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Foreword

It is my pleasure to present the latest volume in this important science-to-policy series. I commend the Nairobi Convention, WIOMSA, the editors and the contributing authors for advancing the use of scientific knowledge in decisions affecting the marine and coastal environment of the Western Indian Ocean.

Governments, scientists, practitioners and communities have long called for stronger translation of science into policy and action. This volume is a practical response to that call. It demonstrates how knowledge generated across our region can inform policy choices, guide implementation and strengthen accountability. Over the past four decades, the Western Indian Ocean region has invested substantially in marine science across a wide range of disciplines and sectors. Our responsibility now is to ensure that this knowledge is accessible to decision-makers and applied effectively.

I am particularly pleased that this volume addresses priorities reflected in decisions adopted at the Eleventh Conference of Parties to the Nairobi Convention, including marine spatial planning, marine litter and microplastics, sustainable fisheries and the blue economy. These are not isolated concerns. They are interconnected dimensions of ocean health, human wellbeing and sustainable development. Addressing them requires evidence that is credible, timely, relevant and responsive to the needs of policy and practice.

This imperative is especially important as our region faces intensifying and interconnected environmental and socioeconomic challenges. We must provide leadership in both nearshore and offshore conservation, including through engagement with the Agreement on Biodiversity Beyond National Jurisdiction, while ensuring that conservation processes and outcomes are effective, inclusive and equitable. We must also identify more efficient ways to use our constrained resources, whether in climate adaptation, biodiversity conservation, fisheries management or pollution reduction, so that interventions deliver the greatest possible benefits for people and nature. The role of science will continue to be key in addressing these challenges.

I therefore encourage scientists, policymakers and practitioners to continue strengthening the shared space in which knowledge is translated into feasible action. Evidence-based implementation depends not only on good science, but also on sustained dialogue, mutual understanding and collaboration across countries, institutions, disciplines and sectors.

Technology will increasingly influence how scientific knowledge is generated, communicated and used. Digital platforms, improved data systems and emerging analytical tools offer important opportunities to connect scientists with decision-makers and communities. We should use these technologies thoughtfully to widen access to knowledge, improve transparency and support more inclusive participation in ocean governance.

The issues considered in this volume underscore the value of integration, linking plastics, fisheries, habitats, and blue carbon to climate and livelihoods, the importance of participation and equity, and the need for sustained capacity and finance. They also show why practical environmental problems cannot be addressed within disciplinary or national boundaries alone.

I commend this volume to governments, scientists, practitioners, communities and development partners across the Western Indian Ocean region. May it strengthen our collective commitment to ocean governance and practice informed by evidence, grounded in collaboration, and directed toward a healthy, equitable, and sustainable future.



Hon. Minister Marie-May Jeremie

Minister of Environment, Climate, Energy & Natural Resources
Seychelles and WIOMSA President

Editorial Foreword

Bridging Science and Policy in the Western Indian Ocean

Introduction

The Western Indian Ocean (WIO) region is making a deliberate effort to connect scientific evidence with actionable policy. The 2023 Science to Policy workshop in Maputo convened scientists, policymakers, civil society, and regional partners to synthesize scientific knowledge, examine pressing coastal and marine challenges, and translate insights into actionable guidance for decision-making. The Science to Policy workshop made a substantial contribution to the Eleventh Conference of Parties (CoP11) to the Nairobi Convention (Antananarivo, 22 August 2024). Although CoP11 decisions reflected multiple inputs and not all workshop themes appeared on the formal agenda, the workshop's proceedings provided critical evidence and framing that informed many outcomes. Conversely, some CoP 11 outcomes emerged from mandates and processes predating Maputo. This foreword acknowledges that dual reality and introduces the five peer-reviewed discussion papers accepted for the second issue of the first volume of the Science to Policy Series.

From Proceedings to Decisions

The Maputo workshop was organized around evidence-to-options dialogue: findings were presented with policy choices, legal instruments, and programmatic pathways in view. This approach enabled specific workshop presentations and discussion papers to inform CoP 11 outcomes in identifiable ways. For marine plastic pollution, the workshop highlighted the need for standardized monitoring, especially for microplastics, and stronger life-cycle approaches. Those proceedings informed CoP11 directions to strengthen regional networks and harmonize protocols, including revision of the Regional Action Plan on Marine Litter and complementary source-to-sea measures (CP 11/4; CP 11/12).

Marine Spatial Planning (MSP) featured prominently through work in the Northern Mozambique Channel (NMC). The workshop made the case for a regional vision and practical roadmaps aligned with consistent cumulative-impact tools and sound social and ecological baselines. These proceedings informed CoP 11 requests for a regional MSP vision and roadmap and for mainstreaming ecosystem-based MSP into development planning, as well as the framing of the Integrated Regional Programme (CP 11/13; CP 11/1).

Evidence-based and inclusive policy making is crucial to support sustainable blue economy development in the Western Indian Ocean (WIO) region, where coastal nations and island states depend heavily on marine and coastal ecosystems for livelihoods, food security, and economic stability. However, persistent gaps between science, policy, and society continue to limit effective governance; in response, co-design approaches are essential to strengthen the science–policy–society interface, enhance knowledge uptake, and deliver more equitable and impactful decisions. This is particularly timely in light of Decision CP11/8 of the Nairobi Convention COP 11, which calls for stronger integration of science into policymaking and inclusive stakeholder engagement to address shared marine challenges.

Seagrass ecosystems were discussed as a convergence of biodiversity, climate, and livelihoods. Proceedings emphasized gaps in mapping their occurrence, condition and status, restoration potential and the need for a regionally coherent strategy attentive to national priorities. These inputs informed CoP 11's call to develop a regional seagrass strategy, vision, and action plan (CP 11/11).

Work on threatened sharks and rays identified urgent needs for species-level protections, harvest and trade controls, and improved spatial alignment between Marine Protected Areas and ecologically important habitats such as Important Shark and Ray Areas. The proceedings informed CoP 11's directions to strengthen protections for highly threatened species and advance coherent habitat management (CP 11/11).

On small-scale fisheries, rapid assessments in Kenya and Tanzania presented at the workshop distilled four cross-cutting drivers of weak compliance: limited awareness, complex social ties, corruption, and inadequate inter-agency coordination. The proposed reform pathway, community-centered co-management, predictable and proportionate sanctions, transparent enforcement protocols, formalized cross-ministry coordination, and investment in data systems and training informed CoP 11's emphasis on implementing the Kunming-Montreal Global Biodiversity Framework and on strengthening the science–policy interface (CP 11/5; CP 11/8).

Transversal discussions at the workshop on climate risk and adaptation, ocean governance, information systems, and source-to-sea approaches provided additional context for CoP outcomes. They helped frame action on operationalizing the WIO Regional Climate Change Strategy and accessing climate finance (CP 11/10), on adopting the Regional Ocean Governance Strategy and the Information Management Strategy (CP 11/6; CP 11/7), and on applying toolkits and communities of practice across source-to-sea linkages and port development (CP 11/12; CP 11/15). Notably, some of these decisions also drew on multi-year regional initiatives and prior mandates: the workshop reinforced and sharpened directions rather than substituting for those processes.

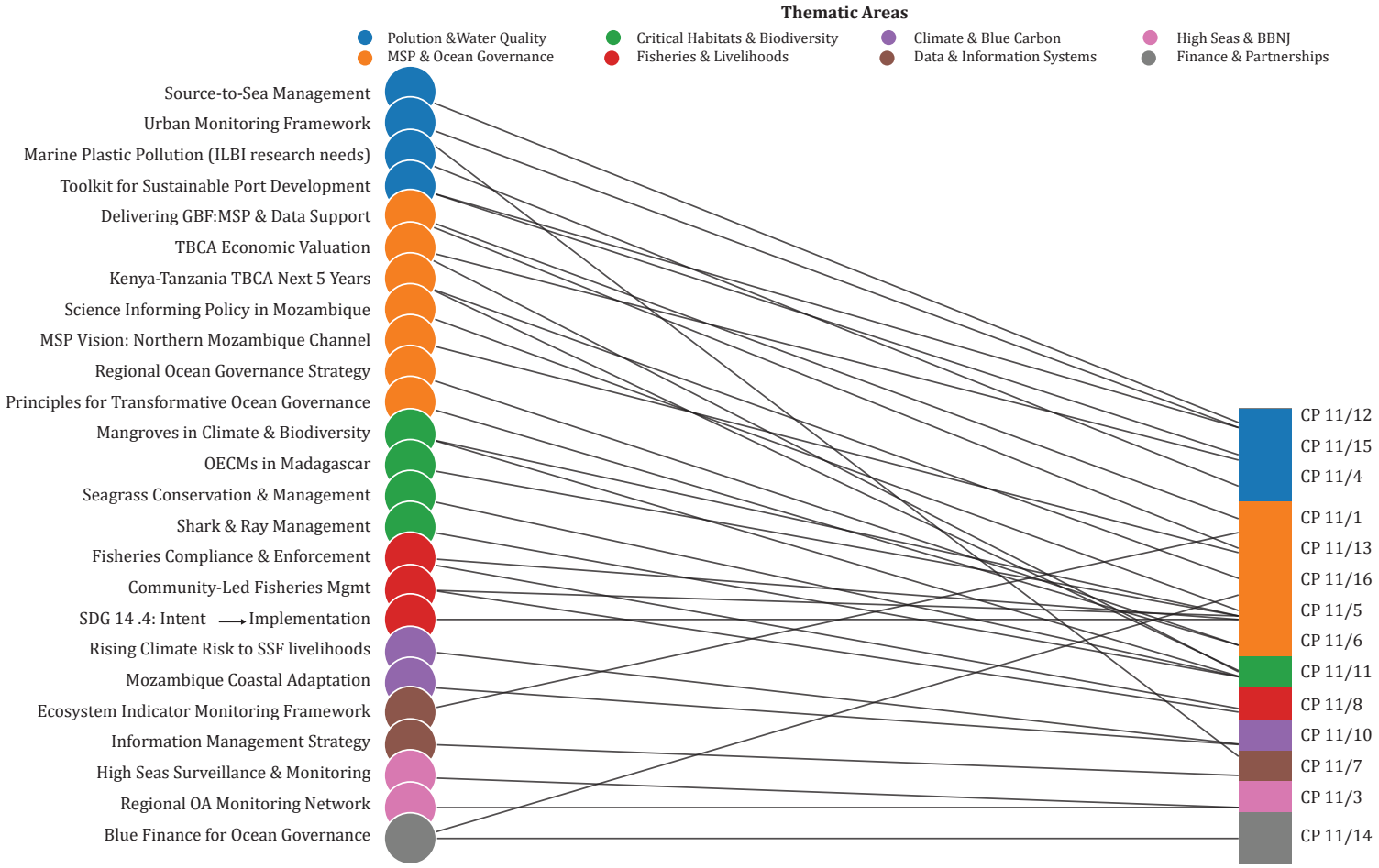


Figure 1. Science-to-Policy linkages from the 2023 workshop to CoP 11 decisions (color-themed network).

This bipartite network visualizes how selected topics presented at the 2023 Science to Policy Workshop (left column, circular nodes) informed specific CoP 11 decisions of the Nairobi Convention (right column, square nodes). Node colors group items by thematic area (legend at top): Pollution & Water Quality; MSP & Ocean Governance; Critical Habitats & Biodiversity; Fisheries & Livelihoods; Climate & Blue Carbon; Data & Information Systems; High Seas & BBNJ; and Finance & Partnerships. Edges **denote "informed" relationships based on the workshop proceedings, i.e. where presentations/discussion papers contributed evidence or options that were reflected in the corresponding CoP 11 decision text. The mapping is** representative, not exhaustive: not every workshop topic fed into a CoP decision, and not every CoP decision originated in the workshop or its five accepted discussion papers.

Within this broader canvas, five discussion papers were developed from workshop contributions, underwent independent peer review and revision, and are presented in this Science to Policy issue. Together they trace a coherent path from diagnosis to action. The paper on plastics argues for confluence around standardized monitoring protocols, especially for microplastics, and for the inclusion of landlocked states in basin-scale analyses, given riverine contributions to coastal and marine litter. It offers a prioritized research and monitoring agenda to support national positions in treaty negotiations and to inform revisions of regional and national action plans. The paper on fisheries compliance distills the drivers of non-compliance and sets out a reform pathway that couples deterrence with legitimacy and incentives, including community-centered co-management, predictable and proportionate sanctions, transparent enforcement protocols, cross-agency coordination mechanisms, and investments in data systems and training. The MSP roadmap for the Northern Mozambique Channel documents a collaborative process to define a vision aligned with earlier CoP mandates and the new Integrated Regional Programme; it emphasizes consistent use of cumulative-impact tools, robust baselines, and a governance ladder that connects regional coordination to national implementation. The seagrass brief synthesizes the state of knowledge and identifies practical steps to close data gaps, strengthen protections, and mainstream seagrass into biodiversity, climate, and fisheries policies, proposing a regional strategy and action plan that supports national mapping, monitoring, and restoration programs while fostering knowledge exchange and capacity building. The sharks and rays brief reviews species status, threats, and management responses, making the case for urgent species-level protections, harvest and trade controls, and expanded spatial measures that align with ISRAs and other critical habitats, supported by harmonized regulatory frameworks and improved enforcement.

Synthesis and Priorities for Delivery

Read together, the five briefs underscore the value of integration (linking plastics, fisheries, habitats, and blue carbon to climate and livelihoods), the centrality of standards and systems (monitoring protocols, data infrastructure, shared tools), the importance of participation and equity (co-management, locally led stewardship), and the need for sustained capacity and finance. As the region moves from decision to delivery, implementing the Integrated Regional Programme (2025–2035) and Programme of Work (2025–2028), three near-term priorities stand out.

First, operationalize regional strategies and standards: develop and socialize seagrass and plastics monitoring protocols; establish data-sharing arrangements under the information management strategy; and mainstream MSP tools and processes. Second, invest in compliance, enforcement, and co-management: build institutional capacity and incentive systems that are transparent, fair, and effective, particularly in small-scale fisheries where legitimacy and livelihoods are at stake. Third, mobilize and align finance: expand access to climate and biodiversity finance mechanisms; design project pipelines that integrate blue carbon, habitat protection, and community resilience; and ensure that monitoring and evaluation systems are adequately funded and used for learning and course correction.

In conclusion, the Western Indian Ocean stands at a pivotal juncture. The region has articulated a shared vision for ocean health and sustainable development and has begun equipping itself with the strategies, tools, and partnerships required to realize that vision. The Science to Policy Workshop in Maputo demonstrated that when science is organized around practical policy questions, and when policymakers and practitioners are engaged as co-producers of solutions, the path from analysis to action shortens. The five peer-reviewed briefs in this Series capture that momentum, translating evidence into tractable steps that have already informed CoP 11 decisions. As the Nairobi Convention and its partners implement the Integrated Regional Programme

(2025 - 2035), the lessons from Maputo and the guidance from this Series can help translate commitment into impact for people, nature, and economies across the Western Indian Ocean. Looking into the future, CoP 12 in 2026 will be informed by policy recommendations drawn from the mini symposiums during the 13th WIOMSA symposium in Mombasa. This approach leverages on the large and diverse participation of WIOMSA symposium, held in 20205, to elicit a more inclusive, comprehensive and robust strategic direction of policy actions in the region.

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Tackling Marine Plastic in the Western Indian Ocean (WIO) countries: *Research Priorities to Global Treaty*

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Executive Summary

Plastic pollution has emerged as a significant environmental hazard, driven by the growing use of plastic products and poor waste management practices, leading to the accumulation of waste in the environment. A large proportion of poorly managed plastic waste ultimately accumulates in the ocean, making the marine environment one of the primary sinks for plastic pollutants. This accumulation poses severe risks to marine life, ecosystems and the human population. Marine organisms may ingest plastic particles together with food, blocking their digestive tracts and ultimately leading to starvation and death. Moreover, ingested plastics can act as carriers of harmful substances, including persistent organic pollutants, heavy metals, and pathogenic microorganisms, potentially causing toxic effects and disease in affected organisms. Organisms may become entangled in larger plastic debris, resulting in injury, suffocation, or drowning.

In response to the growing challenges posed by plastic pollution, a review of existing legislation in the Western Indian Ocean (WIO) region was conducted. Results indicate that considerable effort has been made to address plastic waste across all life-cycle stages. However, given that environmental plastic waste typically enters rivers that eventually flow into the ocean, there is a need to assess the impact of landlocked countries and their contribution to the waste in the WIO basin. Furthermore, the region currently lacks a standardised waste-monitoring protocol, particularly for microplastics, making it difficult to track progress or assess impacts effectively. With the new legally binding global plastic agreement, WIO countries need to develop standard protocols for microplastics assessment and monitoring to track their effectiveness.

Introduction

Global plastic production is rapidly increasing, and consequently increasing plastic pollution in the environment. Considering the total plastic material produced annually, approximately 79% has been reported to be released into the natural environment, while 11% is incinerated and only 9% undergoes recycling (Geyer and others, 2017). In the WIO countries, a higher proportion of plastics is mismanaged, with Tanzania recording 96% and Kenya 92% of mismanaged plastic waste (IUCN-EA-QUANTIS, 2020; Griffin and Karasik, 2022). Once in the environment, plastic pollutants leak into waterways and are transported through them, eventually ending up in the marine environment (Figure 2) (WWF for Nature Report, 2021; Jambeck and others, 2015). With some rivers originating further inland, landlocked countries are likely to contribute to plastic waste in ocean basins.

Plastic pollutants are categorized into macroplastics that are large (25-1000 millimetres), mesoplastics that are medium (5-25 mm), microplastics (MPs) that are small (5-5000 µm) and nanoplastics that are very small (<1 µm) (Bråte and others, 2017; GESAMP, 2019). Marine plastic waste has been reported to have detrimental effects on organisms and the environment at large. There have been reports of plastic particle ingestion by and entanglement of marine organisms, leading to distress and sometimes mortality. Ingested plastic material can obstruct the digestive tract and serve as a vector for persistent organic pollutants (POPs), heavy metals, and/or microorganisms from the environment (Massos and Turner, 2017). Microplastics that penetrate the bodies of organisms can cause cellular effects, such as altering animal behaviour when they enter brain tissue via the blood circulation (Mattson and others, 2017). In humans, MPs have been found to cause oxidative stress, DNA damage, organ dysfunction, metabolic disorder, immune response, neurotoxicity, and reproductive and developmental toxicity (Li and others, 2023). Larger plastic debris is accidentally swallowed by large animals, causing obstruction of the digestive system or entanglement, which can lead to death. Therefore, there is a need for proper management of plastics of all sizes and at all stages of production and use.

The need to tackle plastic waste is more urgent than ever. The global plastics production and use, and poor management practices, mean more plastic waste will continue to accumulate in the environment (Dokl and others, 2024). There is also greater awareness of the impacts of plastic waste on human health, particularly through the release of chemical additives that can cause long-term health problems, including cancer (United Nations Development Programme, 2024). On the other hand, poor plastic waste management practices, such as open burning, continue in some countries despite laws against them. This practice produces dioxins and furans that pollute the air, soil, and water, leading to health problems, including breathing difficulties in humans (Pathak and others, 2024). There is also an urgency to secure buy-in from plastic importers, manufacturers, and policy entrepreneurs for the ambitious obligations of the global plastic negotiations if environmental plastic waste is to be reduced (Vince, 2022; Dauvergne and others, 2025).

Objective

This paper reviews the existing policies and regulations on plastic pollution from the WIO countries to identify a) the countries' efforts on managing plastic pollution in the environment, b) assess how the regional efforts on curbing plastic pollution aligns with the global legally binding instrument being discussed and c) assess the preparedness on implementing of the global instrument on plastic pollution especially on monitoring.

Methods

Literature and policy review

A comprehensive literature search was conducted using the following electronic databases: PubMed, Science Direct, Scopus, Research Gate, Web of Science, and Google Scholar. The search strategy combined keywords and terms related to *'plastic pollution,' 'microplastics,' 'plastic waste management, 'Western Indian Ocean plastic pollution,' 'marine environment,'* and *'waste management policies,'* e.t.c, Boolean operators (and, or) were used to refine the search. The final search was completed in February 2025.

Screening criteria

The authors screened the titles and abstracts of all retrieved articles, followed by a full-text assessment of potentially eligible studies. Disagreements were resolved through discussion to a consensus. Studies included met the following criteria: written in English, coming from peer-reviewed journal articles, government or intergovernmental reports, focusing on plastic pollution, microplastics, or waste management policies in marine or coastal

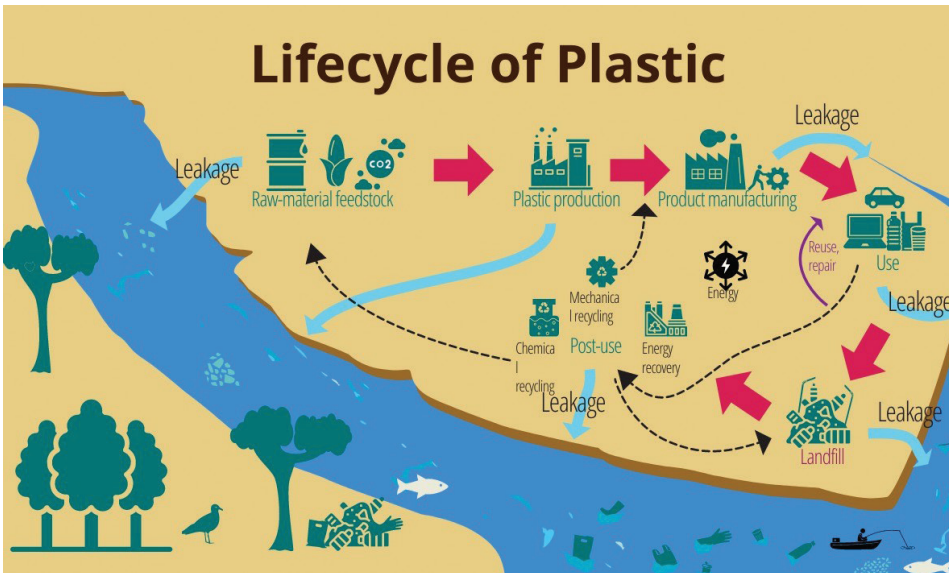


Figure 2: Showing leakage of plastic during the life cycle. The Leakage starts from production throughout each stage of the cycle with rivers and marine environment as their sinks. (Source: Cost of Plastics, Dalberg for WWF for Nature (2021)

Glossary of Terms

Microplastic –Plastic particles smaller than 5-5000 µm, often resulting from the breakdown of larger plastics or primarily manufactured as microbeads.

Nanoplastic – Plastic particles smaller than 1 micrometer (µm); (able to pass through cell membranes).

Persistent Organic Pollutants (POPs) – Toxic chemicals that remain in the environment for long periods and can bioaccumulate through the food web and pose risks to health and the environment.

Meso Litter – Medium-sized plastic debris (5–25 mm) such as bottle caps, cutlery, and small packaging.

Plasticizers – Additives used to make plastics more flexible and easier to handle but can leach out and pose environmental risks.

Antioxidants – Compounds added to plastics to slow down degradation from heat, oxygen, and light.

Polymer – A large molecule composed of repeating subunits (monomers); the basic structure of all plastic materials.

Ecotoxicology – The study of how toxic substances, including plastics and their additives, affect ecosystems and living organisms.

environments, or the plastic life cycle. Studies conducted in or relevant to the WIO region and articles on the global legally binding treaty on plastic pollution.

Studies were excluded if they were from non-peer-reviewed sources (e.g., blogs, editorials, or opinion pieces), did not focus on plastic waste management, plastic pollution, or legislative/policy responses to plastic pollution, were not full-text accessible, or were outside the defined geographic scope.

Data Extraction and Management

Data were extracted using a standardized form capturing key variables, including publication year, study location, type of plastic pollution assessed (microplastics or macroplastics), and environmental impacts and legislation or policy interventions reported.

Local and regional Plastic Problem

The Indian Ocean is bordered mainly by developing countries, some of which have very high human population densities and thus accumulate waste rapidly. These countries are poorly equipped to manage solid waste, including plastics, and it is inefficiently managed, thus accumulating in the environment (Pattiaratch and others, 2022).

Marine plastic pollution is a major issue due to its impacts on environmental, human, and biodiversity health. The Indian Ocean receives enormous levels of plastic waste from polluted rivers and adjacent coastal cities and settlements. Despite this, the ocean basin is understudied; hence, the distribution and impact of plastic debris and microplastics are not well understood or described compared to other ocean basins, such as the Pacific and Atlantic Oceans (Pattiaratch and others, 2022). Along the Kenyan coast, plastic waste accounts for a larger share of marine macro- and meso-litter on several Kenyan beaches (Okuku and others, 2020a,b). Microplastics have been recorded in surface waters and in zooplanktons (Kosore and others, 2018), in macroinvertebrates (Awour and others, 2020; Awuor and others, 2021), and in marine fishes, water, and sediments (Kerubo and others, 2021a and 2021b; Kerubo and others, 2020). Plastics are the dominant mesolitter on most beaches along the Kenyan coast (Okuku and others, 2020a), while 88 per cent of litter from Kenyan coastal households is plastic (Gwada and others, 2019), making plastic a common litter in coastal and marine environments. With increased use of plastic products during the COVID-19 pandemic, plastic pollution in the marine environment may have increased, as solid waste management has long been a challenge (Okuku and others, 2021). In other WIO countries, such as Tanzania, data from beach cleaning indicate that 70 *per cent* of anthropogenic litter on the beaches consists of plastics (Shilla, 2019). This high amount of plastic litter on beaches and other tourism sites is mainly attributed to tourism activity (Maione, 2019). In South Africa, studies on microplastics have reported on MP concentrations in water, sediments, and fauna, but only about 42 *per cent* of studies report on polymer type due to a lack of equipment to identify plastic polymers (Mvovo, 2021). Attempts to model the transport and fate of marine plastics along South Africa's beaches yielded values much lower than global estimates (Ryan, 2020), underscoring the need for more data to develop better models.

Building on the data trends, we now explore the toxicity of common plastic additives. Plastics are usually chemical additives during production to enhance their functionality and performance in various applications (Stipek and Daoust, 2012; Da Costa and others, 2020). Plastic chemical additives include fillers, plasticizers and softeners, lubricants and flow promoters, anti-aging additives, flame retarders, colorants, blowing agents, crosslinking agents, and ultraviolet-degradable (Stipek and Daoust, 2012). Due to plastic accumulation and fragmentation in oceans and waterways, plastic additives now represent a potential ecotoxicological risk for marine organisms (Andrady and Nepali 2019). Plastic chemicals such as polybrominated diphenyl ethers (PBCEs), phthalates, nonylphenols (NP), bisphenol A (BPA), and antioxidants have been reported as common plastic additives in marine environments

(Hermabessiere and others, 2017). Given that these additives readily leach from plastics, a greater focus on their transport and fate is necessary (Hermabessiere and others, 2017; Andrady and Rajapakse, 2019).

Monitoring efforts supported by various partners in the region have been implemented to curb plastic pollution, including the Regional Action Plan on Marine Litter under the Nairobi Convention (UN Environment, 2018). Under this action plan, local and regional institutions, including WIOMSA, Sustainable Sea Trust, and the African Marine WASTE network, have come together and developed a Marine Litter Monitoring manual (Barnardo and Ribbink, 2020). In addition, a synthesis of the status and environmental implications of plastics has been carried out. The report indicates the presence of plastics of all sizes across all environments (UNEP/WIOMSA, 2022), but concentrations are yet to be determined. In Kenya, a national marine litter management action plan, 2021-2030, was developed by the National Environmental Management Authority (NEMA) to enhance monitoring, among other objectives. There is a framework for plastic pollution monitoring in the region that needs to be strengthened by developing standardized sampling techniques, especially for microplastics. Increased human and financial capacity are necessary to maintain regular, harmonised monitoring of plastic waste levels and to identify polymer types.

In most WIO countries, plastic pollution, especially microplastics, is underreported in the marine environment due to a paucity of data stemming from limited studies (Shilla, 2019; Mvovo, 2021). There is also a lack of capacity (human and infrastructure) that limits the studies, and a lack of standardized protocol for analysis and reporting. More data on marine plastic pollution are required through monitoring and evaluation in the region to inform long-term policy implementation and evaluation.

Regional and global processes towards the plastic problem solution

Recognizing the danger that plastic waste continues to pose to the environment, biodiversity, and human well-being, many countries have attempted to implement policies and regulations to curb plastic pollution across the plastic life cycle (upstream, midstream, and downstream) with varying success. In mid-2023, the East African countries met to discuss environmental plastics. The lawmakers were unanimous in their agreement to tackle single-use plastics, transition to a circular economy, including increased use of material substitutes to ensure a healthy environment.

The ban on single-use plastic carrier bags has been implemented in most countries in the WIO region, with some variations, especially in the thickness of the plastic material allowed. In Kenya, for instance, the Nairobi City Council Solid Waste Management Act (2015) provided a county-level framework for solid waste management and prohibited the manufacture and import of plastic bags less than 30 microns thick and smaller than 8x12 inches. This was followed by plastic bag ban (2017) that banned single use plastic (SUP) career bags from production, importation and distribution, while the Wildlife Conservation and Management Act, (2020) banned the use and littering of protected areas such as national parks, beaches, forests, world heritage sites, biosphere reserves, Ramsar sites, and conservation areas with single use plastics. The Tanzania Environmental Management (Prohibition of Plastic Carrier Bags) Regulations (2019) restricted the importation, exportation, manufacture, sale, supply, storage, and use of plastic carrier bags within mainland Tanzania. Zanzibar banned the importation of single-use plastics less than 30 microns in 2006. In 2019, the Tanzanian government passed the solid waste management regulation, which required waste segregation at the source and the application of the Polluter Pays Principle in waste management. Similarly, Uganda implemented the Plastic Bag Ban (2009) that prohibited plastic bags less than 30 microns in the country. In other African countries, attempts have

been made to curb environmental plastic waste through bans on single-use plastics. For instance, Malawi's Plastic Bag Ban (2015) prohibited the use, sale, production, exportation, and importation of plastic bags less than 60 microns thick. South Africa banned certain plastics through the Plastic Carrier Bags and Plastic Flat Bags ban (2003), which prohibited the manufacture, trade, and commercial distribution of domestically produced and imported plastic carrier bags and plastic flat bags. In Mauritius, plastic waste is addressed by 45 percent of legal frameworks concerned with waste in general and marine litter, including the Plastic Bag Ban (2016). Although attempts to curb plastic pollution have been made through various legal and regulatory frameworks in the region, plastics continue to accumulate in the environment (Figure 3).

In addition, the ban on single-use plastics in many of these countries does not apply to cosmetic products containing microbeads or other single-use plastics, except in Mauritius. The government of Mauritius recently implemented the Environment Protection (Control of Single-Use Plastic Products) Regulations (2020), which ban all non-biodegradable single-use plastic products. This put a stop to the importation of cosmetic products containing microplastics and microbeads into the country.

The WIO region is impacted by activities in both hinterland and coastal countries, as well as the Island States. Thus, to address the persistent plastic waste problem, all countries, including landlocked ones, need to be involved, since many pollutants in the rivers entering the WIO originate from both coastal and hinterland countries.

Global Legally Binding Instrument on Plastic Pollution

In March 2022, during the fifth session of the UN Environment Assembly (UNEA), the world governments adopted Resolution 5/14 to launch negotiations on a treaty to address plastic pollution. This intergovernmental negotiation, Committee on a legally binding instrument to end plastic pollution, has been ongoing, with five scheduled meetings. At the end of these negotiations, contracting parties will be expected to implement common actions such as: **1.** Update national action plans reflecting country-driven approaches to contribute to the objectives of the instrument, **2.** Promote national action plans to work towards the prevention of pollution, **3.** Develop strategies to reduce and eliminate plastic pollution, **4.** Support regional and international cooperation. Other activities expected from contracting parties will be a) to periodically assess the progress of implementation of the instrument and its effectiveness in achieving the objectives, and b) to provide scientific and socioeconomic assessments relating to the status of plastic pollution(UNEP, 2022). Countries will need to domesticate and implement the agreement, monitor the success of the adoption, and assess its impact on reducing plastic pollution in the environment. To effectively achieve this, countries need to assess their environmental plastic pollution status and develop standardized monitoring protocols. This requires researchers to collaborate to develop protocols for different size categories of plastic waste to assess plastic pollution status in the region.

Conclusion

The few studies done in the region show the presence of waste pollution in the environment but there is a lack of continuous and consistent monitoring and evaluation of types, sizes and polymer types of the plastic waste. There is a lack of data on plastic pollution in the offshore waters and deep-sea sediments in the WIO region. Since the ocean is the ultimate sink for plastic pollution, continuous monitoring in this environment will help evaluate the success of implementing of various local policies and strategies for plastic pollution management. It will be critical to loop in the landlocked countries, as part of the plastic waste in the ocean that comes from these countries via the river system. Monitoring the effectiveness of the global legally binding plastic pollution instrument when implemented will be necessary, and therefore, there is a need for a universally or regionally agreed protocol for monitoring. It is also important to establish baseline levels of plastic waste across all



Figure 3: Showing the accumulation of plastic waste along a beach in Kenya. This highlights laxity in waste dumping on the beach and a lack of proper waste disposal, making the site a potential source of plastic pollutants into the marine waters. (Source: Kerubo 2023, PhD Thesis)

sizes and types of environments, including marine environments. During manufacturing, chemicals are added to the plastics to improve their properties and performance. The chemicals added are known to easily leak into the environment, where they are likely to cause different impacts that are yet to be confirmed.

Recommendations

- The UNEP-NC should convene Western Indian Ocean governments and research institutes to co-design and launch a coordinated plastic monitoring network in the next two years.
- The regional secretariat of the Indian Ocean Commission should finalize and adopt a unified protocol banning single-use plastics and implement Extended Producer Responsibility schemes across all WIO states within 24 months.
- National Environment Ministries and local NGOs should establish, equip, and train a Floating Debris Rapid-Response Task Force to mobilize clean-up teams in identified marine debris hotspots within six months.
- WIO Customs Authorities, aligned with IMO and Basel Convention guidance, must require chemical manufacturers to report annual tonnages of key plastic additives (e.g., phthalates, flame retardants) for all imports starting in the next fiscal year.
- National planning agencies in the region should set aside funding for research on innovations in plastic recovery, reduction, reuse, recycling, and public education campaigns at all levels in the community

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References

Andrady, A.L. and Rajapakse, N., 2019. Additives and chemicals in plastics. *Hazardous chemicals associated with plastics in the marine environment*, pp.1-17.

Awuor, W., Muthumbi, A.W.N. and Robertson-Andersson, D.V., 2020. Presence of microplastics in benthic macroinvertebrates along the Kenyan coast. *African Journal of Marine Science*, *42*(4), pp.405-411. https://doi.org/10.2989/1814232X.2020.1829045.

Awuor, W., Muthumbi, A. and Robertson-Andersson, D.V., 2021. Presence of microplastics in jellyfish (*Crambionella orsini*) along the Kenyan coast. *Western Indian Ocean Journal of Marine Science*, *20*(1), pp.137-141. https://doi.org/10.4314/wiojms.v20i1.12

Barnardo, T. and Ribbink A., 2020. African Marine Litter Monitoring Manual. African Marine Waste Network, Sustainable Seas Trust. Port Elizabeth, South Africa. https://repository.oceanbestpractices.org/handle/11329/1420.2

Bråte, I.L.N., Huwer, B., Thomas, K.V., Eidsvoll, D.P., Halsband, C., Almroth, B.C. and Lusher, A., 2017. *Micro-and macro-plastics in marine species from Nordic waters*. Nordic Council of Ministers.

Da Costa, J.P., Rocha-Santos, T. and Duarte, A.C., 2020. The environmental impacts of plastics and micro-plastics use, waste and pollution: EU and national measures. http://www.europarl.europa.eu/supporting-analyses

Dauvergne P., J.I. Allan, S. Beaudoin, B.C. Almroth, J. Clapp, E. Cowan, B. de Groot, T. Farrelly, N.deM. Grilli, A. Mah, E. Mendenhall, R. Paik, R. Ralston, P. Stoett, A. Stöfen-O'Brien, J. Taggart, R. Tiller, P. Villarrubia-Gómez, J. Vince.Competing axes of power in the global plastics treaty: Understanding the politics of progress and setbacks in negotiating a high-ambition agreement. Marine Policy: Volume 181, November 2025, 106820

Dokl M., A. Copot, D. Krajnc, Y.Van Fan, A. Vujanović, K.B. Aviso, R.R. Tan, Z. Kravanja, L. Čuček (2024). Global projections of plastic use, end-of-life fate and potential changes in consumption, reduction, recycling and replacement with bioplastics to 2050. Sustainable Production and Consumption Volume 51: 498-518

GESAMP (2019). Guidelines or the monitoring and assessment of plastic litter and microplastics in the ocean (Kershaw P.J., Turra A. and Galgani F. editors), (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 99, 130p.

Geyer, R., Jambeck, J.R. and Law, K.L., 2017. Production, use, and fate of all plastics ever made. *Science advances*, *3*(7), p.e1700782. https://doi.org/10.1126/sciadv.1700782

Griffin, M., and Karasik, R., 2022. Plastic Pollution Policy Country Profile: Kenya. NI PB 22-06. Durham, NC: Duke University.

Gwada, B., Ogendi, G., Makindi, S. M., and Trott, S., 2019. Composition of plastic waste discarded by households and its management approaches. http://ir.mksu.ac.ke/handle/123456780/4158.

Hermabessiere, L., Dehaut, A., Paul-Pont, I., Lacroix, C., Jezequel, R., Soudant, P., and Duflos, G., 2017. Occurrence and effects of plastic additives on marine environments and organisms: a review. *Chemosphere*, *182*, 781-793. https://doi.org/10.1016/j.chemosphere.2017.05.096

Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R. and Law, K.L., 2015. Plastic waste inputs from land into the ocean. *science*, *347*(6223), pp.768-771. https://doi.org/10.1126/science.1260352

Kerubo, J.O., Muthumbi, A.W.N., Onyari, J.M., Robertson-Andersson, D. and Kimani, E., 2021a. Microplastics pollution in the sediments of creeks and estuaries of Kenya, western Indian Ocean. *African Journal of Marine Science*, *43*(3), pp.337-352. https://doi.org/10.2989/1814232X.2021.1966505.

Kerubo, J.O., Agnes, Muthumbi, W.N., Robertson-Andersson, D., Onyari, J.M. and Kimani, E.N., 2021b. Microplastics contamination of fish from the creeks along the Kenya coast, Western Indian Ocean (WIO). African J. Biol. Sci., 17 (1): 297-319 (2021)

Kerubo, J.O., Muthumbi, A.W., Onyari, J.M., Kimani, E.N. and Robertson-Andersson, D., 2020. Microplastic pollution in the surface waters of creeks along the Kenyan coast, Western Indian Ocean (WIO). *Western Indian Ocean Journal of Marine Science*, *19*(2), pp.75-88. https://orcid.org/0000-0002-0002-1149.

Kosore, C., Ojwang, L., Maghanga, J., Kamau, J., Kimeli, A., Omukoto, J., Ngisiag'e, N., Mwaluma, J., Ong'ada, H., Magori, C. and Ndirui, E., 2018. Occurrence and ingestion of microplastics by zooplankton in Kenya's marine environment: first documented evidence. *African Journal of Marine Science*, *40*(3), pp.225-234. https://doi.org/10.2989/1814232X.2018.1492969.

Li, Y., Tao, L., Wang, Q., Wang, F., Li, G. and Song, M., 2023. Potential health impact of microplastics: a review of environmental distribution, human exposure, and toxic effects. *Environment & Health*, *1*(4), pp.249-257. https://pubs.acs.org/doi/10.1021/envhealth.3c00052?ref=pdf

Maione, C., 2019. Emergence of plastic pollution on tourism beaches in Zanzibar, Tanzania. Master's Thesis School for Environment and Sustainability, University of Michigan. https://www.researchgate.net/publication/353677998 [accessed Oct 30 2023].

Massos, A. and Turner, A., 2017. Cadmium, lead and bromine in beached microplastics. *Environmental Pollution*, *227*, pp.139-145. https://doi.org/10.1016/j.envpol.2017.04.034.

Mattsson, K., Johnson, E.V., Malmendal, A., Linse, S., Hansson, L.A. and Cedervall, T., 2017. Brain damage and behavioural disorders in fish induced by plastic nanoparticles delivered through the food chain. *Scientific reports*, *7*(1), p.11452. https://doi.org/10.1038/s41598-017-10813-0.

Mvovo, I., 2021. A comprehensive review on micro-plastic pollution in African aquatic systems. Environmental Advances. Volume 5, October 2021, 100107

Okuku, E.O., Kiteresi, L.I., Owato, G., Mwalugha, C., Omire, J., Mbuche, M., Chepkemboi, P., Ndwiga, J., Nelson, A., Kenneth, O. and Lilian, M., 2020a. Baseline meso-litter pollution in selected coastal beaches of Kenya: Where do we concentrate our intervention efforts?. *Marine Pollution Bulletin*, *158*, p.111420. https://doi.org/10.1016/j.marpolbul.2020.111420.

Okuku, E., Kiteresi, L., Owato, G., Otieno, K., Mwalugha, C., Mbuche, M., Gwada, B., Nelson, A., Chepkemboi, P., Achieng, Q. and Wanjeri, V., 2021. The impacts of COVID-19 pandemic on marine litter pollution along the Kenyan Coast: a synthesis after 100 days following the first reported case in Kenya. *Marine Pollution Bulletin*, *162*, p.111840. https://doi.org/10.1016/j.marpolbul.2020.111840.

Okuku, E.O., Kiteresi, L.I., Owato, G., Mwalugha, C., Omire, J., Otieno, K., Mbuche, M., Nelson, A., Gwada, B. and Mulupi, L., 2020b. Marine macro-litter composition and distribution along the Kenyan Coast: The first-ever documented study. *Marine Pollution Bulletin*, *159*, p.111497.https://doi.org/10.1016/j.marpolbul.2020.111497

Pathak G., M. Nichter, A. Hardon and E. Moyer, 2024. The Open Burning of Plastic Wastes is an Urgent Global Health Issue. Ann Glob Health. 2024 Jan 12;90(1):3. doi: 10.5334/aogh.4232

Pattiaratchi, C., Van der Mheen, M., Schlundt, C., Narayanaswamy, B.E., Sura, A., Hajbane, S., White, R., Kumar, N., Fernandes, M. and Wijeratne, S., 2022. Plastics in the Indian Ocean–sources, transport, distribution, and impacts. *Ocean science*, *18*(1), pp.1-28. https://doi.org/10.5194/os-18-1-2022

Ryan, P.G., 2020. The transport and fate of marine plastics in South Africa and adjacent oceans. *South African Journal of Science*, *116*(5-6), pp.1-9. https://doi.org/10.17159/sajs.2020/7677.

Shilla, D., 2019. Status updates on plastics pollution in aquatic environment of Tanzania: data availability, current challenges and future research needs. *Tanzania Journal of Science*, *45*(1), pp.101-113.

Stipek, J. and Daoust, H., 2012. *Additives for plastics* (Vol. 5). Springer Science & Business Media.

UN Environment, 2018. Western Indian Ocean Regional Action Plan on Marine Litter. UN Environment/ Nairobi Convention, Nairobi, vi + 24 pp.

UNEP-Nairobi Convention/WIOMSA, 2022. Marine plastic litter in the WIO region: Status, implications on the environment, human populations and effectiveness of measures and opportunities. A synthesis report. WIOMSA, Zanzibar, WIOMSA Series (Online) No 5. ix + 64p. A digital copy of this report is available at: www.nairobiconvention.org/; www.wiomsa.org

United Nations Environment Programme (UNEP). (2022). End plastic pollution: Towards an international legally binding instrument (UNEA Resolution 5/14). Nairobi: United Nations Environment Assembly.

United Nations Development Programme (2024). Combatting plastic pollution for sustainable development: A snapshot of UNDP's work in 12 countries. New York: UNDP

Vince J. (2022). A creeping crisis when an urgent crisis arises: The reprioritization of plastic pollution issues during COVID-19 Politics and Policy https://doi.org/10.1111/polp.12512

WWF for Nature Report, 2021. Plastics: The Cost to the Society, the Environment and the Economy. (Downloaded on 24/02/2025) chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://media.wwf.no/assets/attachments/Plastics-the-cost-to-society-the-environment-and-the-economy-WWF-report.pdf

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Integrated MSP Roadmap for the Northern Mozambique Channel (2025–2035)

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Executive summary

The 11th Meeting of the Conference of Parties (CoP) to the Nairobi Convention (Antananarivo, 22 August 2024) recognized the need for an integrated regional programme to be implemented from 2025 to 2035. This included the request to strengthen Marine Spatial Planning (MSP) in the region, specifically to "develop a regional vision and roadmap for MSP that would guide sub-regional, national and local marine spatial plans through the implementation of the regional MSP strategy". The Parties further requested the Secretariat to support the implementation of ongoing projects – including the Consortium for the Conservation of the Coastal and Marine Ecosystems in the Western Indian Ocean region (WIO-C) projects in the Northern Mozambique Channel (NMC) region – through the Integrated Management of the Marine and Coastal Resources of the NMC (NoCaMo) Project and the development of a second phase of the project.

During phase one of this project, a draft roadmap, vision, and goal for the NMC region have been developed. This builds on previous decisions by the 8th, 9th and 10th Conference of Parties at the Nairobi Convention through Decision CP8/6(b) and Decision CP9/7(b) on supporting the implementation of projects in the NMC, and Decision CP8/10(4), Decision CP9/10, and Decision CP10/8 on supporting the development of marine spatial planning tools. These decisions identified the need to mainstream MSP into national development processes and highlighted the NMC as a good example for an integrated ocean management approach.

To support the countries of the NMC region, WWF and the Nairobi Convention (NC) Secretariat, in collaboration with Nelson Mandela University and African Union Interafrican Bureau for Animal Resources (AU-IBAR), hosted three in-person workshops between May 2024 and April 2025 to bring the NMC countries together to develop a regional MSP vision, roadmap and technical guidelines, and to align these with existing frameworks and strategies for the WIO.

This paper reports on the outcomes of the collaboration among NC focal points from NMC countries and other relevant stakeholders during the workshops. While the vision, roadmap and technical guidelines have been technically validated. they will still need to be politically endorsed by NC member states prior to their formal adoption. This paper is intended to serve as a valuable resource to inform policy and decision-making for advancing marine spatial planning in the NMC region.

Introduction

The Northern Mozambique Channel (NMC) is a biodiversity hotspot of global significance, the majority is recognized as an ecologically and biologically sensitive area (EBSA) and with several key biodiversity areas (KBAs) identified (Figure 4). The region is bordered by Comoros, Madagascar, Mozambique, Seychelles and the United Republic of Tanzania (Figure 4). It contains a large proportion (35%) of the entire Indian Ocean's coral reefs (ca. 11,000 km^2 in the Channel), ca. 5% of the world's mangrove forests1 (ca. 7,300 km^2 in the Channel) and seagrass beds (Ghermandi and others, 2019). Studies reveal that coral reefs in the Western Indian Ocean form a relatively well-connected network. The reefs at Mafia Latham Island (Tanzania), Angoche Nacala and Pemba Mecufi (Mozambique), Anjouan and Ngazidja (Comoros), and Glorieuses Islands are the most significant for connectivity. An estimated 450 species of coral are found here. Many of these are highly robust and better able to withstand the impacts of climate change[1]. Highlighting the importance of the area for the regeneration of future coral reefs across the region, once the planet's climate has stabilised.

Owing to its high productivity, the NMC region is one of the most important breeding and foraging areas for key indicator and flagship marine species and

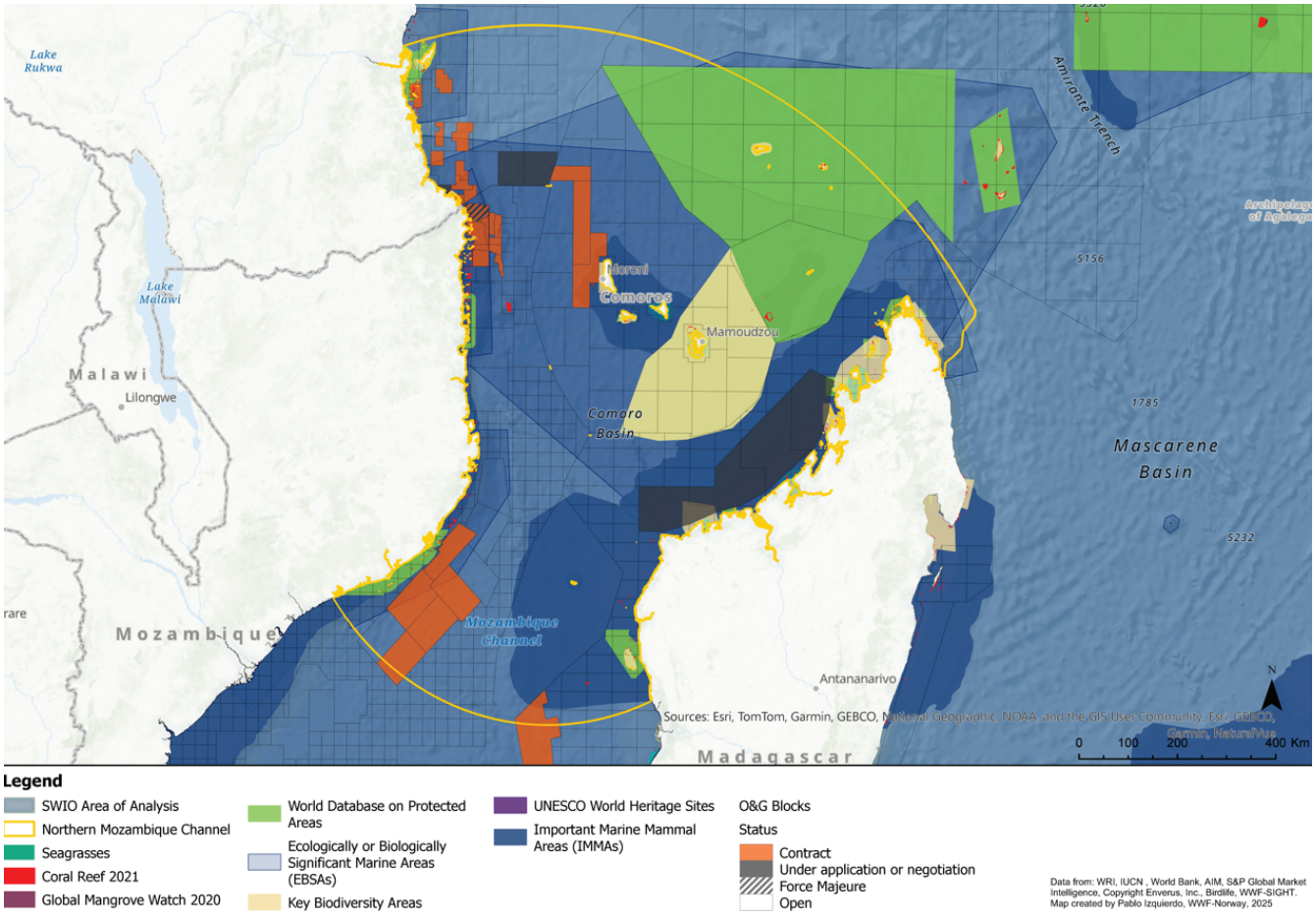


Figure 4: Map depicting the location of EBSAs and KBAs within the NMC region.

[1] https://gcrmn.net/wp-content/uploads/2022/05/Chapter-5.-Status-and-trends-of-coral-reefs-of-the-Western-Indian-Ocean-region.pdf

functions as a corridor for migratory species, such as sea turtles, sharks and rays, marine mammals and tunas (Inventaire National du Patrimoine Naturel, 2018). Surveys of the eastern and central parts of the channel have shown several regions of prime importance for foraging megafauna, while recent work on the Mozambique coastline has revealed high concentrations of whale sharks and manta rays in the south, and humpback whales in the northern part of the channel. The NMC is a prime habitat of the coelacanth; perhaps because of the old and steep coastlines (going back 180 million years) (Fricke and others, 2011). The combination of flagship species and oceanographic dynamics of the NMC are among the key features that make the channel unique globally.

The economic value of a healthy ocean can be quantified by the outputs of its provisioning services (e.g., the value of sustainably caught fish), the services it supports (e.g., tourism), and adjacent benefits (e.g., carbon sequestration). Using this methodology, the total economic value of the Western Indian Ocean has been valued at more than US$333.8 billion (Obura, 2017). Very recently, the NMC's natural capital was valued at US$277 billion (WWF and UNEP, 2025)

The rich fisheries in the Channel, particularly in the northern part, which include major prawn fisheries and a regional tuna stock, are exploited not only by domestic fishing industries but also by foreign fishing fleets (Chassot and others, 2019). The NMC is a key feeding area for tropical tuna and a major spawning area for skipjack tuna thanks to warm waters and strong mesoscale activity that enrich surface waters and enable efficient energy transfer through short food chains (Lee and others, 1999). Furthermore, near-shore fish stocks support centuries-old artisanal fishing industries and significantly contribute to the livelihoods and food security of the region's population.

The sedimentary plains occupying parts of the seafloor of the Mozambique Channel have long been recognized as having potential to store trapped hydrocarbons, with oil and gas exploration starting in the 1950s. The entire Mozambique Channel coastline has been divided into exploration blocks (Figure 5), including areas currently having protected status, wildlife migration corridors, areas demarcated for tourism development, and areas that support fish or prawn breeding and nurseries, mangroves, coral reefs, seagrass beds, lagoons, etc. (WWF, 2018; WWF, 2025. These discoveries could be 'game changers' for the region's economies and put the region on the threshold of a resource-driven 'bonanza' period, which will require comprehensive preparations to ensure both sustainable economic benefits and environmental protection.

The Mozambique Channel also forms an important trade route from southern Africa and the South Atlantic to and from the Indian Ocean (Figure 6). The Channel is a strategic trade route for the Southern Africa Development Community (SADC), carrying more than half of the region's merchandise exports and imports. An estimated 30% of global tanker traffic passes through the Channel, carrying a significant risk of oil spills and environmental damage. Furthermore, the waters off Mozambique are becoming a major new security hotspot in the Indian Ocean (Brewster, 2021). The insurgency in Mozambique threatens security in the Mozambique Channel. There are also growing attacks on maritime infrastructure. In August 2020, insurgents seized a key port in northern Mozambique from government forces. Maritime drug smuggling is a key source of funds for insurgents.

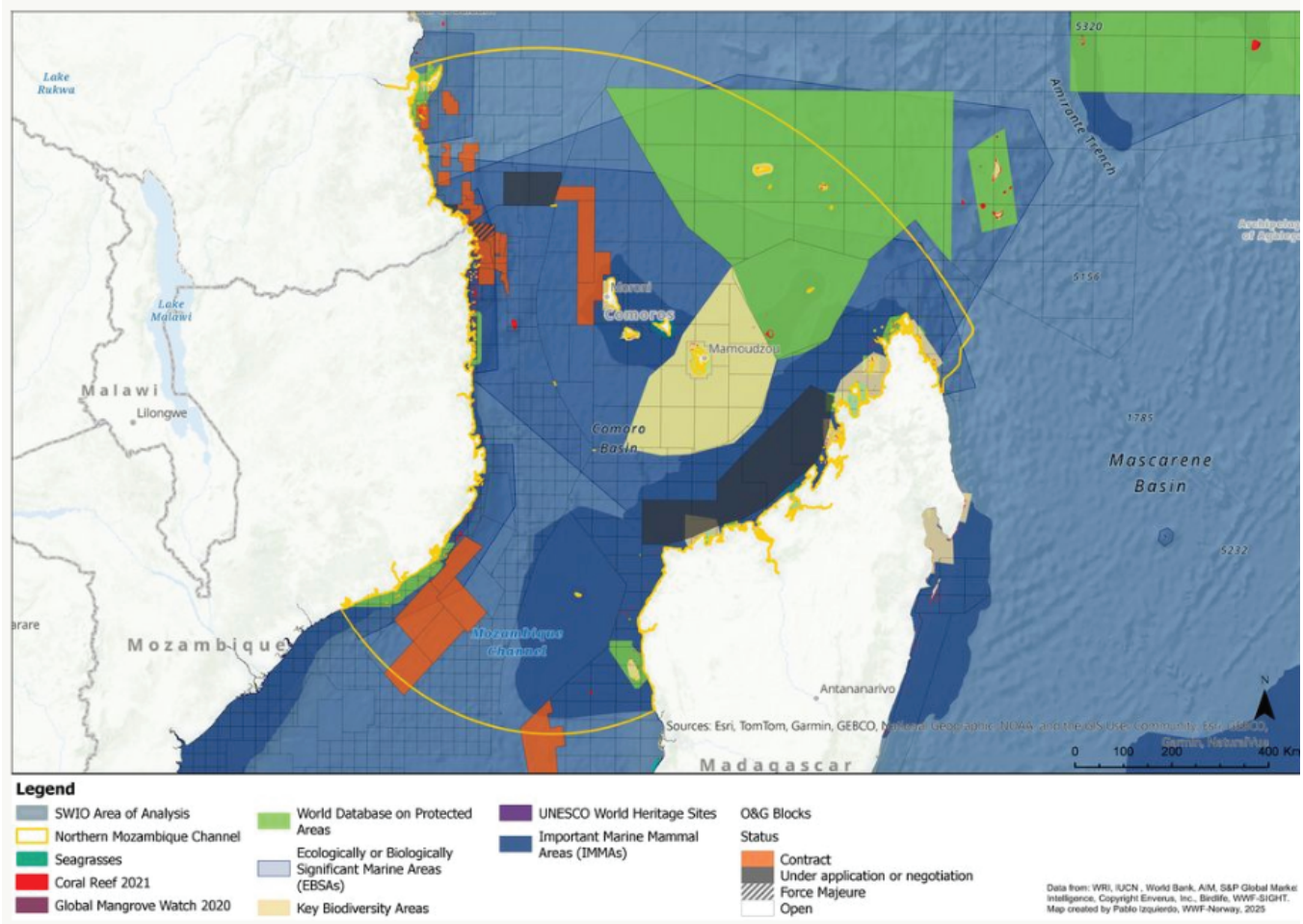


Figure 5: Map depicting the overlap of oil and gas blocks with EBSAs and KBAs within the NMC region.

Linkage of the NMC to regional and global processes

The potential of the NMC region as a transboundary site for regional conservation was first identified by experts during a regional workshop organized by the Indian Ocean Commission (IOC) in November 2009 in Antananarivo, Madagascar (Obura and others, 2015). Such transboundary networking of management areas would build on individual sites already in place and under multiple different management entities and authorities. In 2012, an assessment by the UNESCO World Heritage Centre Marine Programme identified the NMC as the highest priority region meeting the design criteria for a World Heritage Site, comprising multiple sites of potential outstanding Universal Value.

Also in 2012, the NMC was described as meeting the criteria for Ecologically or Biologically Significant Areas (EBSAs) under the Convention on Biological Diversity[2] (CBD., 2016).

Historically, economic sectors have viewed the ocean as an infinite resource for exploitation. But as the global economy has expanded, multiple uses, often with limited sectoral control, have not only come into conflict with one another, but substantial human impacts are seen across the oceans and to their deepest depths. In December 2022, the Kunming-Montreal Global Biodiversity Framework was agreed by 196 nations, including all those of the NMC, to 'take urgent action to halt and reverse biodiversity loss'. This agreement includes targets for all areas to be under inclusive spatial

2 https://www.cbd.int/marine/ebsa/booklet-03-sio-en.pdf

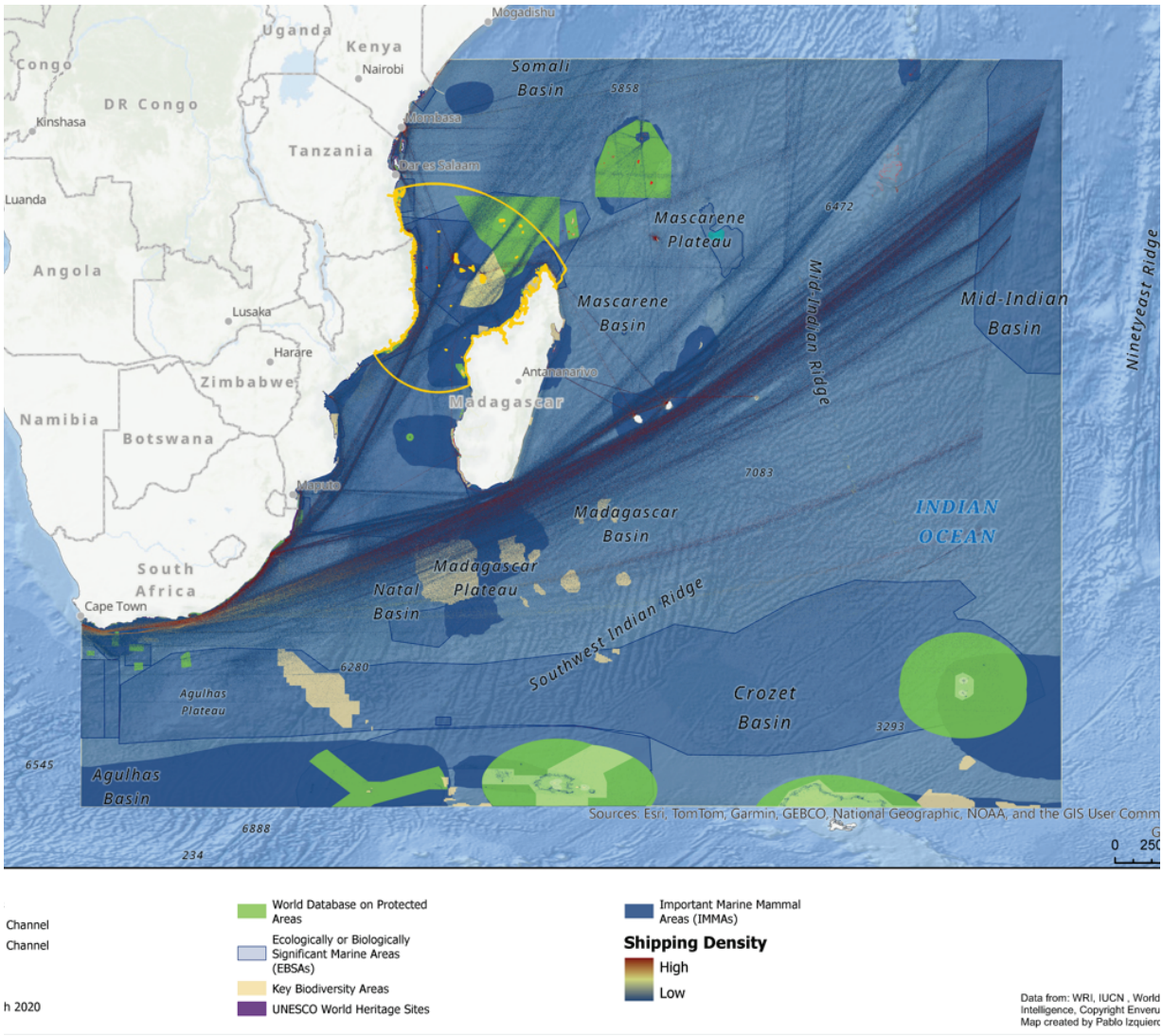


Figure 6: Map depicting the shipping density in the WIO and NMCs regions.

planning and/or effective management processes by 2030, and to effectively protect and conserve 30% of areas by 2030. Furthermore, in June 2023, the United Nations treaty to manage biodiversity beyond national jurisdictions was agreed upon, laying out a pathway for the governance of the high seas to enable increased protection of marine living resources as a global commons. There are, therefore, growing calls for marine spatial planning and integrated ocean management to reconcile conflicting uses and preserve natural assets (UNEA 6 Resolution 6/15).

Marine Spatial Planning (MSP): A tool for an integrated ocean governance in the NMC

Marine spatial planning is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that have been specified through a political process (UNESCO[3]). It is a method of collective governance that involves mapping oceanic usage areas to identify appropriate zones for activities and thereby reduce the potential for future conflicts between

3 https://www.ioc.unesco.org/en/marine-spatial-planning

incompatible uses (Ehler and Douvere, 2009). In the case of the NMC, marine spatial planning would see the governments of the NMC countries convene relevant civil society organizations and the private sector to collectively identify areas for human activities such as commercial fishing, mariculture, oil and gas projects, and tourism and renewable energy, while identifying areas worthy of increased levels of protection to ensure a sustainable blue economy is underpinned by a foundation of healthy ocean ecosystems.

MSP is also a critical governance tool. At the fifteenth Session of the African Ministerial Conference on the Environment (AMCEN) in 2015, African ministers of environment agreed to develop a governance strategy, in accordance with the United Nations Convention on the Law of the Sea and regional seas conventions, on oceans and seas in Africa for the effective management of the region's shared maritime resources. This led to the development of the Africa Integrated Maritime Strategy 2050 (AIMS 2050) and Agenda 2063. Progressing MSP in the region is in line with major outcomes of the Strategic Action Programme Policy Harmonization and Institutional Reforms (SAPPHIRE) and Western Indian Ocean Strategic Action Programme (WIO-SAP) Projects, which recognize that a regional MSP strategy is vital to harmonize the different marine and coastal management and spatial planning initiatives in the countries of the Western Indian Ocean (WIO) region. During 2020-2021, a regional MSP strategy for the WIO was developed with input from the MSP Technical Working Group (TWG) and wider stakeholders (UNEP-Nairobi Convention 2022). In keeping with global best practice, the strategy adopted an ecosystem-based approach to MSP, which acknowledges the importance of ecological functioning that underpins many economic activities.

The Swedish Agency for Water Management (SwAM) has been working with the Nairobi Convention Secretariat and the MSP Technical Working Group to develop the Symphony tool[4] which maps human pressures and ecological impacts for MSP in the WIO. There are numerous other initiatives related to the development of regional databases (such as MASPAWIO) and knowledge-sharing platforms in the WIO that will support MSP activities in the region (Snow, 2022).

While there has been significant progress towards policy development and the availability of institutional structures for MSP in the WIO, the countries of the WIO are still at different stages of MSP uptake and policy and legislative development. A study commissioned by WWF in 2022 in Madagascar and Tanzania highlighted the following key constraints to effective implementation of spatial management in the region[5]:

- Limited financial resources available to design, implement and monitor national and regional plans
- Limited coordination between government maritime agencies, stemming from a lack of a common vision on the use of the maritime space.

Finally, coastal communities in the NMC region rely heavily on marine resources for their livelihoods. Different interests among users of marine space can lead to conflicts and ultimately threaten the welfare and prosperity of these communities (Ghermandi and others, 2019). This highlights the importance of MSP reducing conflicts between users and, in particular, improving the welfare of coastal communities. In addition to strengthening protection and management of the offshore areas of the NMC region, it is recommended that coastal MSP efforts support existing LMMA networks and governance mechanisms, such as community-managed areas and Marine Protected Areas. These strategies could be further integrated and synergised with MSP development.

4 https://www.havochvatten.se/en/eu-and-international/international-cooperation/swam-ocean---improving-lives-through-sustainable-use-of-the-ocean/wio-symphony---a-tool-for-ecosystem-based-marine-spatial-planning.html

Methods

To develop a shared vision, goal, roadmap, and technical guidelines, several stakeholder workshops were organised. The most notable events included stakeholder engagement workshops held on the 6th November 2023 (12 participants), 9th November (16 participants), 14-15th May 2024 (30 participants), August 2024 (35 participants), and the 7-11th April 2025 (40 participants). These workshops included Nairobi Convention focal points, members of the MSP technical working group, academics, NGOs, community representatives, and development agencies to ensure diversity of perspectives and an inclusive approach.

Results

The following vision and goal were developed by workshop participants:

Draft Vision: A sustainable future where healthy ecosystems support – and are supported by – thriving local communities and a vibrant blue economy which optimizes the value of ocean resources within the NMC over the long term without jeopardizing the use for future generations.

Draft Goal: An inclusive and holistic regional process that produces a sub-regional marine spatial plan in alignment with national MSP processes to support the sustainable management and conservation of key biodiversity areas and ecosystems within the NMC for all.

As part of the process of developing a roadmap for the implementation of the MSP in the NMC region, challenges, priorities and opportunities were identified. Based on those, **five main objectives were developed, along with corresponding actions, to enable and promote MSP in the NMC region:**

a) Harmonized governance (supporting Nairobi Convention COP Decision CP.11/1, CP 11/5, CP11/6, 11/13, 11/16: The success of regional MSP for the NMC hinges on an enabling mechanism that includes a strong supporting legal framework. Not only should each country have its own legal and institutional MSP frameworks, but these should also align with transboundary regional frameworks. Cumulative impacts and common threats can then be addressed to improve harmonization, connectivity and enforcement within the region.

- **Action I:** Establish a shared governance mechanism for the NMC
- **Action II:** Conduct inclusive multi-stakeholder engagement
- **Action III:** Develop mechanisms for resolving conflicts

b) Harmonized MSP processes and approaches among NMC countries, including data considerations (supporting Nairobi Convention COP Decision CP.11/1, CP 11/5, CP 11/7, 11/13, 11/16: In line with the regional WIO-MSP strategy (UNEP-Nairobi Convention 2022), harmonizing MSP processes across the NMC sub-region would address transboundary and cross-sectoral marine management challenges such as protecting marine biophysical and ecological processes that transcend political boundaries. Furthermore, developing data collection guidelines and standards for the region will assist data gathering, storage, sharing and collaboration across NMC countries.

- **Action IV:** Develop MSP guidelines
- **Action V:** Exchange experiences and technical know-how
- **Action VI:** Improve access to data

c) Integrated ocean management (supporting Nairobi Convention COP Decision CP.11/1, CP 11/5, CP11/6, CP 11/10, CP 11/11, 11/16: Integrated Ocean management aims to support blue economy initiatives that use ocean resources in ways that preserve the health and resilience of marine ecosystems and improve livelihoods and

jobs, balancing protection and production to achieve prosperity. With a strong drive towards blue economy development in the NMC region, integrated ocean management will be an essential part in conserving coastal and marine habitats and biodiversity and in protecting the coastal and marine environment from land-based pollution, fisheries, tourism, ocean acidification and the impacts of climate change.

- **Action VII:** Increase protection of the marine environment
- **Action VIII:** Sustainably manage marine resources
- **Action IX:** Facilitate adaptation to climate change

d) Poverty reduction through an inclusive and sustainable blue economy (supporting Nairobi Convention COP Decision CP.11/1, CP 11/6, 11/16: Marine spatial plans are expected to build the basis for achieving the objectives of sustainable blue economy strategies, and this includes reducing poverty.

- **Action X:** Focus on blue entrepreneurship to strengthen supplementary livelihoods
- **Action XI:** Secure community access rights

  Action XII: Develop incentives to grow a sustainable blue economy - Key to this would be financial regulation that ensures the Sustainable Blue Economy principles are adopted with sufficient Environmental, Social and Governance (ESG) safeguards in place to secure a sustainable and inclusive blue economy.
- **Action XIII:** Develop innovative and sustainable financing mechanisms

e) Capacity building (supporting Nairobi Convention COP Decision CP.11/1, CP 11/5, CP11/8, 11/16: An effective MSP process requires trained planning teams and increased public awareness and stakeholder engagement on the MSP process and its benefits. The degree of MSP development and its implementation across the NMC region is not currently uniform, nor are the levels of institutional, technical and human capacity. Therefore, this objective aims to build capacity at a regional level so that all countries can learn from each other and grow together towards improved MSP implementation.

- **Action XIV:** Strengthen research for MSP development
- **Action XV:** Build capacity to facilitate stakeholder re-engagement
- **Action XVI:** Build capacity to support science-to-policy gaps
- **Action XVII:** Empower communities to advocate for their rights

Following the collaborative development and validation of the NMC MSP vision, goal, and roadmap, WWF and NCS, in collaboration with NMU and AU-IBAR, are supporting consultative workshops bringing together NMC country FPs, representatives from the MSP TWG, and other key NMC stakeholders to develop MSP Technical Guidelines for the NMC region. The NMC MSP Technical Guidelines aim to support national processes and harmonise the management of marine and coastal areas, given their dynamic and interconnected nature. The guidelines will assist governments, stakeholders, communities, and all relevant parties in the practice and design of marine spatial plans for the NMC region based on the specific regional context, whilst considering international best practice.

Conclusion and Recommendations

Given the exceptional biodiversity value and the increasing scale of the risks, the NMC region deserves special attention. Significant gaps in the protection of key biodiversity hotspots leave the NMC region vulnerable. It also provides an ideal testing ground for multi-country cooperation in applying Integrated Ocean Management MSP and facilitating transboundary management and protection. It is therefore recommended that a transnational MSP process, as laid out in the roadmap described above, be undertaken in the NMC region, forming a second phase to the FFEM-funded NoCaMo project due to be completed by July 2025.

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References

Brewster, D. (2021). The Mozambique Channel is the next security hotspot. Retrieved from https://www.sadf.eu/wp-content/uploads/2021/05/iop_brewster_mozambique.pdf

Chassot, E., Bodin, N., Sardenne, F. and Obura, D. (2019). The key role of the NMC for Indian Ocean tropical tuna fisheries. Rev Fish Biol Fisheries 29:613–638

Convention on Biological Diversity. (2016). Ecologically or Biologically Significant Marine Areas (EBSAs). Special places in the world's oceans. Volume 3: Southern Indian Ocean. pp 128.

Convention on Biodiversity Convention. (2025) Convention on Biodiversity Convention Website. Retrieved from Convention on Biological Diversity Ecologically or biologically significant marine areas: https://www.cbd.int/ebsa/ Accessed 18 July 2025.

Ehler, C. and Douvere, F. (2009). Marine spatial planning: a step-by-step approach. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 53, ICAM Dossier No. 6. Paris. UNESCO.

Fricke, H., Hissmann, K., Froese,R., Schauer, J., Plante, R. and Fricke, S. 2011. The population biology of the living coelacanth studied over 21 years. ***Marine Biology 158***(7):1511-1522.

Ghermandi,A,, Obura D., Knudsen, C., and Nunes, P.A.L.D. (2019). Marine ecosystem services in the NMC: A geospatial and socio-economic analysis for policy support. ***Ecosystem Services, Volume 35***, 1-12.

Inventaire National du Patrimoine Naturel (2018). Campagnes REMMOA (REcensement des Mammifères marins et autre Mégafaune pélagique par Observation Aérienne) - Données d'occurrence de mammifères marins des campagnes REMMOA - Observatoire PELAGIS UMS 3462 et Agence des aires marines protégées. UMS PatriNat (OFB-CNRS-MNHN), Paris. Occurrence dataset https://doi.org/10.15468/ddhzrq accessed via GBIF.org on 2025-07-18.

Lee P.V., Chen I.VC., and Tseng W.VN. (1999) Distribution patterns of three dominant tuna species in the Indian. Ocean. Proc. of the Environmental Systems Research Institute International User's Conference, San Diego.

Obura DO, Burgener V, Nicoll ME, Ralison HO and Scheren P(2015) The Northern Mozambique Channel. Setting the foundations for a regional approach to marine governance. A Background Document. WWF International and CORDIO East Africa.

Obura, D. (2017). Reviving the Western Indian Ocean Economy: Actions for a Sustainable Future. WWF International, Gland, Switzerland. 64 pp.

Snow, B. (2022). Scoping for the design of a methodological tool for enhancing the sustainability and suitability of national MSP in NMC countries. Situational report for Tanzania. NMU, South Africa.

UNEP-Nairobi Convention. (2022). A Strategic Framework for Marine Spatial Planning in the Western Indian Ocean. UNEP-Nairobi Convention, WIOMSA, Nelson Mandela University, and Macquarie University. 82 pp.

WWF (2018). The threat of mining and oil and gas to our marine heritage.

WWF. 2025. Mapping Threats to Ocean Biodiversity: A high-level analysis of sector-specific threats to ocean biodiversity in the South West Indian Ocean, with a focus on the Northern Mozambique Channel. Antananarivo, Madagascar: WWF-SWIO.

WWF and UNEP-Nairobi Convention. 2025. Assessing the Value of the Northern Mozambique Channel: Developing the economic case for integrated ocean governance and ecosystem investment in Africa's most biodiverse oceanic region. Antananarivo, Madagascar: WWF-SWIO.

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Co-designing Science, Policy and Society for a Sustainable Blue Economy in the Western Indian Ocean

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Executive Summary

Evidence-based and inclusive policy making is crucial to support sustainable blue economy development and meet the needs of people while safeguarding marine and coastal ecosystems. In the Western Indian Ocean (WIO) region, coastal nations and island states depend heavily on these ecosystems for livelihoods, food security, and economic stability. However, persistent gaps between science, policy, and society limit the ability to translate knowledge into effective, equitable decisions and undermine effective governance of marine and coastal systems in the WIO region. As pressures on marine resources intensify, these disconnects risk undermining both ecosystem health and societal well-being, highlighting the urgent need for more integrated and participatory approaches. In response, this paper shows that co-design is essential to strengthen the science–policy–society interface and improve policy relevance and impact. By promoting inclusive and participatory approaches, co-design enhances collaboration, knowledge uptake, and more effective governance. With a focus on inclusivity, impact and capacity development, the paper assesses the current status of co-design in facilitating knowledge exchange at the science–policy-society interface and identifies priority actions to contribute to greater cooperation and common efforts at all levels towards the sustainable use and management of marine resources in the WIO region. This is especially timely in response to Decision CP11/8 of the Nairobi Convention COP 11, which calls for stronger science integration in policy making, inclusive stakeholder engagement, and coordinated action to address shared marine challenges.

1. Background and rationale

Urgency of the Issue in the WIO Region

Marine and coastal systems in the WIO region are subject to escalating environmental and socio-ecological pressures, including climate change, biodiversity loss, pollution, and unsustainable resource use, with demonstrable implications for ecosystem functioning and human well being. As reflected by the adoption of the Kunming Montreal Global Biodiversity Framework (GBF) and its action oriented targets under the UN Convention on Biological Diversity (CBD) at COP15, there is an imperative to strengthen the integration of scientific evidence, robust governance mechanisms, and stakeholder engagement to support sustainable development outcomes (CBD 2022). Achieving targets related to capacity building (Action Target 20) and information access for policymakers (Action Target 21) requires timely access to evidence and participatory processes that include both scientific and traditional knowledge systems. In many developing contexts within the WIO region, however, relevant scientific data and locally grounded knowledge remain limited in accessibility or outdated, constraining evidence informed decision making and effective implementation of sustainability commitments. For example, scientific data on billfish species — which are economically,

culturally, and ecologically significant across multiple WIO states — are sparse and fragmented, particularly for artisanal and recreational fisheries, undermining comprehensive stock assessments and coordinated management efforts at national and regional scales. This paucity of harmonised information has impeded efforts to develop integrated management plans and coherent regional policies for these fisheries, despite their importance for food security, livelihoods and tourism in countries such as Kenya, Tanzania, Mozambique and Madagascar (Kadagi *with others*. 2022).

Advances and Emerging Opportunities

In response to these challenges, regional initiatives, such as the Western Indian Ocean Science-to-Policy Platform (WIO-SPP), ProsperBlue and associated capacity-building and regional network programmes under the Nairobi Convention, reflect a growing recognition of the value of integrating scientific knowledge with policymaking and stakeholder engagement to address complex sustainability challenges in the WIO. Efforts such as the establishment of science–policy engagement platforms under the Nairobi Convention and related regional networks demonstrate a clear commitment to improving the integration of knowledge systems and strengthening capacity for evidence informed governance. These platforms facilitate the dissemination of up-to-date scientific insights, foster a shared understanding among diverse actors, and support iterative processes of knowledge exchange that align with the objectives articulated under the GBF and regional governance frameworks. Building on these developments, emerging opportunities for enhanced collaboration include the development of institutional mechanisms that formalize science–policy linkages, the expansion of participatory frameworks that incorporate multiple forms of knowledge, and initiatives to strengthen capacities for the co-production of actionable evidence. Within this evolving landscape, co-design approaches offer a practical means to operationalize collaborative knowledge generation and advance more equitable and contextually relevant governance practices. Ultimately, by leveraging these advances, the research community and regional actors can contribute to more integrated and effective governance responses that address both ecological imperatives and societal needs. However, despite these advances, governments seeking to implement stakeholder-inclusive, science-based policies must still perform a delicate balancing act between conserving their nation's natural resources, promoting economic prosperity, and safeguarding societal well-being.

2. Linkage to global, regional and national processes

Researchers and international organizations have developed various guidance materials to direct the implementation of target 20, 21 and 22 (Bennett 2022). For the marine context, the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) in the framework of the Ocean Decade published a discussion note for collaborative approaches to co-designing salient, credible and legitimate ocean knowledge solutions, to bring about the desired transformation in ocean management, as contribution to GBF targets 20, 21 and 22 (Intergovernmental Oceanographic Commission 2021). While theoretical frameworks and generic principles such as knowledge co-production provide a potentially suitable mechanism for improving knowledge flow for an equitable and sustainable blue economy, their application often remains generic. In contrast, co-design methods at national and regional levels that address the key underlying causes impeding knowledge sharing and exchange, e.g. cultural differences, are more likely to be context-specific and respond to local (policy) and societal needs (Cvitanovic *with others*. 2015).

The Eleventh Meeting of the Conference of Parties (COP11) to the Nairobi Convention, held from 20–22 August 2024 in Antananarivo, Madagascar, adopted a new Integrated Regional Programme (2025–2035) and Programme of Work (2025–2028)

to guide regional cooperation on marine governance, sustainable use of resources, and environmental challenges in the WIO. Among decisions adopted, Contracting Parties emphasized the need to strengthen integration of scientific research into policy and decision-making, including organizing regional and national science-policy dialogues as part of evidence-based ocean governance (Decision CP11/8) and advancing strategic partnerships and collaborative approaches. In addition, the COP11 decisions recognized programmes that promote multi-stakeholder engagement and collaborative governance tools, such as the regional BRIDGES initiative, which supports data integration, tool development and stakeholder dialogue to inform policy decisions at regional levels — an outcome that resonates with the co-design and science-policy-society interface approach discussed in this paper. The ocean forms the backbone of the WIO region's economy, with more than 60 million people living within 100 kilometers from the coast (Murunga 2021). Although sustainable blue economy development is acknowledged for change, the focus often leans towards short-term economic gains rather than sustainability. Hence, traditional livelihoods, scientific research and small-scale local operations are frequently outcompeted by government initiatives, with little regard for social inclusion, science-based policies and environmental sustainability (Sikhunyana *with others*. 2023).

At the local level, efforts for inclusivity include Our Blue Future, a regional alliance, that facilitates collaboration among coastal stakeholders for a sustainable blue economy, showcasing co-design through cross-sector engagement among actors from science, policy and society. Madagascar is taking a leading role with the locally managed marine areas (LMMAs) approach, providing an information-sharing and support platform for community-based marine management. A good example of LMMA expansion in the WIO region is the MIHARI network, a network of 280 LMMA communities that represent the voices of Madagascar's small-scale fishers and promotes peer-to-peer learning. The Network is currently advancing the legal recognition of the LMMAs.

3. Co-designing at the Science-Policy-Society Interface - key questions and answers

The authors of this paper held a session at the Marine Regions Forum on 8 November 2023 to identify potential roles, challenges and synergies of researchers, policy makers as well as social actors, such as Indigenous Peoples and local communities, in advancing sustainable ocean governance. The session convened approximately 30 participants from a range of sectors — including researchers, policymakers, practitioners and representatives of social actors such as Indigenous Peoples and local communities — to explore how to improve the interface between science, policy and society in support of sustainable ocean governance and economy. The session was structured as a facilitated workshop, combining plenary presentations by key experts with breakout group discussions on three thematic dimensions: inclusive co-design, impactful co-design, and capacities for co-design. Each breakout was guided by predefined questions to elicit insights on roles, challenges and synergies for different stakeholder categories. Facilitators documented group deliberations, and findings were synthesized in plenary reporting and thematically clustered by session chairs and rapporteurs to derive a coherent set of recommendations. This participatory process ensured transparent documentation of methods and outputs.

To frame the discussion, the authors adopt an understanding of co-design as an "iterative and collaborative process involving diverse types of expertise, knowledge and actors to produce context-specific knowledge and pathways towards a sustainable future" (Norström *with others*. 2020). Building on this, the science-policy-society interface - as discussed during the session titled, "From Science to Policy and Society: Co-designing a sustainable blue economic development in the framework of the Ocean Decade" at the Marine Regions Forum – refers to the interactions that connect researchers, communities and decision makers for the exchange of information, knowledge and learning to make informed decisions that address societal needs. With this context in mind, participants in the meeting discussed three key questions:

(i) How to ensure inclusion of relevant stakeholders in co-designing at the science-policy-society interface?

Inclusive co-design aims to create a space where scientists, policymakers and non-academic stakeholders collaborate, bridging the gap between science, policy and society to achieve knowledge integration and sustainable societal impact. This requires researchers, policymakers and the public to move beyond disciplinary and sectoral silos towards transdisciplinary and adaptive approaches to research and policy development. For governments, this entails institutionalizing inclusive processes from the outset, including embedding stakeholder participation in legal and policy frameworks, allocating adequate resources, and supporting sustained engagement mechanisms. Policymakers must more actively engage researchers and societal actors to enable evidence-based, collaborative planning that prioritizes local needs and equitable outcomes in the blue economy (Cisneros-Montemayor *with others*. 2021). In parallel, research processes need to become more demand-driven, with questions co-defined with stakeholders to ensure relevance and impact (Mahajan *with others*. 2022; Ferse *with others*. 2022). A well-planned and inclusive co-design process supports continuous learning by building capacity for co-identifying priorities (ensuring that science is at the service of society), mapping key stakeholders and identifying roles and responsibilities, incorporating management messages in science, and utilising adaptive management processes.

(ii) How to strengthen co-designing at the science-policy-society interface for sustainable solutions to societal challenges that deliver required impacts?

To achieve a lasting, meaningful societal impact, the outcomes of co-designed projects – from partnerships to institutions, structures and information – need to be sustained, beyond the duration of the project (Ferse *with others*. 2022). A good example of strengthening co-design at the science-policy-society interface is the MeerWissen project Fishing Data East Africa (FIDEA), which integrated science, policy and societal interests to develop effective and equitable solutions for the management of fisheries resources in Tanzania, Zanzibar and Mozambique. Regular communication, shared goals, flexibility and adaptation, and government support were some of the enabling factors for the implementation of a co-design process within FIDEA. Decision makers and local communities were involved in the project events to ensure smooth implementation. FIDEA successfully ensured the sustainability of fisheries management beyond the project period through co-financing with other partners and ensuring community/beneficiary ownership.

Knowledge transfer at the science-policy-society interface is most effective when it is done from the bottom-up, integrating multiple perspectives, including recognition of less empowered voices, at a larger scale. As communities continue to hold their governments to account, collective action can encourage scientists to speak up, governments to listen, and together to create sustainable solutions for blue economy development. To strengthen impactful co-design at the science-policy-society interface, all relevant stakeholders need to collaborate to synthesize the best available research for decision support, use multiple levels of communication to address different levels of detail, and work together to develop clear, actionable recommendations. Successful co-design at the science-policy-society interface can be measured by supporting co-design platforms and communities of practice, sharing case studies of success, and multidisciplinary science that includes traditional and local knowledge.

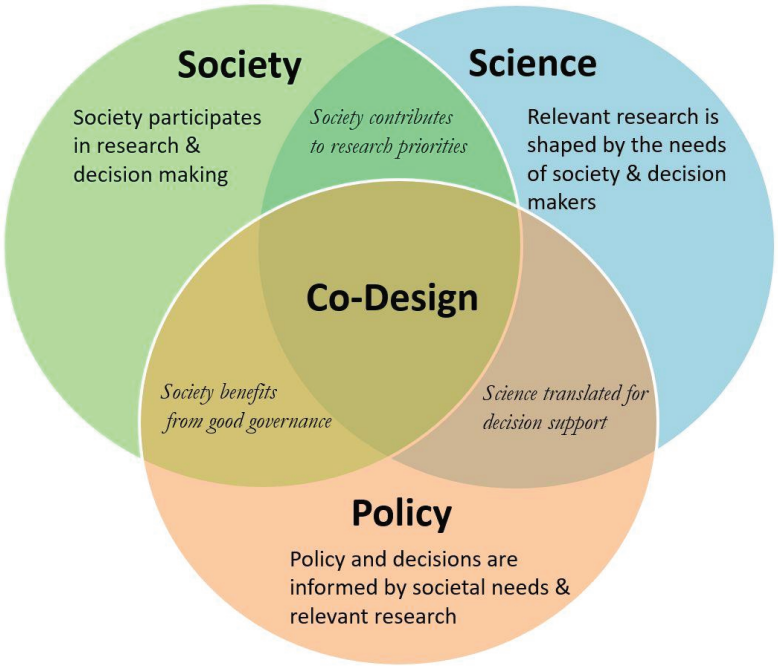
(iii) How to develop capacities for co-designing at the science-policy-society interface that enable evidence-based decision-making and needs-based action?

The blue economy is not just a component but a dominant part of island and mainland nations' economies in the WIO region. Given the current and projected pressures on coastal and marine

Co-designing at the science, policy and society interface

Key Co-Design Elements

- ✓ Shared purpose & local relevance
- ✓ Inclusive stakeholder participation & power-sharing
- ✓ Co-framing of the research challenge and context
- ✓ Iterative process, feedback loops & adaptation
- ✓ Transparency & clarity: roles, methods, decisions
- ✓ Valuing multiple knowledge systems & managing difference
- ✓ Focus on outcomes, learning and enduring change
- ✓ Context-sensitive timeline & resources



resources, many countries in the WIO region need more capacity to systematically evaluate and monitor data and information and to draw actionable conclusions for knowledge-based decision-making. Capacity building for the science-policy-society interface sets preconditions for science-policy-society relations at different levels and scales within marine biodiversity and ecosystem services and beyond. Developing capacities and resources (institutional, financial, human resources) are critical determinants for establishing successful science–policy-society interfaces (Stöbener *with others*. 2023). To meet the needs for effective implementation of inclusive and sustainable blue economy development in the WIO region, relevant stakeholders need to work together to conduct a needs assessment to identify who needs what and who needs whom. There is also an important need for scientists, policymakers and local communities to work together to co-design and co-manage a platform for communication and networking, and to build regional capacity in facilitation and social processes to support participatory approaches to inclusive and effective governance processes. Communicating ideas effectively to relevant stakeholders needs a common language, and a common understanding of the meaning of the symbols used in the language. That is why scientists, policy makers and local communities need training in communication skills to improve their ability to communicate effectively.

4. Conclusion

Strengthening the science–policy–society interface through co-design is fundamental to improving evidence uptake of co-developed knowledge and informed decision-making for sustainable blue economic development in the WIO region. By fostering inclusive stakeholder engagement, aligning research with policy needs, and nurturing institutional and human capacities, co-design transforms scientific insight into actionable knowledge that can inform policy and governance processes. Advancing these collaborative

approaches supports the integration of diverse forms of knowledge and enhances regional commitment to sustainable marine and coastal resource management. In doing so, co-design contributes directly to bridging persistent gaps between science, policy and society and to advancing evidence-informed, equitable and sustainable outcomes in the WIO region.

Recommendations for regional, national and local stakeholders in co-designing a sustainable blue economy development

In conclusion, we highlight the following key messages and recommendations for regional, national and local stakeholders in co-designing for inclusive and sustainable blue economy development:

- **Strengthen legal frameworks and inclusive marine governance**: Governments need to fulfill a critical role in communicating key legal frameworks to society and supporting and recognizing community-based conservation efforts, including by establishing clear mandates, roles and accountability mechanisms across institutions.

- **Allocate sustained resources for inclusive and transdisciplinary research:** Policymakers need to allocate long-term financial and institutional resources for inclusive, transdisciplinary and impactful research and engage early on with key stakeholders, including Indigenous Peoples and local communities, to make informed decisions that meet societal needs. NGOs and development cooperations can play a facilitatory role in enabling crucial participatory processes.

- **Strengthen communication and knowledge translation:** Governments and research institutions need to establish formal science–policy communication platforms, including knowledge brokers or boundary organizations, to translate scientific findings into accessible formats and communicate legal frameworks and policy implications to stakeholders.

- **Support and formalize community-based marine governance:** Governments need to recognize and integrate community-based management systems (e.g. LMMAs) into national governance structures by developing legal recognition mechanisms, supporting local stewardship initiatives, and empowering small-scale resource users through capacity development and equitable participation.

- **Establish regional communities of practice and capacity development mechanisms:** Regional organizations and governments need to co-develop communities of practice and learning platforms to support continuous exchange and mutual learning among scientists, policymakers, communities and practitioners, underpinned by structured approaches to stakeholder mapping, clearer role definitions, adaptive management processes and long term collaboration mechanisms.

References

Bennett N. J. (2022) Mainstreaming equity and justice in the ocean. Frontiers. Sec. Marine Affairs and Policy. Volume 9. https://doi.org/10.3389/fmars.2022.873572

CBD (2022) The Kunming-Montreal Global Biodiversity Framework. https://www.cbd.int/doc/c/e6d3/cd1d/daf663719a03902a9b116c34/cop-15-l-25-en.pdf

Cisneros-Montemayor A.M. *with others*. (2021) Enabling conditions for an equitable and sustainable blue economy. Nature 591 (7850): 396–401. https://doi.org/10.1038/s41586-021-03327-3

Cvitanovic C. *with others.* (2015) Improving knowledge exchange among scientists and decision-makers to facilitate the adaptive governance of marine resources: A review of knowledge and research needs. ScienceDirect. Ocean & Coastal Management. Volume 112: 25-35. https://doi.org/10.1016/j.ocecoaman.2015.05.002

Ferse S., Fujitani M. and Lahl R. (2022) Co-Design in collaborative marine research projects–A guidance with examples Version 2.0: 6 MeerWissen_Co-Design_Guide_2.0._2022. https://meerwissen.org/publications/co-design-in-collaborative-marine-research-projects/

Intergovernmental Oceanographic Commission (2021) Co-designing the science we need for the ocean we want: guidance and recommendations for collaborative approaches to designing & implementing decade actions. https://unesdoc.unesco.org/ark:/48223/pf0000379563

Kadagi N. I. *with others.* (2022) Status and challenges for sustainable billfish fisheries in the Western Indian Ocean. Reviews in Fish Biology and Fisheries. Volume 32, pages 1035–1061, (2022) https://pmc.ncbi.nlm.nih.gov/articles/PMC9510346/

Murunga M. (2021) Towards a better understanding of gendered power in small scale fisheries of the Western Indian Ocean. ScienceDirect. Global Environmental Change. Volume 67. https://doi.org/10.1016/j.gloenvcha.2021.102242

Norström A.V. *with others*. (2020) Principles for knowledge co-production in sustainability research. Nat Sustain 3:183–190

Sikhunyana Z. and Mishi S. (2023) Access, participation and socio-economic benefits of blue versus green economy: a systematic literature review. The International Journal of Justice and Sustainability. Volume 28. Issue 12: 1552-1572. https://doi.org/10.1080/13549839.2023.2238748

Stöbener S. and Gerritsen A. (2023) Co-designed research partnerships to bridge the gap between marine research, policy, and management: The MeerWissen Initiative. Research for Development. Science, Technology and Innovation Diplomacy in Developing Countries. Springer: 329-336

Advancing Seagrass Conservation and Management in the Western Indian Ocean

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Executive Summary

Seagrass meadows provide a range of environmental, economic, climate and social benefits to communities across the Western Indian Ocean (WIO). The management and conservation of this ecosystem can play a vital role in advancing multiple Sustainable Development Goals (SDGs). These include mitigating climate change impacts through carbon sequestration, preserving marine biodiversity, supporting sustainable fisheries, improving food security, and providing sustainable economic benefits for communities. As seagrass ecosystems are being degraded worldwide, there is growing interest in protecting and restoring these areas, particularly given their role in addressing the twin crises of climate change and biodiversity loss (Nordlund and others, 2024). Despite the ecosystem's importance, baseline data on seagrass extent, species distribution, health status, restoration potential, and threats remain limited across the WIO. This data deficiency has impeded policy coordination and hindered effective seagrass management and conservation efforts.

Coordinated and decisive actions are required to advance seagrass science and more effectively integrate into policy and management measures in the WIO region. The Nairobi Convention's 11th meeting of the Conference of Parties (COP 11) provided clear recommendations regarding the advancement of seagrass science, management, and integration of seagrasses into policy frameworks. The COP 11 Decision 11 (Conservation, Restoration and Management of Critical Habitats and Species) calls for a regional seagrass strategy and vision that aligns with local priorities. Here, we assess the science and policy needs for seagrass ecosystems across the region, including how developing a regional seagrass strategy can facilitate knowledge sharing and guide a cohesive regional policy framework for seagrass conservation and management.

Introduction

Seagrass meadows are among the most vital ecosystems on our planet. They provide numerous benefits and services in the Western Indian Ocean (WIO) - a region that boasts an impressive diversity of seagrasses with approximately 13 species reported (Gullström and others, 2002). In the WIO, seagrass meadows extend along roughly 12,000 km of coastline and play a crucial role in maintaining the health of marine ecosystems. They provide habitat for a diverse array of marine life, support local fisheries and tourism industries, and enhance coastal protection and resilience.

Approximately 20 per cent of globally significant commercial fish species utilize seagrass habitat (Unsworth and others, 2019). In the WIO, seagrass is especially important for small-scale and artisanal finfish fisheries as well as macroinvertebrate gleaning (Samoilys, and others, 2017; Wallner-Hahn and others, 2022; Chitará-Nhandimo and others, 2022; Stiepani and others, 2023). The value of ecosystem services provided by seagrasses cannot be overstated. Globally, the ecosystem services provided by seagrasses are valued at USD 6.4 trillion annually (Duarte and others, 2025). While in the WIO, seagrass meadows are estimated to be valued at USD 20.8 billion (Obura 2017). These estimates are based on the ecosystem's role in supporting fisheries, tourism, local livelihoods, and food provisioning, among other activities.

Seagrasses also offer important, yet often overlooked, benefits as a nature-based solution to address the impacts of climate change. Alongside mangrove forests and saltmarshes, seagrass meadows are coastal wetlands known as 'blue carbon' ecosystems due to their ability to act as carbon sinks (see Box 1). These wetlands are frequently or fully submerged, and the waterlogged soils in these ecosystems are naturally low in oxygen, which significantly slows the activity of decomposing microorganisms that break down organic matter. Consequently, when organic materials such as dead leaves and branches reach the soil in these ecosystems, they degrade slowly, allowing coastal wetlands to store significantly more carbon per unit area compared to other forests. It is estimated that seagrass meadows alone sequester around 10 per cent of all the organic matter buried in the ocean. If these meadows remain undisturbed and undegraded, this carbon can remain buried for millennia (Fourqurean and others, 2012).

The Intergovernmental Panel on Climate Change (IPCC) recognizes seagrass meadows as a carbon sink that contributes to climate change strategies (Christianson and others, 2022). Researchers estimate that protecting seagrass meadows worldwide could avert climate damages valued at USD $213 billion by preventing the release of 1.2 billion tonnes of carbon (Krause and others, 2025). In the WIO, carbon data are limited, but researchers estimate that seagrass meadows in Kenya, Tanzania, Mozambique, and Madagascar store between 4 million and 357 million metric tons of carbon, with an average stock of approximately 46 metric tons per hectare (Traganos and others, 2022). Estimates from Seychelles suggest seagrass stores approximately 118 metric tons of carbon per hectare, and when the total area of seagrass meadows is accounted for, this ecosystem represents 96 per cent of the country's blue carbon storage (Rowlands and others, 2024). As carbon stock and sequestration rates vary by seagrass species, hydrology, and other factors, having country-specific data is key for better integrating this ecosystem into blue carbon policy frameworks and financing.

Seagrasses also play an important role in mitigating coastal erosion and other impacts associated with the increasing intensity and frequency of storms. Assessments from Dar es Salaam, Tanzania, indicate that intact seagrass and other coastal ecosystems, such as mangroves, are highly effective in preventing coastal erosion throughout the city (Cortes 2020). Additionally, the canopy of intact seagrass beds buffers the full impact of waves while trapping sediments (Christianen and others, 2013), thereby improving water quality for coral reefs (Hemminga and Duarte, 2000). Coastal communities benefit from these climate adaptation attributes of seagrasses.

Box 1. Common terms used in seagrass conservation

Blue Carbon	The carbon held in coastal and marine environments, including mangroves, seagrass, and saltmarshes. Although coastal wetlands comprise less than 5 per cent of global land area and less than 2 per cent of the ocean, these ecosystems store roughly 50 per cent of all carbon buried in ocean sediments. As these blue carbon ecosystems become degraded or lost, the carbon previously stored is remobilized to carbon dioxide and released.
Carbon Sequestration	The process of capturing carbon dioxide from the atmosphere and storing this carbon in the long term. In nature, carbon dioxide is captured by plants through photosynthesis.
Ecosystem Services	The many benefits that humans derive from nature. For example, seagrass meadows serve as nursery grounds for commercially important fish and shellfish species, making food provisioning one of their key ecosystem services.
Nature-based Solution	Actions that protect, manage, restore, or use ecosystems to address societal challenges to benefit both people and nature. The conservation of blue carbon ecosystems is considered a nature-based solution to climate change.
Seagrasses	A group of marine flowering plants that live in shallow coastal and estuarine waters. They are true plants with roots, stems, and leaves that can grow dense root systems in ocean sediments ranging from mud to sand (Lugendo and others, 2024). There are an estimated 60-72 species of seagrasses found worldwide, and they grow in all oceans except the Antarctic.
Seaweed	Seaweed is the common name for several species of red, brown, or green macroalgae that are unrelated to seagrass. Seaweeds are not true plants and lack roots, stems, and leaves. They anchor to substrates such as rock and corals using holdfasts. While both seaweed and seagrass play important roles in marine ecosystems, their benefits are not identical. Seaweeds do not convey the same climate and fisheries benefits as seagrasses.

Protecting and restoring seagrasses through a regional strategy and shared vision can play a vital role in addressing National Climate Change Adaptation Strategies and Action Plans, advancing multiple United Nations Sustainable Development Goals (SDGs), and informing climate strategies, such as the Nationally Determined Contributions (NDCs) under the Paris Agreement. It is estimated that seagrass conservation can help countries achieve 26 targets and indicators across 10 SDGs, including improving food security, supporting biodiversity, and strengthening climate adaptation and mitigation actions (Fortes and others, 2020).

Increasing collaboration and coordination for seagrass conservation supports multiple regional objectives, including decisions taken at the 2024 Nairobi Convention COP11, not directly related to seagrass. For example, a regional seagrass strategy supports the Kunming-Montreal Global Biodiversity Framework (Decision 5) by aligning national policies with the framework, promoting cohesive conservation efforts, and ensuring inclusive and equitable governance of seascapes. Seagrass conservation aligns with the implementation of the Regional Ocean Governance Strategy for the Western Indian Ocean region (Decision 6), Mainstreaming climate change concerns in marine biodiversity protection (Decision 10) and Improving environmental quality through Source-to-Sea approaches (Decision 12).

Urgent need to improve data, management, and coordination

In the WIO, seagrasses form part of an interconnected system with mangroves and coral reefs, providing coastal protection for the approximately 60 million people living within 100 km of the shoreline (Obura 2017). Historically, scientists have paid less attention to seagrasses, and as a result, this ecosystem remains among the least protected. In addition to this lack of research attention, seagrasses are increasingly impacted by both anthropogenic and natural factors. Increasing coastal development, boat traffic, destructive fishing practices, unsustainable tourism, cyclone impact, and sea urchin herbivory are all negatively impacting seagrasses in the WIO.

A recent review of seagrass cover and trends for Africa found that of the 41 African countries with a coastline, 29 per cent had seagrass coverage data for their entire coastline, 44 per cent had data for some parts of their coastline, and 27 per cent had no data on seagrass cover (Mwikamba and others, 2024a). This lack of baseline data limits the current understanding of seagrass loss. Researchers estimate that Eastern Africa has lost an estimated 26 per cent of its seagrass cover between 1986 and 2016 (Connolly and others, 2020). In Kenya, seagrass is estimated to cover around 317 km^2, with losses increasing from 0.29 per cent per year in 2000 to 1.59 per cent per year in 2016 (Harcourt and others, 2018). In Mozambique, an estimated 51 per cent of seagrasses were lost between 1992-2013 in Inhambane Bay, mainly due to cyclone impact (Amone-Mabuto and others, 2017; Bandeira and others, 2021), and 34 per cent were lost in Maputo Bay between 1991 and 2024, impacted by both anthropogenic activities and sedimentation (Amone-Mabuto and others, 2024). Key drivers of seagrass degradation include coastal development and tourism infrastructure, with destructive fishing practices being a primary cause of loss and degradation in some areas (Mwikamba and others, 2024a; Mwikamba and others, 2024b). Localized studies on seagrass loss are generally limited, with few exceptions, such as Lugendo and others (2024). This is primarily due to funding and capacity constraints, inadequate research infrastructure, and technical challenges, such as difficulties in accurately mapping seagrass in deep or murky waters.

While threats to this ecosystem increase in the WIO, there is growing interest in improving seagrass protection across four key pillars that can be anchored within a regional strategy. These pillars are expanding knowledge, improving management, increasing coordination, and identifying sustainable financing mechanisms (see Figure 7).

Expanding the seagrass knowledge base is crucial for identifying conservation priority areas and integrating seagrass within ocean governance frameworks. For example, mangroves and corals have been mapped at various levels in the WIO, but seagrass mapping remains

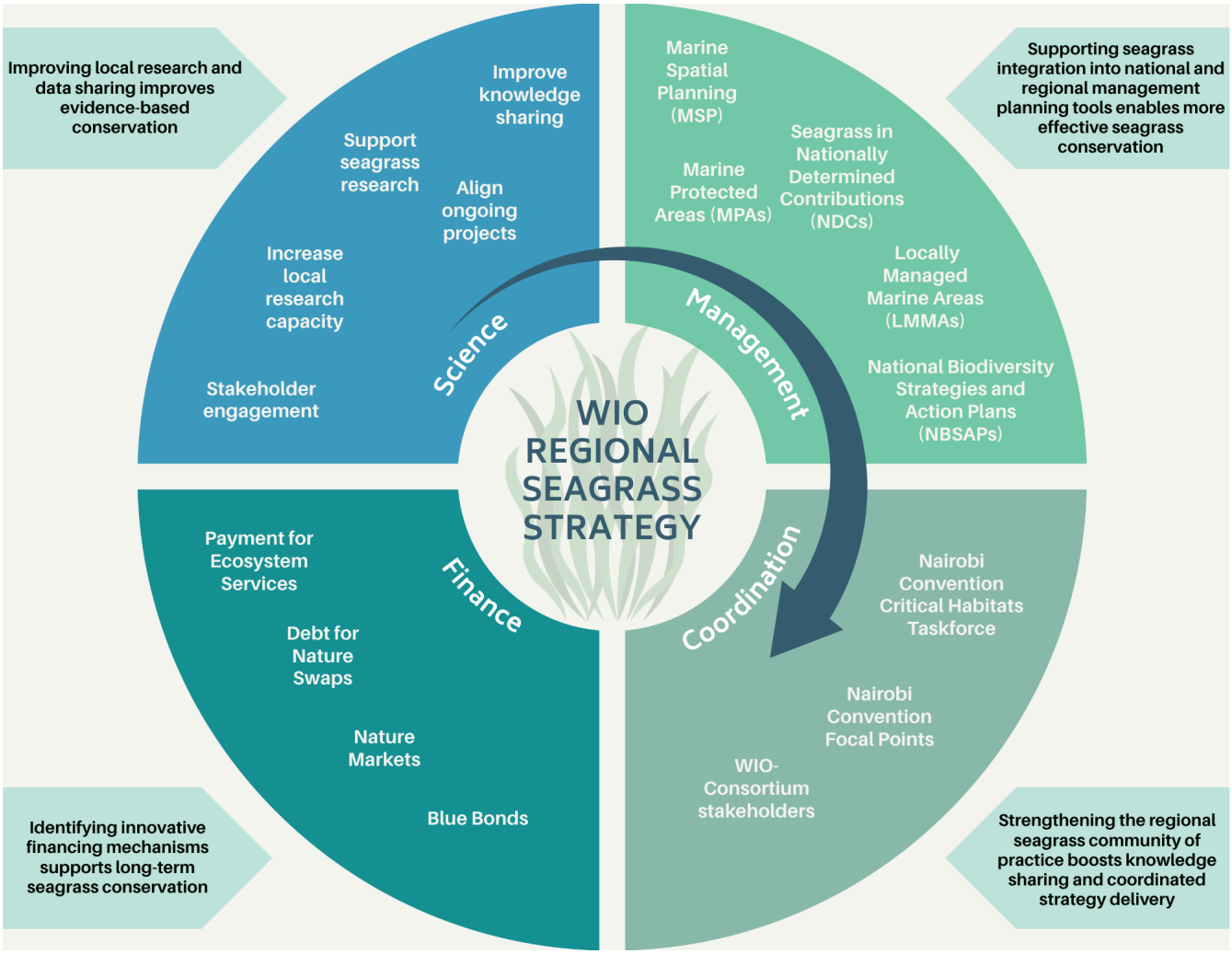


Image 7: A conceptual framework of how a Regional Seagrass Strategy can connect core pillars of science, management, and coordination, which can better enable the flow of sustainable financing options for the ecosystem. Credit: The Pew Charitable Trusts.

piecemeal, with no standardized field-verified map for the wider WIO region, hindering seagrass management (McKenzie and others, 2020). Large-scale mapping can be achieved through optical remote sensing, typically by analyzing free or low-cost satellite imagery (e.g., Rowlands and others, 2024), supplemented with georeferenced field images for validation.

Increasing regional-level dialogue and coordination can better ensure effective seagrass management across transboundary areas. While there is a strong and growing seagrass Community of Practice that is composed of researchers and NGOs operating through research initiatives and other collaborations, this network can be strengthened through a regional strategy. Enhancing data on seagrass combined with monitoring, multi-stakeholder coordination, and science-policy dialogues can lead to more effective ecosystem management and better enable sustainable financing.

Advances in science, management and coordination

A review by the Western Indian Ocean Marine Science Association (WIOMSA) indicates a growing number of publications on seagrass in the WIO (see Figure 8). This increase in publications reflects growing scientific capacity and an expanding base of scientific knowledge. Providing the evidence base necessary for informed policy development, resource management, and regional conservation strategies and practices. With foundational research growing, now is an opportune moment to both strengthen collaboration on seagrass conservation and to develop a science-policy framework that supports the creation and implementation of a regional strategy for seagrass conservation and management in the WIO.

Developing a shared vision for seagrass and a regional strategy can harmonize scientific data to inform policy frameworks, enhance cooperation, and promote market-based approaches for seagrass conservation. A regional strategy also fosters collaborative efforts to address common challenges, such as those around seagrass restoration. In recent years, countries have sought to better include seagrass meadows within policy and management frameworks. For example, in Kenya seagrasses have been included in the National Coral Reef and Seagrass Conservation Strategy (2013) (Uku and others, 2021), and in Mozambique, seagrasses have been mentioned in a number of legal instruments, including the National Strategy and Action Plan of Biological Diversity (2015 - 2035) (UNEP Nairobi Convention/WIOMSA, 2020), Environmental Impact Assessment Regulation (54/2015), NDC Commitment (2020 - 2025), Regulation of Sea Fishing (89/2020), and the National Strategy for Expansion of Marine Conservation Areas (under development in 2025).

Box 2: Seychelles Case Study - A Model for Coordinated Seagrass Conservation

A coordinated strategy to improve seagrass science, management, and dialogue can help create the enabling conditions for sustainable financing. These steps have been taken in Seychelles, which offers a compelling case study of how a science-based national commitment combined with community engagement can drive conservation, integrate seagrasses into governance frameworks, and set the stage for financing. Like many countries in the region, Seychelles lacked a field-verified seagrass map and an assessment of carbon stocks in seagrass. However, starting in 2019, the Seychelles Seagrass Mapping and Carbon Assessment project, a partnership with the Government of Seychelles, led by the University of Oxford, the University of Seychelles, and others, helped to address these data gaps (Rowlands and others, 2024). The start of this research project, along with technical policy support provided to the government by the Seychelles Conservation and Climate Adaptation Trust (SeyCCAT) and The Pew Charitable Trusts, helped inform the country's commitment to protect all seagrass ecosystems in its Nationally Determined Contribution (NDC) 2.0 by 2030. Additionally, data from field-verified seagrass maps have been used in the Seychelles Marine Spatial Plan. The national commitment to seagrass protection within NDC 2.0 also led to the co-creation of Creole names for seagrass, as there were no unique words for seagrass. Through a national media campaign, culturally appropriate words in Seychelles Creole, five functional groups of seagrasses were created. These names are now officially included in the country's Creole dictionary (Mortimer and others, in prep). The expansion of science, management, and coordination has led to current explorations of sustainable financing mechanisms for seagrass in Seychelles. Serving as a case study on the value of a coordinated strategy for seagrass conservation and as a model for other countries in the region.

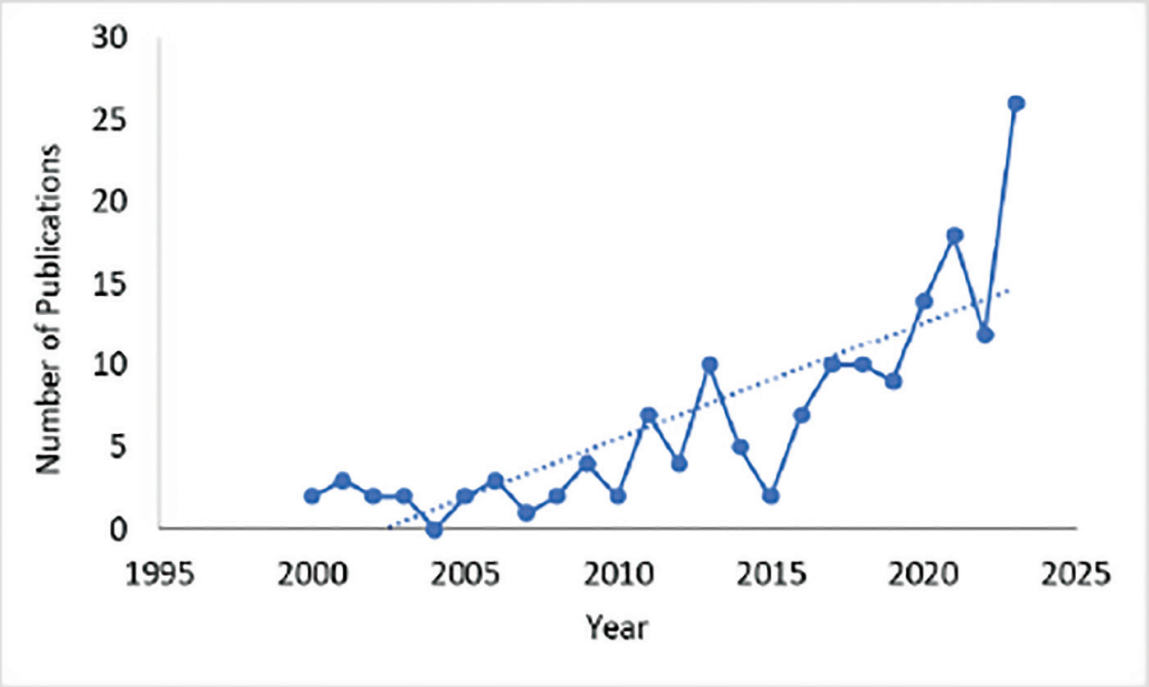


Figure 8. Trend in seagrass publications for the Western Indian Ocean region from 2000-2024. Courtesy WIOMSA

Incorporating seagrass into current ocean management plans is crucial for enhancing marine conservation in the WIO. Marine Protected Areas (MPAs) are among the most prevalent instruments for preserving biodiversity and essential habitats, especially for coral reefs and fisheries. Yet, seagrass environments are infrequently the central emphasis of these conservation initiatives. When seagrass habitats are included within MPAs, their level of protection depends on the MPA's management regime, which can range from strict no-take zones to areas allowing multiple uses.

Currently, no WIO countries have established specific protection levels for seagrass beds. In addition to formal MPAs, there is growing support for community-based methods, particularly Locally Managed Marine Areas (LMMAs). These areas, which are managed collaboratively by local communities, governments, and NGOs, represent a promising platform for merging seagrass conservation with local development priorities. WIOMSA's 2024 mapping identified over 300 LMMAs in the WIO region, with over 200 in Madagascar alone, highlighting the growing significance of community stewards and the need for a mechanism to increase local participation in seagrass management.

The targeted protection of seagrass habitats can also yield significant ecological benefits, such as conserving endangered species. For example, seagrass meadows in Mozambique's Bazaruto Archipelago National Park and Vilanculos Wildlife Sanctuary are important to the health of the WIO's largest dugong population. The Dugong Memorandum of Understanding (MoU) under the Convention on the Conservation of Migratory Species of Wild Animals (CMS) provides a significant opportunity to boost regional seagrass protection. The MoU encourages the protection and management of dugongs and their ecosystems throughout their range. Signatories include the Comoros, Kenya, Madagascar, Mozambique, Seychelles, Somalia, and Tanzania.

There is an opportunity for countries to take global leadership on seagrass protection and restoration as a climate action towards the 2030 Agenda. Nationally Determined Contributions (NDCs) under the Paris Agreement enable countries to outline their

commitments to reduce greenhouse gas emissions and enhance climate resilience, offering a strategic opportunity to integrate seagrass conservation into national climate policies, ecosystem management, and financing frameworks. Several countries in the region have included blue-carbon ecosystems, such as seagrass, in their NDCs. Kenya, for example, has committed to conducting a blue carbon readiness assessment to support the full integration of blue carbon/ocean carbon in NDC 2.0. Seychelles' NDC 2.0 outlined the ambition to map the full extent of its seagrasses, account for the associated carbon, and establish a long-term monitoring programme for seagrass, as steps towards protecting 100 per cent of the ecosystem by 2030, and including their "blue carbon" values in the national Greenhouse Gas Inventory.

Projects across the WIO region are demonstrating a growing ambition to protect and manage seagrass. In Seychelles, a partnership involving the government, Seychelles Conservation and Climate Adaptation Trust (SeyCCAT), The Pew Charitable Trusts, University of Oxford, and others developed the first field-validated seagrass map and soil carbon stock assessment (Lee and others, 2023; Rowlands and others, 2024), informing the country's updated NDC (Republic of Seychelles 2021) and national marine spatial plan (see Box 2). This project is now expanding to Kenya, Tanzania, Mozambique and Madagascar through the Large-scale Seagrass Mapping and Management Initiative (LaSMMI) with project leadership from research institutions in each country and guidance from WIOMSA, University of Southampton, and Pew.

In Mozambique, a project by the University of Eduardo Mondlane, supported by the Nairobi Convention and other agencies, aims to develop a draft management action plan for seagrass meadows. In Mauritius, the Nairobi Convention is supporting research to assess the status of seagrasses and evaluate their carbon-sink potential to inform management strategies. While regional efforts such as those by the International Union for Conservation of Nature (IUCN) and partners focus on bridging knowledge gaps related to seagrasses through studies on ecological connectivity, threat assessment, and ecosystem valuation. This project aims to simultaneously increase political ambition for seagrass conservation and restoration, and promote seagrass's contribution to socio-ecological resilience and the development of the blue economy in the Western Indian Ocean.

With a shared vision and regional seagrass strategy, this growing interest in seagrass creates an opportunity for the WIO region to take global leadership in seagrass conservation. Regional leadership on seagrass can serve as a model for other regions, demonstrating the importance of collective action in addressing environmental challenges.

Conclusion

Seagrass ecosystems are critical to the well-being of communities in the WIO. As threats to this ecosystem intensify, there is an urgent need to develop a cohesive vision and strategy that advance scientific research on seagrasses, foster regional dialogue, improve seagrass conservation and management, and identify sustainable financing for this critical ecosystem. As we continue to prioritize seagrass conservation, we can ensure the long-term health and resilience of these vital ecosystems, benefiting both the environment and local communities for generations to come.

Recommendations:

- Encourage the Nairobi Convention Secretariat, Parties, and partners to develop a regional seagrass strategy and shared vision by 2026. This strategy should outline seagrass conservation goals and priorities, data sharing mechanisms, coordination and dialogue processes, implementation mechanisms, and identify potential sustainable financing mechanisms.

- Call on the Nairobi Convention Parties to facilitate and strengthen the institutional arrangements among researchers, communities,

policymakers, and other stakeholders and enhance partnerships among stakeholders through initiatives such as a Seagrass Community of Practice (CoP).

- Call on the Nairobi Convention Parties to support the inclusion of seagrass into relevant regional and country-level policies, management, and socioeconomic frameworks. For example, including seagrass in MSP and MPA processes and establishing country-level mechanisms for monitoring and evaluating the effectiveness of conservation, restoration, and management efforts.

- Call on the Nairobi Convention Parties to address data gaps by supporting actions to evaluate ecosystem extent, services, health, and threats. For example, prioritising assessments that map seagrass distribution and cover change over time, quantify associated ecosystem services, and evaluate drivers of degradation.

- Call on the Nairobi Convention Parties to facilitate knowledge sharing and support local actions to underpin conservation and restoration programmes that enhance seagrass meadows. Actions can include raising awareness about the importance of seagrass meadows, encouraging local communities to participate in conservation efforts, and providing opportunities for involvement in restoration projects

- Call on the Nairobi Convention Secretariat and Parties to enhance measures for protecting and restoring seagrass ecosystems as a nature-based solution to climate change and a regenerative blue economy. This includes providing technical support to countries aiming to promote and preserve the services and climate benefits of seagrass meadows within frameworks such as national biodiversity action plans and NDCs, with clear targets, indicators, and resource mobilization strategies.

References

Amone-Mabuto, M., Bandeira, S. and Da Silva, A. (2017). Long-term changes in seagrass coverage and potential links to climate-related factors: the case of Inhambane Bay, southern Mozambique. *Western Indian Ocean Journal of Marine Science,* 16, 13-25.

Amone-Mabuto M., Bandeira S., Hollander J., Hume D., Campira J. and Adams J.B. (2024). Monitoring seagrass meadows in Maputo Bay using integrated remote sensing techniques and machine learning. *Regional Studies in Marine Science*, 79, p.103816.

Bandeira, S., Amone-Mabuto, M., Chitará-Nhandimo, S., Scarlet, M.P. and Rafael, J. (2021). Impact of Cyclones and Floods on Seagrass Habitats. In: *Cyclones in Southern Africa. Sustainable Development Goals Series* (eds. Nhamo, G., Chikodzi, D.) pp. 279-288.

Chitará-Nhandimo, S., Chissico, A., Mubai, M. E., Cabral, A. D. S., Guissamulo, A. and Bandeira, S. (2022). Seagrass invertebrate fisheries, their value chains and the role of LMMAs in sustainability of the coastal communities—case of southern Mozambique. *Diversity,* 14, 170.

Christianen, M. J. A., Van Belzen, J., Herman, P. M. J., Van Katwijk, M. M., Lamers, L. P. M., Van Leent, P. J. M. and Bouma, T. J. (2013). Low-canopy seagrass beds still provide important coastal protection services. *PLoS one,* 8, p.e62413.

Christianson, A. B., Cabré, A., Bernal, B., Baez, S. K., Leung, S., Pérez-Porro, A. and Poloczanska, E. (2022). The promise of blue carbon climate solutions: where the science supports ocean-climate policy. *Frontiers in Marine Science,* 9, p.851448.

Connolly, R., Collier, C., O'leary, J., Mckenzie, L., Ambo-Rappe, R., Bandeira, S. and Kiswara, W. (2020). Threats to seagrasses and ecosystem resilience. In *Out of the blue: the value of seagrasses to the environment and to people*. pp. 36-47. UNEP, Nairobi.

Cortes, J. (2020). Back to mother nature: the potential of using nature-based solutions to mitigate climate change vulnerabilities along the coast of Dar es Salaam, Tanzania. *Lund University*.

Duarte, C. M., Apostolaki, E. T., Serrano, O., Steckbauer, A. and Unsworth, R. K. F. (2025). Conserving seagrass ecosystems to meet global biodiversity and climate goals. *Nature Reviews Biodiversity*, 1, 150-165.

Fortes, M., Griffiths, L., Collier, C., Nordlund, L., De La Torre-Castro, M., Vanderklift, M., Ambo-Rappe, R., Grimsditch, G., Weatherdon, L., Lutz, S. and Potouroglou, M. (2020). Policy and management options. United Nations Environment Programme. In *Out of the blue: the value of seagrasses to the environment and to people*. pp. 63-69 UNEP, Nairobi.

Fourqurean, J. W., Duarte, C. M., Kennedy, H., Marbà, N., Holmer, M., Mateo, M. A., Apostolaki, E. T., Kendrick, G. A., Krause-Jensen, D., Mcglathery, K. J. and Serrano, O. (2012). Seagrass ecosystems as a globally significant carbon stock. *Nature Geoscience*, 5, 505-509.

Gullström, M., De La Torre Castro, M., Bandeira, S. O., Björk, M., Dahlberg, M., Kautsky, N., Rönnbäck, P. and Öhman, M. C. (2002). Seagrass Ecosystems in the Western Indian Ocean. *Ambio,* 31, 588-596.

Harcourt, W. D., Briers, R. A. and Huxham, M. (2018). The thin(ning) green line? Investigating changes in Kenya's seagrass coverage. *Biology letters,* 14, p.20180227.

Hemminga, M. A. and Duarte, C. M. (2000). *Seagrass ecology*, vol 298. Cambridge University Press.

Krause, J. R., Cameron, C., Arias-Ortiz, A., Cifuentes-Jara, M., Crooks, S., Dahl, M., Friess, D. A., Kennedy, H., Lim, K. E., Lovelock, C. E., Marbà, N., Mcglathery, K. J., Oreska, M. P. J., Pidgeon, E., Serrano, O., Vanderklift, M. A., Wong, L.-W., Yaakub, S. M. and Fourqurean, J. W. (2025). Global seagrass carbon stock variability and emissions from seagrass loss. *Nature Communications*, 16, 3798.

Lee, C. B., Martin, L., Traganos, D., Antat, S., Baez, S. K., Cupidon, A., Faure, A., Harlay, J., Morgan, M., Mortimer, J. A., Reinartz, P. and Rowlands, G. (2023). Mapping the National Seagrass Extent in Seychelles Using PlanetScope NICFI Data. *Remote Sensing,* 15, 4500.

Lugendo, B., Wegoro, J., Shaghude, Y., Pamba, S., Makemie, M. and Hollander, J. (2024). Seagrass mapping across the coast of Tanzania. *Ocean & Coastal Management,* 253, p,107169.

Mckenzie, L. J., Nordlund, L. M., Jones, B. L., Cullen-Unsworth, L. C., Roelfsema, C. and Unsworth, R. K. F. (2020). The global distribution of seagrass meadows. *Environmental Research Letters*, 15, p.074041.

Mortimer, J.A., Watson, M-F., Faure, A., Choppy, T.P., Ebrahim, A., Harlay, J., Morel, C., Bijoux J., Matyot, P., Baez, S., and Rowlands, G. (In prep). From slime to seagrass: Formalizing names in a local creole language to assist conservation communication.

Mwikamba, E. M., Githaiga, M. N., Briers, R. A. and Huxham, M. (2024a). A review of seagrass cover, status and trends in Africa. *Estuaries and Coasts*, 47, 917-934.

Mwikamba, E. M., Githaiga, M. N., Huxham, M., and Briers, R. A. (2024b). Understanding the drivers of seagrass loss in Kenya: Evidence for the impacts of population and fishing. *Aquatic Conservation: Marine and Freshwater Ecosystems,* 34, 7-10.

Nordlund, L. M., Unsworth, R. K., Wallner-Hahn, S., Ratnarajah, L., Beca-Carretero, P., Boikova, E., Bull, J. C., Chefaoui, R. M., de los Santos, C. B., Gagnon, K. and Garmendia, J.M., (2024). One hundred priority questions for advancing seagrass conservation in Europe. *Plants, People, Planet*, *6*, 587-603.

Obura, D. (2017). *Reviving the Western Indian Ocean Economy: Actions for a Sustainable Future - Summary.* WWF International, Gland, Switzerland.

Republic of Seychelles (2021). Seychelles' updated nationally determined contribution.

Submission under the Paris Agreement. Climate Change and Energy Department, Ministry of Agriculture, Climate Change and Environment. Retrieved from: https://unfccc.int/sites/default/files/NDC/2022-06/Seychelles%20-%20NDC_Jul30th%202021%20_Final.pdf

Rowlands, G.P., Antat, S., Baez, S.K., Cupidon, A., Faure, A., Harlay, J., Lee, C.B., Martin, L.E.C., Masque, P., Morgan, M., Mortimer, J.A. and Traganos, D. (2024). *The Seychelles Seagrass Mapping and Carbon Assessment. A report submitted to the Government of Seychelles, Ministry of Agriculture, Climate Change and Environment (MACCE)*.

Samoilys M., Osuka K., Muthiga N. and Harris, A. (2017). *Locally managed fisheries in the Western Indian Ocean: a review of past and present initiatives, iv + 40p.* WIOMSA Book Series 17. WIOMSA.

Stiepani, J., Jiddawi, N. and Mtwana Nordlund, L. (2023). Social-ecological system analysis of an invertebrate gleaning fishery on the island of Unguja, Zanzibar. *Ambio,* 52, 140-154.

Traganos, D., Pertiwi, A. P., Lee, C. B., Blume, A., Poursanidis, D., and Shapiro, A. (2022). Earth observation for ecosystem accounting: Spatially explicit national seagrass extent and carbon stock in Kenya, Tanzania, Mozambique and Madagascar. *Remote Sensing in Ecology and Conservation*, 8, 778–792.

Uku, J., Daudi, L., Alati, V., Nzioka, A. and Muthama, C. (2021). The status of seagrass beds in the coastal county of Lamu, Kenya*. Aquatic Ecosystem Health & Management,* 24, 35- 42.

UNEP-Nairobi Convention/WIOMSA (2020). *Guidelines for seagrass ecosystem restoration in the Western Indian Ocean region*. Nairobi, Kenya.

Unsworth, R. K. F., Nordlund, L. M. and Cullen-Unsworth, L. C. (2019). Seagrass meadows support global fisheries production. *Conservation Letters,* 12, p.e12566.

Wallner-Hahn, S., Dahlgren, M. and De La Torre-Castro, M. (2022). Linking seagrass ecosystem services to food security: The example of southwestern Madagascar's small-scale fisheries. *Ecosystem Services,* 53, p.101381.

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Improving shark and ray management in the Western Indian Ocean

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Executive summary

Sharks and rays are under intense pressure, with overexploitation and other anthropogenic factors leading to major population declines globally, and particularly in the Western Indian Ocean (WIO). Owing to these threats, 39 per cent of the 235 known shark and ray species in the WIO are now assessed as threatened (Vulnerable, Endangered or Critically Endangered) by the IUCN Red List of Threatened Species. These species require vastly improved conservation and management actions, to avoid further population declines and localised extinctions. However, WIO States generally protect few shark or ray species, even the most threatened, and few are covered under species-level catch or trade limits. Regional and international conservation and management measures under agreements to which WIO States are signatory, including legal species protections, harvest controls and trade controls for shark and ray species, are inadequately implemented at national level in most WIO countries.

Although WIO countries have established numerous Marine Protected Areas (MPAs), most are small relative to the distribution ranges of threatened shark and ray species, and no-take zones represent only a small fraction of their total coverage. While several MPAs in the region list shark or ray species among the conservation targets, few actually consider the ecological needs of shark or ray species. This is highlighted by poor spatial alignment between existing MPAs and i) threatened shark and ray species distributions, and ii) Important Shark and Ray Areas (ISRAs, IUCN 2024) - areas identified as being ecologically important for shark and ray species in the WIO. Poor alignment means existing MPAs offer minimal protection for threatened species or ecologically important areas. Key actions needed for sharks and rays in the WIO include, among others: strict protections for highly threatened species and those prohibited under multilateral agreements; harvest controls for threatened and Near Threatened species, particularly those subject to capture in high numbers or listed as species of concern under multilateral agreements; trade controls, particularly for CITES-listed and other threatened species; and improved spatial management, through expansion of MPAs and other spatial management measures, to cover important habitats for threatened WIO sharks and rays.

Introduction

Urgency

The Western Indian Ocean (WIO[1]) has a rich marine diversity, with 235 known shark and ray species (Bennett and others 2022). However, extensive fisheries in this region are impacting shark and ray populations, with at least 39 per cent of all WIO shark and ray species now listed as threatened (IUCN 2026), making this the second most threatened marine species group in the WIO after marine turtles (Bullock and others 2021). However, fishing continues and, as human populations increase, so too will fishing pressure and its impacts on sharks and rays (Jabado and others 2024). There is thus an urgent need for corrective management and improved conservation of the shark and ray species in the WIO, to ensure that consumptive uses of marine resources remain at (or return to) sustainable levels.

This poor conservation status is despite numerous multilateral environmental agreements (MEAs), some now several decades old, established specifically for the conservation of the world's biodiversity and natural resources, with most calling for protection of threatened species, sustainable use of natural resources, and protection of critical habitats. The following sections present examples relevant to sharks and rays.

Advances

In 2022, Parties to the Convention on Biological Diversity (CBD) adopted the Kunming-Montreal Global Biodiversity Framework (GBF), agreeing to several ambitious Targets considered necessary for the conservation of threatened biological diversity. One of these is Target 3, the 30 x 30 goal to *"ensure and enable that by 2030 at least 30 per cent of terrestrial, inland water, and of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed"*. The goal is 30 per cent coverage, specifically of ecologically important areas. The current WIO Marine Protected Area (MPA) network collectively spans an impressive 555 436.68 km^2 across 143 MPAs (UNEP-Nairobi Convention and WIOMSA 2021). However, this network covers just 7 per cent of the total area within the exclusive economic zones (EEZ) of WIO States, and none of these MPAs was designed specifically for the protection of shark or ray species, with management plans of few MPAs noting sharks or rays as target species for protection. As WIO States now work towards achieving the 30 per cent protection target, sharks and rays should be among the top priorities for spatial protection in national marine spatial planning (MSP) initiatives and expansion of national MPA networks.

Under Target 4 of the GBF, Parties also agreed to "halt human induced extinction of known threatened species" and "significantly reduce extinction risk". This means that countries must prevent further mortality to the most threatened species (through legal species protections and conservation of critical habitats) and ensure only sustainable levels of exploitation (catch/trade controls) of species not yet threatened.

Similarly, the Code of Conduct for Responsible Fisheries (FAO 1995) promotes sustainable use of fishery resources, with clearly defined text to guide Parties towards sustainable fisheries. Article 6.12[2] of the Code, alone, calls for multilateral cooperation, responsible fisheries, and effective conservation and protection of living aquatic resources within and beyond national jurisdiction. The Code lists several objectives for responsible fisheries, including among others to "promote protection of living aquatic resources and their environments and coastal areas", noting that i) measures implemented should provide that "biodiversity of aquatic habitats and ecosystems is conserved and endangered species are protected", and ii) "The right to fish carries with it the obligation to do so in a responsible manner so as to ensure effective conservation and management of the living aquatic resources" (FAO 1995).

1 The Western Indian Ocean is defined herein as the geographic area spanning the Exclusive Economic Zones (EEZs) of the ten Nairobi Convention Member States (South Africa, Mozambique, Tanzania, Kenya, Somalia, Comoros, Madagascar, Mauritius, Seychelles, and the French Indian Ocean Territories of Mayotte and Reunion). A northern limit is placed at Ras Hafun, slightly south of the horn of Africa, with a western limit set at East London in South Africa (Bennett and others 2022).

2 "States should, within their respective competences and in accordance with international law, cooperate at subregional, regional and global levels through fisheries management organizations, other international agreements or other arrangements to promote conservation and management, ensure responsible fishing and ensure effective conservation and protection of living aquatic resources throughout their range of distribution, taking into account the need for compatible measures in areas within and beyond national jurisdiction." (FAO 1995)

The Southern African Development Community (SADC) Protocol on Fisheries (SADC 2006) calls on Member States to "take conservation and management measures to regulate the use of living aquatic resources (within and beyond national jurisdiction), to prevent overexploitation, whilst enabling sustainable utilization of the resources" and to "prevent and eliminate overfishing and excess fishing capacity".

Despite this guidance, across numerous agreements and guiding documents, shark and ray populations in the WIO and globally show major population declines as a direct result of overexploitation and unsustainable fisheries and trade. Yet, few species are nationally protected, with the majority of shark and ray species in the WIO not protected at national level, including numerous Critically Endangered and Endangered species, threatened endemics, and species required by legally and non-legally binding agreements to be "strictly protected".

Improved conservation and management of shark and ray populations in the WIO now require urgent and dedicated actions that will lead to reduced mortality, particularly of threatened species. There are several MEAs and regional fisheries management organizations (RFMOs) that include measures specifically for shark and ray species, which simultaneously commit and can guide States to improve management through binding and voluntary measures. Relevant conservation and management actions can be grouped into several broad objectives:

- Protecting of highly threatened species to mitigate further population declines;
- Regulating international trade, to ensure that trade can be traceable and sustainable and that trade does not drive unsustainable harvesting;
- Managing populations of non-prohibited species, particularly those already threatened or approaching a threatened status, to allow for sustainable utilization;
- Strengthening area-based management (including MPAs and other spatial management categories), which provide protection for critical habitats, critical life stages and populations of highly threatened species.

Methods, Approaches, and Results

Protection of highly threatened species

Numerous shark and ray species are listed under global MEAs that bind States to various protection measures for these species, while other measures provide a basis for identifying species for which protection should be considered by virtue of their poor conservation status.

The *Convention on the Conservation of Migratory Species of Wild Animals* (CMS) provides a binding global platform for the conservation and sustainable use of migratory animals and their habitats. Parties are required to "strictly protect" species listed in CMS Appendix I, defined as migratory species with an unfavourable conservation status. By April 2020, thirteen shark and ray species in the WIO had been listed on CMS Appendix I (CMS 2024, see Annex I of this document) and should have been protected at national level by all CMS Parties by that date; all WIO States other than Comoros are signatory[3] to CMS. However, by 2024, Mozambique was the only WIO State to have fully protected all CMS Appendix I shark and ray species present in its waters (Marine Fishing Regulations of Mozambique, Decree 89/2020, Republic of Mozambique 2020). Subsequently, one additional shark species (*Carcharias taurus*) was listed on CMS Appendix I at the Conference of Parties (CoP) in 2024 (whose listing entered into force in May 2024), and five at the CoP in 2026 with an entry into force of June 2026 (CMS 2026). These listings therefore total 19 shark and ray species in the WIO that are listed on CMS Appendix I (see Annex I) and require strict protection. Among these are the largetooth sawfish *Pristis pristis* and green sawfish *P. zijsron*, which have already been extirpated from most of the WIO, through coastal overfishing (particularly entanglement in fishing nets) and habitat loss (Everett and others 2015, Leeney 2017, Braulik and others 2020).

3 Somalia, Kenya, Tanzania, Mozambique, South Africa, Madagascar, Mauritius, France (Reunion) and Seychelles are party to CMS. Comoros is not signatory to CMS but is a Range State of many of the species of sharks and rays listed on CMS Appendices

The *Indian Ocean Tuna Commission* (IOTC) is responsible for the management of tuna and tuna-like species in the Indian Ocean, but also makes provision for bycatch species including sharks and rays that are considered under threat from IOTC-linked fisheries. The IOTC imposes binding Conservation and Management Measures on its Contracting Parties, including full retention bans for 12 shark and ray species that occur in the WIO (IOTC 2024, see Annex I). Therefore, these species should be prohibited from retention in tuna and tuna-like fisheries in WIO States, which are all Contracting Parties of the IOTC. In 2025, partial retention bans were imposed for two additional species (*Isurus oxyrinchus* and *I. paucus*), for all individuals alive at haulback or any individuals captured in the absence of an on on-board observer or electronic monitoring system (IOTC 2025). IOTC Contracting Parties are obliged to implement this measure, and should consider full protection for these species.

The *IUCN Red List of Threatened Species* (IUCN 2026) categorises species according to their risk of extinction. Endangered and Critically Endangered species face a very high or extremely high risk, respectively, of extinction in the wild (IUCN 2001). While IUCN categories impose no regulatory actions on governments, the FAO Code of Conduct for Responsible Fisheries (FAO 1995) and other guiding texts suggest that the harvesting of threatened species should be regulated in line with the precautionary principle. This is particularly relevant to shark and ray species, whose life-histories are generally not resilient to exploitation. The 17 Critically Endangered and 36 Endangered shark and ray species in the WIO (see Annex I), most of which are impacted by fisheries, should thus be considered for full protection at national level in their range states, to mitigate further population declines.

Regulating international trade for sustainability

International trade in shark and ray products, particularly fresh and frozen shark meat and high-value fins, is one of the main drivers of shark and ray exploitation globally. If uncontrolled, this trade will lead to further population declines and likely local extirpations of some species. *The Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) is a binding MEA intended to ensure that international trade in specimens of wild animals and plants does not threaten their survival in the wild. All Nairobi Convention Member States are Party to CITES.

a. CITES Appendix I includes species threatened with extinction, and commercial international trade in these species is prohibited. In the WIO, there are 11 shark and nine ray species listed on CITES Appendix I (see Annex I), all of which are also listed on CMS Appendix I and should be prohibited from capture as well as commercial export.
b. CITES Appendix II includes species not necessarily threatened with extinction, but for which trade must be controlled to avoid utilization incompatible with their survival. All international trade in Appendix II species requires evidence that the products have not been taken in contravention of national or global measures (such as national legislation or listing on CMS Appendix I), and a confirmation from the CITES Scientific Authority of the State that the trade would not detrimentally affect wild populations. In the WIO, there are 58 shark and ray species listed on CITES Appendix II (see Annexes I, II). Among these, four species had zero annual export quota annotations added at the 20th CITES CoP in 2025, prohibiting any commercial export (CITES 2026), while a further seven species should be prohibited from capture due to their listing on CMS Appendix I or an IOTC retention ban. A further 11 of these species should be considered for protection due to being Endangered (see Annex I). For the remaining 34 CITES Appendix II species (see Annex II), international trade could be permitted, only if not detrimental to the wild population and not in contravention of a national measure.

Managing populations of non-prohibited species for sustainable utilization

In addition to protecting highly threatened species and controlling trade, it is necessary to actively and effectively manage catches of other shark and ray species to ensure that populations are fished sustainably.

CMS Appendix II lists migratory species that require or would benefit from international co-operation. Such species are listed to promote multilateral management agreements that ensure appropriate management throughout their ranges. Such species are not automatically required by CMS to be protected, unless also listed on CMS Appendix I. However, in the WIO, there are 26 shark and ray species listed on CMS Appendix II (see Annexes I, II), of which 18 are also listed in CMS Appendix I, meaning that they must be protected in CMS Parties. Of the remaining eight species listed on CMS Appendix II only (i.e. not also on CMS Appendix I), five are Critically Endangered or Endangered (Annex I). This means that most CMS Appendix II species should be protected or considered for protection. Silky sharks *Carcharhinus falciformis,* blue sharks *Prionace glauca*, and smooth hammerheads *Sphyrna zygaena*, are the only CMS Appendix II species in the WIO that are neither the subject of protection through CMS Appendix I or an IOTC retention ban, nor Endangered or Critically Endangered. However, they are subject to high catch levels in fisheries throughout their ranges, thus warranting dedicated multilateral management plans. WIO States should thus implement more effective management plans, including joint management for CMS Appendix II species.

Species are listed on CITES Appendices due to threats that international trade poses to their wild populations and should thus also be managed to ensure population stability. Management measures that mitigate negative impacts and ensure sustainable utilization should therefore be considered for the 51 CITES Appendix II shark and ray species in the WIO (Annex I, II) that do not otherwise require protection by virtue of listing in CMS Appendix I or an IOTC retention ban (noting that four of these species are Critically Endangered with a zero annual export quota and a further 13 are Endangered, and these should be considered for full protection regardless of their CITES listing). Importantly, commercial international trade in these species must be controlled, through effectively implementing CITES trade controls, which for some species may require a prohibition on international trade.

IUCN Red List categories do not impose legal restrictions, but the conservation status of each species should be considered and management measures developed in accordance. The harvesting of Vulnerable species (facing a high risk of extinction) and Near Threatened species (not yet threatened but which may become so without management intervention) should be regulated, to avoid further population reductions. There are 38 Vulnerable and 28 Near Threatened shark and ray species in the WIO (see Annexes I, II), of which four (all Vulnerable) require protection by virtue of listing in CMS Appendix I or an IOTC retention ban (Annex I). The remaining 34 Vulnerable and all 28 Near Threatened species should thus be managed in a way that ensures stable populations.

Strengthening area-based management

Spatial management measures can act as an important tool to provide protection for threatened shark and ray species, but these must be appropriately sized and designed to incorporate ecologically important areas for these species.

The existing 143 MPAs in the WIO region span just 7 per cent of the total area within the EEZs of WIO States, and overlap just 12 per cent, 11 per cent and 18 per cent (average across species), respectively, of the species distribution ranges of Critically Endangered, Endangered and Vulnerable shark and ray species. No-take zones within these MPAs overlap less than 2 per cent of ranges of Critically Endangered and Endangered species, and just 5 per cent of the ranges of Vulnerable species. Most existing MPAs thus offer minimal protection for the WIOs threatened shark and ray species.

An opportunity to better align MPAs and the distribution ranges of threatened shark and ray species comes from a global initiative, led by the Shark Specialist Group of the IUCN Species Survival Commission (IUCN SSC SSG), to identify Important Shark and Ray Areas (ISRAs, IUCN 2024), which could help to inform MPA delineation and MSP processes at national level. The ISRAs are defined

as "discrete, three-dimensional portions of habitat, important for one or more shark, ray, or chimaera species, that are delineated and have the potential to be managed for conservation". The initiative is modelled on other spatial-based assessments of biodiversity importance, including Important Marine Mammal Areas (IMMAs) developed by the IUCN Marine Mammal Protected Areas Task Force, Important Bird and Biodiversity Areas (IBAs), Ecologically or Biologically Significant Marine Areas (EBSAs), and Key Biodiversity Areas (KBAs). In addition to guiding actions under Target 3 of the GBF, the ISRA initiative is supported by other important global processes. At the 4th Meeting of the Signatories (MOS4) to the Sharks Memorandum of Understanding (Sharks MOU) under CMS, Signatories (which include Comoros, Kenya, Madagascar, Somalia, South Africa and France (La Réunion and Mayotte)) welcomed the ISRA initiative and progress made by the IUCN SSC SSG in developing robust selection and review criteria for identifying ISRAs, and included activities to support the implementation of the ISRA initiative in their Program of Work for 2023-2025. In addition, a Resolution adopted at the 14th Conference of the Parties to CMS, in February 2024, encourages Parties to use ISRA resources for designating marine protected areas and marine spatial planning processes, to support the conservation of CMS-listed sharks and rays.

A regional expert workshop was held in South Africa in September 2023, to review and assess ISRA proposals from the broader WIO region, including the WIO as defined herein and the Northern Indian Ocean and "marginal seas" to the north of the WIO (i.e., Red Sea and Persian Gulf). Prior to the workshop, the ISRA project team worked closely with regional experts and participants to gather scientific evidence on the use of habitats by sharks and rays in the WIO region and to identify preliminary Areas of Interest. The workshop resulted in at least 53 ISRAs and 16 Areas of Interest within the WIO States that are Member States of the Nairobi Convention, or in Areas Beyond National Jurisdiction (ABNJ) within the WIO region (Jabado and others 2023). Details of each ISRA and its supporting evidence are available on the ISRA e-Atlas (IUCN 2024) and included in the database.

The WIO ISRAs overlap on average 25-26 per cent, respectively, of the species distribution ranges of Critically Endangered, Endangered and Vulnerable shark and ray species, which is considerably greater overlap than the WIO MPA network. Furthermore, while existing MPAs in the region overlap with ISRAs across 37 086.8 km^2, this area of overlap represents just 8.5 per cent of the total MPA area and only 5.1 per cent of the total ISRA area in the region, again highlighting the limited alignment of the existing WIO MPA network and ecologically important areas for sharks and rays. The ISRA resources offer a good opportunity to inform MSP processes in WIO States, to both support States in their efforts to implement Target 3 of the GBF and to ensure that areas of importance for sharks and rays are included in the process.

Conclusions

Shark and ray populations in the WIO are under severe threat, particularly from overexploitation, yet management measures are inadequate in most WIO countries to allow populations to recover. Most management measures under resolutions and decisions by CITES, CMS and IOTC are legally binding on Parties, yet most WIO States fall short in their binding commitments and thus in their obligations to implement these MEAs, with generally limited legislation for sharks and rays in most States. While there are numerous existing MPAs in the WIO, some of which are of significant spatial coverage, the existing MPA network falls short of the 30x30 target and currently offers minimal protection for shark and ray species.

There is thus a need for improved legislation for and management of sharks and rays at national and regional levels in the WIO, to reduce the impacts of fishing on these species, particularly those that are threatened, and to improve adherence to the MEAs to which WIO States are party. Being the second most threatened marine group in the WIO, sharks and rays should be among the primary conservation targets considered during MSP processes at national

level. States should thus consider the conservation needs of shark and ray species, particularly those that are threatened, during MSP processes, to ensure their MPA networks provide improved protection for sharks, rays and their critical habitats. Finally, existing and new measures will require strengthened capacity, to ensure that they are effectively enforced.

Recommendations

WIO States are urged to implement fishery and trade measures at national level towards reduced mortality of threatened shark and ray species, to support stable populations and sustainable fisheries and trade. Recommended actions are listed below, under five key objectives:

1. **Protect highly threatened shark and ray species:** WIO States should urgently adopt national legislation to fully protect all CMS Appendix I-listed shark and ray species, impose immediate retention bans for IOTC-listed species, and safeguard all Critically Endangered and Endangered shark and ray species (as categorised by the IUCN Red List of Threatened Species), by 2026.
2. **Regulate international trade**: By 2026, implement rigorous customs and trade inspection procedures, legality checks (legal acquisition findings), sustainability checks (non-detriment findings), and traceability processes (permitting and reporting), to prohibit commercial international trade in CITES Appendix I species and strictly regulate and monitor trade in CITES Appendix II species to ensure compliance and sustainability.
3. **Implement management measures and harvesting regulations:** Establish regional agreements or national regulations, such as catch limits, seasonal closures, or gear restrictions, for managing CMS Appendix II and IOTC-listed species, as well as threatened and Near Threatened species not otherwise protected, by 2027, to ensure sustainable harvesting and prevent further population declines.
4. **Strengthen area-based management**: By 2027, explicitly integrate Important Shark and Ray Areas (ISRAs) and other habitats critical to shark and ray species, into national Marine Spatial Planning processes, targeting an increase in MPA coverage specifically for shark and ray habitats to at least 20% within EEZs by 2030, offering improved spatial protection for threatened and endemic species and their habitats.
5. **Strengthen monitoring and enforcement:** Develop and implement robust monitoring, compliance, and reporting frameworks by 2027 to assess the effectiveness of shark and ray management measures, facilitating adaptive management, and build capacity for strengthened enforcement of management measures.

The actions recommended above align with numerous measures under several MEAs, such as the GBF and the Code of Conduct for Responsible Fisheries, among others. The actions also align well with, and would contribute to the implementation of, the following:

- Priority area ii of the Nairobi Convention's 2022-2024 Programme of Work, "assessment and conservation of critical habitats and endangered species" (aligns with recommendations 1-5 above);
- Components 2 and 4 of the Nairobi Convention's 2025-2028 Programme of Work "Component 2: Improved area-based planning underpinned by an ecosystem-based approach to integrated ocean management"; and "Component 4: Improved biodiversity conservation underpinned by area-based planning and innovative approaches to habitat restoration and management" (recommendations 1-5);
- Outcome 4.1 of the 2025-2028 Programme of Work: "Increase spatial coverage and improved management effectiveness of MPAs and OECMs such as LMMAs in the WIO (for biodiversity and fisheries management)" (recommendations 4 and 5);
- Decision CP11/5 of the 11th Conference of Parties (CoP) to the Nairobi Convention "Implementing the Kunming-Montreal Global Biodiversity Framework", in particular Targets 3, 4 and 5, as defined earlier herein (recommendations 1-5);

- Decision CP11/11 of the 11th Nairobi Convention CoP: "Conservation, Restoration and Management of Critical Habitats and Species", with particular emphasis on paragraph 4 "To urge Contracting Parties to continue protecting highly threatened species including but not limited to sharks, rays, sea birds, dugongs, marine turtles and coelacanths" (recommendations 1, 2 and 4);
- Decision CP11/13 of the 11th Nairobi Convention CoP: "Strengthening Marine Spatial Planning" (recommendation 4);
- CMS Resolution 14.7, adopted at the 14th CMS CoP, which "Encourages Parties to make use of the identified Important Shark and Ray Areas (ISRAs) posted on the ISRA website (https://sharkrayareas.org) when designating marine protected areas, or generally for marine spatial planning processes, to support the conservation of CMS-listed sharks and rays" (recommendation 4).

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References

Bennett, R.H., van Beuningen, D., Bräutigam, A., Bürgener, M.C.R., Bladon, A., Kiszka, J.J., Leeney, R.H., Okes, N., and Samoilys, M. (2022) *Chondrichthyans of the Western Indian Ocean: Biodiversity, Fisheries and Trade, Management and Conservation.* A Status Report prepared by the Wildlife Conservation Society for the Nairobi Convention. WCS, New York: 339 pp, 2 appendices. https://doi.org/10.19121/2022.Report.44805

Braulik, G., Kasuga, M., and Majubwa, G. (2020) Local ecological knowledge demonstrates shifting baselines and the large-scale decline of sawfishes (Pristidae) in Tanzania. *African Journal of Marine Science* 42: 67–79.

Bullock, R., Ralph, G., Stump, E., Al Abdali, F., Al Asfoor, J., Al Buwaiqi, B., Al Kindi, A., Ambuali, A., Birge, T., Borsa, P., Di Dario, F., Everett, B., Fennessy, S., Fonseca, C., Gorman, C., Govender, A., Ho, H., Holleman, W., Jiddawi, N., Khan, M., Larson, H., Linardich, C., Matiku, P., Matsuura, K., Maunde, C., Motomura, H., Munroe, T., Nair, R., Obota, C., Polidoro, B., Russell, B., Shaheen, S., Sithole, Y., Smith-Vaniz, W., Uiblein, F., Weerts, S., Williams, A., Yahya, S., and Carpenter, K. (2021). *The conservation status of marine biodiversity of the Western Indian Ocean*. Gland, Switzerland: IUCN. vii + 32 pp.

CITES (2026) *Appendices I, II and III*. Convention on International Trade in Endangered Species of Wild Fauna and Flora. https://cites.org/eng/app/appendices.php. Accessed May 2026.

CMS (2024) *Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS).* https://www.cms.int/en/species/appendix-i-ii-cms. Accessed February 2025.

CMS (2026) *Notification to the Parties. Amendments to the Appendices of the Convention*. 4 pp. https://www.cms.int/news/2026006-amendments-appendices-convention. Accessed May 2026.

Everett, B.I., Cliff, G., Dudley, S.F.J., Wintner, S.P., and van der Elst, R.P. (2015) Do sawfish *Pristis* spp. represent South Africa's first local extirpation of marine elasmobranchs in the modern era? *African Journal of Marine Science* 37: 275–284.

FAO (1995) *Code of Conduct for Responsible Fisheries*. FAO, Rome.

IOTC (2024) *Compendium of Active Conservation and Management Measures for the Indian Ocean Tuna Commission*. Indian Ocean Tuna Commission. 331 pp. https://iotc.org/cmms. Accessed February 2025.

IOTC (2025) *Resolution 25/09 on the conservation of shortfin and longfin mako sharks caught in association with IOTC fisheries.* Indian Ocean Tuna Commission. 4 pp.

IUCN (2001) *IUCN Red List Categories and Criteria: Version 3.1.* IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 30 pp.

IUCN (2024) *Important Shark and Ray Areas web-GIS electronic atlas*. https://sharkrayareas.org/e-atlas/. Accessed November 2024.

IUCN (2026) *The IUCN Red List of Threatened Species. Version 2025-2*. https://www.iucnredlist.org. Downloaded May 2026.

Jabado, R.W., Kyne, P.M., García-Rodríguez, E., Charles, R., Armstrong, A.O., Mouton, T.L., Gonzalez-Pestana, A., Battle-Morera, A., and Rohner, C.A. (2023). *Western Indian Ocean: A regional compendium of Important Shark and Ray Areas*. Dubai: IUCN SSC Shark Specialist Group. https://doi.org/10.59216/ssg.isra.2023.r7

Jabado, R.W., Morata, A.Z.A., Bennett, R.H., Finucci, B., Ellis, J.R., Fowler, S.L., Grant, M.I., Barbosa Martins, A.P., and Sinclair, S.L. (eds.) (2024). *The global status of sharks, rays, and chimaeras.* Gland, Switzerland: IUCN.

Leeney, R.H. (2017) Are sawfishes still present in Mozambique? A baseline ecological study. *PeerJ* 2017.

Republic of Mozambique (2020). Regulamento da Pesca Marítima (REPMAR). *Boletim da Republica Publicacao Oficial da Republica de Mocambique*. 8 de Outubro de 2020.

SADC (2006) *Protocol on Fisheries*. Southern African Development Community, 29 pp.

UNEP-Nairobi Convention and WIOMSA (2021) *Western Indian Ocean Marine Protected Areas Outlook: Towards achievement of the Global Biodiversity Framework Targets*. UNEP and WIOMSA, Nairobi, Kenya, 298 pp.

Annex 1: Shark and ray species in the Western Indian Ocean that should be protected.

This includes species with binding protection requirements based on i) their listing on the Convention on the Conservation of Migratory Species of Wild Animals Appendix I (CMS I) or ii) having a retention ban (X) or partial retention ban (P) under an Indian Ocean Tuna Commission (IOTC) Resolution, and species for which protection is not binding but should be considered due to their conservation status of Critically Endangered (IUCN CR) or Endangered (IUCN EN) under the International Union for Conservation of Nature Red List of Threatened Species (IUCN). Also shown are listings on Appendices I or II of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES, IIZ for CITES Appendix II species with zero annual export quota), listing on Appendices I and/or II of CMS, current IUCN Red List status (IUCN) for each species (CR = Critically Endangered, EN = Endangered, VU = Vulnerable), and countries in which the species is confirmed (1) or reported but not confirmed (-) (ZA = South Africa, MZ = Mozambique, TZ = Tanzania, KE = Kenya, SO = Somalia, MG = Madagascar, MU = Mauritius, RE = La Réunion, SC = Seychelles, KM = Comoros, YT = Mayotte, ABNJ = Areas Beyond National Jurisdiction).

Family	Species	Common name	Taxonomic reference	ZA	MZ	TZ	KE	SO	MG	MU	RE	SC	KM	YT	ABNJ	CITES	CMS	IOTC	IUCN	Criteria for protection
Rays																				
Aetobatidae	*Aetobatus ocellatus*	Indian eagle ray	(Kuhl, 1823)	1	1	1	1	1	1	1	1	1	1	1	1				EN	IUCN EN
Dasyatidae	*Himantura leoparda*	Leopard whipray	Manjaji-Matsumoto & Last, 2008	1	1	1	1	1											EN	IUCN EN
Dasyatidae	*Himantura uarnak*	Honeycomb stingray	(Gmelin, 1789)	1	1	1	1	1	1	1		1		1					EN	IUCN EN
Dasyatidae	*Pateobatis jenkinsii*	Jenkins whipray	(Annandale, 1909)	1	1	1	1	1	1										EN	IUCN EN
Dasyatidae	*Urogymnus asperrimus*	Porcupine ray	(Bloch & Schneider, 1801)	1	1	1	1	1	1			1		1					EN	IUCN EN
Dasyatidae	*Urogymnus granulatus*	Mangrove whipray	(Macleay, 1883)				1					1		1					EN	IUCN EN
Glaucostegidae	*Glaucostegus halavi*	Halavi guitarfish	Forsskål, 1775				1									IIZ			CR	IUCN CR
Mobulidae	*Mobula alfredi* [a]	Reef manta ray	(Krefft, 1868)	1	1	1			1			1	1	1	1	I	I, II	X	VU	CMS I; IOTC
Mobulidae	*Mobula birostris* [a]	Giant manta ray	(Walbaum, 1792)	1	1	1	1	1	1	1	1	1	1	1	1	I	I, II	X	EN	CMS I; IOTC; IUCN EN
Mobulidae	*Mobula eregoodoo* [a]	Longhorned pygmy devil ray	(Cantor 1849)	1	-	-	-	1	-	-	-	-	-	-	-	I	I, II	X	EN	CMS I; IOTC; IUCN EN
Mobulidae	*Mobula kuhlii* [a]	Shortfin devil ray	(Valenciennes, 1841)	1	1	1	1	1	1	-	-	1	-	1		I	I, II	X	EN	CMS I; IOTC; IUCN EN
Mobulidae	*Mobula mobular* [a]	Spinetail devil ray	(Bonnaterre, 1788)	1	1	1	1	1	1			1		1	1	I	I, II	X	CR	CMS I; IOTC; IUCN CR
Mobulidae	*Mobula tarapacana* [a]	Sicklefin devil ray	(Philippi, 1892)	1	-	1				1	1				1	I	I, II	X	CR	CMS I; IOTC; IUCN CR

Family	Species	Common name	Taxonomic reference	ZA	MZ	TZ	KE	SO	MG	MU	RE	SC	KM	YT	ABNJ	CITES	CMS	IOTC	IUCN	Criteria for protection
Mobulidae	*Mobula thurstoni* [a]	Bentfin devil ray	(Lloyd, 1908)	1	-	1			1						-	I	I, II	X	CR	CMS I; IOTC; IUCN CR
Myliobatidae	*Aetomylaeus bovinus*	Duckbill ray	(Saint-Hilaire, 1817)	1	1	1											II		CR	IUCN CR
Myliobatidae	*Aetomylaeus vespertilio*	Ornate eagle ray	(Bleeker, 1852)	1	1	1	1					1							CR	IUCN CR
Myliobatidae	*Myliobatis aquila*	Common eagle ray	(Linnaeus, 1758)	1	1	1	1			1	1								CR	IUCN CR
Pristidae	*Pristis pristis*	Largetooth sawfish	(Linnaeus, 1758)	1	1	1	1	1	1	-	-	-				I	I, II		CR	CMS I; CITES I; IUCN CR
Pristidae	*Pristis zijsron*	Green sawfish	(Bleeker, 1851)	1	1	-	1	1		-	-					I	I, II		CR	CMS I; CITES I; IUCN CR
Rajidae	*Raja ocellifera*	Twineyed skate	Regan, 1906	1	-	-	-												EN	IUCN EN
Rajidae	*Rostroraja alba*	Spearnose skate	Lacepède, 1803	1	1		1		1			1							EN	IUCN EN
Rhinidae	*Rhina ancylostomus*	Bowmouth guitarfish	Bloch & Schneider, 1801	1	1	1	1	1	1	1	1	1		1		IIZ			CR	IUCN CR
Rhinidae	*Rhynchobatus australiae*	Bottlenose wedgefish	Whitley, 1939		1	1	1	1	1	1	1	1				IIZ	II		CR	IUCN CR
Rhinidae	*Rhynchobatus djiddensis*	Whitespotted wedgefish	(Forsskål, 1775)	1	1	-	-	-	-	-	-	-		-		IIZ			CR	IUCN CR
Rhinobatidae	*Acroteriobatus leucospilus*	Greyspot guitarfish	Norman, 1926	1	1	1										II			EN	IUCN EN
Sharks																				
Alopiidae	*Alopias pelagicus* [b]	Pelagic thresher shark	Nakamura, 1935	1	1	1	1	1	1	-	-	1	1	1	-	II	I, II	X	EN	CMS I; IOTC; IUCN EN
Alopiidae	*Alopias superciliosus* [b]	Bigeye thresher shark	(Lowe, 1841)	1	1	1	1	1	1	1	1	1	1	1	-	II	I, II	X	VU	CMS I; IOTC
Alopiidae	*Alopias vulpinus* [b]	Common thresher shark	(Bonnaterre, 1788)	1	-	-	-	-	-	-	-	-	-	-	1	II	I, II	X	VU	CMS I; IOTC
Carcharhinidae	*Carcharhinus amblyrhynchos*	Grey reef shark	(Bleeker, 1856)	1	1	1	1	1	1	1	1	1	1	1		II			EN	IUCN EN
Carcharhinidae	*Carcharhinus longimanus* [c]	Oceanic whitetip shark	(Poey, 1861)	1	1	1	1	1	1	1	1	1	1	1	1	I	I	X	CR	CMS I; IOTC; IUCN CR
Carcharhinidae	*Carcharhinus obscurus*	Dusky shark	(Lesueur, 1818)	1	1	-		1	1						-	II	II		EN	IUCN EN
Carcharhinidae	*Carcharhinus plumbeus*	Sandbar shark	(Nardo, 1827)	1	1	1	1	1	1	1	1	1	1	1		II			EN	IUCN EN

Family	Species	Common name	Taxonomic reference	ZA	MZ	TZ	KE	SO	MG	MU	RE	SC	KM	YT	ABNJ	CITES	CMS	IOTC	IUCN	Criteria for protection
Carcharhinidae	*Negaprion acutidens*	Sicklefin lemon shark	(Rüppell, 1837)	1	1	1	1	1	1	1		1	1	1		II			EN	IUCN EN
Carchariidae	*Carcharias taurus*	Sandtiger shark	Rafinesque, 1810	1	1	1	-	1				1					I, II		CR	CMS I; IUCN CR
Centrophoridae	*Centrophorus granulosus*	Gulper shark	(Bloch & Schneider, 1801)	1	1	1		1	1			1	1	1	1	II			EN	IUCN EN
Centrophoridae	*Centrophorus lesliei*	African gulper shark	White, Ebert & Naylor 2017		1				1							II			EN	IUCN EN
Centrophoridae	*Centrophorus squamosus*	Leafscale gulper shark	(Bonnaterre, 1788)	1	1							1			1	II			EN	IUCN EN
Centrophoridae	*Centrophorus uyato*	Little gulper shark	(Rafinesque, 1810)	1	1	1		1	1	1				1	1	II			EN	IUCN EN
Cetorhinidae	*Cetorhinus maximus*	Basking shark	(Gunnerus, 1765)	1											1	II	I, II		EN	CMS I; IUCN EN
Echinorhinidae	*Echinorhinus brucus*	Bramble shark	(Bonnaterre, 1788)	1	1	1		1											EN	IUCN EN
Ginglymostomatidae	*Pseudoginglymostoma brevicaudatum*	Shorttail nurse shark	Günther, 1867	1	1	1	1		1										CR	IUCN CR
Hemigaleidae	*Hemipristis elongata*	Snaggletooth shark	(Klunzinger, 1871)	1	1	1	1	1	1			1							EN	IUCN EN
Lamnidae	*Carcharodon carcharias*	Great white shark	(Linnaeus, 1758)	1	1	1	1		1	1	1	1	1	1	1	II	I, II		VU	CMS I
Lamnidae	*Isurus oxyrinchus* [d]	Shortfin mako shark	Rafinesque, 1810	1	1	1	1	1	1	1	1	1	1	1	1	II	II	P	EN	IUCN EN
Lamnidae	*Isurus paucus* [d]	Longfin mako shark	Guitart Manday, 1966	1	1	1	1	1	1	1	1	1	1	1	1	II	II	P	EN	IUCN EN
Odontaspididae	*Odontaspis ferox*	Smalltooth sand tiger shark	(Risso, 1810)	1	-	1			1			1	1						EN	IUCN EN
Oxynotidae	*Oxynotus centrina*	Angular rough shark	(Linnaeus, 1758)		-	-			1						-				EN	IUCN EN
Pentanchidae	*Holohalaelurus favus*	Honeycomb catshark	Human, 2006	1	1														EN	IUCN EN
Pentanchidae	*Holohalaelurus punctatus*	African spotted catshark	(Gilchrist, 1914)	1	1				1										EN	IUCN EN
Rhincodontidae	*Rhincodon typus* [e]	Whale shark	Smith, 1828	1	1	1	1	1	1	1	1	1	1	1	1	I	I, II	X	EN	CMS I; IOTC; IUCN EN
Scyliorhinidae	*Haploblepharus edwardsii*	Puffadder shyshark	(Schinz, 1822)	1															EN	IUCN EN

Family	Species	Common name	Taxonomic reference	ZA	MZ	TZ	KE	SO	MG	MU	RE	SC	KM	YT	ABNJ	CITES	CMS	IOTC	IUCN	Criteria for protection
Sphyrnidae	*Sphyrna lewini*	Scalloped hammerhead	(Griffith & Smith, 1834)	1	1	1	1	1	1	1	1	1	1	1		II	I, II		CR	CMS I; IUCN CR
Sphyrnidae	*Sphyrna mokarran*	Great hammerhead	(Rüppell, 1837)	1	1	1	1	1	1	1	1	1	1	1		II	I, II		CR	CMS I; IUCN CR
Stegostomatidae	*Stegostoma tigrinum*	Indo-Pacific Leopard shark	(Herman, 1783)	1	1	1	1	1	1	1	1	1		1					EN	IUCN EN
Triakidae	*Mustelus manazo*	Starspotted smoothhound	Bleeker, 1855		-	1	1		-			1				II			EN	IUCN EN
Triakidae	*Mustelus mustelus*	Common smoothhound	(Linnaeus, 1758)	1												II			EN	IUCN EN

[a] IOTC Resolution 19/03 (https://iotc.org/cmm/resolution-1903-conservation-mobulid-rays-caught-association-fisheries-iotc-area-competence) CPC's "shall prohibit all vessels from intentionally setting any gear type for targeted fishing of mobulid rays in the IOTC Area of Competence, if the animal is sighted prior to commencement of the set" and "shall prohibit all vessels retaining onboard, transhipping, landing, storing, any part or whole carcass of mobulid rays caught in the IOTC Area of Competence" and "shall require all their fishing vessels, other than those carrying out subsistence fishery, to promptly release alive and unharmed, to the extent practicable, mobulid rays as soon as they are seen in the net, on the hook, or on the deck, and do it in a manner that will result in the least possible harm to the individuals captured".

[b] IOTC Resolution 12/09 (http://www.iotc.org/cmm/resolution-1209-conservation-thresher-sharks-family-alopiidae-caught-association-fisheries-iotc) "Fishing Vessels flying the flag of an IOTC Member or Cooperating Non-Contracting Party (CPCs) are prohibited from retaining on board, transhipping, landing, storing, selling or offering for sale any part or whole carcass of thresher sharks of all the species of the family Alopiidae";

[c] IOTC Resolution 13/06 (http://www.iotc.org/cmm/resolution-1306-scientific-and-management-framework-conservation-sharks-species-caught) "CPCs shall prohibit, as an interim pilot measure, all fishing vessels flying their flag and on the IOTC Record of Authorised Vessels, or authorised to fish for tuna or tuna-like species managed by the IOTC on the high seas to retain onboard, tranship, land or store any part or whole carcass of oceanic whitetip sharks";

[d] IOTC Resolution 25/09 (https://iotc.org/sites/default/files/documents/compliance/cmm/iotc_cmm_2509_0.pdf) "CPCs shall require vessels flying their flag to promptly release unharmed, to the extent practicable, shortfin mako sharks (*Isurus oxyrinchus*) and longfin mako sharks (*Isurus paucus*) when brought along side for taking on board the vessel." "In the absence of an observer or a functioning EMS, all shortfin and longfin mako sharks shall be released or discarded."

[e] IOTC Resolution 13/05 (http://www.iotc.org/cmm/resolution-1305-conservation-whale-sharks-rhincodon-typus) CPC's "shall prohibit their flagged vessels from intentionally setting a purse seine net around a whale shark in the IOTC area of competence, if it is sighted prior to the commencement of the set" and that "in the event that a whale shark is unintentionally encircled in the purse seine net, the master of the vessel shall: a) take all reasonable steps to ensure its safe release."

Annex 2:

Shark and ray species in the Western Indian Ocean for which harvesting regulations and/or trade controls should be imposed, based on their listing on the International Union for Conservation of Nature Red List of Threatened Species as Vulnerable (IUCN VU) or Near Threatened (IUCN NT), on the Convention on the Conservation of Migratory Species of Wild Animals Appendix II (CMS II, excluding those also listed on CMS I, see Annex 1), or on the Convention on International Trade in Endangered Species of Wild Flora and Fauna Appendix II (CITES II). Also shown are current IUCN Red List status (IUCN) for each species (VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient, NE = Not Evaluated) and countries in which the species is confirmed (1) or reported but not confirmed (-) (ZA = South Africa, MZ = Mozambique, TZ = Tanzania, KE = Kenya, SO = Somalia, MG = Madagascar, MU = Mauritius, RE = La Réunion, SC = Seychelles, KM = Comoros, YT = Mayotte, ABNJ = Areas Beyond National Jurisdiction).

Family	Species	Common name	Taxonomic reference	ZA	MZ	TZ	KE	SO	MG	MU	RE	SC	KM	YT	ABNJ	CITES	CMS	IUCN	Criteria for harvest or trade regulation
Rays																			
Anacanthobatidae	*Anacanthobatis marmorata*	Spotted legskate	(Von Bonde & Swart, 1923)	1	1										-			NT	IUCN NT
Dasyatidae	*Bathytoshia lata*	Brown stingray	(Garman, 1880)	1	1	1	1				1		1					VU	IUCN VU
Dasyatidae	*Dasyatis chrysonota*	Blue stingray	(Smith, 1828)	1	-				1		-		-					NT	IUCN NT
Dasyatidae	*Maculabatis ambigua*	Baraka's whipray	Last, Bogorodsky, & Alpermann, 2016		1	1	1	1	1									NT	IUCN NT
Dasyatidae	*Pastinachus ater*	Broad cowtail ray	(Macleay, 1883)	1	1	1	1	1	1			1	-	1				VU	IUCN VU
Dasyatidae	*Pateobatis fai*	Pink whipray	(Jordan & Seale, 1906)	1	1	1			1					1				VU	IUCN VU
Dasyatidae	*Taeniurops meyeni*	Blotched stingray	(Müller & Henle, 1841)	1	1	1	1	1	1	1	1	1		1				VU	IUCN VU
Gymnuridae	*Gymnura poecilura*	Longtail butterfly ray	(Shaw, 1804)		-	-	1	1	-									VU	IUCN VU
Narkidae	*Heteronarce garmani*	Natal electric ray	Regan, 1921	1	1				1									NT	IUCN NT
Rajidae	*Dipturus campbelli*	Blackspot skate	(Wallace, 1967)	1	1													NT	IUCN NT
Rajidae	*Dipturus crosnieri*	Madagascar skate	(Serét, 1989)						1						-			VU	IUCN VU
Rajidae	*Leucoraja wallacei*	Yellowspotted skate	(Hulley, 1970)	1	1										-			VU	IUCN VU
Rajidae	*Raja clavata*	Thornback skate	Linnaeus, 1758	1					1	1	1							NT	IUCN NT
Rajidae	*Raja straeleni*	Biscuit skate	Poll, 1951	1	1				-	-								NT	IUCN NT
Rhinobatidae	*Acroteriobatus annulatus*	Lesser guitarfish	Smith, 1841	1												II		VU	CITES II; IUCN VU
Rhinobatidae	*Acroteriobatus andysabini*	Malagasy blue-spotted guitarfish	Weigmann, Ebert, & Séret, 2021						1							II		NE	CITES II

Annex 2 continued:

Family	Species	Common name	Taxonomic reference	ZA	MZ	TZ	KE	SO	MG	MU	RE	SC	KM	YT	ABNJ	CITES	CMS	IUCN	Criteria for harvest or trade regulation
Rhinobatidae	*Acroteriobatus ocellatus*	Speckled guitarfish	Norman, 1926	1	1											II		DD	CITES II
Rhinobatidae	*Acroteriobatus zanzibarensis*	Zanzibar guitarfish	Norman, 1926			1	1	-								II		NT	CITES II; IUCN NT
Rhinobatidae	*Rhinobatos austini*	Austin's guitarfish	Ebert & Gon, 2017	1	1	1			1							II		DD	CITES II
Rhinobatidae	*Rhinobatos holcorhynchus*	Slender guitarfish	Norman, 1922	1	1	1	1		1							II		DD	CITES II
Rhinobatidae	*Rhinobatos nudidorsalis*	Bareback Guitarfish	Last, Compagno, & Nakaya, 2004												1	II		DD	CITES II
Sharks																			
Carcharhinidae	*Carcharhinus albimarginatus*	Silvertip shark	(Rüppell, 1837)	1	1	1	1	1	1	1	1	1	1	1		II		VU	CITES II; IUCN VU
Carcharhinidae	*Carcharhinus altimus*	Bignose shark	(Springer, 1950)	1	1	1	-	-	1					-		II		NT	CITES II; IUCN NT
Carcharhinidae	*Carcharhinus amblyrhynchoides*	Graceful shark	Whitley 1934					1				-				II		VU	CITES II; IUCN VU
Carcharhinidae	*Carcharhinus amboinensis*	Pigeye shark	(Müller & Henle, 1839)	1	1	1	1	1	1	1		1				II		VU	CITES II; IUCN VU
Carcharhinidae	*Carcharhinus brachyurus*	Copper shark	(Günther, 1870)	1	-				1			1				II		VU	CITES II; IUCN VU
Carcharhinidae	*Carcharhinus brevipinna*	Spinner shark	(Valenciennes, 1839)	1	1				1	1	1	1				II		VU	CITES II; IUCN VU
Carcharhinidae	*Carcharhinus falciformis*	Silky shark	(Müller & Henle, 1839)	1	1	1	1	1	1	1	1	1	1	1	1	II	II	VU	CITES II; CMS II; IUCN VU
Carcharhinidae	*Carcharhinus galapagensis*	Galapagos shark	(Snodgrass & Heller, 1905)		1				1			1			1	II		LC	CITES II
Carcharhinidae	*Carcharhinus humani*	Human's whaler shark	White & Weigmann, 2014	1	1	1	1	1	1	1	1	1				II		DD	CITES II
Carcharhinidae	*Carcharhinus leucas*	Bull shark	(Valenciennes, 1839)	1	1	1	1	1	1	1	1	1	1	1		II		VU	CITES II; IUCN VU
Carcharhinidae	*Carcharhinus limbatus*	Blacktip shark	(Valenciennes, 1839)	1	1	1	1	1	1	1	1	1	1	1		II		VU	CITES II; IUCN VU
Carcharhinidae	*Carcharhinus macloti*	Hardnose shark	(Müller & Henle, 1839)			1	1	1								II		NT	CITES II; IUCN NT
Carcharhinidae	*Carcharhinus melanopterus*	Blacktip reef shark	(Quoy & Gaimard, 1824)	1	1	1	1	1	1	1	1	1	1	1		II		VU	CITES II; IUCN VU

Annex 2 continued:

Family	Species	Common name	Taxonomic reference	ZA	MZ	TZ	KE	SO	MG	MU	RE	SC	KM	YT	ABNJ	CITES	CMS	IUCN	Criteria for harvest or trade regulation
Carcharhinidae	*Carcharhinus sorrah*	Spottail shark	(Valenciennes, 1839)	1	1	1	1	1	1	1	1	1		1		II		NT	CITES II; IUCN NT
Carcharhinidae	*Loxodon macrorhinus*	Sliteye shark	(Müller & Henle, 1839)	1	1	1	1	1	1	1	1	1				II		NT	CITES II; IUCN NT
Carcharhinidae	*Prionace glauca*	Blue shark	(Linnaeus, 1758)	1	1	1	1	1	1	1	1	1	1	1	1	II	II	NT	CITES II; CMS II; IUCN NT
Carcharhinidae	*Rhizoprionodon acutus*	Milk shark	(Rüppell, 1837)	1	1	1	1	1	1	1		1				II		VU	CITES II; IUCN VU
Carcharhinidae	*Scoliodon laticaudus*	Spadenose shark	Müller & Henle, 1838		-	1	1	1	1							II		NT	CITES II; IUCN NT
Carcharhinidae	*Triaenodon obesus*	Whitetip reef shark	(Rüppell, 1837)	1	1	1	1	1	1	1	1	1	1	1		II		VU	CITES II; IUCN VU
Centrophoridae	*Centrophorus moluccensis*	Smallfin gulper shark	Bleeker, 1860	1	1	1			1			1		1	-	II		VU	CITES II; IUCN VU
Centrophoridae	*Centrophorus seychellorum*	Seychelles gulper shark	Baranes, 2003									1				II		LC	CITES II
Centrophoridae	*Deania calceus*	Birdbeak dogfish	(Lowe, 1839)	1	-				-						1	II		NT	CITES II; IUCN NT
Centrophoridae	*Deania profundorum*	Arrowhead dogfish	(Smith & Radcliffe, 1912)	1	-				-		-				1	II		NT	CITES II; IUCN NT
Centrophoridae	*Deania quadrispinosa*	Longsnout dogfish	(McCulloch, 1915)	1	1				1		-					II		VU	CITES II; IUCN VU
Dalatiidae	*Dalatias licha*	Kitefin shark	(Bonnaterre, 1788)	1	1	1			1						1			VU	IUCN VU
Galeocerdonidae	*Galeocerdo cuvier*	Tiger shark	(Péron & Lesueur, in Lesueur, 1822)	1	1	1	1	1	1	1	1	1	1	1	1			NT	IUCN NT
Ginglymostomatidae	*Nebrius ferrugineus*	Tawny nurse shark	(Lesson, 1831)	1	1	1	1	1	1	1	1	1	1	1				VU	IUCN VU
Hemigaleidae	*Hemigaleus microstoma*	Sickelfin weasel shark	Bleeker 1852			1												VU	IUCN VU
Hemigaleidae	*Paragaleus leucolomatus*	Whitetip weasel shark	Compagno & Smale, 1985	1	1	-	-	-	1									VU	IUCN VU
Hexanchidae	*Heptranchias perlo*	Sharpnose sevengill shark	(Bonnaterre, 1788)	1	1	1		1	1	1	1	1	1	1	-			NT	IUCN NT
Hexanchidae	*Hexanchus griseus*	Bluntnose sixgill shark	(Bonnaterre, 1788)	1	1	1		1	1	1	1	1	1	1				NT	IUCN NT
Hexanchidae	*Hexanchus nakamurai*	Bigeyed sixgill shark	Teng, 1962	1	1	1	1	1	1	1	1	1	1	1				NT	IUCN NT

Annex 2 continued:

Family	Species	Common name	Taxonomic reference	ZA	MZ	TZ	KE	SO	MG	MU	RE	SC	KM	YT	ABNJ	CITES	CMS	IUCN	Criteria for harvest or trade regulation
Hexanchidae	*Notorynchus cepedianus*	Sevengill shark	(Peron, 1807)	1														VU	IUCN VU
Pentanchidae	*Bythaelurus hispidus*	Bristly catshark	(Alcock, 1891)				1	1										NT	IUCN NT
Pentanchidae	*Halaelurus boesemani*	Speckled catshark	Springer & D'Aubrey, 1972				1	1										VU	IUCN VU
Pentanchidae	*Halaelurus natalensis*	Tiger catshark	(Regan, 1904)	1	1													VU	IUCN VU
Pentanchidae	*Haploblepharus fuscus*	Brown shyshark	Smith, 1950	1														VU	IUCN VU
Pentanchidae	*Haploblepharus kistnasamyi*	Natal shyshark	Human & Compagno, 2006	1														VU	IUCN VU
Scyliorhinidae	*Cephaloscyllium sufflans*	Balloon shark	(Regan, 1921)	1	1	-	-	-	1				1		-			NT	IUCN NT
Scyliorhinidae	*Scyliorhinus capensis*	Yellowspotted catshark	(Smith, 1838)	1														NT	IUCN NT
Somniosidae	*Centroscymnus coelolepis*	Portuguese dogfish	Barbosa du Bocage & de Brito Capello, 1864	1	1				1			1			1			NT	IUCN NT
Somniosidae	*Centroscymnus owstoni*	Roughskin dogfish	Gaman, 1906	-	-				1		1	1		1	1			VU	IUCN VU
Somniosidae	*Centroselachus crepidater*	Longnose velvet dogfish	(Barbosa du Bocage & de Brito Capello, 1864)	-	-				1		1	1		1	1			NT	IUCN NT
Somniosidae	*Scymnodon macracanthus*	Largespine velvet dogfish	Regan, 1906	-	-						1				1			VU	IUCN VU
Sphyrnidae	*Sphyrna zygaena*	Smooth hammerhead shark	(Linnaeus, 1758)	1	1	-		1	1	1	1	1	1		-	II	II	VU	CITES II; CMS II; IUCN VU
Squalidae	*Squalus acutipinnis*	Southern African spiny dogfish	Regan, 1906	1	-					1	-							NT	IUCN NT
Squatinidae	*Squatina africana*	African angelshark	Regan, 1908	1	1	1	1	1	1	1		1						NT	IUCN NT
Triakidae	*Mustelus mosis*	Arabian smoothhound	Hemprich & Ehrenberg, 1899	1	1	1	1	1		1	1					II		NT	CITES II; IUCN NT
Triakidae	*Mustelus palumbes*	Whitespot smoothhound	Smith, 1957	1	1						1					II		LC	CITES II
Triakidae	*Scylliogaleus quecketti*	Flapnose houndshark	Boulenger, 1902	1														VU	IUCN VU

Improving Fisheries Compliance in the Western Indian Ocean Region

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Executive Summary

There is growing concern about the persistence of unsustainable fishing practices in small-scale fisheries in the Western Indian Ocean (WIO) region, as fish populations decline, with direct and widespread impacts on livelihoods and economies. This undesirable context is partly attributable to major weaknesses in enforcement by regulatory authorities and to few incentives for compliance among marine resource users.

To understand the drivers of weak enforcement and compliance in small-scale fisheries across the WIO region, CORDIO East Africa commissioned a rapid assessment study in 2022. The study examined the enforcement and compliance architecture of small-scale fisheries in Kenya and Tanzania.

The findings of this study were presented and discussed at a regional multi-stakeholder workshop held in April 2023 in Dar es Salaam, Tanzania, attended by different stakeholders' representatives from Tanzania, Kenya, Comoros, Mozambique and Madagascar. The workshop also yielded several recommendations that can serve as tools for resource management across the WIO region.

Four major drivers of weak enforcement and non-compliance in the marine small-scale fisheries sub-sector in the WIO region were identified: lack of awareness, social and cultural ties, corruption, and inadequate coordination (synergy) among ministries and state departments. A raft of policy and technical recommendations were proposed.

Background and Rationale

The Southwest Indian Ocean (SWIO) region covers 15,000km of the coastline from Kenya through Tanzania, Madagascar and Mozambique to South Africa, and includes a maritime (EEZ) area of about 4.5 million km^2. The region is one of the most important biodiversity hotspots on the planet and supports the livelihoods of more than 100 million people (Obura 2017).

Local communities bear the brunt of the environmental stressors and governance failures that impact the marine and coastal ecosystems on which their livelihoods depend. These include factors such as (i) habitat destruction, (ii) climate change, (iii) unsustainable and illegal harvesting of marine living resources, (iv) poorly managed coastal development, and (v) pollution, all of which affect local communities and emphasize the importance of effective enforcement and compliance measures.

There have been many significant interventions across the Western Indian Ocean (WIO) region to support the sustainable use and conservation of marine resources and ecosystems. Among these efforts is the upscaling of Locally Marine Managed Areas (LMMAs) through co-management between national authorities and Beach Management Units (BMUs), wherein the legal and institutional frameworks supporting the improved management of small-scale fisheries (SSFs) have been reconstituted (Andrew and others, 2023). Despite such action, marine resources, ecosystems, and habitats continue to decline. The socioeconomic conditions of small-scale fisheries and coastal communities have also deteriorated (UNEP-Nairobi Convention and WIOMSA, 2015; Global Fund for Coral Reefs, 2021; Phua and others, 2021).

One challenge arising from the rapid evolution of blue economy strategies and related policy instruments is the lack of clear institutional mandates for implementation and coordination, as well as for monitoring and reporting on progress. In addition, enforcement and compliance in small-scale fisheries throughout the SWIO are affected by a combination of governance, socioeconomic, and cultural factors.

A "*Rapid Assessment and Review of Enforcement and Compliance in Marine Small-Scale Fisheries in Kenya and Tanzania"* was, consequently, undertaken to better understand the status of enforcement and compliance in small-scale fisheries.

Common violations in these fisheries were broadly identified as stemming from illegal fishing, such as using the wrong gear, harvesting out of season, using banned fishing techniques, pollution, poaching, exceeding specified catch limits, and fishing in closed areas or during closed seasons.

These violations were partly attributed to major weaknesses in enforcement by regulatory authorities, and little incentive for compliance by marine resource users

The WIO governments' efforts have been evident in the introduction of sound fisheries legislation, the revision of regulations, and the implementation of new policies. Full community engagement and management of marine resources through the establishment of co-management structures and Locally Managed Marine Areas (LMMAs) has also gained momentum in the last ten years, and the co-management approach has resulted in noteworthy progress, especially in voluntary compliance with the by-laws thereto. Examples abound; for instances in Kenya's Mkunguni, Munje and Wasini Beach Management Units (BMUs). However, despite these positive developments, improvements are not reflected in the recovery of fish stocks. Fish populations are declining, and fishers' livelihoods are not improving. Lack of adequate enforcement and low levels of compliance with regulations are considered significant factors contributing to this situation.

Method and approach

To understand the drivers of weak enforcement and compliance in small-scale fisheries across the WIO region, CORDIO East Africa conducted a rapid assessment titled "A Rapid Assessment and Review of Enforcement and Compliance in Marine Small-Scale Fisheries in Comoros, Kenya, Madagascar, Mozambique and Tanzania" in 2022. The study examined enforcement and compliance architecture in small-scale fisheries – particularly in Kenya and Tanzania – to identify major gaps, risks, and opportunities for better rule adherence.

The findings of the study were presented and discussed at a regional multi-stakeholder workshop held in April 2023 in Dar es Salaam, Tanzania titled "*Enforcement and Compliance as a mechanism to safeguard Small Scale Fisheries and biodiversity for improved livelihoods*" that brought together forty-five (45) participants, including representatives from government, community, and NGOs from Kenya, Tanzania, Mozambique, Madagascar, and Comoros. Representatives from the participating States delivered detailed presentations regarding the status of SSF enforcement and compliance within their jurisdictions. In addition, working group sessions were convened to examine various aspects of compliance and enforcement, identify existing gaps and challenges,

Glossary of Terms

Rapid Assessment - means the cost-effective method that was used to quickly evaluate the compliance status in the small-scale fisheries in the candidate countries (through the workshop format)

Compliance architecture - refers to the systems, structures and processes designed to ensure that fishing activities are conducted in accordance with established laws, regulations, and guidelines.

Co-management - is a partnership arrangement that shares responsibilities between the government and other stakeholders in the management of fisheries resources.

Locally Managed Marine Areas (LMMAs) - An LMMA is a designated area of nearshore waters and coastal resources that is largely or wholly managed by local communities, land-owning groups, partner organizations, and/or collaborative government representatives who reside in or near the area.

Beach Management Unit (BMU) - means an organization of fishers, fish traders, boat owners, fish processors and other beach stakeholders who traditionally depend on fisheries activities for their livelihoods.

and formulate appropriate recommendations.

The main objective of the workshop was to find common ground and identify the best approaches to collaboration to safeguard SWIO small-scale fisheries and biodiversity and improve livelihoods. The specific objectives included the following:

- Develop a shared understanding of the enforcement landscape in WIO countries and highlight best practices.
- Profile the persistent drivers undermining enforcement efforts, both nationally and regionally.
- Deliberate on potential solutions to identified challenges.
- Explore opportunities from co-management and locally led approaches to strengthen enforcement and compliance.
- Formulate a roadmap for transformative actions that foster improved enforcement and voluntary compliance, leading to better socioeconomic and conservation outcomes.

Findings of the study

The workshop identified four major drivers associated with weak enforcement and non-compliance in the marine small-scale fisheries sub-sector in the WIO region, which include:

1. Lack of awareness,
2. Social and cultural ties,
3. Corruption, and,
4. Lack of synergy (inadequate coordination) between different ministries and state departments.

The workshop outcomes also highlighted systemic challenges affecting small-scale fisheries governance. Participating States and delegates also noted general policy and technical issues that required attention. Key policy and technical recommendations for addressing the four major drivers are as follows (Table 1):

Table 1: Key policy and technical recommendations

Driver	Policy Recommendations	Technical Recommendations
1. Lack of Awareness	Ensure deliberate concerted effort for active involvement, participation and representation of small-scale fishing and coastal communities in the development and review of pertinent laws and regulations, as well as when decisions are made on the fisheries and other marine resources.	Continuously build the capacity of fisher co-management groups to enhance their understanding of their roles and responsibilities in fisheries governance and management.
		Promote learning exchanges between communities on best practices on compliance.
	Embed inclusion of social communication, information dissemination, and education outreach in the pertinent laws and regulations to increase public access to information, access to decision-making, and opportunity to participate, as well as access to judicial and administrative redress and remedy.	Promote bottom-up, interactive, multi-stakeholders' forums to improve information flow.
		Promote political will by improving scientific knowledge through regular training of government officers on the importance of conservation in fisheries management.
2. Social and Cultural Ties	Establish a clear and elaborate framework for fisher co-management groups accountability, and amicably address social-cultural ties and relationships that generate conflicts that promote non-compliance among members (for example, use of ring nets in shallow water lagoons in Kenya contravening existing guidelines on minimum depth of 30m, which occurs because the guidelines are not enforced, partly due to corruption and that fishers do not understand the guidelines).	Involve community members in the collection and analysis of socio-ecological data on marine resources to promote behaviour change in compliance. Utilize local and religious groups to educate the community on their role in the protection and conservation of marine resources.
	Review and amend the fisher co-management groups' by-laws to integrate existing local and national administration.	Involve members in the fisher co-management groups' operations and financial planning to enhance accountability.
3. Corruption	Develop and enforce ethics and anti-corruption laws	Conduct joint enforcement patrols with government agencies and communities.
	Strengthen whistle-blower protection at the local level.	Conduct training for the judiciary on fisheries matters to enhance an informed and fair judgment process.
	Strengthen committees within fisher co-management groups, e.g., BMUs/CCPs, Shehia/DINA, to address corruption at the local level.	Encourage reporting of corrupt officers publicly.
	Empower patrol enforcement officers and issue on-the-spot fines for arrested offenders.	Introduce an anti-corruption sub-committee within fisher co-management groups.

Driver	Policy Recommendations	Technical Recommendations
4. Lack of Synergy	Review fishery law and regulations to ensure text is well defined, precise, and without ambiguity on the roles and responsibilities of the different duty bearers and right-holders.	Set up an inter-ministerial and inter-agency SSF enforcement platform to enhance coordination between different agencies.
	Anchor local and community regulatory mechanisms in national laws.	Create technical working groups at the local, county, and national government levels to enhance the effectiveness of enforcement linkages among key stakeholders and local communities.
	Transcribe legal national texts into local and community regulations for consistency, coherence, positive relationships, and good judgment.	
5. General recommendations	Achieve the desired recognition by the member states of the Nairobi Convention on SSFs, and agreement that low enforcement and lack of compliance in SSF fisheries are a threat and should be addressed.	Conduct a WIO regional threat assessment that focuses on enforcement and compliance practices in SSFs.
	Develop a WIO regional plan of action by the member states of the Nairobi Convention to address issues of enforcement and compliance in SSF fisheries.	Establish a regional inter-sectoral expert panel on SSF fisheries' threats and solutions that will facilitate sustainable ocean-based economic, social and environmental benefits.

Conclusion and recommendations

Weaknesses in enforcement by regulatory authorities have played a major role in SSFs' downturns, with little incentive for resource users to comply. The effective enforcement and compliance with rules embedded in fisheries legislation and regulations can, therefore, be said to constitute a growing challenge to the sustainability of marine SSFs across the Western Indian Ocean (WIO).

Therefore, to summarize the key recommendations from the regional workshop, is a call to action to duty-bearers, enforcement agencies and policymakers with authority in decision-making to implement the recommendations addressing the drivers of poor enforcement and compliance in small-scale fisheries in the WIO region. This includes:

- Adherence to set rules and regulations for fish capture and other related fisheries activities.
- Use of permitted gear and fishing methods, including fishing in fishing designated areas and times.
- Conserving and protecting marine resources from harmful activities that would affect fisheries productivity, and thus the need to protect key habitats and ecosystems for sustained fisheries stock.
- Fisheries co-management approaches through the Beach Management Units (BMUs) and establishment of Locally Managed Marine Areas (LMMAs).
- Community-based monitoring, control and surveillance (MCS) protocols and informants complement government frameworks.
- Formation and use of multi-agency institutions and committees. Judiciary capacity building and sensitization on fisheries matters.
- Youth involvement, coaching and mentoring in fisheries activities to produce future stewards in fisheries.
- Complementary local and traditional alternative conflict resolution and mediation, including warning and sanctions in promoting effective compliance as opposed to penalties imposed on offenders.

Small-scale fisheries should be prioritized by Nairobi Convention member states, and a regional action plan should be developed to address enforcement and compliance issues. Additionally, a regional threat assessment and an expert panel are needed to guide sustainable fisheries governance.

Drawing on the identified issues, the following table presents recommended actions, anticipated outcomes upon implementation, and potential challenges. These recommendations represent the fishery sector's best practices.

Table 2: Action matrix with recommendations on identified issues, expected outcomes and potential challenges

Issue	Recommendation	Expected Outcomes	Potential Challenges
Lack of Awareness	• Involve small-scale fishing communities in the development and review of fisheries laws and regulations.	• Increased community engagement and adherence to regulations.	• Resistance to change • Limited resources for community involvement • Communication barriers.
	• Incorporate education and outreach programs into fisheries policies to improve public awareness and access to decision-making.	• Enhanced understanding of sustainable practices and improved compliance.	• Limited funding for education programs • Low literacy levels • Cultural resistance.
Social and Cultural Ties	• Develop accountability frameworks for fisher co-management groups that consider social and cultural factors contributing to non-compliance.	• Better alignment of regulations with local customs, leading to higher compliance.	• Balancing traditional practices with modern regulations • Potential conflicts within communities.
	• Revise by-laws to be consistent with both local customs and national administrative structures.	• Harmonized regulations that respect local traditions and national standards.	• Ensuring consistency across diverse communities • Potential resistance from local leaders.
Corruption	• Implement and enforce anti-corruption policies within fisheries governance.	• Reduced corruption and increased trust in fisheries management.	• Overcoming entrenched corruption • Ensuring effective enforcement • Effective protection of whistleblowers.
	• Establish local whistleblower protection mechanisms and anti-corruption committees within Beach Management Units (BMUs).	• Enhanced reporting of corrupt practices and protection for whistleblowers.	• Ensuring anonymity and safety for whistleblowers • Potential backlash from corrupt individuals.
Lack of Synergy	• Specify roles and responsibilities in fisheries legislation to reduce ambiguity.	• Clearer understanding of duties and improved coordination among stakeholders.	• Resistance to change, • Lack of clarity in complex legal frameworks • Interagency conflicts.
	• Create interagency coordination platforms at both national and local levels to enhance enforcement collaboration.	• Strengthened collaboration and more effective enforcement of fisheries regulations.	• Ensuring effective communication and cooperation • Managing diverse stakeholder interests.

Lastly, the full range of compliance and enforcement actors must be mobilized, especially in the local communities and the private sector, through an inclusive planning and execution process, informed by the necessary dialogue, policy-harmonization, capacity building and peer learning. The strengths and opportunities of the SWIO coastal communities must be leveraged to achieve sustainable compliance in the fisheries sector.

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References

Andrew, C., James S., Ciaran H., and Alex B. (2023). Assessing the foundations for delivering a Sustainable Blue Economy in the Southwest Indian Ocean. Report compiled by RESOLVE sarl Ivandry Business Center Rue Velo Rainimangalahy, Ivandry – Antananarivo (101), Madagascar.

Global Fund for Coral Reefs. (2021). Global Fund for Coral Reefs Investment Plan. London.

Obura, D.O. (2017). Reviving the Western Indian Ocean economy: actions for a sustainable future. WWF.

Phua, C., Andradi-Brown, D., Mangubhai, S., Gabby, N., Ahmadia, G. *with others.* (2021). Marine Protected and Conserved Areas in the Time of COVID19. Parks Vol. 27.

UNEP-Nairobi Convention and WIOMSA. (2015). The Regional State of the Coast Report: Western Indian Ocean. UNEP and WIOMSA, Nairobi, Kenya, 546 pp

