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Mainstreaming Key Biodiversity Areas (KBAs), piloting Blue Carbon, and Strengthening Coral Reef Fisheries in Mozambique

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Mainstreaming Key Biodiversity Areas (KBAs), piloting Blue Carbon, and Strengthening Coral Reef Fisheries in Mozambique

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Report Author(s): Hugo Costa, Hermenegildo Matimele, Erwan Sola and Acácio Chechene

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COR: Nelson Guilaze

Chief of Party: Kate Heuisler

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ACRONYMS

CBD – Convention on Biological Diversity

CCBS - Climate, Community and Biodiversity Standards

DINAB – Direção Nacional do Ambiente

IUCN – International Union for Conservation of Nature

KBA- Key Biodiversity Areas

m – Meters

MTA – Ministério da Terra e Ambiente

MoU – Memorand of Understanding

NCG – National Coordination Group

OECS - Other Effective Area-Based Conservation Measures

SIBMOZ - Sistema de Informação de Biodiversidade de Moçambique

SPEED – Supporting the Policy Enabling Environment for Development

TLLG -The Landscapes and Livelihoods Group

UN – United Nations

VCS - Verified Carbon Standard

WDKBA - World Database of Key Biodiversity Areas

WIO -Western Indian Ocean

I. INTRODUCTION

Biodiversity is being lost at an unprecedented rate (Jaureguiberry *et al.*, 2022). It has been suggested by researchers that the present-day extinction rates of fauna and flora are approximately a thousand times higher than those before the time of the Industrial Revolution and the subsequent human pressure caused largely by human population growth and the associated increase in consumption (Veitch *et al.*, 2017). Habitat loss and fragmentation resulting from human appropriation of land for activities such as urban development, agricultural expansion and energy production are the most serious threats to biodiversity. This fact is of major concern worldwide but is particularly impacting tropical regions where the world's biodiversity is concentrated (Bax & Francesconi, 2019). Given this, biodiversity experts are increasingly acknowledging the urgent need to employ tools that allow to understand the conservation status of species and ecosystems and which are the most relevant sites for biodiversity overall, that should be avoided by development projects and protected from human impacts. The IUCN Red List criteria and categories is one of the most widely used tools to assess the conservation status of as many identified species worldwide as possible. This methodology has been improved over the many years of its implementation, reaching international recognition for being a consistent and rigorous approach. The information resulting from this process makes a major contribution to guiding decision-making about which species and areas need urgent conservation initiatives.

Furthermore, and with the aim of halting the current trend of biodiversity loss, countries signatories to the United Nations Convention on Biological Diversity (CBD) have agreed, under Target 3 of the Kunming-Montreal Global Biodiversity Framework, to conserve at least 30% of land and sea by 2030. The expansion of land and sea area under conservation should be directed towards areas that are important for biodiversity and the provision of ecosystem services (Girardello *et al.*, 2019). Therefore, identifying areas that hold high proportions of biodiversity globally, such as Key Biodiversity Areas (KBAs), is of vital importance for the effective expansion of conservation areas. Identifying Other Effective Area-Based Conservation Measures (OECMs) is another relevant endeavor. Doing so, it provides the basis for inter-governmental organizations to direct funding and focus activities on sites where intervention is needed most. The KBA approach, therefore, provides the "building blocks" for the

expansion of conservation areas. In addition, KBAs are considered indicators of the Sustainable Development Goals 14 and 15 (UNDP, 2015). SDG 14 promotes conservation and balanced use of the oceans, seas and marine resources for sustainable development, while SDG 15 aims to stop biodiversity loss by emphasizing activities for the protection, restoration, and sustainable use of terrestrial ecosystems (UNDP, 2015).

In February 2019, with support from SPEED, a USAID project, WCS established a partnership with the Ministry of Land and Environment (MTA), through the National Directorate of Environment (DINAB), to develop an innovative project aimed to assess conservation status of species based on the IUCN Red List criteria and map Key Biodiversity Areas (KBAs) in Mozambique (WCS, 2021; WCS, 2021a). The IUCN Red List assessments were deemed highly relevant due to Mozambique's numerous endemic and near-endemic flora and fauna species, many of which had not been previously assessed for their conservation status or had outdated assessments. Moreover, this project stood as one of the pioneering global initiatives to conduct a comprehensive nationwide KBA assessment, applying the 2016 Global Standard across various biological groups and elements. Throughout the project implementation, 29 KBAs were identified and delineated, now accessible in the World Database of Key Biodiversity Areas (WDKBA).

The project conducted Red List assessments for 67 endemic and near-endemic faunal species (reptiles, amphibians, freshwater fish, and butterflies), and half of them were found to be threatened. Furthermore, the project established the National Coordination Group (NCG) on KBAs and Red Lists. Currently chaired by DINAB, this national platform coordinates the identification, documentation, and description of important biodiversity areas for species conservation in Mozambique and comprises about 20 national institutions, many of them governmental. The NCG is currently operational, with a management structure in place and ready to review and validate KBA proposals.

During this first phase, the project identified 15 additional sites that were not triggered as KBAs but were found to have the potential to be labeled as such, provided that more information would be gathered. Some of these sites are coastal or marine, with high conservation priority due to the human and climatic pressures they currently face. There may be other sites along the coastline with similar potential, for which no information is yet available either. Therefore, it was recognized that there was a

necessity for collecting additional information about the triggering species occurring at those sites, including the current situation and threats that the sites are facing.

In order to fill up the gaps presented above, once again with the support of SPEED, WCS launched the third phase of the KBAs (*Mainstreaming Key Biodiversity Area*), *piloting Blue Carbon, and Strengthening Coral Reef Fisheries in Mozambique*), aiming at: i) collecting data that can help identify and map potential coastal and marine KBAs, with focus on Nampula province, ii) completing additional Red List assessments for fauna and flora, including marine species, iii) increasing national capacity in KBA and Red List estimates and their use for decision-making iv) supporting the development of conservation plans and financial solutions that can ensure the long-term sustainability of these KBAs by creating opportunities to improve the economic situation of local communities, such as performance-based payments, through blue carbon solutions, v) compiling information on the conservation status of coral reef ecosystems in the coastal region of the country.

In accordance with task i) outlined above, it was decided to concentrate efforts on three coastal sites: Pemba Bay (Cabo Delgado), Memba-Mossuril (Nampula), and Maputo North. These were identified as priorities for initiating data collection to determine whether they would meet the criteria to be designated KBAs. In Pemba, efforts were focused on flora species. In Memba-Mossuril, surveys were carried out on a coastal anchialine system (“Blue Holes of Nacala”) both for flora and fauna (terrestrial and aquatic) and in Maputo North the focus was on bird and plant species. The shared goal across the three sites was to confirm the presence of KBA trigger species and obtain quantitative data on their populations.

Furthermore, acknowledging the importance of coral reefs and their ecosystem services, a desktop study was conducted. This study utilized existing field data to assess the status of coral reefs in Mozambican waters. The findings from this assessment would aid in identifying potential new marine KBAs.

Finally, to ensure the lasting sustainability of marine and coastal protected areas as well as KBAs, this project explored an innovative financial solution: performance-based payments via blue carbon initiatives. The goal is to enhance the economic conditions of local communities, thereby incentivizing their

involvement in ecosystem protection efforts, promoting the conservation of KBAs and MPAs in the long term.

2. OBJECTIVE OF THIS REPORT

This report describes the activities conducted in Mozambique throughout the implementation period of this project, focusing on i) promoting the identification of coastal and marine KBAs, Red List assessment and mainstreaming the use of KBAs; ii) modeling coral reef conservation priorities along the Mozambican coastline; and iii) exploring blue carbon as a financial mechanism for enhanced protection of MPAs and KBAs through a pilot study.

3. STRUCTURE OF THE REPORT

This synthesis report aims to provide a comprehensive overview of the work undertaken for each objective. Multiple deliverables were produced for each objective, containing detailed information on the conducted work. Table I shows the complete list of deliverables, which could be consulted to have access to the full content of the work developed. presents the complete list of deliverables, serving as a reference for accessing the full content of the work accomplished. The initial section of this synthesis report outlines the workflow employed in the project. Subsequently, a section on key findings delineates the specific objective, background, methodology, results, conclusions, and recommendations, including proposed next steps. The concluding sections of the report contain the overarching conclusions and recommendations.

Table I. Complete list of deliverables for each objective

Objective	Deliverable name	Deliverable and Annex reference
I. Promoting the identification of coastal and marine KBAs, Red List assessment and mainstreaming the use of KBAs		

Objective	Deliverable name	Deliverable and Annex reference
1.1. Collaboration and reporting	Inception report	D1 – Annex 1.1
	Weekly Follow up with SPEED+	D2 – Annex 1.2
	Midterm report	D7 – Annex 1.7
1.2. Identification of coastal and marine KBAs,	Report of the Identification and mapping of coastal and marine Key Biodiversity Areas	D4– Annex 1.4
	Version 2.0 of the technical factsheet report of national KBAs and the proposals	D8 – Annex 1.5
1.3. Red List assessments	Coastal Fauna and Flora Red list assessment report	D5 – Annex 1.6
1.4. NCG capacity building	Report of training on Red List Criteria	D3 – Annex 1.3.1
	Report on training on KBA Criteria	D3 – Annex 1.3.2
1.5. Mainstream KBAs as avoidance areas for projects that can potentially compromise key biodiversity	Communication Materials	D6 – Annex 1.8
	Reports of training seasons on Mainstreaming KBAs as avoidance areas for projects that can potentially compromise key biodiversity	D9 – Annex 1.9
2. Modeling coral reef conservation priorities along the Mozambican coastline		
2.1. Collaboration and reporting	Inception report	D1. – Annex 2.1
	Weekly Follow up with SPEED+	D2. – Annex 2.2
	Midterm report	D3. – Annex 2.3
2.2. Compile information on the conservation status of coral reef ecosystems throughout Mozambique	Report with Coral reefs Maps, conservation status and developed predictions models	D4 – Annex 2.4
3. Piloting Blue Carbon in Mozambique (Support the development of conservation plans and financial solutions that can guarantee the long-term sustainability of the KBAs)		
3.1. Collaboration and reporting	Inception report	D1. Annex 3.1
	Weekly Follow up with SPEED+	D2. Annex 3.2
	Midterm report	D4. Annex 3.4
3.2. Pre-feasibility study for a Blue Carbon project proposal	Pre-feasibility report for a Blue Carbon project proposal	D3. Annex 3.3
3.3. Pre-feasibility study for a Blue Carbon project proposal	Full feasibility assessment report for proposing a Blue Carbon project for the study area by the protection of Mangrove forests	D5. Annex 3.5

Objective	Deliverable name	Deliverable and Annex reference
3.4. Workshop to present the report results	Workshop reports	D6. Annex 3.6

4. KEY FINDINGS

4.1. Promoting the identification of coastal and marine KBAs, Red List assessment and mainstreaming the use of KBAs in Mozambique

4.1.1 Background

The previous phases of the SPEED funded projects have improved national knowledge and capacity concerning KBAs, key species and the threat status of several endemic and near endemic species based on the IUCN Red List. However, a number of actions are still needed to ensure that the work undertaken is continued and achieves its full potential.

For example, 15 sites were shortlisted as potential KBAs, some of these being coastal or marine, and there may be other sites along the coastline with similar potential for which no information is yet available either. Therefore, there is an urgent need to collect additional information on the trigger species that occur at these sites, and on their characteristics and the current threats, these sites face.

In addition, there is also a need to complete the global Red List assessments for endemic or near-endemic species, especially for flora, since the previous phases have only focused on red list assessments some of the groups of terrestrial faunal species.

The 29 KBAs identified in the previous phase were incorporated into the National Plan for Territorial Development (PNDT), the National Marine Spatial Planning (POEM) and in national legislation, such as the Ministerial Diploma for the implementation of biodiversity offsets, the Decree for the protection, conservation and sustainable use of birds and their habitats, and the Forest Law. In all cases, KBAs were considered as avoidance areas for development, protection areas for birds and forests or as offset

recipient sites. The information on KBAs and Red Lists was shared but there is still a need to disseminate the information on KBAs and Red Lists of species and ecosystems to provincial and district authorities so that these areas and species will be preserved and provincial authorities will avoid development projects that can compromise their ecological condition.

Therefore, this component of the current project promoted the identification of coastal and marine KBAs, trained and supported relevant stakeholders in conducting Red List assessments for plant species and promoted training to Provincial authorities to mainstream KBAs in Mozambique.

4.2.1 Objectives

The objectives of this component were to:

1. Increase national capacity on KBA and Red List assessments and its use for decision making, including:
 - Build the capacity of the National Coordination Group (NCG) and taxon experts on KBAs and the Red List with respect to assessing, interpreting and using the related data;
 - Mainstream KBAs by sharing information and creating capacity in the southern and northern regions of Mozambique with a view to avoiding projects that can potentially compromise the key biodiversity elements that triggered the KBA status.
2. Complete additional Red Listing assessments for endemic and near endemic flora species;
3. Collect data onsite that can help identify and map potential coastal and marine KBAs, with a focus on the Nampula province, Pemba Bay and Maputo North, developing and submitting new KBA proposals to the KBA Secretariat.

4.1.3 Methodology

Training experts to use the IUCN Red List criteria to evaluate species' extinction risk

WCS and MTA organized a five-day workshop for training taxon experts from academia including Eduardo Mondlane University and Lúrio University together with public research institutes, namely the

Mozambique Agricultural Research Institute and the Natural History Museum, to apply the IUCN Red List criteria (IUCN, 2012). The training involved a participatory approach covering the contents of all five criteria of the IUCN Red List (A – declining populations, B – geographical range size, and fragmentation, decline or fluctuations, C – small population size, and fragmentation, D – very small population or very restricted distribution, E – quantitative analysis of extinction risk).

Training the NCG members to apply the KBA global standards

A further two-day workshop was organized for training members of the KBA National Coordination Group (NCG) to apply the 2016 IUCN global standards for identification of KBAs. The training was to ensure that members of NCG have a thorough understanding of the criteria and associated thresholds so that they can apply them in the correct manner. The training sessions were based on the Portuguese version of the course consisting of eight modules available online, which were developed by the KBA Secretariat with the support of WCS (please see on [Annex 1.3.2](#)). WCS carried out the translation of the course to Portuguese under the scope of the current project. Using this online version (Figure 1), the training was given face to face with a group meeting at the same time and facilitated by Mozambican WCS experts, with recognized experience in applying the KBA criteria. This approach was to guarantee the successful completion of the modules.

Identificação e delimitação de Áreas-Chave para a Biodiversidade

Seja bem-vindo(a) ao Curso Online sobre Identificação e delimitação de Áreas-Chave para a Biodiversidade.

Author: KBA Partnership
Support Contact: cfp@training@iucn.org

Áreas-Chave para a Biodiversidade (KBAs)
As Áreas-Chave para a Biodiversidade (KBAs) são locais que contribuem significativamente para a persistência global da biodiversidade. Elas oferecem um modelo para intensificar as ações para a biodiversidade do nosso planeta e podem desempenhar um papel fundamental na direção da perda de habitats naturais, na manutenção da integridade ecológica e na prevenção do declínio e extinção de espécies.

O Padrão das KBAs
O Padrão das KBAs fornece uma abordagem baseada em ciência globalmente padronizada para identificar KBAs. Inclui definições, critérios e limites quantitativos projectados para garantir que a identificação de KBAs seja objectiva, replicável e transparente.

O presente curso foi desenvolvido para lhe prover de conhecimentos e habilidades necessários para identificar e delimitar KBAs consistentes com o Padrão das KBAs.

Figure 1. Online platform for the Portuguese version of the free online course on "Identification and delimitation of Key Biodiversity Areas (KBAs)".

Training governmental technicians to integrate KBAs into provincial plans

Apart from this criteria-oriented training (IUCN Red List and KBA standards and thresholds), WCS and MTA also conducted two workshops focused on mainstreaming KBAs, which targeted governmental officers at provincial level. Each two-day workshop was presented in the southern and northern regions of Mozambique and provided details on what are KBAs and what they can be used for. It was explained that these areas are already considered in the National Territorial Development Plan and Marine Spatial Plan as avoidance areas for development projects and that several legislation already includes KBAs. The workshop provided insights into why KBA sites should be avoided by projects that have a negative impact on biodiversity features and involved discussion of approaches for integrating KBAs into territorial development plans at local level.

Assessing the risk of extinction for endemic and near endemic plant species

As part of this project, a conservation status assessment for flora species was conducted following the IUCN Red List criteria (the detailed methodology can be consulted in [Annex 1.6](#)). The initial steps for applying the IUCN Red List criteria consisted of compiling a list of 100 priority species. The

establishment of this list of priority plants consisted in selecting species that met one or more of the following criteria: (1) species that had not yet been assessed against their conservation status, (2) endemic or near-endemic to Mozambique, (3) range restricted, (4) rare, (5) data deficient, and (6) species Red Listed more than five years ago for which new distributional data is available. These species are from the whole of Mozambique including coastal and inland areas.

Following this process, a subset of 30 species was selected, comprising those that are coastal endemic and near-endemic to Mozambique, as well as those of restricted distribution. Two data management assistants were employed to gather species information on distribution, ecology and threats. Subsequently, this information was used to complete the Species Information Service (SIS) platform, a mandatory step in IUCN's methodology: SIS is the central database used by the IUCN to store and manage species accounts and assessments for publication on the IUCN Red List. SIS allows various specialists to contribute to the assessment of a given species in real time.

For that reason, flora experts could apply the IUCN Red List criteria to evaluate species conservation status. The assessments were undertaken using the IUCN version 3.1 criteria (IUCN, 2012). The 30 species were assessed against all five quantitative criteria from A to E (IUCN, 2012). This process was accomplished in six workshops, between October and November 2023, where Mozambican flora experts, members of the Southern Africa Plant Specialist Group, under the IUCN species survival commission, met to analyze the species information already added to the SIS by the data management assistants. During the workshops the participants confronted the data against criteria to determine adequate conservation status.

Identifying and mapping Key Biodiversity Areas

The first steps in the process of applying the KBA approach consisted of establishing a list of flora and fauna species with the potential to trigger the KBA status. The preliminary list of these species includes threatened (Critically Endangered, Endangered and Vulnerable) species based on the IUCN Red List, together with range restricted species. The focus was on species from marine or coastal environments that occur in Mozambique. Thereafter, species' global distribution data was gathered from various

sources including the IUCN Red List database for threatened species as well as through literature, Herbaria and Museum databases and individual experts working in Mozambique. The data from the IUCN Red List was in range map format and GPS coordinates for some species. Following this process, to complement existing information, three areas that had previously been considered potential KBAs were targeted for fieldwork, namely Pemba Bay, Memba-Mossuril and Maputo North between December 2022 and July of 2023 by WCS and selected subcontractors. The fieldwork aimed at collecting additional data on species with potential to trigger KBA at each site. These activities were important as they helped fill data gaps particularly in the Pemba and Memba-Mossuril areas. Therefore, building on the fieldwork and other data relevant sources mentioned above, a final list of 28 trigger species which had the required data to assess KBAs (distribution and population) was established. For flora species, totaling 25, most of the data was collated from the Tropical Important Plant Area¹ (Darbyshire et al. 2023), and the remaining resulted from information collected in the fieldwork promoted by WCS under the current project. A total of three fauna species was assessed against the KBA criteria. For these species data was gathered from two sources including the IUCN Red List for *Mobula alfredi* and from a scientific paper by Tibiriçá et al. (2017) for *Aldisa fragaria* sp. nov. and *Aldisa zavorensis* sp. nov.



Figure 2. Fieldwork carried out in Pemba Bay, top left, Maputo North, top right, terrestrail and aquatic assesment in the blue holes in the lower left and right corners.

Following the collection of data, the KBA assessment entailed evaluating the species data against global standards for KBA identification. The KBA standards comprise five high-level criteria ranging from A to E, together with 11 sub-criteria and quantitative thresholds. The five high-level criteria include the following: (A) threatened biodiversity; (B) geographically restricted biodiversity; (C) ecological integrity; (D) biological processes; and (E) irreplaceability through quantitative analysis (IUCN, 2016). The application of these criteria is based on four assessment parameters namely: (1) the number of mature individuals, (2) the extent of suitable habitat, (3) the species range and (4) the number of localities. These parameters are used to determine whether each site, at which the species has ever been recorded, meets the quantitative thresholds of the KBA criteria. In the case of this project the data available was suitable for applying the KBA criteria based on two parameters: (1) species range and (2) number of localities. In terms of criteria, these data sets were adequate to apply criterion AI – threatened species, BI – geographically restricted species and DI – demographic aggregation (IUCN, 2016). Through this, five KBA proposals were developed and submitted to NCG for review and validation at the national level.

4.1.4 Results

This project component achieved four main results: i) the first consisted of training taxon experts on the use of the IUCN Red List criteria, and the members of the NCG on applying the 2016 KBA standards; ii) the second focused on training Government staff to mainstream KBAs, ensuring their adequate use in spatial planning at the provincial and district levels; iii) the third comprised assessing the red list status of 30 coastal flora species; iv) and the fourth entailed identifying new coastal/marine KBAs.

Training on the IUCN Red List criteria and categories

To strengthen skills on Red Listing, WCS and MTA held a one-week training session from 22 to 26 May 2023 in Maputo on the application of the criteria and categories of the IUCN Red List of threatened species. The training session benefited experts in various taxonomic groups of flora and fauna, as well as academics. It was attended by 22 experts, including 13 women and nine men. These experts represented institutions engaged in biodiversity research in Mozambique, such as the National Herbarium of

Mozambique and the Natural History Museum, as well as academic institutions like Eduardo Mondlane and Lúrio Universities (please see the report in [Annex I.3.1](#)). This training strengthened the skills of taxon experts in the use of the IUCN Red List criteria and categories to assess the risk of extinction for species. Therefore, Mozambique is prepared to rapidly expand the evaluation of species conservation status across a wide range of taxonomic groups to identify those taxa in the most need of management plans to avoid their extinction.



Figure 3. Participants in the plant group carrying out activities in the training event

Training on the KBA global standards

An additional training was also provided to members of the NCG on the application of the KBA criteria and thresholds. This training was based on the course titled “Identifying and Delineating Key Biodiversity Areas” which was made available online by the KBA Secretariat early in 2023. Part of the technical content of this training and the translation of the full course to Portuguese was developed with the support of WCS Mozambique during 2022 and early 2023. The course includes eight modules, and it can be completed in approximately 10 hours. Although the training material is available online, the training was in person with Mozambican WCS facilitators present in the training room. This was to help members of the NCG easily navigate through the online materials, but more importantly, it intended to provide explanations for concepts deemed unfamiliar. The training took place in Maputo in June 2023 and was attended by 24 participants consisting of 15 women and nine men. By the end of the course,

participants were in a position to initiate the process of applying the KBA criteria for species (please see the report [Annex I.3.2](#)). This training strengthened the knowledge of NCG members, who are now in a better position to assist in the process of identifying and delineating KBAs consistently.



Figure 4. NCG participants

KBA mainstreaming

With respect to mainstream the KBAs in the country, two workshops were organized to provide training to the governmental officers on the integration of KBAs into the local network of ecological assessments and development plans (please see the reports on [Annex I.9](#)). Emphasis was also placed on explaining how projects that can potentially compromise KBAs should be avoided. The first workshop was held in Maputo, May 2023, targeting governmental officers in the southern region of the country and was attended by 33 participants consisting of 11 women and 22 men. The second workshop was held in Nampula, August 2023, and targeted public employees in the northern region. This training benefitted 38 staff of which 13 were women and 25 were men. This training equipped governmental officers with the knowledge to develop land use plans that consider KBAs as important areas for biodiversity that should be avoided from development projects.

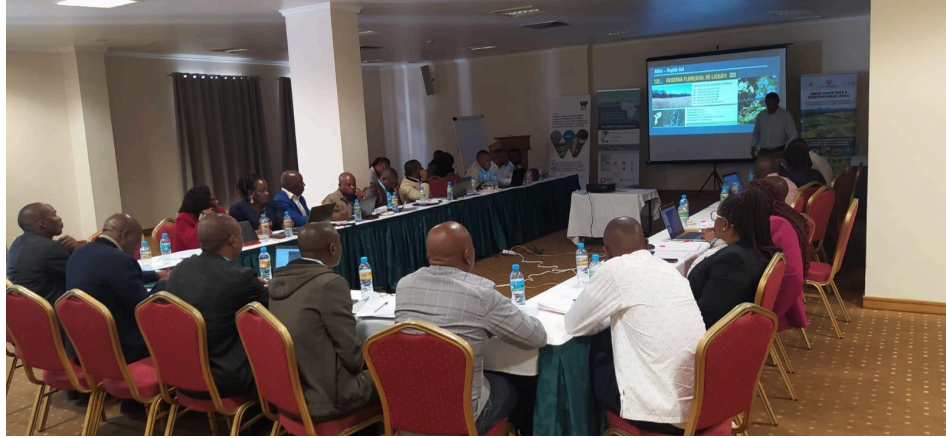


Figure 5. Environmental technicians from various institutions of southern Mozambique (© WCS, 2023)



Figure 6. Environmental technicians from various institutions of southern Mozambique (© WCS, 2023)

IUCN Red Listing of flora species

As explained above, the project supported the assessment of 30-flora endemic and near endemic species using the IUCN Red List criteria. This entailed a series of six workshops held between October and November 2023 where flora experts worked closely to apply the IUCN Red List criteria for all the 30 species (please see the report on [Annex I.6](#)). Resulting from these assessments, 13 fall under threatened categories (Critically Endangered – CR, Endangered – EN, and Vulnerable – VU), one was assessed as Near Threatened (NT), 11 are of Least Concern and five are Data Deficient (DD). 24 of

these assessments were reviewed by peer experts and then submitted to the IUCN for publication. A total of six species is still under review by the specialists². These results will enable rapid and informed decision making about what species require conservation efforts to prevent extinction of known threatened species (Critically Endangered, Endangered and Vulnerable), contributing to target 4 of the Kunming-Montreal Global Biodiversity Framework.



*Figure 7. Assessed species with their preliminary conservation status defined based on the IUCN Red List criteria and categories, at left *Hartliella txitongensis* assessed as CR (© WCS, 2023) and right *Cladoceras rovumense* assessed as Endangered (© Marcelino C*



Figure 8. Experts working to apply the IUCN Red List criteria

² The review of the plant species assessed in the whole Southern African region is carried out by a small number of international/regional specialists who have limited time. Therefore, the teams are dependent on their availability, and sometimes the reviewing process takes longer than expected.

Identification of KBAs

For the KBA assessment work, it was possible to develop five proposals encompassing 447,811 km² of area. The proposed sites are primarily coastal, except for one, which includes both coastal and marine environments: i) Pemba Bay; ii) Janga; iii) Pomene National Reserve; iv) Zavora and v) Chidenguele. These KBA proposals were based on a final list of 28 trigger species of which 90% (25) are terrestrial plants and 10% (three) are marine, namely *Mobula alfredi* (Reef Manta Ray), *Aldisa fragaria* sp. Nov. and *Aldisa zavorensis* sp. Nov. The two *Aldisa* species are new to science and currently only known from Závora in Inhambane Province. Of the 25 plant species, 21 are threatened with extinction based on the IUCN Red List, as is the case of the Reef Manta Ray. The five KBA proposals have been submitted to the KBA focal point within the NCG for review prior to submission to the regional KBA focal point. The regional focal point will also review the assessments and provide comments where appropriate. Thereafter, as a final step, the proposals will be submitted to the KBA secretariat for final consideration and publication in the World Database of KBAs. These results will further expand the network of biodiversity offset receiver areas in accordance with the Decree N° 55/2022 of 19 May. In addition, these results will inform the expansion of the current network of protected areas by targeting areas of high biodiversity importance enabling implementation of an effective area-based conservation measures approach in response to targets 1 and 3 of the Kunming-Montreal Global Biodiversity framework.

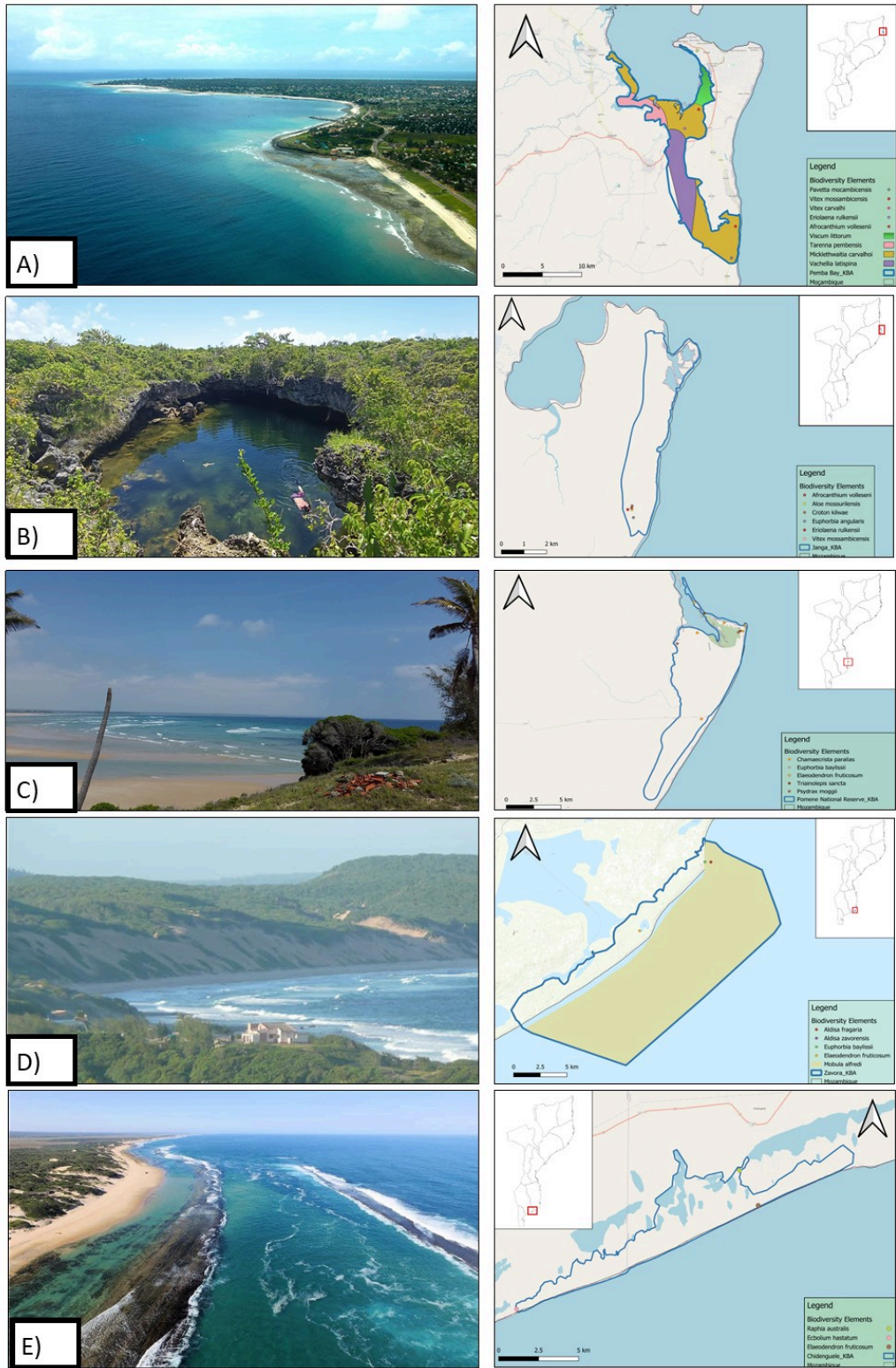


Figure 9. Five potential coastal and Mozambique KBAs: A) Pemba Bay; B) Janga; C) Pomene National Reserve; D) Zavora; and E) Chidenguele.

4.1.5 Conclusions and next steps

This work has created awareness on governmental officers at provincial level on KBAs and how these are already included in national policy and legislation. It also developed these officers' skills to integrate KBAs into Provincial territorial development plans and District Land Use Plans, highlighting strategies to ensure these areas are avoided in projects that can harm key biodiversity areas' trigger species. Additionally, members of the National Coordination Group and taxon experts have had their skills strengthened regarding application of the IUCN Red List of Threatened Species criteria and the IUCN global standards for identifying KBA.

In the context of IUCN Red Listing (IUCN, 2012) for endemic and near endemic flora species and the development of KBA (IUCN, 2016) proposals, as explained in the methodological section, these approaches contain five assessment criteria each. Similarly, to the first phase of KBA identification, data availability remains a challenge despite efforts to fill the gaps over the years. For that reason, although we tried to apply several of these criteria, the data we were able to gather was only adequate to apply one criterion (B) of the IUCN Red List, two criteria (A and B) and three of the II KBA sub-criterion of the KBA Global Standard.

Despite this, significant progress was made in enhancing knowledge on the threat status of species and Key Biodiversity Areas (KBAs) within the country. Moving forward, prioritizing fieldwork for data collection, particularly focusing on potential priority sites and Data Deficient species, is essential. Information gathered from species assessments not only aids in determining the conservation status of Mozambique's flora but also plays a pivotal role in identifying critical biodiversity areas, including KBAs. These efforts are crucial for meeting the targets outlined in the new Kunming-Montreal Global Biodiversity Framework (GBF), which Mozambique is committed to achieving. The alignment of the national biodiversity targets and the National Biodiversity Strategy and Action Plan with the GBF is already underway by MTA and gathering additional and updated information like the assessments carried out under this project is paramount. Consequently, identifying, assessing, and integrating species and areas of global significance, such as KBAs, in conservation planning and carrying out prioritization

analyses becomes imperative for Mozambique to align with global biodiversity targets and meet national targets.

In conclusion, the identification of these five new potential KBAs marks another significant milestone in Mozambique's conservation efforts. These newly identified sites will supplement the existing list of 30 Government endorsed KBAs, enriching the understanding of the country's biodiversity hotspots and facilitating more informed conservation planning. It is imperative that this comprehensive list, the role of KBAs and its context within the country continue to be disseminated widely among stakeholders to enhance the application of national policies and legislation that already recognize KBAs as crucial sites for biodiversity conservation. The success of KBAs in Mozambique is attributable to the simplicity of the concept, despite the rigorous criteria involved in their assessment, and the widespread engagement of government, academia, civil society, and the private sector through the KBA and Red List NCG, added to a significant amount of awareness and training like the one provided by the current project³.

Two next steps remain for this component of the project:

- i. The remaining six plant species assessed against IUCN Red List criteria are awaiting publication on the IUCN Red List webpage pending completion of the peer review process. National plant experts within the KBA and Red List NCG will oversee this task;
- ii. The five KBA proposals are currently undergoing final review by the KBA and Red List NCG. Following this, the KBA Secretariat will submit them to the regional KBA focal point for further evaluation before final consideration and publication in the World Database of KBAs. The NCG KBA focal points and Secretariat (currently hosted by WCS) will ensure their publication and subsequent inclusion in the national biodiversity platform (SIBMOZ).

³ More information on KBAs and its role, advantages and disadvantages can be found in Volumes 1 to 4 of the KBA project Phase I at <https://sibmoz.gov.mz/key-biodiversity-areas/>.

4.2. Modeling coral reef conservation priorities along the Mozambican coastline

4.2.1 Background

In 2022, the Government of Mozambique approved the National Strategy and Action Plan (currently under implementation) aimed at improving the management and conservation of Coral Reefs in Mozambique (ECOR 2022-2032). To enhance its implementation and provide data for spatial planning activities, USAID SPEED, through the Wildlife Conservation Society Mozambique (WCS-MZ), compiled existing information on the conservation status of coral reef ecosystems throughout Mozambique, including new data collected in Nampula Province in 2022, to model conservation priorities along the coastline of the country.

4.2.2 Objectives

The main objectives of this component were: 1) to model and map coral reef hotspots, 2) to verify if these have the potential to trigger Key Biodiversity Area (KBA) status, and 3) to assess whether these sites overlap with both existing and proposed marine conservation areas (MPAs).

4.2.3 Methodology

To model and map coral reef hotspots as well as assessing the likelihood of triggering KBA status and determining whether there is overlap between existing and proposed MPAs, WCS used existing and recently collected field data from the Western Indian Ocean (WIO) region and Mozambique (empirical data). T. McClanahan and Friedlander collected data for the greater WIO between 2007 and 2021, while newer data from Mozambique were collected by E. Sola (WCS-MZ) in the Memba and Mossuril districts of the Nampula Province in 2022. All coral reef surveys were done on SCUBA by trained observers collecting fish biomass, diversity using underwater visual census, as well as coral cover and diversity using line-intercept transect, and photo-quadrant transects. In addition, we combined these data with a vast dataset of environmental and biological variables from satellites and shipboard measurements (remote sensing data). The use of these numerous environmental and biological variables took into account

smaller scale environmental spatial variability and ecological processes (Pilowsky et al., 2022). Thereby, this allowed a more spatially refined view of the biodiversity of Mozambique's coast than was shown in previous studies. Three modeling options were tested, using different processes for variable selection. The modeling process was based on pre-existing data, in combination with recent field data and the collaboration among experienced observers applying similar methods. This proved to be critical in the development of the current predictive model, contributing to its robustness. The detailed methodology is included in [Annex 2.4](#).

4.2.4 Results

The different models exhibited small differences in predicting areas of high fish and coral diversity, the overall variation between the types of models was low, and relatively consistent, reflecting confidence in the predictions made. All models successfully identified 19 coral reef hotspots, showing the relevance of targeted fieldwork to collect data (Figure 10). Moreover, the results revealed a significant overlap between most of the existing protected areas and the identified hotspots (the complete report is available [Annex 2.4](#)). One notable exception was observed in northern Mozambique, where the actual coverage of protected areas is relatively lower than what the models indicate as being of high significance for biodiversity conservation. The most notable discrepancies between the models were observed in specific locations, such as:

- Nearshore reefs in the Quirimbas Archipelago
- Reefs between the Cabo Delgado and Nampula provinces
- Southern Primeiras and Segundas Archipelago

These discrepancies may arise from limited and uneven sampling, potentially impacting the model's predictions, suggesting the need for prioritizing on-site field studies to validate and refine the accuracy of the model predictions.

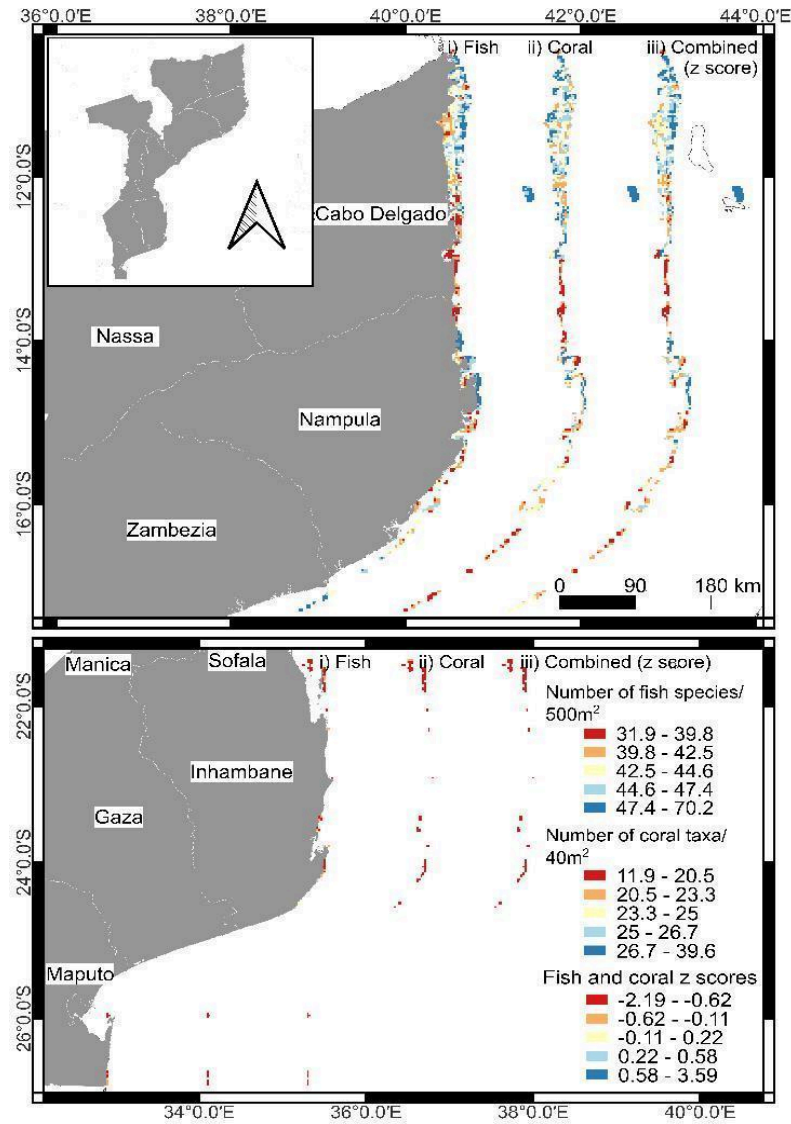


Figure 10. Mapping of the biodiversity hotspots according to the results of the Mozambique data only Model. For each reef cell, predictions are given for (i) total number of fish species, (ii) total number of coral genera and (iii) a total biodiversity score which combines coral and fish numbers of taxa scores in a single metric, as a proxy for total biodiversity (z-score).

While previous conservation efforts in Mozambique focused on large areas covering substantial portions of the Mozambican coastline (e.g. Primeiras and Segundas Environmental Protection Area or Maputo Environmental Protection Area), the current predictive model uses a more localized approach, identifying smaller specific high-biodiversity locations, which could also be assessed as potential KBAs. The predictive models used here also differ from past approaches that prioritized large-bodied, rare, and threatened species, such as the dugong, found in Bazaruto in Inhambane Province. In this updated

method, smaller-bodied species of fish and corals are incorporated, providing a more comprehensive and thorough perspective on biodiversity.

4.2.4 Conclusions and next steps

Several scientific advances used for this study allowed finer-scale predictions and maps of marine biodiversity. These included: 1) moderate resolution (i.e., <10 km²) but large-scale mapping of coral reefs, 2) global satellite coverage of environmental variables and proxies (<10-km steps), and 3) statistical machine learning algorithms (Boosted Regression Tree – BRT), which can handle large amounts of complex and interactive predictors and response data to make predictions. BRT classification and tree methods allow nonlinear relationships, missing values in covariates, interactions between predictors, and produce high predictive performance. Making use of emerging tools in this study provided data for spatial planning activities in the absence of spatially complete field data, which can also point out areas that should be prioritized for field data collection. The following conclusions should be highlighted:

- **Priority Locations:** The 19 coral reef hotspots identified can now be prioritized for additional field work to collect data, which can be used to potentially trigger these areas as KBAs and define site-specific conservation management types and protection measures. With substantial overlap between hotspots and existing protected areas, as well as newly identified unprotected hotspots especially in Nampula and Cabo Delgado, clear opportunity exists to bolster conservation efforts in the northern region. Focus on increasing the marine protected area coverage in the north of the country can be recommended from the results of this study. This information should be used in the national prioritization and planning processes.

- **Optimizing Fisheries Management for Biodiversity Conservation:** As discussed in previous studies conducted in the WIO, managing fish biomass on a large scale is crucial for maintaining biodiversity and fisheries yields. Maintaining fish biomass at optimal yield levels (~500 kg/ha) is suggested as a practical goal to ensure both food security and conservation benefits, indirectly protecting fish biodiversity and maintaining coral reef ecosystem integrity. However, designating marine habitats as protected areas does not necessarily guarantee protection or

resource status. Compliance is improved when local governance functions effectively. It is crucial to engage closely with local communities to establish restrictions on access, fishing gear, times, locations, and capture choices.

The results of this study can be used to guide future conservation efforts decision-making processes. It is recommended to follow a more effective management approach, which involves focusing on modest-sized conservation actions, accounting for both community-based and state-managed conservation strategies - particularly relevant in smaller priority locations, as identified in this study, rather than pursuing ambitious goals through the declaration of extensive protected areas.

These modeling methods not only identified new areas that are effectively aligned with conservation goals and could as well be potential KBAs, but also validated the significance of existing protected areas. This reinforces the key importance of having high-quality spatial and biological data to inform the process of identifying priority areas for biodiversity and for protection.

- **Strengths and Caveats:** As shown by a higher prediction confidence of the larger data regional WIO models, availability and quality of data is essential for this modelling approach and further data collection will improve the predictive power of the models for Mozambique. However, BRT methods used here allow nonlinear relationships, missing values in covariates, interactions between predictors, providing the ability to control for many factors, which is a key strength of this predictive modelling approach, which still produced high predictive performance for this study. Clearly, filling spatial gaps, ground-truthing, and evaluating other environmental and important demographic influences will be an important next step to improve the prediction and prioritization process. This approach of comparing common modelling decisions produced both differences and novel insights that should stimulate further investigations.

- **Future sampling:** Consistent and standardized sampling methods are crucial for maintaining the reliability and effectiveness of predictive models, especially when addressing biodiversity

distributions at varying spatial scales. Future sampling efforts should follow along similar lines to the current assessment methods, involving specific scales for corals (~40 m²) and fish (500 m²).

Filling spatial gaps, ground-truthing, and considering additional environmental and demographic factors, are essential to improve the prediction and prioritization process. It is recommended that the coral reef communities be monitored in various locations, such as the smaller priority locations identified in this study, to better understand the responses to environmental conditions and ultimately protect a greater diversity of coral reef habitats.

4.3. Exploring Blue Carbon as a Financial Mechanism for Enhanced Protection of MPAs and KBAs through a pilot study

4.3.1 Background

WCS has been working with the Ministry of Sea, Inland Waters and Fisheries (MIMAIP) for coastal conservation in Mozambique and has a MoU in place to support the Government in marine conservation activities, in which the “Building a Blue Future for Ecosystems and People on the East African Coast” (Blue Futures/Futuro Azul) program is included. The program aims to develop a proposal for creating a new sustainable-use Marine Protected Area (MPA) in the coastal area of Memba and Mossuril Districts, Nampula Province, which includes a well-operated network of community-managed fishing areas, with several KBAs within its limits, and submit this to the Mozambican Government. Performance based payments for greenhouse gas emission reductions and removals that result from blue carbon solutions offer a potential opportunity for financing ecosystem protection and restoration within and around the proposed MPA and coastal KBAs in the country , creating opportunities to improve the economic situation of local communities and, consequently, creating interest from people to protect ecosystems.

Although Mozambique submitted its First Nationally Determined Contribution (INDC) to the UNFCCC on October 1, 2015 and has taken the first steps towards incorporating the blue economy, there is still limited data available on how to conduct Blue Carbon initiatives. Recognizing these gaps, the United States Agency for International Development (USAID), through the SPEED program, decided to support

this component, which aims to explore blue carbon as a financial mechanism for enhanced protection of MPAs and KBAs through a pilot study.

4.3.2 Objectives

This study assessed the feasibility of developing a carbon project involving mangrove protection and/or restoration in the districts between Memba and Mossuril (Nampula Province in northern Mozambique) as part of the broader Blue Future programme that aims to establish a Marine Protected Area (MPA) in the region, which includes KBAs, and ensure its financial sustainability.

4.3.3 Methodology

The potential project area is the coastal areas between the southern border of Cabo Delgado Province to the north, and the southern border of Lunga District to the south in Memba and Mossuril Districts, Nampula Province (see Figure 11).

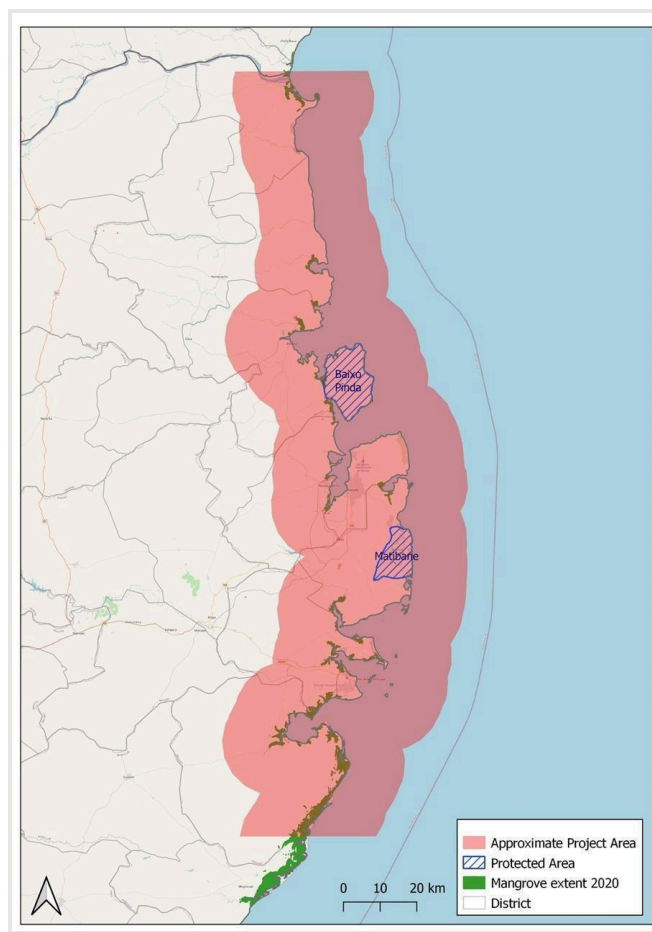


Figure 11. The region within which a mangrove carbon project could be located. Mangrove extent in 2020 (Source: Bunting et al., 2022) and Protected Areas (Source: UNEP-WCMC & IUCN, 2023)

The Landscapes and Livelihoods Group (TLLG) was the specialized consultancy company selected to conduct the study. A pre-feasibility study was initially conducted, and identified the potential for a blue carbon project to generate GHG emission reductions and removals from mangrove protection and restoration activities (see [Annex 3.3](#)). Based on the preliminary results WCS decided to submit an Expression of Interest (Eoi) to the Government, through the National Directorate for Climate Change, to conduct a feasibility assessment for a blue carbon project focused on restoration (Afforestation, Restoration and Rehabilitation activities) and avoided deforestation and degradation (REDD+) as per the national regulation (Decree 23/2018 of 3 May).

To further explore the feasibility of the potential mangrove carbon project, a full feasibility study was conducted aiming to estimate the potential volume of carbon credits that could be generated by the

project, the transaction costs associated with carbon project development, validation, monitoring, reporting and verification and to identify areas that would need to be addressed through project development. This took into consideration the information included in the pre-feasibility assessment, and the ecological and socioeconomic assessments conducted under the Blue Future project.

The potential carbon benefits from mangrove protection and restoration activities were estimated using available datasets and default values, and data collected from the proposed project site. The methods used follow an approved Plan Vivo methodology. Estimates that are consistent with the applicable Verified Carbon Standard (VCS) methodologies would require additional data collection and analysis. The detailed methodology can be found in the feasibility report [Annex 3.5](#). The main steps taken were:

- An assessment of legal context within which a mangrove carbon project could be developed, including land and carbon rights;
- An assessment of stakeholder engagement activities that would be needed for development of a mangrove carbon project, the extent to which they are included in the existing Blue Futures program's stakeholder engagement plan and recommendations to address the observed gaps;
- Improved estimates of potential to generate carbon credits from: i) mangrove restoration activities, addressing issues such as additionally, increasing carbon stored in woody biomass; increasing carbon storage in soils; potential increases in carbon stored in woody biomass and soils; and ii) mangrove protection activities, addressing project boundaries, historical deforestation rates, carbon density, baseline emissions from woody biomass, baseline emissions from soil and potential emission reductions and removals. Potential leakage was also analyzed.
- An initial assessment of environmental and social risks that would need to be managed in a mangrove carbon project was conducted, screening for access restrictions and livelihoods, gender equality and vulnerable groups, climate change and cumulative impacts; the assessment also included risks to non-permanence of carbon benefits (internal, external and natural), and the extent to which these will be mitigated by the Blue Futures program's environmental and social management plan; and

- A high-level assessment of potential income from carbon credit sales, balanced against project implementation, including development, coordination, management, monitoring, stakeholder engagement and risk monitoring, and carbon credit transaction costs.

Carbon benefits from mangrove restoration

According to the mangrove mapping and restoration assessment work conducted under the Blue Futures project (Fernando & Macamo 2023), sites identified as being suitable for restoration cover between 92 and 148 hectares of degraded mangroves. To estimate the potential carbon benefits from mangrove restoration it was assumed that areas where restoration activities will be carried out would not regenerate naturally in the absence of the project, so it is conservative to assume no removals from mangrove biomass or soils under the baseline scenario. The project removals were then calculated by estimating the increase in biomass and soil organic carbon expected because of the project, using available datasets and default values, and data collected from the proposed project site. Carbon stocks in aboveground and belowground biomass and soils were surveyed in 28 sample plots across twelve sites in the proposed project area in February and March 2023 (Fernando & Macamo 2023).

Carbon benefits from mangrove protection

To describe the expected rate of deforestation in the potential project area, the Plan Vivo Tool for Estimation of Carbon benefits from REDD in Community-Managed Forests (PT002) was used. It uses analysis of historical rates of deforestation in a reference region that has similar forest type and exposure to drivers of deforestation as the project area (TLLG & Plan Vivo 2023). Protection status, distance to human settlements, and mangrove condition in 2000 were used as strata representing exposure to drivers of deforestation in the reference region and project area (Simard et al. 2019; UNEP-WCMC & IUCN 2023; Wang et al. 2019). For the purposes of this analysis, a reference region including all mangrove forests in Mozambique was selected and historical deforestation was analysed for the period from 2015 to 2020. Potential carbon benefits are assessed for a crediting period of 20 years, the minimum allowable for a VCS Agriculture, Forestry and Other Land Use (AFOLU) project.

Workshop to share and discuss results

The workshop was conducted in a hybrid format and aimed to present the results of the Feasibility Study for the Blue Carbon Credit Generation Project in the future Memba-Mossuril Marine Conservation Area. It analyzed whether the potential revenue generated by selling credits could finance local communities and justify the transaction costs involved. Additionally, it sought to examine how Mozambican authorities were delineating approaches for REDD+ and ARR with conservation, including permitted activities in each case. The legal framework for blue carbon credits in Mozambique and the registration process were discussed, alongside debates on the best method for benefit sharing from blue carbon credits. Furthermore, the workshop aimed to enhance understanding of available funding opportunities. Approximately 100 people relevant to blue carbon development in Mozambique were invited to attend the workshop.

4.3.4 Results

Generation of carbon credits from mangrove protection and restoration activities in Mozambique come under Mozambique's REDD+ Decree that defines the pathway for REDD+ project development. WCS has secured approval from the Government to develop a carbon project in Memba, Nacala-a-Velha and Mossuril that includes reforestation, restoration and conservation of mangroves. Approval for activities that result in reduced emissions from deforestation and forest degradation was also requested, but the rights to these activities have been granted to a different project developer – Carbon Offsets SA. If Carbon Offsets SA maintains this license, developing a project that generates carbon credits from reduced emissions from deforestation and forest degradation in mangrove areas of Memba, Nacala-a-Velha and Mossuril would require WCS to work together with Carbon Offsets SA. If Carbon Offsets SA pursues registration of a project based on reducing emissions from deforestation and forest degradation, this may also prevent WCS from generating credits from restoration of forested areas within the Carbon Offsets SA project.

For details on the carbon project development pathway, the land carbon rights, stakeholder engagement, including gaps, details on the project additionality and a thorough risk assessment, please consult [Annex](#)

3.5, which contains all details. The results of the potential carbon benefits by restoration and protection are summarized below.

Carbon benefits from mangrove restoration

An area of 121 ha suitable for mangrove restoration has been identified so far under the Blue Future project. The results showed that accumulation in aboveground and below ground biomass of between 3.5 tCO₂e/ha/yr and 16.1 tCO₂e/ha/yr and accumulation in soil of 4.42 tCO₂e/ha/yr could potentially be achieved over a 20-year period. Estimated GHG removals from the proposed restoration activities are therefore between 19,152 and 43,598 t CO₂e (Table 2).

Table 2. Potential GHG removals in woody biomass and soils from mangrove restoration over a 20-year period

Location	Area available for restoration (ha)	Potential GHG removals over 20-years (t CO ₂ e)		
		Biomass	Soil	Total
Memba	28.5	1,994 to 9,171	2,518	4,511 to 11,688
Mossuril	90.9	6,363 to 23,270	8,036	14,399 to 31,306
Nacala-a-Velha	1.5	107 to 468	135	242 to 603
Total	120.9	8,464 to 32,909	10,688	19,152 to 43,598

After deductions for risk buffer and leakage and assuming a carbon credit price between \$10 and \$20 per tonne of CO₂e, which was considered to be a reasonable conservative price, potential income from the sale of carbon credits generated from mangrove restoration activities is estimated to be between \$134,065 and \$610,366 (**Error! Reference source not found.**).

Table 3. Potential income from carbon credits generated from mangrove restoration activities over a 20-year period

Project Activity	Carbon Benefit (t CO ₂ e)*	Carbon Credits (t CO ₂ e)**	Income at \$10 Per tCO ₂ e (US\$/ t CO ₂ e)	Income at \$20 Per tCO ₂ e (US\$/ t CO ₂ e)
Mangrove Restoration (121 ha)	19,152 to 43,598	13,407 to 30,518	\$134,065 to \$305,183	\$268,130 to \$610,366

*See Sections 4.2.3 of Annex 3.2; **After deduction of risk buffer credits at 20%, and leakage deduction of 10%

The estimated costs of implementing and monitoring the proposed mangrove restoration activities is \$168,618 and costs associated with stakeholder engagement and preparing and implementing a carbon project would be additional to this. As a stand-alone carbon project, supplementary sources of finance and or implementation of restoration activities over a greater area would therefore be likely to be needed to develop a feasible project based solely on mangrove restoration in the proposed project area. Since initial project development and implementation costs would be covered in part by the Blue Futures program, the additional finance generated from the sale of carbon credits could be channeled to activities outside that program that directly benefit local communities.

Carbon benefits from mangrove protection

According to maps of mangrove cover produced from Sentinel-2 L2A multitemporal images (Fernando & Macamo 2023), in 2022 the proposed project area included 12,225 ha of mangroves. Global Mangrove Watch Data for 2020 suggests a lower mangrove extent in the proposed project area of 9,645 ha, however, which is broadly consistent with mapping of mangrove extent from Landsat imagery carried out by Silvestrum that identified 8,907 ha of mangroves in the proposed project area (Silvestrum 2023). For the purpose of the study a mangrove area protection of around 9,645 ha of degraded mangrove to prevent deforestation and enable natural regeneration was considered.

According to the Global Mangrove Watch datasets, in 2015 there was around 294,015 hectares of mangrove forest in Mozambique (Bunting et al. 2022). By 2020, this had been reduced to 257,419 hectares, representing a loss of around 36,597 hectares of mangrove forest over the 5-year period. The average annual rate of deforestation ranged from 0.6 % per year to 6.8 % per year, depending on the stratum. The average across all strata was 2.5 % per year for the period from 2015 to 2020 (please see details [Annex 3.5](#)).

In the absence of effective protection, it is assumed that mangroves in the proposed project area have similar exposure to drivers of deforestation as mangroves in the rest of the country, that are in the same stratum. This simple assumption would be improved by identifying spatial variables that explain the patterns of deforestation in the reference region and developing a calibrated risk map that shows risk of

deforestation for each pixel on a numerical scale, as is required by the VCS Consolidated REDD Methodology⁴. Mangroves are excluded from the Consolidated REDD Methodology, but similar approaches could be incorporated into planned updates to VCS Methodology for Tidal Wetland and Seagrass Restoration (VM0033)⁵.

The historical rate of deforestation within the proposed project area, reported within the ecological assessment report, is lower than the historical rate of deforestation at the national level. For the period between 2012 and 2022 a deforestation rate of 0.79% per year was reported (Fernando & Macamo 2023). This is 1.7% lower than the national level analysis. The difference may represent an increase in deforestation over recent years – analysis of deforestation between 2008 and 2020 using the Global Mangrove Watch data shows an average rate of deforestation of 0.59% per year. It may also indicate that mangroves in the proposed project area are exposed to a lower level of threat than mangroves in other regions.

Average carbon stocks in aboveground and belowground woody biomass at each site ranged from 1.4 tC/ha to 28.0 tC/ha. Estimates of mangrove carbon stocks derived from a global canopy height model (Lang et al 2023), and carbon density values reported for different mangrove height classes in a study of mangrove carbon stocks in the Zambezi River Delta (Stringer et al 2015) suggested carbon stocks in the range of 109 tC/ha to 137 tC/ha for mangroves in the proposed project area (Silvestrum 2023). Mangroves of the Zambezi River Delta may be more productive than those in the proposed project area, however, with taller and wider trees (Fernando & Macamo 2023).

Average soil organic carbon stocks in the sampled areas ranged from 60.1 tC/ha to 179.1 tC/ha (Fernando & Macamo 2023), which is, again, lower than the average values for proposed project area derived from data collected in the Zambezi River Delta that ranged from 279 tC/ha to 285 tC/ha (Silvestrum 2023). Globally, average soil organic carbon stocks in mangrove areas are around 350 tC/ha (Maxwell et al. 2023).

⁴ <https://verra.org/methodologies/redd-methodology/>

⁵ <https://verra.org/verra-revises-blue-carbon-methodology/>

According to data available in the Global Mangrove Watch platform, the proposed project area included around 9,645 ha of mangroves in 2020 (Bunting et al. 2022). Using Global Mangrove Watch datasets from 2015 and 2020, and estimates of mangrove biomass from the 2023 biomass survey (Fernando & Macamo 2023), protection of mangroves in the proposed project area could avoid emissions from loss of woody biomass of up to 250,065 tCO₂e over a 20-year project period or owing the Plan Vivo methodology for Estimation of Carbon benefits from REDD in Community-Managed Forests (PT002), without-project (or 'baseline') GHG emissions from deforestation were estimated using specific equations presented in Annex 3.2 (calculations presented in the annexes section). 12,503 tCO₂e per year.

This estimate is based on application of the Plan Vivo Tool for Estimation of Carbon benefits from REDD in Community-Managed Forests (PT002) (TLLG & Plan Vivo 2023). Actual emissions avoided would depend on the success of project activities in addressing the drivers and underlying causes of deforestation. Details and calculations are provided in [Annex 3.5](#) (annexes section). These estimates are also subject to uncertainty in estimates of mangrove extent, historical deforestation, and carbon density.

To claim emission reductions from avoided loss of soil organic carbon, the VCS Methodology for Tidal Wetland and Seagrass Restoration (VM0033) requires projects to define the period over which soil organic carbon is released following deforestation. No studies of soil organic carbon losses from mangrove deforestation in Mozambique were identified, but a study of mangroves in northwestern Madagascar showed that around 20% of soil organic carbon from the upper 1m of mangrove soils was lost in the 10-years that following mangrove clearance (Ariaz-Ortiz et al 2021). Applying these values to the average soil organic carbon density recorded in the potential project area of 105 tC/ha. (Fernando & Macamo 2023), and the baseline rates of deforestation provides an estimate of emissions from loss of soil organic carbon in the proposed project area of 206,747 t CO₂ (see Annex 3.2 and its annexes section for calculations).

Following the Plan Vivo methodology for Estimation of Carbon benefits from REDD in Community-Managed Forests (PT002), emission reductions were calculated by subtracting project

scenario emissions from without-project scenario emissions. Expected project scenario emissions were estimated with a specific equation detailed in [Annex 3.5](#)

To estimate expected effectiveness before evidence of the effectiveness of project activities is available, it is assumed that the effectiveness of project activities will increase over time as project activities to address the drivers of deforestation and forest degradation are developed and implemented. For this analysis expected effectiveness is therefore based on a gradual increase in effectiveness over the first 10-years of the project until the project can prevent 90% of the deforestation and degradation expected in the without project scenario from year 10 onwards. With this approach, the average effectiveness over the 25-year crediting period is 68%.

Using this value in the equation above gives expected project scenario emissions from deforestation of 147,322 tCO₂. Subtracting this value from the expected baseline emissions gives an estimated emission reduction potential over a 20-year crediting period of 309,490 t CO₂, or 15,475 t CO₂ per year. The potential to generate income from carbon credit sales in the region ranges from \$2.1 million to \$4.3 million (Table 4).

Table 4. Potential income from carbon credits generated from mangrove protection activities over a 20-year period

Project Activity	Carbon Benefit (t CO ₂ e)*	Carbon Credits (t CO ₂ e)**	Income at \$10 Per tCO ₂ e (US\$/ t CO ₂ e)	Income at \$20 Per tCO ₂ e (US\$/ t CO ₂ e)
Mangrove Protection (9,645 ha)	309,490	216,643	\$2,166,430	\$4,332,860

See Sections 4.2.3 of Annex 3.2; **After deduction of risk buffer credits at 20%, and leakage deduction of 10%

Since mangroves throughout the proposed project area appear to be in a degraded state (see Section 4.2.1 of [Annex 3.5](#)) it is also likely that effective protection would result in an increase in carbon stocks within these areas. If initial carbon stocks in these areas are estimated, the without-project scenario for carbon stock changes can be described, and increases in carbon stocks are monitored, it may be possible to claim carbon credits from this assisted natural regeneration as well as, or instead of, claiming carbon credits for avoided deforestation. It is unlikely that this would be possible if another project were claiming the carbon credits for avoided deforestation from the same area, however.

Costs for implementing mangrove protection activities have not been estimated, but a combined project that includes mangrove protection and restoration activities would be more likely to be financially feasible than a project based on mangrove restoration alone, if the necessary permissions can be obtained (please see [here](#) the complete report).

The potential emission reductions estimated do not include any increases in greenhouse gas emissions outside the project area that could occur because of project activities, or 'leakage'. Leakage could occur if the project activities involve restrictions on mangrove use that would occur in the baseline scenario, for example introduction or enforcement of regulations on firewood collection, timber harvesting. The risk of leakage can be mitigated through activities that address the underlying causes of mangrove degradation, and that ensure that mangrove users are able to secure alternative sources of resources and income that are sufficient to outweigh any negative livelihood impacts, something that is foreseen under the Blue Futures project.

Several potential risks to mangrove carbon project were also identified, including social and environmental risks that would need to be mitigated through project activities; and internal, external and natural risks that could endanger the permanence of carbon benefits if they are not addressed. Activities to mitigate these risks would need to be incorporated into the project design and would add additional operational costs (see Annex 3.2 for complete details).

Workshop to share and discuss results

The workshop was held on 24 April 2024 at the Radisson Blue Hotel in Maputo City and was attended by 37 participants in the room (Figure 12) and 45 participants' online, representing government institutions, NGOs, academia and the private sector. The project team brought to the discussion table several topics that were identified during the feasibility study as potential bottlenecks to the development of a blue carbon project. The detailed report can be found in [Annex 3.6](#).



Figure 12. Workshop participants at the venue.

A presentation was carried out by the consultancy company that developed the study and another one by a representative from Fair Carbon (<https://www.faircarbon.org/>) on the enabling conditions to unlock the potential of blue carbon in Mozambique. The main key take aways on what the country can do to see more high-quality blue carbon projects on the market are that Mozambique needs to:

- Enhance expertise in blue carbon project development by strengthening technical capacity, fostering communities of practice, and implementing suitable regulations for high-quality projects.
- Establish a comprehensive regulatory framework for nature-based carbon credits, including clear guidelines for carbon market trading in the VCM, and implement a standardized process for transferring carbon rights.
- Integrate a governance framework for community-owned nature-based projects, promoting inclusive participation and local empowerment in decision-making.
- Advance the Carbon Market Activation Plan to further stimulate market development and engagement, incorporating social and environmental safeguards mechanisms, corresponding adjustments, establishing a strong National Carbon Registry, benefit sharing agreements, Monitoring, Reporting, and Verification.

The first discussion points were focused on the legal and policy framework for blue carbon credits and registration, namely the method for separating REDD+ and ARR approaches with conservation activities

included. Another topic of discussion raised by the project team was related to the benefit-sharing mechanism, specifically on how gains can be maximized for local communities. The most relevant questions raised by the project team were:

- Viability of this project and several similar others depends on authorization of REDD+ for mangroves as well as ARR.
- Is it necessary to separate REDD+ and ARR permissions? In addition, specifically for blue carbon projects?
- If the above, why can't REDD+ be separated for blue carbon, developing a national FREL for mangroves?
- How can we build a policy/legislation environment that is enabling for both terrestrial AND mangrove ecosystem restoration and conservation?
- How feasible it is to apply the REDD+ decree to ARR projects ie. Minimum threshold (200,000 TCO_{2e})?
- There are overlapping project licences and these raise coordination and legal challenges. How will the government coordinate this situation? REDD+ district license already has the ARR license built in.
- How will developers ensure reduction of emissions from deforestation and degradation at the district level without control over the jurisdiction, conversely to cases where protected areas are being created and it will be possible to have control over the jurisdiction?
- Is there a place for small scale, voluntary carbon market projects within the policy updates?
- Mangrove conservation is currently being organized and driven by organizations at the local level; will district level project developers undermine them?

After the workshop there was a meeting between the project team and the Provincial and District Authorities representatives where the topics raised before were addressed again to ensure that everyone was clear on the discussions that happened in the workshop, trying to collect additional

comments and discussing on how the lessons learnt from this study can contribute to the new Mozambican carbon regulations under development. The discussions held in the workshop and this complimentary meeting did not provide specific solutions for the questions raised but the conclusions drawn are presented in the next section.

4.3.5 Conclusions and next steps

Blue Future project aims to improve the livelihoods of communities through a set of mechanisms, which include alternative and environmentally sustainable activities. Blue carbon is one of the possibilities: its focus is on the financial benefit of communities for mangrove improvement and protection; the benefit-sharing mechanism must be focused on communities. However, the project is only viable if REDD+ is authorised for mangroves and not just ARR.

The relatively small scale of the mangrove restoration activities (~121 ha) means that the net-benefits, after covering costs of project development and implementation are likely to be marginal. The carbon benefits generated are also below the minimum stipulated for registration of a REDD+ project in Mozambique. A broader scale project that aims to protect all mangroves in the focal districts has potential to generate carbon benefits 15 times higher and income from carbon credit sales 6 to 15 times higher from avoided deforestation over a 20-year period. Additional carbon credits may also be generated from regeneration of degraded mangroves.

Achieving these carbon benefits would require close engagement with all mangrove users throughout the districts, to develop activities that address local drivers of mangrove degradation, and to secure the rights to operate a carbon project. It is unclear whether WCS can secure the carbon rights for this broader area however, as there is another project developer that has had an expression of interest approved for a project that covers the whole district, including the mangrove area.

Given that the Blue Futures project aims to establish a MPA and incorporates various initiatives to mitigate degradation and enhance ecosystems by fostering environmentally sustainable and income-generating alternative livelihoods, the option of developing a larger REDD+ project for the full

MPA appears to be the most viable. However, it necessitates policy adjustments, ideally including a revised carbon legislation, which is already in progress.

The following conclusions were drawn for the presentation workshop:

- The legal framework in Mozambique do not exist to secure land tenure for mangrove management. This is a current barrier to developing a mangrove carbon project. It is not clear whether community rights would be superseded by TUPEM, and how mangroves would be licensed through DUATs below the high tide mark considering mangroves inhabit intertidal zones primarily. The process of securing customary rights is also not stated in law. Legal gaps will need to be filled prior to proceeding with this carbon project pilot.
- The carbon rights of project developers are not clearly distinguished in the current government licensing procedure of separating ARR and REDD+ licenses. All the permissions granted under ARR are also granted under REDD+, meaning the carbon rights to these activities may be contested by another entity.
- Including mangroves within jurisdictional carbon licenses means that carbon developers have to work on large scales across multiple land systems ie. Agricultural land, forestry, mangroves, grassland and marine ecosystems, lessening the ability of organisations already delivering this work and specialised in this area from utilising carbon finance to drive conservation impact.
- The benefits sharing is not specified in REDD+ regulations, leaving it open to the discretion of project developers to decide how to distribute benefits between stakeholders. A suggestion from the room included approaching benefits sharing after project costs have been covered.

The feasibility study yielded a "maybe" regarding the viability of carbon finance for mangrove conservation, primarily due to uncertainties surrounding carbon credit ownership and the cost of behavior change needed to prevent degradation. To proceed, clarity on carbon credit allocations and rights is imperative. Two key actions are proposed: i) advocating for policy changes and ii) obtaining clarification on current rights. Once clarified, the project could be divided into manageable units for piloting, allowing for scalability over time. It is essential to distinguish this feasibility study from the broader Blue Futures project, which aims to create a sustainable conservation area benefiting communities financially and ecologically. This includes promoting alternative livelihoods and preparing communities for mangrove restoration and protection. Financial mechanisms to engage communities in

these activities also include Mozambique's biodiversity offset legislated mechanism. Therefore, considerations on stacking and bundling will also need to be taken into account. It is important to carefully design and implement stacking and bundling strategies to ensure that they align with regulatory frameworks, maximize synergies between different benefits, and avoid potential trade-offs or conflicts.

5. CONCLUSIONS

In conclusion, this project has developed the skills needed by governmental officers at provincial level to integrate KBAs into their local territorial development plans. In addition, it has provided knowledge to ensure that these governmental officers avoid KBA sites from projects that are likely to have a negative impact on their biodiversity trigger elements. Moreover, the project has built capabilities for members of the National Coordination Group with respect to applying the 2016 IUCN global standards for identifying KBA. Therefore, NCG members can assist the government of Mozambique in identifying areas that contribute significantly to biodiversity persistence globally. In a similar manner, taxon experts from universities and research institutes now understand the use of the IUCN Red List of Threatened Species criteria to assess species conservation status. Furthermore, the IUCN Red List assessment and the KBA identification conducted in this project provided valuable insights into species conservation status, distribution and levels of endemism. Specifically, the IUCN Red List process included 30 taxa and the KBA assessment covered 28 species of which 25 are plants and three are fauna species, while identifying 5 new coastal and marine KBAs. This development has the potential to increase the total number of KBAs in the country to 35.

The coral reef study showed that historical focus on large-scale protected areas might not adequately capture the biodiversity of certain regions, particularly those in northern Mozambique, where additional unprotected smaller size areas of high conservation importance have been predicted by the models. While ground-truthing for model validation will be important, the innovative environmental modelling methods used here provided an alternative broad- and finer-scale approach by accounting for smaller scale environmental spatial variability and ecological processes. These methods were better able to

identify potential patterns and support the importance of some of the protected area choices of the past. Findings also provided information on other small to modest-sized area-based conservation planning and management needs. The methods developed here should eventually augment past and current practices of mapping diversity from sparse or selective information, and improve ability for effective management and conservation decision-making.

The feasibility study for the Blue Futures project highlighted uncertainties regarding carbon credit ownership and the cost of the activities needed to prevent mangrove degradation, resulting in significant doubts regarding the viability of carbon finance for ARR activities only. Advocating for policy changes and obtaining clarification on carbon credit allocations and rights are crucial next steps. The project's viability depends on securing rights for mangrove conservation, particularly regarding REDD+ authorization and legal frameworks for land tenure. Additionally, a broader scale project encompassing mangrove protection and restoration activities appears more financially feasible than restoration alone, but necessitates policy adjustments and clear carbon legislation. This underscores the importance of addressing legal gaps and ensuring community engagement in benefit-sharing mechanisms to enhance project sustainability and success. It should be noticed that the objective of Blue Futures, as several other similar blue carbon projects being developed in Mozambique, is to channel as most of the carbon credit revenue sales as possible to the local communities that will be involved in these activities.

KBAs identified through this project together with the 19 coral reef hotspots can be used to inform the expansion of the current network of conservation areas including establishment of OECMs (other effective area-based conservation measures) contributing to achieving a number of targets, particularly global targets 1, 2, 3 and 4 of the Kunming-Montreal Global Biodiversity Framework. Ultimately, this would enhance community engagement in biodiversity conservation, mitigating the impacts of climate change and enable sustainable development.

6. RECOMMENDATIONS

The assessment of species conservation status together with the identification of areas that are important for biodiversity, particularly KBAs, is key to governments' efforts to halt biodiversity loss worldwide. This is in alignment with the Kunming-Montreal Global Biodiversity Framework where nations have committed to focus conservation on areas that are important for biodiversity. Building from the findings of this project, it is recommended that the species and areas highlighted as being of global importance should be considered for further conservation prioritization analyses. The Mozambique government would greatly benefit from this as it attempts to meet the global biodiversity targets. Species that have been identified as Data Deficient based on the IUCN Red List assessment, should be targeted for fieldwork to gather additional data. Species that fall under threatened categories, together with information about their distribution and endemism, should be taken into account when updating the National Territorial Development Plan, developing Provincial Territorial Plans, District Land Use Plans and when making future decisions related to biodiversity conservation. It is important to acknowledge that as information on biodiversity increases, the likelihood of identifying new KBAs also grows. Therefore, there is a need to intensify efforts to collect additional data across the country on species and ecosystems that could potentially qualify new sites as KBAs.

Pertaining to the coral reef fisheries component, it is recommended that future sampling efforts should follow along similar lines to the current assessment methods, defining, in particular, specific scales for corals (~40 m²) and fish (500 m²). Coral reef communities should be monitored at various locations, such as the smaller priority locations identified in this study. By doing so, we could better understand the responses of coral reef habitats to environmental conditions, thereby protecting a broader range of coral reef habitats. The present modelling approach takes into consideration the ecological functions and services provided by fish and corals at a finer scale. Therefore, it is crucial that conservation management type considers smaller areas that could be under community-based management schemes. This shift in focus is seen as more appropriate, especially in the context of resource dependency and compliance challenges in large MPAs. As a guarantee of their protection, it is necessary to put in place

adequate management including engaging with communities when establishing restrictions on access, fishing gear, times, places, and capture options.

Several legal and procedural challenges were identified during the presentation workshop that require attention at the national level. The absence of a clear legal framework for securing land tenure for mangrove management poses a significant barrier to carbon project development. Ambiguities in carbon rights allocation and overlapping licensing procedures for ARR and REDD+ licenses further complicate matters, necessitating clarification and distinction to avoid conflicts. Moreover, integrating mangroves within jurisdictional carbon licenses presents logistical challenges, hindering the efficient utilization of carbon finance for conservation impact. Addressing these issues requires policy adjustments and legislative revisions to provide clarity and support project implementation. Additionally, establishing guidelines for benefit-sharing mechanisms under REDD+ regulations is essential to ensure equitable distribution of project benefits among stakeholders, promoting community engagement and project sustainability.

If the REDD+ license is provided to the Blue Futures project, it is imperative to enhance the existing Stakeholder Engagement Plan, specifically tailoring it for the carbon project. Direct engagement with diverse mangrove user groups is crucial, necessitating exploration of alternative engagement avenues beyond community groups like the Community Fisheries Councils (CCPs), whose representativeness of mangrove users remains uncertain. It's essential to comprehensively identify specific mangrove user demographics at project sites, categorize these groups, grasp their customary rights, and formulate a strategic approach for engagement at this level.

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