mangroves through World Mangrove Day activities, propagule collection events, communications efforts, awareness campaigns, and other outreach initiatives.



Bahamas Mangrove Alliance and Northern Bahamas Mangrove Restoration Project (NBMRP) Partners participate in mangrove planting in Dover Sound. © Bonefish & Tarpon Trust

Looking ahead, BMA has an opportunity to build on restoration work while also strengthening its role in national policy, protection, management, and stewardship. This includes continued support for the development and implementation of The Bahamas' National Mangrove Management Plan, ensuring that restoration, policy, protection and monitoring are clearly highlighted and connected under one coordinated national framework. BMA will also continue supporting awareness, community involvement, and monitoring and evaluation of mangroves planted as part of the one million mangrove target.

By 2030, BMA aims to contribute to stronger national protection measures for mangroves, expanded conservation of priority sites, improved use of GIS and field data, strengthened monitoring systems, and increased local capacity for mangrove management. BMA also hopes to deepen youth, volunteer, and community participation.

Ultimately, BMA, its partners and members are working toward a future where Bahamian mangrove ecosystems are healthy, protected, restored, and actively managed. Staying true to its mission and vision, BMA remains committed to promoting public awareness, collaboration, and long-term stewardship for mangrove ecosystems throughout The Bahamas.

2 | BELIZE

Roots of Resilience: How the Belize Chapter of the Global Mangrove Alliance Is Protecting Coastlines and Communities

Nadia Bood and Juliet Neal (World Wildlife Fund Mesoamerica) and **Minerva Gonzalez** (Belize Forest Department)

# of members
42

Chapter inception
May, 2021

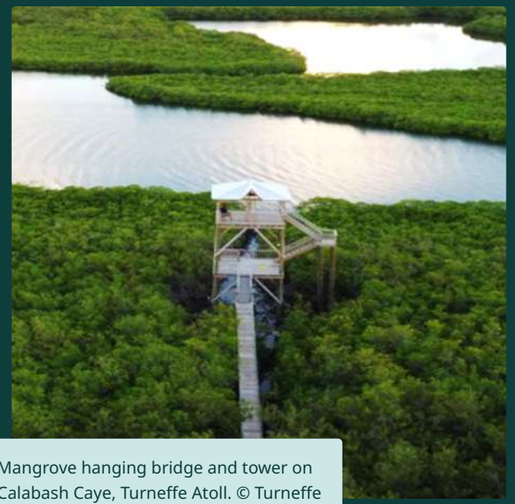
Type of Chapter members
NGOs, Academia, Community-Based Organizations, Civil Society Groups, Private Sector, Government, Quasi-Governmental, Researchers, Local Communities & Committed Citizens, and Trust Fund

Overview of Chapter structure

The Belize Chapter is a multi-stakeholder platform dedicated to improving the management, conservation, restoration, and research of mangrove ecosystems across Belize. The Chapter promotes an inclusive approach and operates under a neutral and collaborative framework.

Structure

- Steering Committee consisting of nine members from eight different organizations who represent the north, central, south and offshore of Belize
- Chapter members



Mangrove hanging bridge and tower on Calabash Caye, Turneffe Atoll. © Turneffe Atoll Sustainability Association (TASA)



Mangrove Friendly Development Challenge launch workshop in Belize City. © Avant Garde/WWF

Along Belize's coastline, mangroves serve as vital natural defenses—protecting communities from storms, supporting fisheries, and storing large amounts of carbon. However, these ecosystems face increasing pressure from coastal development, pollution, and unsustainable land use. In response, the Belize Mangrove Alliance (BMA), the National Chapter of the Global Mangrove Alliance, has emerged as a coordinated platform to protect and restore these critical habitats.

A major achievement of the Alliance is the completion of an updated national mangrove land tenure analysis, covering nearly 30,000 parcels and over 209,000 hectares. This database has become an essential tool for guiding conservation planning and policymaking. One key finding—that most mangroves are located on private lands—has shifted the conservation strategy to prioritize engagement with landowners. Through voluntary agreements, incentives, and exploration of carbon market opportunities, private landowners are now central to ensuring long-term mangrove protection.

To support this shift, the Alliance has developed practical tools that integrate mangrove conservation into private land management and coastal development. By promoting nature-based solutions such as living shorelines and climate-resilient design, these approaches demonstrate that conservation can align with economic benefits. These include reduced erosion, increased property value, and enhanced tourism potential, helping position mangroves as assets rather than barriers to development.

Collaboration is at the core of the Alliance's success. By bringing together government agencies, NGOs, communities, and private actors, the BMA has strengthened coordination and shared action. This has been instrumental in advancing a National Mangrove Restoration Action Plan, aligning science, policy, and implementation. Through these efforts, Belize is increasingly recognized as a leader in applying nature-based solutions to address climate risks and coastal vulnerability.

At the community level, the Alliance has nurtured a culture of environmental stewardship. Through training and outreach, coastal residents are actively participating in mangrove monitoring, restoration, and advocacy. This engagement has transformed conservation from an externally driven initiative into a locally owned effort. Mangrove planting and natural regeneration are already delivering tangible results—stabilizing shorelines and restoring nursery habitats for marine life. These outcomes directly benefit local livelihoods.

The Alliance has also contributed to strengthening policy frameworks by supporting science-based decision-making and encouraging compliance with existing mangrove regulations. By facilitating dialogue among stakeholders, it helps balance economic development with environmental protection, ensuring that growth does not come at the expense of critical ecosystems.

Beyond national benefits, Belize's mangroves play a globally significant role as highly effective carbon sinks, storing millions of tons of carbon. Protecting them is therefore essential for climate mitigation and biodiversity conservation. The Alliance's work contributes to both national priorities and international climate goals.

Education and outreach are key to sustaining progress. Through public campaigns, training programs, and youth engagement, the Alliance is building long-term awareness and strengthening environmental responsibility across generations.

Looking ahead, the Belize Mangrove Alliance is well positioned to expand its impact by scaling restoration efforts, deepening private-sector partnerships, and unlocking blue carbon financing. By continuing to integrate nature-based solutions into development and empowering communities, the BMA can further enhance Belize's resilience to climate change while protecting our invaluable coastal ecosystems.

3 | BRAZIL

Northeast Brazil Chapter

Natali Piccolo, Renan Alves, Alex Alves, and **Rafaela Sousa** (Conservation International – Brazil)

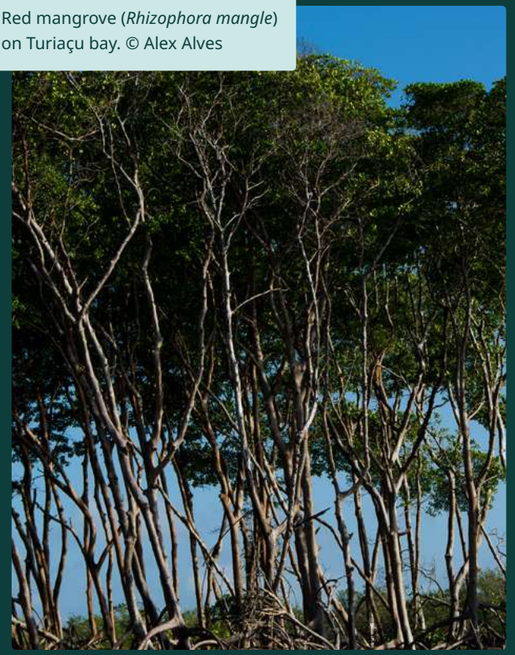
# of members
40

Chapter inception
January, 2026

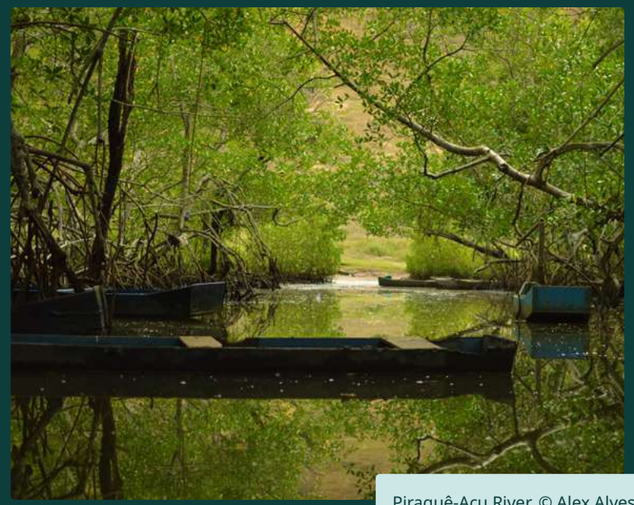
Type of Chapter members
NGO's, Academia, Civil Society Groups, Government Environmental sectors, Social Impact companies, Local Communities (fishermen, crab collectors, shellfish collectors), Educational Organizations

Overview of Chapter structure

The Brazil National Chapter of the GMA is being established as a governance and implementation framework connecting global commitments, national public policies, and territorial action for mangrove conservation, restoration, and sustainable use. With a strategic focus on Northeastern Brazil, the initiative responds to the growing recognition of mangroves as critical ecosystems for climate resilience, blue carbon, food security, and coastal protection. Aligned with the National Program for the Conservation and Sustainable Use of Mangroves in Brazil (ProManguezal - Decree No. 12,450/2024) and international climate and biodiversity agendas, the Chapter is structured around two implementation axes: (1) National Policy Architecture and Global Alignment and (2) Northeast Brazil: Diagnosis, Potential, and Action.



Red mangrove (*Rhizophora mangle*) on Turiaçu bay. © Alex Alves



Piraquê-Açu River. © Alex Alves

Since its establishment in January 2026, the GMA Northeast Brazil Chapter has created a coordinated regional network for mangrove conservation, restoration, sustainable use, and climate resilience. Operating in a region that contains nearly half of Brazil's mangrove coverage and supports thousands of coastal families whose livelihoods depend directly on these ecosystems, the Chapter has created a network that brings together government agencies, academic institutions, civil society organizations, traditional communities, and international partners around a shared vision aligned with Brazil's National Program for the Conservation and Sustainable Use of Mangroves (ProManguezal).

A major achievement was the completion of a comprehensive stakeholder mapping process across the nine states of Northeastern Brazil. The effort identified 57 organizations and 129 initiatives working on mangrove conservation, restoration, environmental education, research, governance, monitoring, and community development. Beyond establishing an important knowledge base, the mapping demonstrated the strength of local leadership while highlighting the need for stronger coordination among actors operating at multiple territorial scales.

In this context, an engagement strategy was developed to strengthen regional collaboration and support ProManguezal implementation. Through stakeholder mobilization, outreach, and thematic Working Groups, the initiative has promoted dialogue among public institutions, NGOs, universities, social movements, and community representatives. It has placed particular emphasis on engaging local communities, artisanal fishers, shellfish gatherers, and women-led organizations, recognizing their essential role in mangrove governance, biodiversity conservation, and the preservation of traditional knowledge.

The Chapter has also advanced strategic discussions on financing, governance, monitoring, and policy integration by preparing two Technical Notes and a Policy Brief on the synergies between GMA and ProManguezal, regarding the fulfillment of national and international commitments on Biodiversity Conservation and Climate Change Adaptation and Mitigation, including recommendations for the Brazilian government. Additionally, a monitoring and evaluation model for ProManguezal's actions was developed. This monitoring will be carried out through dashboards currently under development. These efforts respond directly to priorities identified under ProManguezal, including the need for stronger monitoring systems, sustainable financing mechanisms, and enhanced institutional coordination, representing a contribution to the implementation of this public policy. In particular, the Chapter has helped create conditions for the development of project pipelines and partnerships aligned with national and international commitments such as the Global Biodiversity Framework, the Mangrove Breakthrough, and climate adaptation agendas. Additionally, we're mapping shrimp farming areas and other infrastructures for priority mangrove restoration in Northeast Brazil.

> The effort identified **57 organizations and 129 initiatives** working on mangrove conservation

Looking ahead to 2030, the Northeast Brazil Chapter aims to consolidate its role as a permanent platform for collaboration, innovation, and resource mobilization and to fully integrate with a North Brazil Chapter, currently in development led by Rare Brazil. Priority actions include strengthening the regional stakeholder network, expanding participation in decision-making processes, supporting ProManguezal implementation, determining priority mangrove restoration, management and conservation areas, and improving public policies, monitoring and knowledge-sharing mechanisms. The Northeast Brazil Chapter also seeks to facilitate access to climate and biodiversity finance, including opportunities linked to public funds, international climate finance, and emerging blue carbon initiatives.

4 | COLOMBIA

Colombia Chapter

Gustavo Castellanos-Galindo and **Luis Zapata** (WWF Colombia)
on behalf of all GMA Colombia Chapter members

# of members
7

Chapter inception
April, 2019

Type of Chapter members
NGOs, Government, Private-Public Entity

Structure

- One lead organization (WWF)
- Chapter is composed of seven organizations, which include NGOs and the Colombian Ministry of Environment and Sustainable Development, Minambiente (government). The Chapter also includes INVEMAR, which is a mixed entity (partly public, partly private), doing research on Colombian marine ecosystems.



GMA Colombia National Chapter members met on July 1st and 2nd of 2026 in Cali, Colombia to draw a roadmap of activities for the coming years. © Luis Zapata



Tourists in Parque Nacional Natural Corales del Rosario, Colombia. © Mark Spalding / TNC

As part of the Global Mangrove Alliance's (GMA) renewed focus on strengthening the capacity of its national chapters, the Colombia National Chapter has, since 2025, intensified communication and collaboration among its members while expanding its engagement with organizations and civil society interested in mangrove conservation in Colombia.

The chapter's main achievements over the past two years can be grouped into two broad areas: (1) organizational strengthening and (2) outreach and external visibility. At the organizational level, more frequent interaction among chapter members has resulted in two major milestones. First, the chapter **jointly developed and submitted its first collaborative project proposal in 2025** *(Enhancing mangrove conservation benefits for nature and people in Colombia)*. Second, members **collectively drafted a chapter strategy**, which is expected to be finalized in 2026. The development of this strategy has been particularly valuable because it has created a shared space for members to discuss their respective interests, strengths, and priorities, allowing the chapter to define a common roadmap while recognizing the diversity of the seven organizations that comprise it. This process has established a strong foundation for the chapter's work in the coming years.

In terms of outreach and external visibility, one of the chapter's most significant achievements has been the establishment of a dedicated dialogue space for the GMA and the Colombia National Chapter within the annual National Mangrove Workshop organized by the Colombian Ministry of Environment. This forum, which brings together the government agencies responsible for mangrove management and conservation across the country, has provided an excellent platform to present the chapter's objectives and activities. It has also strengthened alignment between the chapter's priorities and national mangrove policy.

As a result of this sustained engagement, the updated national mangrove policy and its accompanying national program explicitly recognize the GMA Colombia National Chapter as a key stakeholder in mangrove conservation and management.

The GMA National Chapter work is planned for the long term; therefore, it will be necessary to establish a governance structure that facilitates dialogue that transcends presidential terms and creates a strategic position and opportunities for collaboration with stakeholders across the political, academic, community, and financial sectors. At the same time, the Chapter's strength lies in its close collaboration with local communities and regional environmental authorities, providing a practical pathway for advancing the objectives set out in its strategic plan. Through these efforts, the Chapter aims to contribute to the long-term conservation of Colombia's mangroves and to the well-being of the people whose livelihoods depend on them.

5 | ECUADOR

Ecuador Chapter

Raúl Carvajal and Ariel Ramos (Conservation International Ecuador) and **Elba Fiallo** (The Nature Conservancy Ecuador)

# of members
33

Chapter inception
September, 2023

Type of Chapter members
NGOs, Government, UN agency, academia (institutions and individuals), research (institutes and individuals), private sector, a trust, fishing associations

Overview of Chapter structure

The Ecuador Chapter's mission emphasizes collaborative work between civil society, the private sector, academia, local communities and public and international organizations, promoting adaptive, inclusive conservation based on scientific evidence and nature-based solutions.



TNC, CI, and WWF teams during the working meeting for the launch of the latest project "Strengthening the GMA Ecuador Chapter". © TNC Ecuador

Structure

- Three co-leads from different organizations (TNC Ecuador, CI Ecuador, and WWF Ecuador)
- One facilitator/national coordinator (Universidad Casa Grande)
- Eight Working Groups: communication, conservation and restoration, education, public policy, fisheries resource management, research, and a steering group.

The Ecuador Chapter has adopted a two-tier participation model:

- Tier One: A core group of founding members (CI, WWF, TNC, and Universidad Casa Grande), responsible for strategic guidance and decision-making
- Tier Two: Expanded meetings that include all member organizations to ensure inclusiveness and transparency in planning and implementation

Since its establishment in September 2023, the Ecuador Chapter of the Global Mangrove Alliance (GMA) has consolidated a multi-sectoral platform comprising 33 members, including non-governmental organizations, academia, public institutions, private sector actors, researchers, international organizations, and small-scale fisheries groups. The Chapter operates with a shared mission to halt mangrove loss and promote science-based restoration, positioning mangroves as a cornerstone of climate resilience and sustainable development in Ecuador.

A key achievement has been the strengthening of collaborative governance mechanisms. The Chapter has advanced the development of a citizen-based mangrove observatory, supported the training of restoration practitioners, and implemented pilot restoration demonstration units. These actions are complemented by efforts to enhance sustainable livelihoods linked to mangrove ecosystems. The Chapter has also contributed to the updating and implementation of Ecuador's National Mangrove Plan, alongside innovative communication strategies and environmental education programs.

Capacity building has been central to the Chapter's work, targeting both community custodians and decision-makers. A major milestone was the 2nd Ecuadorian Mangrove Congress, organized under the leadership of the Public Institute for Aquaculture and Fisheries Research (IPIAP), with the support of the Ecuador Chapter and Universidad del Pacífico. This event convened national and international experts, authorities, academia, NGOs, and local communities, fostering knowledge exchange on restoration, conservation, and sustainable management. The Chapter provided training sessions, including on the use of the Global Mangrove Watch platform and fisheries management of key species such as the black clam. The Congress also highlighted climate-smart strategies, innovative restoration practices, and community stewardship experiences under Sustainable Use Agreements for Mangrove Ecosystems (AUSCEM), including their potential recognition as Other Effective Area-Based Conservation Measures (OECMs).

Beyond its technical contributions, the event reinforced the crucial role of local communities in mangrove governance.

The Chapter has played a significant role in expanding community-based conservation, promoting more than 45 AUSCEM agreements and supporting the consolidation of over 100,000 hectares of mangroves under community stewardship. These efforts reflect a broader commitment to inclusive governance and local empowerment.

Since August 2025, the Chapter has been implementing a strategic initiative to further strengthen its national multi-actor platform for mangrove conservation, restoration, and sustainable use. This strategic initiative includes the development of a community-based early warning system for mangrove degradation, strengthened governance frameworks, and enhanced local capacities. It also aims to improve management across 38,040 hectares, including the recognition of 20,000 hectares as OECMs, improved management of 18,000 hectares under AUSCEM, restoration of 40 hectares, strengthening of productive ventures, mangrove information management (dashboard), effectiveness evaluation of AUSCEM management, and capacity building for approximately 700 stakeholders.

In the past year, the Chapter has strengthened alliances among key organizations, including The Nature Conservancy (TNC), Conservation International (CI), and World Wildlife Fund (WWF), promoting a shared vision for sustainable shrimp production. Progress has also been made in the development of the Community Early Warning System, integrating technology with participatory monitoring and technical training. In June 2026, Guayaquil hosted the Second Meeting of GMA National Chapters, further positioning Ecuador as a regional leader.

Guided by its Strategic Framework (2025–2030) and Operational Plan (2025–2027), the Ecuador Chapter continues to align national efforts with global GMA objectives, contributing to the conservation and sustainable management of mangroves worldwide.

6 | GUINEA-BISSAU

Connecting People, Data, and Nature: PLANTA's Leadership in Mangrove Conservation in Guinea-Bissau

Abdoulaye NDIAYE (Laye) (Wetlands International Guinea Bissau)

# of members
37

Chapter inception
September, 2024

Type of Chapter members
Technical services, institutes under the Ministry of the Environment & Biodiversity of Fisheries, NGOs, Civil Society members, and Community-Based Organizations

Overview of Chapter structure

The main partners are currently grouped together within the PLANTA/GMA network. PLANTA/GMA brings together organizations directly involved in mangrove conservation and restoration, as well as institutions that oversee the various sectors that use the natural resources of mangrove ecosystems, including sectors that may have a negative impact on mangrove ecosystems.

Structure

- PLANTA is the National Chapter (PLANTA/GMA).
- One GMA lead (Wetlands International)
- Six Committees, open to all members, gives members the opportunity to join groups and/or access information. Committees include: Environmental Assessment, Environmental Education, PLANTA/GMA, GMA, Research Investigation, and Gender.



Community members in the Jeta-Pecixe-Cacheu (JPC) landscape carrying out ecological mangrove restoration by digging channels to restore the hydrology of abandoned rice fields, allowing them to revert to mangrove habitat. © Wetlands International & Beyond Borders Media

Mangroves are one of Guinea-Bissau's most valuable natural assets, covering approximately 10% of the national territory and providing essential ecosystem services that support local livelihoods, fisheries, biodiversity, climate resilience, and food security. Recognizing the importance of these ecosystems and the need for stronger coordination among stakeholders, the Platform on Mangrove Landscapes of Guinea-Bissau (PLANTA) was established in 2020.

As Guinea-Bissau's Chapter within the Global Mangrove Alliance (GMA), PLANTA serves as a multi-stakeholder platform dedicated to promoting collaboration, knowledge sharing, and coordinated action for the sustainable management of mangrove landscapes. The platform brings together government institutions, national and international NGOs, conservation projects, researchers, and technical experts working on mangrove-related issues throughout the country. PLANTA operates under the supervision of the Ministry of Environment and Biodiversity, with secretarial functions provided by the Institute for Biodiversity and Protected Areas (IBAP) and leadership from the Coastal Planning Office (GPC).

Since its creation, PLANTA has become an important national mechanism for aligning efforts across sectors and institutions. Through regular meetings, workshops, and training sessions, PLANTA promotes dialogue and action on key themes including mangrove conservation, rice farming, biodiversity protection, sustainable livelihoods, and environmental awareness.

The platform's priorities encompass a broad range of interventions, including mangrove protection and restoration, sustainable ecosystem management, the promotion of income-generating activities, environmental education and communication, scientific research, capacity building, regional cooperation, and resource mobilization. Today, PLANTA brings together 22 active stakeholder organizations and institutions working toward a shared vision of healthy and productive mangrove landscapes.

One of PLANTA's most significant achievements has been the development of a participatory and publicly accessible geoportal, which has become a central tool for mangrove monitoring and decision-making in Guinea-Bissau. Available through **www.plantagb.org**, the platform compiles data collected across the country using Survey123 and other monitoring tools. The system integrates information on mangrove extent aligned with Global Mangrove Watch datasets, as well as data on fishing activities, fire alerts, illegal hunting incidents, biodiversity monitoring, restoration activities, and other indicators relevant to ecosystem management.

The digital platform consists of three complementary components. First, the *Data Portal* provides users with information on interventions carried out by PLANTA's 22 stakeholders. Second, the Geoportal offers access to mangrove cover maps alongside restoration and rehabilitation maps, providing a spatial perspective on conservation efforts and ecosystem change. Third, the *PLANTA Website* serves as a communication and knowledge-sharing hub.

Local communities have been equipped with tablets and trained to use digital data collection applications, allowing them to contribute directly to monitoring efforts and ensuring that local knowledge informs national decision-making. This participatory approach strengthens data quality, promotes local ownership, and enhances the effectiveness of mangrove conservation initiatives.

Together, PLANTA's governance structure, collaborative network, and digital tools have significantly advanced the sustainable management of Guinea-Bissau's mangrove ecosystems. By bringing together diverse stakeholders, facilitating data-driven decision-making, and empowering local communities to contribute to monitoring and conservation, PLANTA continues to strengthen national efforts to protect and restore one of the country's most important coastal ecosystems. With the nascent GMA partnership, all the results and advances will be visible worldwide.

7 | INDIA

Building Collaborative Architecture for India's Mangroves

Jayati Chourey (SaciWATERs) and **Mr. A. Sridhar** (Wetlands International South Asia)

# of members
27

Chapter inception
April, 2025

Type of Chapter members
NGOs, INGOs, and Academic and Research Institutions



Investing in the Next Generation of Mangrove Stewards: A youth delegate addresses the Mangrove Parliament as Minister of Sundarban Affairs during GMA India's Youth Changemakers workshop, organised with NEWS, SaciWATERs, and Axis Bank. © Jayati Chourey / SaciWATERs

Overview of Chapter structure

The Chapter operates under a shared leadership model, with the Secretariat housed at SaciWATERs in Secunderabad, Telangana, and co-led by Wetlands International South Asia. This co-lead arrangement ensures balanced representation of national and international perspectives, and equitable coordination across regions and sectors. The Secretariat is responsible for overall coordination, member engagement, reporting to the GMA global team, and facilitating the Chapter's strategic visioning process.

Structure

GMA India remains an inclusive, member-driven platform where all members retain equal standing. The Core Group structure was created only to support continuity and coordination - not to create hierarchy or privilege.

- General membership
- Seven-member core group, which includes two co-leads (one of whom also serves as the Secretariat)
- Five thematic task groups: Research & Knowledge; Capacity Building; Partnerships & Communications; Resource Mobilization; Policy Advocacy

A National Opportunity

India supports approximately 4,992 km² of mangroves, representing one of the world's most ecologically significant and institutionally rich mangrove landscapes. Spanning diverse biogeographic regions from the Sundarbans of the Bay of Bengal to the estuaries of the Arabian Sea, India's mangroves sustain extraordinary biodiversity, support millions of coastal livelihoods, and serve as critical natural infrastructure against cyclones, storm surges, erosion, and sea-level rise.

A strong ecosystem of research institutions, conservation organizations, government agencies, and community practitioners has long engaged with mangroves. Yet these efforts have often evolved in parallel rather than in partnership, limiting the scale, coherence, and systemic impact of national conservation and restoration action.

Established in April 2025 as the 14th National Chapter of the Global Mangrove Alliance (GMA), GMA India was created to address this structural gap. The Chapter currently comprises 23 member organizations representing research institutions, conservation organizations, academia, international agencies, and civil society. As a neutral, member-driven collaborative platform, it enables GMA members and partners to align expertise, strengthen partnerships, generate shared knowledge, and collectively contribute towards India's national priorities and the GMA 2030 Goals.

Building the Collaborative Architecture

The Chapter's first year focused on creating the institutional foundations required for long-term collective action. Its defining milestone was the Strategic Visioning and Goal-Setting Workshop held amidst the Mandovi River mangroves of Goa in November 2025. Bringing together fifteen founding member organizations, the workshop co-developed a shared national strategy, governance framework, implementation roadmap, and thematic working groups, providing the Chapter with a common strategic direction and operational structure.

Supporting this process, GMA India initiated a national mapping of mangrove conservation and restoration initiatives to better understand the existing landscape of institutions, projects, and opportunities for collaboration. Knowledge exchange emerged as another strategic priority. A Global South Peer-Learning Exchange on World Mangrove Day connected practitioners from India, Indonesia, Panama, and Africa around Ecological Mangrove Restoration, blue carbon, and community stewardship, while the GMA India Technical Series created a continuing platform for dialogue between researchers, practitioners, and policymakers. The Chapter also strengthened the visibility of mangroves within national policy discourse through engagement at Sagar Manthan during India Maritime Week and invested in future leadership through the Youth Changemakers for Mangroves initiative in the Sundarbans.

Together, these initiatives have begun to establish a collaborative ecosystem where science, policy, practice, and community perspectives can converge around shared national priorities.

Towards Collective Impact

The next phase of GMA India is defined by implementation. The Chapter seeks to enable collaborative, landscape-scale initiatives that build upon the complementary strengths of its members while supporting measurable contributions towards the GMA 2030 Goals. Priority areas include strengthening science-based restoration, advancing common standards and knowledge systems, promoting policy coherence and Source-to-Sea approaches, expanding innovative financing for mangrove conservation, and fostering collaborative project pipelines across India's east and west coasts.

More fundamentally, GMA India is working to demonstrate that collaboration is itself an enabling mechanism for conservation. By transforming India's considerable scientific, institutional, and community capacity into coordinated national action, the Chapter aims to amplify collective impact and contribute meaningfully to a resilient future for mangroves, coastal communities, and climate.

8 | INDONESIA

GMA Indonesia Chapter: Advancing Collaboration for Mangrove Conservation and Restoration

Aji Wahyu Anggoro, A. Yoseph Wihartono, and Topik Hidayat (Yayasan Konservasi Alam Nusantara), **Apri Susanto Astra, Aji Nuralam Dwisutono, Tyas Ayu Lestari, and Fransisca Noni Tirtaningtyas** (Wetlands International Indonesia)

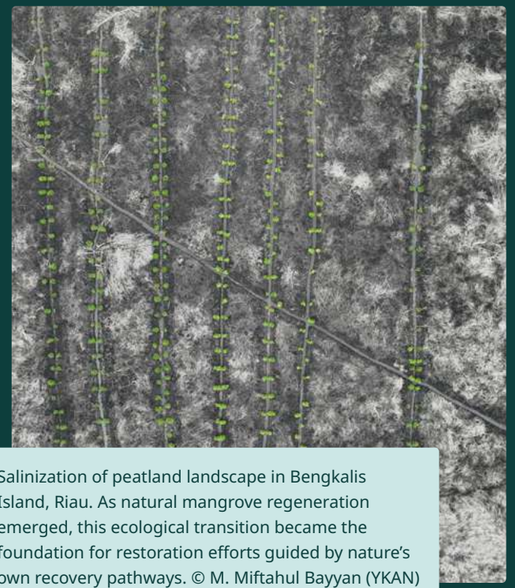
# of members
4

Chapter inception
November, 2022

Type of Chapter members
NGOs

Structure

- Member Assembly: Highest authority composed of all members
- Steering Committee: Elected strategic body
- National Secretariat: operational arm led by a Coordinator



Salinization of peatland landscape in Bengkalis Island, Riau. As natural mangrove regeneration emerged, this ecological transition became the foundation for restoration efforts guided by nature's own recovery pathways. © M. Miftahul Bayyan (YKAN)



Natural mangrove regeneration advances landward across the degraded peatland, following hydrological pathways that create corridors for establishment and signal an ongoing ecosystem transition. © M. Miftahul Bayyan (YKAN)

The Global Mangrove Alliance Indonesia Chapter (GMA-IC) was established in November 2022 to strengthen collaboration and align efforts to protect and restore Indonesia's mangrove ecosystems. The Chapter currently consist of Wetlands International Indonesia (WII), Yayasan Konservasi Alam Nusantara (YKAN), and Konservasi Indonesia (KI). It promotes science-based mangrove conservation and restoration, facilitates knowledge exchange, strengthens stakeholder coordination, and supports national efforts to address biodiversity loss, climate change, and sustainable coastal livelihoods.

For the first few years, the GMA-IC focused on establishing the National Chapter; advancing mangrove conservation, restoration, and community livelihoods in Demak, Central Java; Berau, East Kalimantan; Fakfak, West Papua; Ogan Komering Ilir, South Sumatera; Bengkalis, Riau; and Bulungan, North Kalimantan; providing training on mangrove restoration and Global Mangrove Watch (GMW); and engaging government through policy dialogues on mangrove ecosystem protection and management.

In 2025, the Chapter continued strengthening national collaboration. In partnership with the Mangrove Breakthrough (MB), it focused on developing the national strategy and Indonesia Country Proposition, supporting proposal development, and preparing and implementing a MB workshop. The activities also strengthened collaboration among GMA members and partners through the GMA Indonesia Chapter consortium, including technical inputs, consultant coordination, and partner engagement.

In 2026, the Chapter further expanded its knowledge-sharing, capacity-building, and coordination efforts. On 20–22 May, WII conducted SMART PATROL training in Demak for government officials and fishers, introducing GMA and GMW as tools for monitoring mangrove ecosystems. From 8–12 June, Aji Nuralam (WII) and Ismu Hidayat (KI) represented the Chapter at the GMA National Chapters 2026 Workshop in Guayaquil, Ecuador, which strengthened collaboration under the vision of "One GMA", a global alliance



Figure 1: Photo Session from Left to Right: The DoMR – MoF (Giri Suryanta), GMA-IC representatives (Aji Nuralam-WII, Nikki Astrida-YKAN), resource persons (Yusran Nurdin – Yayasan Hutan Biru), and moderator Susan Lusiana (KI). © Wetlands International Indonesia

working collectively toward shared goals. On 30 June, GMA Indonesia organized a workshop on Rehabilitation and Protection of Coastal Ecosystems through the Ecological Mangrove Rehabilitation (EMR) Approach, initiated by WII in collaboration with the Directorate of Mangrove Rehabilitation (DoMR), Ministry of Forestry (MoF). Giri Suryanta of the DoMR highlighted the continued decline of Indonesia's mangroves and reaffirmed the government's commitment to restoration that strengthens ecosystem resilience, coastal livelihoods, fisheries, and food security. The event introduced EMR principles and practices to approximately 600 online and 75 in-person participants from government, academia, research institutions, universities, the private sector, NGOs, and local communities (Figure 1).

On 21–22 July, the Chapter held an internal workshop to strengthen governance, communication, fundraising, and implementation of its Action Plan (Figure 2). The workshop established short, medium, and long-term priorities covering policy engagement, capacity building, restoration and conservation, financial sustainability, and communications, providing a foundation for a stronger, more coordinated, and sustainable GMA-IC.



Figure2 : The GMA-IC (WII, YKAN, and KI) held an internal workshop. The drawing in the background, created by participants, reflects their vision for the future of the GMA Indonesia Chapter. © GMA-CI

9 | KENYA

Kenya's Mangroves Momentum: Growing Partnerships, Lasting Impact

Francis Okalo (International Union for Conservation of Nature (IUCN), **Louisa Chinyavu** and **Maresi Ibrahim** (Wetlands International Eastern Africa), **Carol Chao Kimbio** (Conservation International), **Nathaniel Mwangeka** and **Lilly Mwasi** (WWF-Kenya), **Lenice Ojwang** (Fauna and Flora), **Damaris Kinyua** and **George Maina** (The Nature Conservancy)

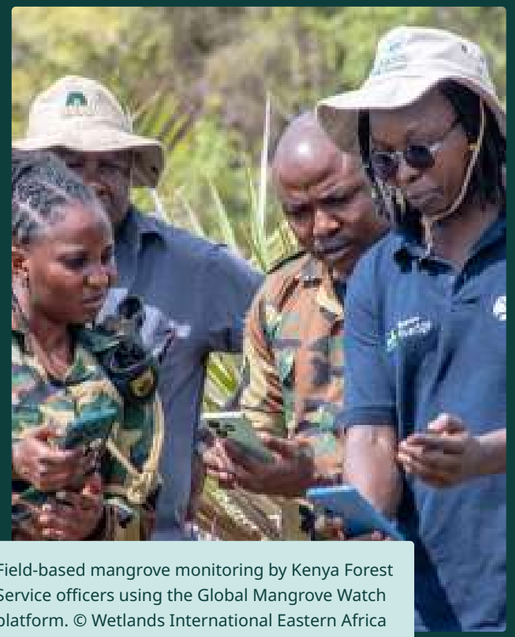
# of members
18

Chapter inception
September, 2022

Type of Chapter members
NGOs, CBOs, and International Membership Union

Structure

- Five Core Partners (Conservation International, IUCN, TNC, Wetlands International-Eastern Africa, and WWF-Kenya)
- Chapter Lead: one of the core partners (on rotation & currently IUCN)
- Steering Group: Provides strategic linkages between the Chapter and government priorities. Composed of two core partners, two government representatives, one Mangrove Community Forest representative, one national NGO.
- Five Working Groups: co-led by two core partners. Alliance Development, Science Knowledge Management & Monitoring, Capacity Building, Global Policy & Communication, and Innovative Finance.



Field-based mangrove monitoring by Kenya Forest Service officers using the Global Mangrove Watch platform. © Wetlands International Eastern Africa



Signing of the GMA-Kenya chapter MoU. © IUCN

The Global Mangrove Alliance Kenya Chapter has had a transformative growth. By June 2026, it had expanded from five to eighteen organizations, comprising government agencies, civil society, community-based organizations, and private sector stakeholders. United by a shared commitment to conserving Kenya's 61,000 ha of mangrove forests, the alliance has strengthened national collaboration in mangrove protection, restoration, and sustainable coastal ecosystem management.

Recognition of the importance of multi-stakeholder collaboration led to the formalization of the Kenya Chapter through a Memorandum of Understanding signed on the 26th July 2025. This agreement institutionalized the Chapter's governance and shared objectives, strengthening member trust and enhancing coordination for mangrove conservation and restoration efforts.

As Kenya advances toward the GMA 2030 targets, it is strengthening long-term mangrove conservation through policy, science, community leadership, and partnerships. The Chapter has significantly strengthened mangrove governance in Kenya by contributing to key policy and regulatory frameworks, including the Blue Carbon Ecosystems NDC Implementation and Investment Plan (2025–2035), the Mangrove Ecosystem Harvest Management Plan for Lamu County (2025-2035), the National Mangrove Ecosystem Restoration Guidelines, and the Mangrove Forest Management Technical Order No. 1 of 2025. The Chapter also co-organized National Events that advanced mangrove conservation and restoration efforts.

The Chapter has enhanced mangrove forest monitoring by applying the Global Mangrove Watch platform, in collaboration with the Kenya Forest Service and local communities. This has strengthened ecosystem surveillance and management of the mangrove forest.

The Chapter has enhanced the adoption of Community-Based Ecological Mangrove Restoration (CBEMR) best practices and fostered a growing network of restoration practitioners, including *'Champions'* and *'Community of Practice'*. Uptake of locally appropriate restoration approaches is enhancing ecosystem recovery, community ownership, and the sustainability of mangrove conservation efforts.



Civil Society Organizations CBEMR Training. © Wetlands International Eastern Africa

A major milestone was the launch and operationalization of the *'Mangrove Champions Initiative'*, which scales and mobilizes local practitioners, coastal communities, and youth as advocates for mangrove conservation. Through field-based learning, knowledge exchange, and capacity building, the initiative is strengthening a growing network of community-led conservation champions and advancing locally driven, sustainable mangrove stewardship.

Looking Ahead: Kenya's Mangrove Vision to 2030

The Kenya Chapter is working closely with government and partners to translate mangrove policies and commitment into measurable conservation outcomes. By broadening engagement across the finance, legal, and ocean governance sectors, the Chapter is keen to strengthen implementation and position Kenya as a model for how multi-stakeholder partnerships can effectively bridge global commitments and action for mangrove conservation. The momentum is real, the partnerships are strong, and a committed network of champions is driving the future of Kenya's mangroves. Continued investment, partnership, and community leadership are critical to scaling mangrove protection and restoration and achieving the GMA 2030 targets.

10 | LIBERIA

Liberia Chapter

Peace Amoah-Quiminee and Varney Sirleaf (Conservation International – Liberia)

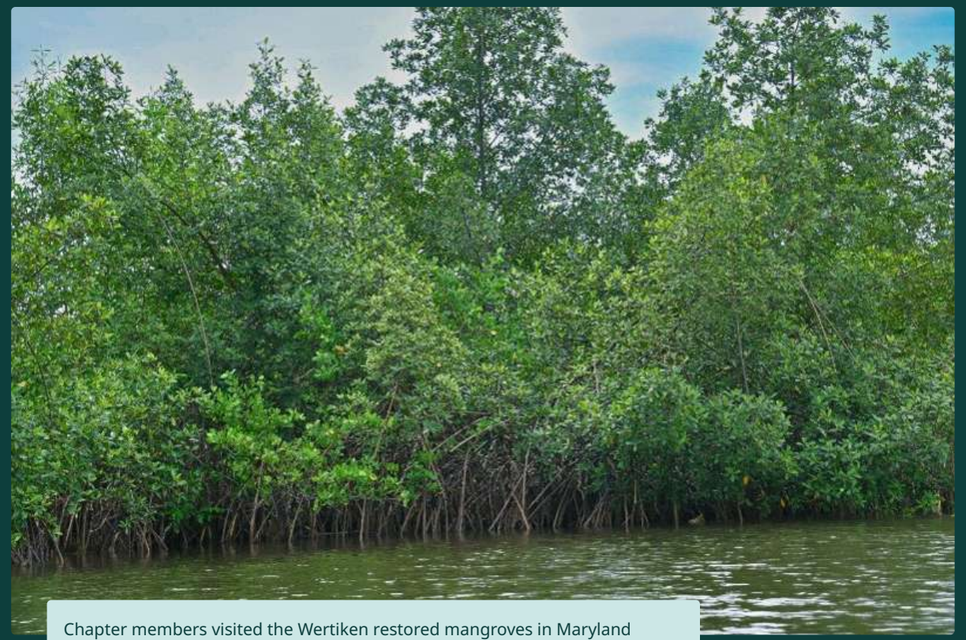
# of members
93

Chapter inception
August, 2024

Type of Chapter members
Government, NGOs, Academia, CSOs and INGOs

Structure

- One lead institution manages the Chapter (Environmental Protection Agency)
- One institution co-leads on policy (Forest Development Authority)
- One institution co-leads on capacity building & research (University of Liberia)
- Other members represent local communities and traditional peoples



Chapter members visited the Wertiken restored mangroves in Maryland county. © Varney Sirleaf-Conservation International

The Liberia Chapter of the Global Mangrove Alliance continues to demonstrate strong commitment in advancing a coordinated, multi-sectoral approach to the protection and conservation of the country's mangrove ecosystems.

Launched in August 2024 in partnership with the Environmental Protection Agency of Liberia and Conservation International, the chapter serves as a national platform uniting diverse stakeholders in a coordinated effort to halt mangrove loss and restore degraded ecosystems.

Since its establishment, the chapter has convened two General Assemblies, bringing together representatives from government, civil society, development partners, non-governmental organizations, academia, as well as youth and student groups. These forums have provided space to review progress, approve strategic priorities, and establish a leadership structure to guide the chapter's work.

> A nationwide assessment and **awareness mission targeted mangrove communities** across Liberia's nine coastal counties

At its first General Assembly in December 2025, members endorsed a nationwide assessment and awareness mission targeting mangrove communities across Liberia's nine coastal counties. This initiative aimed to generate a comprehensive understanding of the condition of mangrove ecosystems, while also assessing community reliance on mangroves and their levels of awareness regarding the ecological and socio-economic importance of mangroves ecosystems.

Through a series of community engagements and town hall meetings conducted during the mission, chapter members gathered valuable insights directly from local communities. Communities shared experiences of how human activities, particularly the use of mangroves as firewood, have contributed to mangrove degradation. At the same time, encouraging examples emerged of behavioral change driven by ongoing interventions from Chapter member organizations and other partners.



Chapter First General Assembly held at the University of Liberia. © Varney Sirleaf-Conservation International

Findings from the assessment and awareness mission were presented at the second General Assembly in April 2026. The report provided critical evidence to inform collective decision-making and shape future priorities.

Building on these insights, the assembly adopted several key actions to strengthen the chapter's effectiveness and long-term impact. These include:

- Strengthening and decentralizing the chapter's structure to enhance local engagement and responsiveness
- Establishing continuous monitoring and collaboration with stakeholders in observing mangrove ecosystems and community practices
- Expanding public awareness initiatives to improve understanding of mangrove ecosystem benefits
- Developing a strategic framework to guide coordinated planning, implementation, and partnership

These milestones underscore the Liberia Chapter's growing role as a collaborative platform driving national efforts to safeguard mangrove ecosystems and sustain the people that depend on them.

11 | MALAYSIA

Malaysia Chapter

Norita Ja'afar (Global Mangrove Alliance Malaysia Chapter)

# of members
25

Chapter inception
November, 2023

Type of Chapter members
NGOs, Government, Private Sector, and Academia

Overview of Chapter structure

The Chapter's mission is to address environmental challenges with a focus on coastal wetlands, particularly mangrove ecosystems.

Structure

The Chapter operates as a non-profit social enterprise with a three-person board of directors and two Executive Directors. The Chapter's membership includes individuals and organizations from academia, NGOs and the private sector collaborating on mangrove restoration, conservation, research, capacity building, and advocacy.



Mineral and toxic runoff from a former bauxite mining site flows into the rivers, not the mangrove directly, yet it travels downstream to impact the mangroves these waters feed. © Akhramsyah Sanusi



Freshly cleared mangrove on a tidal bank. Encroachment arrives without warning, often at unexpected hours, and moves with a speed that leaves communities and monitors little time to respond. © Norita Ja'afar

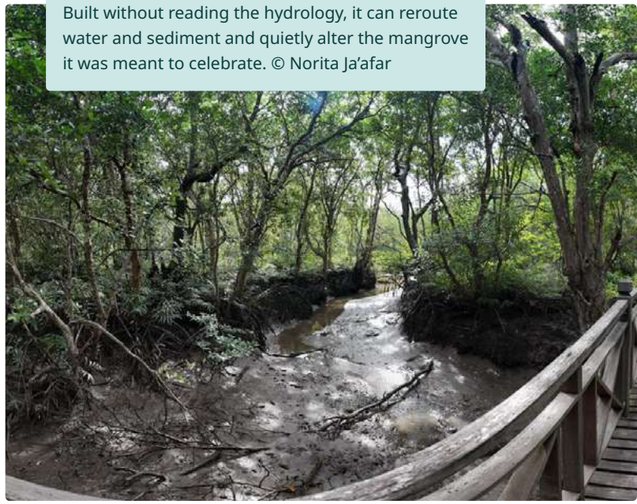
Chapter Successes and the Road to 2030

The Malaysia Chapter of the Global Mangrove Alliance (GMA) has been established as a formally constituted national entity, governed by a board of directors that holds the Chapter to standards of ethics and integrity in all of its operations. This governance is itself an achievement, because it gives partners, communities and funders an accountable body to engage rather than an informal network. From this footing the Chapter has positioned itself as a credible national convenor for mangrove action, and it has secured formal partnerships with two state governments in Malaysia through signed Memoranda of Understanding, moving from a network presence into an entity that governments engage directly.

One of the Chapter's flagship initiatives is Jejak Bakau, its community-based mangrove immersion program, now active in Sungai Santi and Limbang. The program works with fishermen and the local communities living around the mangroves whose livelihoods depend on these ecosystems, and it is supported by two corporate partners, one in each of the two states. Rather than treating engagement as a single event, Jejak Bakau produces a publication that documents how these communities live and the challenges they face, placing that evidence directly in front of government so that the people closest to the mangroves are heard in the decisions that affect them.

> The Chapter's flagship Jejak Bakau initiative… is placing evidence directly in front of the government so that **the people closest to the mangroves are heard**

Financing mangrove restoration at scale is difficult, and the Chapter's progress on this front matters. Restoration delivers ecological and carbon returns over years and



A boardwalk brings people closer to the mangrove. Built without reading the hydrology, it can reroute water and sediment and quietly alter the mangrove it was meant to celebrate. © Norita Ja'afar

decades, a horizon far longer than most capital is willing to wait. It also depends on aligning many stakeholders at once, state and federal authorities, local communities with customary rights, corporate sponsors and carbon buyers, each of whom must commit for the long term. The pressures on a mangrove often originate beyond its own boundary, in the rivers and land uses upstream, so no single party controls the outcome. Against this, the Chapter has secured early seed funding to take its first restoration site through feasibility, and it is now raising the same funding for the remaining sites, addressing the hardest part of the problem: the cost of bringing a credible project to the point where it can attract investment.

Looking to 2030, the Chapter's ambition sits within the GMA goal to halt mangrove loss, restore half of restorable losses, and double the area of mangroves under formal protection. For Malaysia, that means expanding from two state partnerships into a wider national coalition, advancing its restoration sites toward measurable and verified outcomes, scaling Jejak Bakau so that more communities shape the decisions that affect them, and building the local evidence base so that mangroves are managed by people who understand their hydrology, their carbon, and the livelihoods dependent on them.

12 | MEXICO

Advancing Mangrove Conservation in Mexico Through Collaborative Action

Fernanda Tonalli Ramírez Aguilera (World Wildlife Fund México)

# of members
68

Chapter inception
October, 2022

Type of Chapter members
NGOs, Academia, Independent Consultants, Private Sector, and Government



GMA Mexico Chapter exchange workshop: social and environmental best practices for mangrove restoration, conservation, and sustainable economic activities. Mexico City. October 2023.

Structure

The Chapter operates as a technical subgroup under the Coastal-Marine Working Group (GTCM) of the Mexican Alliance for Ecosystems Restoration (AMERE).

The Chapter is structured to function as a collaborative and non-hierarchical platform, with a technical coordination, a secretariat, both carried out by WWF Mexico, and a coordination group with participants from WRI Mexico, TNC, WWF Mexico, CI Mexico and National Audubon Society, and The Ocean Foundation within the GTCM-AMERE framework. This structure enables consistent follow-up of activities, fosters coordination between stakeholders, and ensures technical alignment with broader national strategies and the GMA's global goals.



Women leaders and community members gathered at the Second Women's Exchange on Mangrove Conservation in La Paz, Baja California Sur, Mexico, led by Costa Salvaje A.C. November 2024.

The Mexico Chapter of the GMA (MX-GMA), established in October 2022, has evolved into a national platform that connects actors, strengthens partnerships, and aligns efforts around a shared agenda for mangrove conservation and restoration. As of June 2026, the Chapter brings together 68 members from 39 entities, including government agencies, civil society and grassroots organizations, academia, and the private sector, fostering collaboration across sectors and scales. The Chapter is nested within the Coastal Marine Working Group of the Mexican Alliance for Ecosystem Restoration (AMERE), reinforcing its role within broader national restoration efforts.

A defining milestone has been the creation of a Coordinating Group composed of representatives of GMA in Mexico. This structure has strengthened coordination and enabled more strategic engagement in national and international processes. The MX-GMA has played a leading role in coordinating the development of the national proposal for mangroves, with support from the Mangrove Breakthrough initiative. This effort has contributed to its endorsement by federal and state governments, and engaged stakeholders at multiple levels. The process has helped position mangrove conservation and restoration as a shared national priority.

Beyond policy alignment, the MX-GMA has fostered technical collaboration and knowledge exchange among its members. One key outcome is the jointly developed document "Restoration, Conservation, and Sustainable Economic Activities in Mangrove Ecosystems: Ten principles of Social and Environmental Best Practices," which reflects a shared vision for inclusive and sustainable mangrove management. The Chapter has also supported spaces for learning and exchange, enabling participation from diverse actors, including local community representatives.

The MX-GMA has actively pursued funding opportunities to support collective action. While not all initiatives have been successful, it has established a strong foundation for collaboration and strengthened processes for designing and coordinating joint proposals.

To further enhance its internal functioning, the Chapter has initiated a process to consolidate its governance structure. In 2026, the Chapter launched a call for proposals to engage consultants in the development of a governance and operational manual. This initiative will help clarify roles, improve decision-making, and strengthen the Chapter's overall effectiveness.

Looking ahead, the MX-GMA has identified key priorities, including advancing financial mechanisms for long-term mangrove conservation and strengthening meaningful engagement with local communities. While many member organizations already work directly with communities, the Chapter aims to build a shared, culturally grounded engagement framework that integrates local knowledge, promotes inclusive participation, and ensures community perspectives are reflected across its work.

The MX-GMA has also maintained an active presence in key national and international forums, including the Summit for Ecosystem Restoration in Mexico – AMERE 2025, Climate Week New York and Mexico 2025, and the in-person meeting of National Chapters in Ecuador 2026. Continued participation in upcoming events such as Climate Week Mexico 2026 and the 3rd Mangrove Congress of the Americas will further strengthen exchange, visibility, and collaboration.

Collectively, these efforts reflect the Chapter's growing role as a coordinating platform that bridges actors and scales, strengthens collaboration, and supports more coherent action for the long-term conservation, restoration, and sustainable management of mangrove ecosystems in Mexico.

13 | PANAMA

Panama Chapter

Yenifer Díaz (Sociedad Audubon de Panamá)

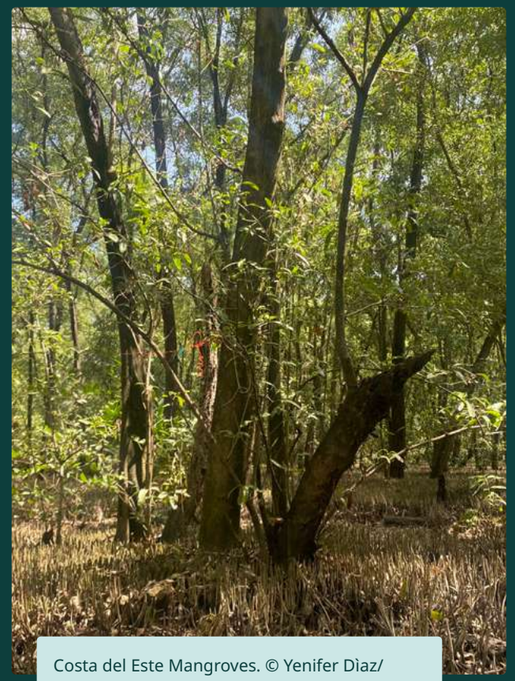
# of members
43

Chapter inception
November, 2023

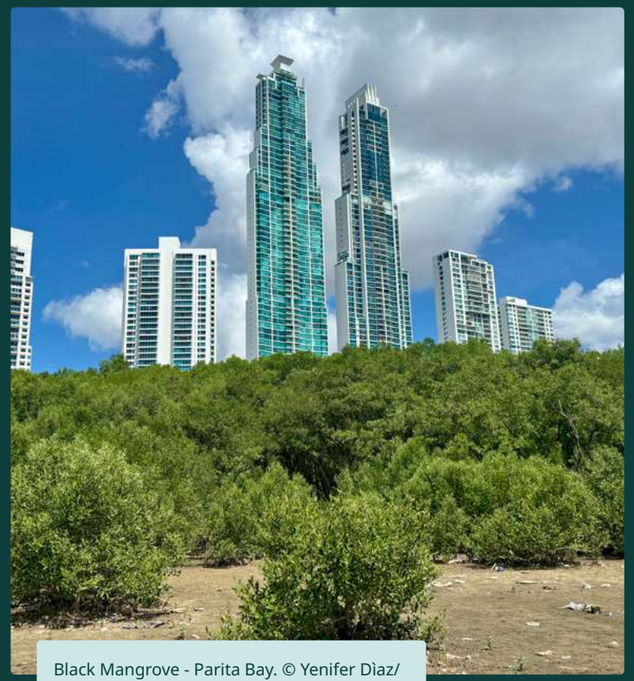
Type of Chapter members
NGOs, Government, Academia, Researchers, Community Groups

Structure

- One lead convener organization (Panama Audubon Society)
- A lawyer redefines the structure of the Chapter, the roles and responsibilities, to ensure participation, democracy, and equity.



Costa del Este Mangroves. © Yenifer Dìaz/ Sociedad Audubon de Panamá



Black Mangrove - Parita Bay. © Yenifer Dìaz/ Sociedad Audubon de Panamá

The Panama Chapter was formally established in 2023, during the first symposium "Towards a Blue Economy in the Region: Restoring and Protecting Mangroves," held in Panama City. The Chapter is anchored in the National Wetlands Committee of Panama (CNHP), an interinstitutional body created in 2006, which has served as the country's key advisory body on wetland management and the implementation of the Ramsar Convention.

The Chapter brings together a diverse membership organized into four categories: Founding Members (led by the CNHP), Technical and Scientific Members (universities and research institutions), Contributing Members (including private-sector partners), and Community and Operational Members (including NGOs and community-based organizations). This diverse structure reflects the Chapter's vision that **effective mangrove conservation requires shared responsibility across government, academia, civil society, and local communities.**

Chapter successes

Since its founding, the Panama Chapter has aligned its work with Panama's National Wetlands Policy (Executive Decree No. 127 of 2018) and the country's Nationally Determined Contributions (NDCs), thereby linking the Global Partnership's objectives to national legal frameworks. The Chapter has developed an Action Plan structured around six strategic pillars: capacity building, knowledge generation and management, biodiversity management, regulatory framework, climate change mitigation and adaptation, and ecological restoration. Capacity building workshops and validation processes have been conducted with founding members, strengthening shared protocols for monitoring restoration and community participation. The Chapter also focuses on ensuring that the scientific base contributes to the country's goal of restoring 1,800 hectares of mangroves by 2028, an effort estimated to capture approximately 210,000 tons of CO_2 equivalent.



Fishermen and Red Mangroves. © Yenifer Dìaz/Sociedad Audubon de Panamá

Looking ahead

The Panama Chapter's vision for 2030 is ambitious and based on concrete objectives. By 2029, the goal is to restore 1,800 hectares of mangroves nationwide, using scientific protocols developed in collaboration with local communities. By 2030, at least 50% of Panama's mangrove area will be integrated into the National System of Protected Areas (SINAP), and a fully updated National Wetlands Inventory will be submitted to the Ramsar Convention. The Chapter also aims to complete an interactive geospatial map of the country's wetlands, establish an early warning system for mangrove vulnerability to climate events, and ensure that at least 75% of Marine Protected Areas with mangroves have updated management plans and financial mechanisms in place for their implementation. Underlying all these objectives is the Chapter's commitment to zero net mangrove loss caused by human activity, a goal aligned with the three critical goals of the Global Mangrove Alliance for 2030: halting mangrove loss, restoring half of the recoverable mangroves lost since 1996, and doubling the area under conservation measures.

Panama is at a crucial juncture. With 177,293 hectares of mangroves, representing more than 30% of Central America's total mangrove cover, and a strengthening governance framework, the Panama Chapter is uniquely positioned to demonstrate that collaborative conservation can deliver results—for mangroves, for communities, and for the climate.

14 | PHILIPPINES

Global Mangrove Alliance Philippines: Progress on the Journey to 2030

Maria Josella M. Pangilinan and Annadel Cabanban (Wetlands International Philippines)

# of members
12

Chapter inception
June, 2022

Type of Chapter members
NGOs, Academia, and Youth Organizations

Overview of Chapter structure

GMA Philippines unites NGOs, governments, scientists, industries, communities, and funders to increase global mangrove habitat through conservation, restoration, and equitable management.

Structure

- Founded by five member organizations (Conservation International, Rare, Wetlands International, WWF, ZSL) and local partners
- One lead convener organization (on rotation)
- All organizations have equal standing



In the tangled canopy of a Philippine mangrove forest lies a story: an ecosystem sustained not by law, but by the people who call it home. © Alfredo B. Guab III / WWF-Philippines



The 1st National Mangrove Youth Summit was an empowering gathering that brought together youth leaders and partner organizations from across the Philippines to strengthen collaboration, exchange knowledge, and build a unified movement for mangrove conservation. © LPPWP Protected Area Management Office



Oceanus Conservation is working with local sea patrols and fisherfolk in Bais to promote bird conservation as a pathway for mangrove protection, sustainable ecotourism, and community development. Community-led monitoring has already documented 91 bird species in Talabong Island. © Vicross Yumol, Oceanus Conservation

The Philippines lost over two-thirds of its mangroves between 1918 and 1990 — from 450,000 to just 132,500 hectares — driven largely by aquaculture expansion. Recovery efforts have since brought cover to approximately 311,000 hectares, but vast areas of abandoned fishponds on former mangrove lands remain a significant restoration opportunity. Unlocking that opportunity requires exactly what Global Mangrove Alliance Philippines (GMA Philippines or GMAP) was built to deliver: coordinated science, sustained advocacy, and a unified national alliance.

Established in 2022 with five founding members and now twelve organizations strong, GMA Philippines works on two mutually reinforcing fronts — generating and applying science to inform action on the ground, while pursuing policy reform at local and national levels. In just a few years, the Alliance has moved from its formation to measurable impact.

A key milestone has been the enactment of coastal greenbelt ordinances across 127 local government units (LGUs), protecting 30,129 hectares of coastal mangrove. This work was led by Oceana, with strong technical and advocacy support from other GMAP member organizations. Together, they showed that local leaders are willing to act when provided science-based guidance and technical support. These locally rooted frameworks — adapted to local ecology, livelihoods, and governance — have strengthened the case for a National Coastal Greenbelt Act and show policymakers that the model works. In May 2026, GMA Philippines submitted a position paper to the Committee on Climate Change calling for a standalone National Coastal Greenbelt Bill with DENR-BMB as lead agency and a unified National Coordinating Council.

That national momentum was further consolidated at the Philippine Mangrove Conference (PMC 2026), co-organized by GMA Philippines and DENR's Biodiversity Management Bureau in March 2026. Drawing over 250 participants from government, civil society, science, local communities, the private sector, and international partners, PMC 2026 reaffirmed GMA Philippines as the country's foremost mangrove coordination platform. It renewed action on three critical fronts: assessment of unproductive released public lands to determine their best use, passage of the National Coastal Greenbelt Act, and blue carbon integration into the Philippines' Nationally Determined Contribution.

PMC 2026 also marked the formal turnover of the National Blue Carbon Action Partnership (NBCAP) Roadmap from Zoological Society of London (ZSL) to DENR — a decisive shift from development to national ownership and eventual implementation. GMAP member organizations helped shape the roadmap through Technical Working Groups on policy and governance, financing and sustainable livelihoods, science and innovation, and community engagement. Next steps focus on developing a government work and financial plan and accessing sustainable financing for blue carbon ecosystems.

The growing influence of GMAP has not gone unrecognized. On 05 December 2025, DENR-NCR awarded GMA Philippines a plaque of recognition for its contributions to policy lobbying, resource mobilization, project implementation, and partnership building — accepted by Alliance lead convenor Dr. Annadel Cabanban. It is a fitting acknowledgment of what the Chapter's journey has shown: that when organizations work together with shared goals, grounded in science and rooted in local realities, lasting change becomes possible. GMA Philippines carries that conviction forward as it works toward its 2030 targets — halting mangrove loss, restoring 150,000 hectares, and securing long-term protection for at least 300,000 hectares.

15 | SENEGAL

Strengthening Mangrove Conservation in Senegal: A Year of Growth, Coordination, and Capacity Building for the PMS

Gabin Agblonon (Wetlands International Africa)

# of members
58

Chapter inception
November, 2024

Type of Chapter members
CSOs, NGOs, Researchers, Government, Local-level Organizations & Structures Network

Overview of Chapter structure

The Chapter is represented by the Senegal Mangrove Platform (PMS), a mechanism established under the supervision of the Ministry of the Environment to monitor the implementation of Senegal's national mangrove ecosystem management strategy. It operates through the activities of its members, the activities of existing regional platforms in the country, and also the establishment and coordination of thematic groups.



Meeting with Casamance (region) Mangrove Platform. © Platforme Mangrove du Sénégal (PMS)

Structure

The PMS brings together civil society organizations involved in mangrove management and conservation, local governance entities, and national government structures, including technical departments within ministerial departments.

It consists of a general assembly, a central team, officers, and a thematic committee:

- Central Team: one president, one vice-president, one secretary
- Officers: administration & finance, one monitoring & evaluation, and communications
- GMA Thematic Group: coordinate relations between the PMS and the GMA and is responsible for coordinating and managing issues relating to the GMA

Over the past year, the Senegal Mangrove Platform *(Plateforme Mangrove du Sénégal, PMS)*, which serves as Senegal's Chapter within the Global Mangrove Alliance (GMA), has made significant strides in strengthening governance, expanding membership, building technical capacity, and enhancing coordination among mangrove stakeholders across the country.

The PMS is a national mechanism established under the supervision of the Ministry of the Environment to support the implementation of Senegal's National Mangrove Ecosystem Management Strategy. It brings together civil society organizations working on mangrove conservation and management, local governance institutions, and national government agencies, including technical departments from various ministries. Its work is implemented through its members, regional mangrove platforms, and thematic working groups. Among these, the GMA Thematic Group—the first of its kind—plays a key role in coordinating engagement between the PMS and the Global Mangrove Alliance while supporting the platform's management Committee.

A major milestone during the year was the successful Casamance Mangrove Platform meeting held in Ziguinchor on February 11–12, 2026. The meeting provided an opportunity for members to review achievements from the previous year, validate priorities, and adopt a new action plan. It also served as an important capacity-building forum, with technical sessions on carbon credits delivered by WeForest, the management and application of Global Mangrove Watch alerts facilitated by Wetlands International Africa – West Coast and Gulf of Guinea, and monitoring methodologies for mangrove restoration sites. These trainings strengthened the technical knowledge of PMS members and improved their ability to support effective mangrove management and restoration efforts.

The PMS convened its first General Assembly and advanced several organizational and strategic priorities. Notably, the assembly facilitated the formal establishment of the PMS management team. The participants also drafted a revised two-year Action Plan (2026–2027), which is currently being finalized through a compilation and validation process. Members worked collectively to develop a strategic proposal focused on community awareness and engagement, recognizing the critical role of local communities in mangrove conservation. The proposed awareness-raising strategy is currently being refined to integrate specific recommendations and feedback from the General Assembly.

Ahead of the General Assembly, two dedicated preparatory meetings were held in Saloum and Saint-Louis. These meetings focused on reviewing the regional platforms' 2026 workplans, exploring emerging carbon market opportunities, and identifying clear conservation and development priorities for both the Saloum and Senegal River Delta regions. Through these consultations, participants imitated project concepts and priority actions to present at the General Assembly, and reached a consensus on nominating representatives for the national platform meeting. Additionally, a standardized project template was distributed to members to help populate a national database, facilitating better knowledge sharing, coordination, and fundraising.

While the PMS has not yet established a dedicated financial plan, important progress has been made in identifying potential funding sources. A collaborative approach to resource mobilization is being pursued by responding collectively to funding opportunities and calls for proposals. Overall, the past year marked an important phase of consolidation and growth for the Senegal Mangrove Platform. Through strengthened governance, increased membership, enhanced technical capacity, improved communication mechanisms, and the development of a strategic action framework, the PMS has reinforced its position as the national coordination mechanism for mangrove conservation and management in Senegal and an active contributor to the Global Mangrove Alliance.



Colombia launches an updated national mangrove policy framework!

After several years of inter-institutional exchange and close work with local communities, in 2026 the government of Colombia officially launched the "National Program for the Sustainable Use, Management, and Conservation of Mangrove Ecosystems in Colombia". Structured in eight strategic lines (Planning, Bioeconomy, Restoration, Protected Areas, Knowledge and Research, Governance, Education, and Financing) and 46 specific actions, this milestone document defines the vision for mangrove ecosystems in Colombia by 2030 and draws a roadmap that helps direct the strategy and activities of the GMA National Chapter in Colombia in the coming years.

Prepared by the Colombian Ministry of Environment and WWF Colombia on behalf of the GMA Colombia National Chapter.



Kenya gender equity and community conservation

Gabriella Balfour-Church, Jeniffer Adero and **Lenice Ojwang** (Fauna & Flora)**, George Maina** (TNC) on behalf of **GMA-Kenya Chapter**

Northern Kenya's Lamu County hosts 65% (37,000 hectares) of the nation's mangroves, which provide vital ecosystem services. GMA-Kenya Chapter members Fauna & Flora, NRT Coast and TNC partner to support Pate Island communities to conserve mangroves. The Mtangawanda Women Association, led by Zulfa Hassan, known as *Mama Mikoko*, have benefited from the partnership's efforts around financial literacy and microfinance programs, mangrove restoration best practices, crab farming and eco-tourism ventures, fisheries co-management, and blue carbon initiatives. Through their hard work, the Women have taken on stronger leadership roles, improved their livelihoods, and advanced gender equity in mangrove conservation and fisheries co-management.

Together, these interventions illustrate how the Chapter is accelerating coordinated conservation and restoration of mangrove forests along the Kenyan coast, while supporting livelihoods, biodiversity conservation, and climate resilience.

Zulfa Hassan (Mama Mikoko) has led women on Pate Island to champion mangrove conservation. © Duncan Moore / Fauna & Flora



Mangroves and Honey Bees

Andrés Fraiz-Toma (MarAlliance)

Mangroves provide essential ecosystem services, such as coastal protection against extreme weather events, carbon sequestration, improved water quality, climate regulation, and resources like food and building materials. Despite their value, mangroves remain threatened in many regions of the world (IUCN, 2024). Beekeeping offers a promising solution for both mangroves and local communities. A single hive can pollinate hundreds of hectares, improve seed and propagule production, and generate income through honey production. MarAlliance and the Islas Secas Foundation support the Puerto Remedios Fishermen's Cooperative in Panama in promoting sustainable livelihoods and mangrove conservation through community-based beekeeping initiatives.

Hive inspection with community members and beekeeping experts. © Guadalupe Atencio



Belize GMA Chapter - working together on big wins

Authors: Jaramar Villarreal-Rosas (Queensland University of Technology)**, Nadia Bood** and **Juliet Neal** (WWF Mesoamerica)**, Minerva Gonzalez, Mercedez Valdez,** and **Florencia Guerra** (Belize Forest Department)**, Dominic A. Andradi-Brown** (WWF US)

In 2026, we launched the Belize National Mangrove Restoration Action Plan, a five-year strategy identifying priority areas for restoration and protection across public and private lands. The Plan integrates restoration potential, ecosystem services, and climate vulnerability to guide investment and action. Endorsed by the Belize Forest Department, it supports national initiatives, including the National Landscape Restoration Strategy for Belize 2022–2030, and contributes to Belize's NDC 3.0 commitments to protect 8,000 hectares of mangroves and restore 2,500 hectares by 2035. Developed with 31 partners and 200 community members, implementation will be led by the Belize Global Mangrove Alliance Chapter (BMA).

The BMA has developed a national roadmap for restoring and protecting Belize's mangroves through science, collaboration, and climate action. © Nadia Bood



Blue Yatra: A Scalable Model for Mangrove Restoration in India

Pradeep Tripathi and **Madhavi Bhalekar**
(Green Yatra Trust)

Green Yatra Trust launched its flagship initiative, **Blue Yatra**, in 2023 to restore degraded mangrove ecosystems along India's western coast (Maharashtra and Gujarat) through hydrological rehabilitation, native mangrove restoration, and community participation. Its innovative Fishbone Canal Method restores tidal connectivity, improves site conditions, and promotes natural regeneration, creating resilient mangrove habitats. To date, the initiative has facilitated the plantation of 170,500 native mangrove saplings across 33.25 hectares. Green Yatra is establishing a 100,000-sapling mega nursery and aims to restore over 200 hectares with one million mangroves, strengthening biodiversity, coastal resilience, and sustainable livelihoods for fishing communities.

Photo: Aerial View of a Fishbone Canal-Based Mangrove
© Green Yatra Trust



Global Standard for Effective and Equitable Protected and Conserved Areas

Swati Hingorani, Thierry Lefebvre, and Nadine Seleem (IUCN)

The **IUCN Global Standard for Effective and Equitable Protected and Conserved Areas** provides a globally recognized framework for measuring how effectively protected and conserved areas are governed, managed, and delivering conservation outcomes. Referenced in the Global Biodiversity Framework (GBF) as an indicator supporting the quality component of Target 3, it has been applied in mangrove ecosystems across 15 countries such as Brazil, Belize, Saudi Arabia, Madagascar, Mexico and Viet Nam. The results help sites identify strengths and improvement priorities in areas such as governance and management effectiveness, while providing governments and donors with robust evidence to target investments where they can maximize effective and equitable conservation. The **IUCN Green List** represents the recognition pathway of the Standard, acknowledging sites that demonstrate successful implementation and achieve high levels of conservation performance.

Under the Sea - Tun Mustapha Park, Malaysia.
© WWF-Malaysia



Mangrove Crab relationship

Ajanta Dey, Adrija Paul, Sahid Hossain, and **Angshuman Raha**
(Nature Environment & Wildlife Society (NEWS)),
Santanu Mitra (Zoological Survey of India)

Crabs are instrumental bio-engineers of mangrove ecosystems, contributing to soil aeration, nutrient cycling, litter decomposition, and overall ecosystem productivity. Despite their ecological importance, crab diversity remains poorly documented in the Indian Sundarban. To address this knowledge gap, NEWS initiated a study across restored mangrove habitats outside Protected Areas to understand the relationship between crab assemblage and habitat heterogeneity.

The study revealed distinct shifts in crab communities along the riverbank–embankment gradient. *Dotillopsis* and *Episesarma* were more common in muddy riverbank habitats, *Metaplax* and *Scylla* in intermediate grass-covered zones, and *Clistocoeloma* and *Metopograpsus* in harder vegetated areas, while *Astruca* and *Tubuca* occurred throughout the gradient. To date, 15 crab species belonging to 12 genera were recorded. Remarkably, the study led to the rediscovery of the family Hymenosomatidae from Indian Sundarban after more than a century, signifying how crab diversity is intricately related to the mangrove ecosystem restoration.

A study by NEWS led to the rediscovery of the crab family Hymenosomatidae after more than a century. © NEWS



“Guardians of the Mangroves” © Olivier Clement / Ocean Image Bank / Mangrove Photography Awards

8

Final words

Mark Spalding and **Maricé Leal** (The Nature Conservancy),
and **Sophie Nazeri** (Impact by Design)

It is somewhat remarkable at a time of considerable uncertainty in the world – both the natural world and the many worlds of politics – that we have a positive story to tell. Mangroves appear to be turning a corner.

The total area is increasing, restoration stories abound and mangrove protection is higher than for most other ecosystems. Behind those numbers are stories of people. The Global Mangrove Alliance is not the sole arbiter of these successes, but it has developed a remarkable model with a wide-reaching, decentralized structure, encouraging ongoing patterns of engagement and developing networks of knowledge-sharing and empowerment – governments, NGOs, local communities, business, women, youth, scientists...

Such a story remains positive in part because the challenge remains large. We have to keep up the good work – mangroves are too important for us to relax our efforts. Although losses have slowed, mangrove degradation has not. Current protection is still not sufficient, and new threats, from plastics to sea level rise, compound our concerns. Opportunities for conservation and restoration are everywhere, ready for the taking.

So we can take the opportunity to be grateful. For each of us to be thankful for the work of our colleagues, partners and friends in our joint venture towards mangrove conservation. And we can hold up the successes for others to see: effective interventions depend on understanding, and on sharing our knowledge -both of what works, and what fails.

Many in the world of conservation are looking at what we are achieving – new alliances and breakthroughs are in development for other ecosystems. And perhaps the message is even wider. Making space and sharing opportunities with partners who are different opens new possibilities. Different perspectives and varied skills have uncovered novel solutions, while collaboration has generated gains far greater than the sum of our parts. It is only through diversity and collaboration that our impact can reach the magnitude of our 2030 Goals – and we intend to keep it up!

Join the Global Mangrove Alliance

GLOBAL MANGROVE ALLIANCE

The GMA is rapidly approaching a critical deadline - can we ensure the future of mangroves by 2030? Not alone.

The GMA’s successes are only as impressive as those of our members and National Chapters. Every lesson learned, tool developed, document shared, webinar hosted, training given, arises from multiple members working together to create something for the benefit of all other members, partners, and stakeholders. Every hectare measured toward our 2030 Goals is the result of dedication, advocacy, and rigorous effort. GMA members come to the table selflessly, ready to share and ready to learn.

The GMA Leadership Team is also working hard to make sure that our member’s accomplishments are seen, valued, and that they benefit as much or more from GMA membership as we do from their experiences.

If your organization would like to join the GMA and be part of the amazing group of over 100 members that are working together to safeguard mangroves, please visit our site to learn more and to apply for membership.

Learn more here.





www.mangrovealliance.org