Preserving coastal and marine ecosystem services through effective NIMPA management

Assessment, Case Studies and Recommendations

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Executive Summary

Well-managed Marine Protected Areas (MPAs) provide a range of benefits to biodiversity, climate, and people through provisioning, supporting, regulating and cultural ecosystem services (ES). Indeed, MPAs are vital sanctuaries for numerous marine species, protecting them from dangers such as overfishing, habitat loss, and pollution. By providing safe breeding and feeding grounds, MPAs not only conserve biodiversity but also help restore fish populations, benefiting both marine ecosystems and the livelihoods of coastal communities. This dual impact highlights the crucial role MPAs play in sustaining ocean health. In addition, MPAs serve as valuable centres for scientific research, advancing our understanding of marine ecology and guiding more effective conservation strategies to strengthen the resilience of global marine environments.

The Namibian Islands' Marine Protected Area (NIMPA) lies within a crucial Ecologically or Biologically Significant Marine Area (EBSA), encompassing the primary upwelling centre of the Benguela Current off Namibia's coast. Covering approximately 9,500 km², NIMPA is Africa's second-largest marine protected area, and aims to be safeguarded through its new operational management plan currently in the approval phase. The NIMPA+ project supports this implementation and is driving additional initiatives to support coastal livelihoods.

Ecosystem services in Namibia's coastal waters are under threat from impacts from diamond mining, oil and gas exploration, and overfishing. The management of NIMPA aims to protect critical ecosystem services — including fisheries, kelp habitats, carbon sequestration, and cultural heritage — essential to biodiversity, climate resilience and local communities against such threats. Quantifying and valuing these services, through ecosystem services valuation (ESV) can underscore NIMPA's impact and inform better resource management. Although ESV supports more inclusive decision-making through highlighting non-market values, some benefits of nature defy precise valuation and should be viewed as approximate.

This report highlights a selection of ecosystem services that are being protected and improved through the implementation of the Operational Management Plan (OMP) of the NIMPA. It also aims to help identify where further research and data collection is required in order to achieve the best understanding of the benefits provided by a healthy and thriving NIMPA. These ecosystem services are summarized in the table below, with recommended next steps for quantification:

Ecosystem service		Current state & threats	NIMPA enforcement effect	Key recommendations for quantification
Provisioning	Fisheries	Decreasing fish stocks due to overfishing. Lower catch per unit effort for species such as rock lobster.	Fishing restrictions leading to increased fish and crustacean stocks. Spillover effect leading to positive impacts on fish stocks outside of NIMPA.	Collection of baseline data on understudied fish populations & predictors of ecosystem health (e.g. seals).
Supporting	Biodiversity	Breeding grounds for 11 out of 14 Namibian seabirds, including endangered species in NIMPA. At least 88 chondrichthyan species that are thought to inhabit Namibian waters. Significant decline in populations, due in part to decreasing fish stocks.	Fishing restrictions, increased monitoring on islands and decreasing habitat threats, all supporting recovery of seabird and chondrichthyan populations.	Further research on the presence of marine mammals, elasmobranchs, and fish species within the NIMPA, and their abundance over time.
Regulating	Carbon storage	The presence of kelp within NIMPA is currently unmapped and carbon storage capacity uncertain.	Protection of existing kelp habitat and associated carbon stocks.	Compilation of more precise mapping of kelp habitats within NIMPA. Development of a methodology for carbon capture

		Kelp habitats are threatened by disturbance from mining and oil and gas industries.		quantification for Namibian kelp habitats.
Cultural and Amenity	Tourism & recreational activities	Underutilization of tourism opportunities in the region.	Improved biodiversity and recreational fishing offer enhanced tourism and recreational opportunities, increasing income opportunities for coastal communities. Investments as part of NIMPA+ project adding more enterprise and learning opportunities (e.g. NAMCOB Centre). Increasing attendance to yearly events boosting local economy.	Collection of perception and empirical data on jobs and income in Lüderitz.
	Endemic species Research	Endemic and critically endangered species present within NIMPA boundaries.	Stock recovery of key species allowing for future research. Initiatives part of NIMPA+ project to enhance research opportunities around endemic species.	Further identification of endemic species, their abundance and behaviours through additional research.
	Cultural heritage	Several sites of importance located within or near NIMPA	Protection by proxy of important sites of cultural heritage	Engagement of stakeholders to assess priority cultural services.

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Acronyms

CPUE	Catch Per Unit Effort
EA	Ecosystem Accounting
EBSA	Ecologically or Biologically Significant Marine Area
EIA	Environmental Impact Assessment
ES	Ecosystem Services
ESV	Ecosystem Services Valuation
MEA	Millenium Ecosystem Assessment
MEFT	Ministry of Environment, Forestry and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MPA	Marine Protected Area
NIMPA	Namibian Islands' Marine Protected Area
SEEA	System of Environmental Economic Accounting
OMP	Operation Management Plan for the NIMPA
WTP	Willingness to Pay

1. Introduction

1.1 Namibia's Marine Environment and its uses

Namibia's marine and coastal environment is part of the exceptionally productive Benguela current ecosystem. This region is bustling with various economic and social activities, offering a range of ecosystem services that support both the economy and biodiversity. The rich marine biodiversity and fisheries provide significant food security and livelihoods for local communities. Commercial fisheries contribute substantially to the national economy through exports, being the fourth largest foreign currency earner and a significant source of employment, with around 16,800 people working directly in the fishing industry (Iitembu, et al., 2021). The Namibian fishing industry is geared towards exports, with only 25% of production being directed for local consumption (The Namibian, 2021). Fishing activity is regulated through quotas, allocated by the Ministry of Fisheries and Marine Resources (MFMR). In 2019, it was revealed that significant corruption had permeated the allocation of fishing quotas, leading to what is known as the "Fishrot Scandal", resulting in upheaval in the ministry and fishing sector.

In addition, Namibia's marine environment supports tourism activities, with attractions like whale watching and coastal national parks drawing many visitors. The benefits also extend to regulating services, such as carbon sequestration and coastal protection, which help mitigate climate change and buffer against storm surges. Marine-based economic activities are estimated to contribute about 10% of the country's GDP, with maritime transport as the primary contributor, followed by tourism and fisheries (Carbon Trust, 2018).

In Namibia, undervaluing the marine and coastal ecosystems has led to significant degradation over the past fifty years. During the late 1960s and early 1970s, rampant overfishing caused the collapse of small pelagic fish stocks. This was followed by the overfishing of other species such as hake and horse mackerel, impacting the entire Northern Benguela Current ecosystem, particularly affecting seabirds dependent on these fish. The collapse of sardine and anchovy stocks over fifty years shifted Namibia's marine ecosystem from a productive to one dominated by jellyfish and other non-commercial, commercially low-value species like the bearded goby. As a result, the Benguela has become a degraded ecosystem, leading to a significant decline in biodiversity including a drop in the populations of some regionally endemic seabirds, such as the African Penguin, Cape Gannet, Bank Cormorant and Cape Cormorant (Ludynia et al. 2010; Roux et al., 2013 cited in Khan et al., 2021).

1.2 Namibian Islands' Marine Protected Area

The Namibian Islands' Marine Protected Area (NIMPA), situated within a key Ecologically or Biologically Significant Marine Area (EBSA), includes the primary upwelling centre of the Benguela Current off the Namibian coast. Through enforcing its operational management plan, the NIMPA should protect roughly 9,500 km² from damaging activities, making it Africa's second-largest marine protected area. However, this area only covers 1.7% of Namibia's Exclusive Economic Zone (EEZ). It includes 10 islands, and 12 islets or rocks within 2-3 nautical miles offshore, such as Halifax, Mercury, Ichaboe and Possession Islands, which provide breeding and roosting habitats for seabird colonies. These include globally important populations of seabirds such as African Penguins and Bank Cormorants and marine mammals like Cape Fur Seals. The coastal areas are crucial for juvenile and larval stages of pelagic fish and lobsters, offering retention areas and nursery grounds. Despite its size, NIMPA is threatened by overfishing, mining, large mariculture developments, climate change, ineffective management, and a society disconnected from marine values. NIMPA's protection is crucial for conserving these species and their habitats, playing a vital role in Namibia's Marine Spatial Planning (MSP) (Blue Action Fund, 2023; Currie, Grobler, & Kemper , 2008; Namibia Nature Foundation , 2023).

2. Report purpose and definitions

This report aims to highlight a selection of ecosystem services that are being protected and improved through the implementation of the Operational Management Plan (OMP) of the NIMPA. It also aims to help identify where further research and data collection is required in order to achieve the best understanding of the benefits provided by a healthy and thriving NIMPA. It focuses on key ecosystem services which are expected to bring the largest value.

2.1 Ecosystem Services

Ecosystem services (ES) are defined by the Millennium Ecosystem Assessment (MEA) (MEA, n.d.) as the direct and indirect benefits people obtain from their surrounding ecosystems. ES quantification and valuation is often used to demonstrate the benefits of a healthy and thriving ecosystem by illustrating the potential improvements to ES that would be acquired through protection and restoration. For protected areas such as the NIMPA, quantifying and assessing ES can help highlight areas of concern and showcase the impact of the MPA on these services, allowing for better informed and improved resource management decisions.

Ecosystem services can be further categorised into four main types of ES: provisioning (i.e. food provision); regulating (i.e. gas and climate regulation); supporting (i.e. nutrient recycling); and cultural (i.e. cultural heritage and identity). The MEA is widely considered as the baseline for all ES definitions and differentiations.

Brief descriptions of these ES are provided below, showcasing examples of goods and services provided by marine ecosystems. Table 1 outlines the primary benefits associated with each of these ES, although it should be noted that within a functioning ecosystem, no process operates in isolation. As such, to some extent, each ES provides value for all of the benefits listed.

Table 1 – Ecosystem services quantified in the model and their associated benefits (adapted from (Beaumont, 2007)*).*

Ecosystem Service Category	Ecosystem Service Quantified	Associated benefit
Provisioning	Food provision	Fisheries and commercial activity support
	Raw materials	
Regulating	Gas and climate regulation	Climate change mitigation
	Resilience and resistance	Biodiversity improvement
	Biologically mediated habitat	
Supporting	Nutrient recycling	
	Bioremediation of waste	
	Habitat	
Cultural and amenity	Leisure and recreation	Community enhancement
	Cultural heritage and identity	

2.2 Ecosystem Service Valuation

With importance often being assigned to economically viable policies and plans, being able to quantify the value of ecosystems allows scientists and economists to encourage and further justify the inclusion of environmental protection in decision making. Ecosystem service valuation (ESV) is used to both incentivise protection and to help highlight and integrate non-market values into decision making. ESV has grown in popularity over the last three decades, increasing its relevance and impact in policymaking. It is a step towards more inclusive decision-making that

incorporates nature, but it should be recognised that some of nature's benefits simply cannot be measured in monetary terms and therefore values should be considered approximate.

Furthermore, for marine ecosystems specifically, the scarcity of spatial data has been a major challenge, limiting the range of ecosystem services that can be valued. The focus on more accessible habitats such as mangroves, coral reefs, seagrass and salt marshes has delayed the data collection and development of assessment tools for other ecosystems. This has led to a lack of understanding on habitat distribution, which is needed to adequately quantify ecosystem services for marine environments. Furthermore, inadequate knowledge on the spatial interconnectivity of ecosystem services and processes, especially for those associated with the regulatory and habitat functions of marine ecosystems, has made economic valuation more challenging. In the NIMPA there is currently a lack of identification and quantification of ES, but ESV is a step that can be undertaken at a later date once more data on ES has been collected.

2.3 Ecosystem Service Valuation Methodology

Differentiation among ES values for the same ecosystem can often be attributed to the valuation method used in the study. ESV methods are chosen based on a variety of reasons, the most dominant being that of the purpose of the study and the ES that are going to be observed. Other reasonings include ease of communication, participation of available stakeholders, and other practical reasons, such as access to data and expertise. These methodologies rely on two main types of input: questionnaire-based methods and data-based methods.

The methodologies in Table 2 are categorised and defined using the System of Environmental Economic Accounting (SEEA) Ecosystem Accounting (EA) framework (SEEA EA). In summary, *stated preference* methods are used when there is no existing market for the goods provided by the ecosystem, and rely on a sample of individuals determining the value they attach to a specific service, often via a questionnaire. If a market does exist, then a *revealed preference* method can determine how ES appear in market goods. *Cost-based methods* are based on the estimated costs of damages if these ES did not exist, the cost of replacing ES with man-made equivalents, or the cost of restoring existing ecosystems. *Price-based methods* measure the price of the ES directly observable in the market. *Production-based* methods rely on the value of the revenue from the sale of the ecosystem-related goods including the cost of all other inputs. Finally, *benefit transfer methods* use information from existing sites to estimate the value of ES at the study site. More

specifically, they can be defined as "the use of research results from pre-existing primary studies at one or more sites (often called study sites) to predict welfare estimates, such as willingness to pay, for other, typically unstudied sites (often called policy sites)" (Johnston, Waigner, 2015). While *Benefit transfer methods* have not been officially categorised by the SEEA EA, in settings with limited data availability, they are often the most fit for purpose due to the ability to transfer values from one location to another which is likely to be the case when assigning values to ES in the NIMPA.

Table 2 – Valuation method classification into general approach methods

Approach	Valuation method
Stated preference	- Contingent valuation - Deliberative group valuation
Revealed preference	- Hedonic pricing - Travel cost
Cost based	- Avoided damage cost - Replacement cost - Production function approach - Restoration cost
Price based	- Market price
Production based	- Net factor income approach
Other	- Benefit transfer

2.4 Marine Ecosystem Services in Namibia

As outlined in the introduction, Namibia's marine and coastal ecosystems offer a wealth of resources and potential uses, providing a wide range of benefits to people economically, socially, and culturally. The table below outlines the provisioning, supporting, regulating, and cultural ecosystem services generated by Namibia's marine and coastal environment. Many of these ecosystem services are also further provided by the NIMPA and are enhanced due to the protections received by the area.

Table 3: Overview of ecosystem services provided in Namibia's waters (Adapted from Khan et al., 2021).

Categories	Ecosystem services	Example for Namibia
Provisioning	*Food: wild and farmed*	Horse mackerel, Hake, Monkfish, Tuna, Kingklip, some pelagic species, red crab, rock lobster. Oyster farming, abalone farming.
	Non-food organic	Kelp Guano Seaweed
	Mineral	Diamonds Phosphate (not exploited) Gas and Oil (not exploited, but explored) Salt
	Water	Desalination
Supporting services	*Habitat Services*	Fisheries nurseries Migratory birds habitat
Regulating services	*Climate regulation*	CO2 stocks and capture
	Disturbance prevention or moderation	Storm surge and flood protection
	Water treatment and assimilation	Wastewater disposal at sea. Discharges.
	Regulation of water flows	
	Coastal erosion prevention	Beach and coast erosion – natural phenomenon
	Biological control	Regulation against pests, resilience to disease etc.
	Tourism	All coastal and marine tourism activities (wildlife watching, surfing, boat tours, kite surfing, fishing tours)
	Recreation and leisure	Recreational fishing, walking by the beach, surfing.
	Aesthetic experience	Wellbeing and appreciation of inhabitants and visitors of coastal towns.

Cultural and Amenity Services	*Inspiration for culture art and design*	Local art shops selling paintings of the sea in coastal towns.
	Cultural heritage and cultural diversity	Local museums at the coast, Shark Island memorial. Cultural value to Topnaar community.
	Spiritual experience	Unknown (religious ceremonies are conducted mainly in the intertidal zone)
	Education	Scientific research with UNAM campus in Henties Bay

Based on a range of case studies, the average monetary value of 1 km² of marine area is estimated to be equivalent to USD 744 per year (Groot et al. 2012; adjusted for inflation). This suggests that the area covered by NIMPA would represent approximately USD 7,068,000 in benefits per year. This is likely a conservative estimate as these values are based on global averages, and areas with high levels of biodiversity which can yield significantly higher values. The rest of this report highlights different characteristics of NIMPA that suggest that its value is indeed significantly higher.

3. Ecosystem Services in NIMPA

3.1. Threats to Ecosystem Services

Marine ecosystems are changing fast under increasing pressures from climate change and anthropogenic activities. Sea level rise, ocean acidification, eutrophication, changes in water temperature and coastal weather patterns directly impact, often negatively, wild fish stocks and aquaculture production, coastal infrastructures, and recreational activities. Additionally, mass tourism, shipping, deep sea mining, and oil exploitation further damage these often fragile environments. The benefits provided by marine ecosystems are hence under threat, and in some cases shrinking rapidly.

In Namibia, and in NIMPA, there are several threats to the marine environment impacting its ability to deliver ecosystem services including diamond mining, oil and gas exploration, and overfishing.

Diamond mining and illegal kelp harvesting

The NIMPA is diamond-rich as Northward currents along the Namibian coast transport diamond deposits from the mouth of the Orange River. Diamond mining consists of both land-based operations close to the shore as well as marine mining activities. Marine mining activities involve relatively less harmful diver-operated mining northwards from the Chamais Bay shore and diver-operated mining using smaller vessels in shallow waters, as well as more damaging activities such as offshore remote-operated mining in deep waters, inshore and offshore dredge mining and surf zone mining (Currie, Grobler, & Kemper, 2008). Diamond mining poses a threat to ecosystem services in the NIMPA as it causes significant sediment disturbance which can smother habitats and destroy fragile ecosystems. It has also warranted illegal kelp cutting which is done to release marine pipes that get entangled in dense kelp beds. Additionally, diamondiferous gravels are removed during diamond mining, destroying healthy reef areas.

Sediment movement and removal are caused by dredge, pocket beach mining and overburden strip mining, cause the formation of land bridges, which threaten the exposure of ground nesting seabirds to land predators such as brown hyenas and black backed jackals. Sediment movement also displaces local prey available to marine predators. Sediment plumes threaten inshore reef habitats and kelp beds, as the movement of sediments covers kelp beds and rocky outcrops, affecting a host of organisms associated with these habitats. Kelp beds provide shelter and food resources to lobster recruits and other benthic species. Juvenile rock lobsters take shelter at the base of kelp plants. Illegal kelp cutting threatens the loss of habitats of these species. The movement of sediments and destruction of kelp hence causes habitat loss for several species (Pisces Environmental Services, 2007).

Overfishing

Overfishing is a critical issue in Namibian waters and has led to significant degradation of the marine environment over the past five decades. Namibia's marine ecosystem supports a variety of vital fisheries, including small pelagic species like pilchard (sardine), anchovy, and horse mackerel, larger pelagic species like tuna, swordfish, and pelagic shark, and larger demersal species such as hake, monkfish, and sole. The pilchard population has declined by an estimated 99.5% over the last 50 years. The collapse of small pelagic fish stocks in the late 1960s and early 1970s, followed by the overfishing of other species such as rock lobster, hake, and horse mackerel disrupted the entire Northern Benguela Current ecosystem, particularly impacting top predators like seabirds. Similarly, while the number of Cape fur seals in Namibia has remained relatively stable, their distribution has

shifted northward, with the population in southern Namibia declining by half over the past 30 years.

This decline in fish stocks is also believed to threaten employment opportunities, negatively affecting an industry of around 10,000 workers across Walvis Bay and Lüderitz. Given that fisheries historically represented almost 3% of Namibia's GDP, ensuring the sustainability of fish stocks is crucial for the country's economy (International Trade Administration, 2024).

Oil spills and exploitation

Oil spills from ships off the Namibian and South African coasts threaten the population of African penguins which are particularly sensitive to oil pollution (Vanstreels et al., 2023). There are limited ways to mitigate the impact once spills occur.

In addition, recent oil discoveries off the Namibian coastline presage large-scale development, associated with severe marine ecosystem disruption (Cavcic, 2024).

Within this context, it is hence crucial to safeguard the marine ecosystems from these economically profitable but environmentally harmful activities. MPAs, and hence, NIMPA, through the effective implementation of its Operational Management Plan and forbidding or strictly regulating several practices in its waters, provides such protection. The remainder of the report will focus on the ecosystem services and associated benefits that are provided by the NIMPA that will be safeguarded or even enhanced by its effective implementation.

3.2 Provisioning Ecosystem Services

Provisioning services refer to any benefit derived from nature that can be directly utilized by people. In marine ecosystems, these services encompass food (such as fish and shellfish), natural gas extracted from undersea reserves, and medicinal resources derived from marine plants and animals (National Wildlife Federation, n.d.).

Fisheries

MPAs play a crucial role in supporting fish reproduction and maintaining populations. Their benefits extend beyond the protected area, as fish migrate beyond the MPA, benefiting fishers in surrounding zones. Additionally, they aid marine ecosystems in adapting to the impacts of climate change, including ocean acidification. MPAs are considered essential tools in implementing the ecosystem approach to fisheries (EAF) management, which is a legal commitment in the SADC

Fisheries Protocol and a management approach embraced by the Namibian Ministry of Fisheries and Marine Resources (MFMR).

This, in turn, provides economic results, via increased fisheries profitability. Increased profitability can be attributed to the recruitment of juvenile fish within the protected areas and the spillover of fish biomass into regions where fishing occurs. This spillover effect leads to higher revenue per unit of fishing effort or lower effort and costs per unit of fish caught (Davies et al. 2019). When combined with effective fisheries management, MPAs contribute significantly to the sustainable use of oceans by enhancing the long-term productivity of fisheries (Davies et al., 2019, Currie et al. 2008). These benefits, however, are dependent on fisheries management outside the MPA as well (Pantzar et al. 2018).

Under the NIMPA Operational Management Plan, strict fishing regulations are to be followed within the MPA waters. Fishing of certain species is forbidden or restricted depending on the area. This includes species of conservation significance, which will benefit from increased stock. For instance, harvesting of silver kob (kabeljou) a vulnerable species (Saambr, n.d.) and steenbras, an endangered species, ranges from completely forbidden in the line fish sanctuary to restricted in other areas. Restrictions also apply to kelp harvesting and inter-tidal species. Additionally, damaging practices such as purse seining, trawling, and long lining, are forbidden. Aquaculture practices, such as mariculture are permitted under certain regulated conditions only (MFMR, 2012). Commercial Cape Rock lobster (*Jasus lalandii)* fishing is permitted in the NIMPA under strict quotas and outside the bounds of the three lobster sanctuaries.

Focusing on rock lobster as an example can help demonstrate the potential benefits of these protective measures. Lüderitz is Namibia's rock lobster fishing hub, with 17 vessels landing 190 tons of rock lobster and employing about 170 men (2021 data). The Seaflower factory processed these catches, exporting 160 tons of rock lobster worth over USD 2.9 million and selling 30 tons locally for N$6 million, employing both men and women. However, the FAO deems the rock lobster fisheries to be overexploited in Southern Africa, and rock lobster landings in Namibian waters have fluctuated over the last decades but overall are on a downward trend, providing a worrying picture for the industry. The Catch Per Unit Effort (CPUE) for the rock lobster industry has significantly decreased in the last decades, more precisely dropping over 55.3% in the last 24 years. Overfishing in Namibian waters has caused a reduction in the average size of catches, with 72% of rock lobsters caught being undersized. This decline in productivity adversely impacts the livelihoods of communities and leads to decreased economic returns from commercial fisheries nationwide (Shuuluka, 2018). Increasing the rock lobster population, through

appropriate enforcement of NIMPA, could hence not only ensure the sustainability of the industry in years to come but also provide additional jobs and revenues by increasing the industry's profitability.

The NIMPA Operational Management Plan also includes a strong monitoring component, with options for adaptative response as data becomes available. Environmental Impact Assessments (EIAs) are mandatory for new fishing activities, further protecting stocks.

The exact impact of NIMPA enforcement on fisheries will depend on the biological characteristics of the fish populations in and around NIMPA, their exact geographic distribution and current state of their stock, as well as how strictly the NIMPA regulations are implemented (Davies et al., 2019). However, given, the current landscape; it is reasonable to assume a significant positive effect.

Kelp

Modelling has revealed that NIMPA also covers a large area of kelp – *Ecklonia maxima* and *Laminaria schinzii*. These species provide valuable provisioning services. Indeed, they are bottom-growing species that regularly lose large sections of kelp which may drift at sea or wash ashore. This occurs more often after storm events and the amount of kelp floating free in the ocean or drifting onto beaches can be considerable. Collection of drifting kelp at sea or from beaches is possible and in Namibia at least three licenses have been issued for the collection of kelp on beaches in the Lüderitz/Sperregebiet area. By preventing disruption to kelp, enforcement of NIMPA regulations could hence increase these outputs.

More importantly, mariculture is permitted within specific zones of the NIMPA. Companies such as Kelp Blue already have plans to cultivate kelp in these areas. To ensure this mariculture is conducted sustainably, NIMPA enforces strict regulations and monitoring. This rigorous oversight helps balance economic development with the preservation of marine ecosystems, ensuring that mariculture activities do not harm the environment or biodiversity (Kelp Blue, n.d.).

Case study: Columbretes Islands Marine Reserve, Spain

A case study conducted on the Columbretes Islands Marine Reserve (CIMR), in the Western Mediterranean illustrates the significant positive impact of the MPA on local fisheries. Research findings demonstrate a clear spillover effect of fish from the CIMR into adjacent fishing grounds, evidenced by a continuous increase in commercial fish yields within 0.5 km from the MPA boundary throughout the study period. Despite local depletion caused by concentrated fishing efforts along the reserve's edge, there was a noticeable improvement in fish size and species diversity at this border area, indicating it serves as a transitional zone influenced by the MPA. Overall, the establishment of the CIMR has positively influenced the exploitable fish community, demonstrating tangible biomass exportation benefits to surrounding fisheries. (Stobart et al., 2019).

Recommendations:

In order to assess the benefits of NIMPA on fisheries and kelp habitats, further data on species and size of population for fish and kelp within and around NIMPA is needed, hence we recommend the following research is conducted:

- Collect baseline data on fish populations and habitats as well as kelp. The current data lanscape focuses on hake and rock lobster populations, hence data on Orange Roughy (Hoplostethus atlanticus), Snoek (Thyrsites atun), Horse Mackerel (Trachurus trachurus), Cod (Gadus morhua) and shellfish would be particularly relevant .
- Collect baseline data on top predictors of ecosystem health, such as Cape fur seals (Arctocephalus pusillus).
- Encourage the development of eDNA to assess the presence of species and biodiversity levels in specific areas.
- Use models to simulate NIMPA impacts on fish populations and kelp.
- Conduct systematic monitoring of fish stocks and biodiversity within and outside the MPA
- Measure Catch Per Unit Effort (CPUE) to assess fishing efficiency and stock abundance changes.
- Survey local fishers for qualitative data on changes in fish abundance and economic impacts.
- Estimate the financial benefits of enhanced fish stocks through combining data on improved catch rates, increased market value and reduced fishing effort.
- Conduct market research to understand kelp demand and current supply.

3.3 Supporting Ecosystem Services

Supporting services refer to the natural processes that underpin the production of other ecosystem services. In marine ecosystems, these include functions such as nutrient cycling, which involves the movement and exchange of organic and inorganic matter to support marine life; the water cycle, which regulates the distribution and quality of water; and habitat services, which provide essential living spaces for marine organisms such as seagrass beds. These processes are crucial for maintaining the health and productivity of marine environments (National Wildlife Federation, n.d.).

Biodiversity

Evidence from around the globe testifies that MPAs that are highly or fully protected have increased functional biodiversity in their waters, allowed for habitat recovery and increased their climate resilience (Leenhardt et al. 2015). More precisely, MPAs help increase the diversity, abundance, size and biomass of marine species by 2-5 times than in fished areas (Lester et al. 2009, Edgar et al. 2014; McCook et al. 2010).

With an abundant supply of nutrients in the upper layers, the Benguela current region supports a large production of plankton and small pelagic fishes. These in turn provide a food source for larger organisms, making the area ideal as a nursery and feeding habitat for a wide range of fish and bird species.

The coastal and near shore ecosystem in Namibia's waters provide breeding habitat for seabirds and fur seal colonies, as well as a habitat for a number of other endemic and native species, such as seaweeds, molluscs, crustaceans, fish as well as resident and transient marine mammals. Early life stages and juveniles of most fish species found in the northern Benguela ecosystem including Cape hake (*Merluccius capensis)* and Deepwater hake (*M. Paradoxus)*, can be found in the continental shelf ecosystem of the EEZ, providing a key supporting service for local fisheries. The nursery habitat for the biggest commercial fishery, Cape horse mackerel (*Trachurus capensis)*, is found in the shelf-break and slope ecosystem, which also sustains seabird feeding habitats.

The 10 islands, 12 rocks or islets and kelp forests located within the NIMPA provide a sanctuary to a considerable variety of life, including shelter and breeding grounds for the Cape rock lobster (*Jasus lalandii)*, the Southern right whale, and the Heaviside's dolphin. Humpback whales, Dusky dolphins, Minke whales, Southern right whale dolphins and Killer whales are also regularly seen. The Benguela endemic Heaviside's Dolphin (*Cephalorhynchus heavisidii*) and a considerable number of whale species are regularly encountered at sea while vast colonies of Cape Fur Seal (*Arctocephalus pusillus pusillus)* occur near upwelling centres along the coast, e.g. near Lüderitz, Cape Cross, and Cape Fria. Almost 70% of the global population of Cape Fur Seals occur in these Namibian colonies. The islands provide breeding grounds for 11 out of 14 Namibian seabirds, including the endangered African penguin (*Spheniscus demersus)* and 90% of the world's endangered Bank Cormorant (*Phalacrocorax neglectus*). Mercury Island alone, which is ca. 3 hectares in size, was once a vital habitat: in the early 2000s, it hosted over 50% of Namibia' African Penguins, 80% of the world's black cormorants, Namibia'ss second largest Cape Gannet colony and a large number of Cape Cormorants. These species have all dramatically declined in numbers according to the 2023 census. Of particular concern is the African Penguin population: in 2002, 3,000 active nests were

recorded, yet none were found in 2023. Lack of monitoring on the island is thought to be one of the drivers of this decline (Ludynia et al. 2024).

Sharks, skates, rays and chimaeras, collectively known as chondrichthyans, are also in crisis. Populations of many species are in decline, due to an array of threats including overfishing (both targeted and bycatch), habitat degradation and loss. Ocean warming caused by climate breakdown is also likely to have significant impacts on many chondrichthyan species. Many of these species grow slowly, reach sexual maturity at a late age, and have relatively few young over the course of their lifetimes. These life history traits compound the impacts of the threats, reducing the ability of chondrichthyan populations to recover from declines in population size.

Evidence and support are growing for the use of spatial management to protect chondrichthyans. Some marine protected areas (MPAs) have been implemented specifically for shark and ray conservation. However, conservation outcomes of MPAs for mobile and long-lived predators such as sharks are highly variable. The effectiveness of MPAs for chondrichthyans depends on how much the protected area overlaps with the animals' movements and critical habitats. These vary widely by species, meaning that MPAs are more effective for some chondrichthyan species than others. Research has shown that many MPAs designated to protect sharks are too small to do so effectively (Dwyer et al. 2020). Species that are highly migratory, travel large distances along coastlines or regularly move between coastal and offshore habitats are less likely to have protection throughout their full home ranges. The abundance of a given chondrichthyan population and the fishing pressure surrounding the protected area are also important factors determining the size of an effective MPA (Dwyer et al. 2020).

There are at least 88 chondrichthyan species that are thought to inhabit Namibian waters (Leeney 2024), but the first efforts to document chondrichthyan species diversity in Namibian waters only began in 2022. Detailed bathymetry data are not available for the NIMPA, but it appears to be c. 165 m at its deepest. This suggests that some of Namibia's deepwater chondrichthyan species – many of which are encountered by industrial fisheries operating beyond the 200-metre isobath – may also use the deepest sections of the NIMPA, although sampling in those areas would be required to confirm which species are present. At least eight species of shark, three batoid species (two skates and one guitarfish) and one chimaera species are present in the NIMPA. Bronze whaler, (Carcharhinus brachyurus);Tope/ soupfin shark (Galeorhinus galeus); Whitespotted smoothhound (Mustelus palumbes); Smoothhound (Mustelus mustelus); White shark (Carcharodon carcharias);

Sevengill cowshark (Notorynchus cepedianus); Spotted gully shark (Triakis megalopterus) Dark shyshark (Haploblepharus pictus); BATOIDS: Bluntnose guitarfish (Acroteriobatus blochii); Biscuit skate (Raja straeleni); White/ spearnose skate (Rostroraja alba); CHIMAERAS: St. Joseph shark (Callorhinchus capensis). This species list is largely based on the list of chondrichthyans documented during stereo-BRUV surveys in the NIMPA conducted by the NaRaS project (2022 – 2024) and the species that recreational anglers have reported in their catch. The species list is thus biased towards coastal species, and more effort is required to document the species present further offshore.

The effective implementation of the NIMPA, which includes monitoring on the islands, will help increase the sustainability and long-term health of these threatened habitats, along with the various species that depend on them.

Case study: **Importance of MPAs as a nursery habitat, Ghana.**

A participatory project was conducted in Ghana to assess the local communities' priorities within a future MPA. Nursery grounds for fish were the second-highest priority service for the communities. This is due to the fact that shallow waters are essential for providing food, protection, and habitat for juvenile fish, which mature into adults that can be harvested. A nursery is a habitat that facilitates the reproduction of species that eventually form adult populations. Many exploited marine fishery species spend at least part of their life cycle in nearshore coastal habitats. All the ecosystems studied, except for the sandy beach, were ranked highest for providing nursery services by both communities. This choice underscores the importance of fish provisioning for the communities and their understanding of the significance of coastal ecosystems for the continuous supply of fish, which is their top priority. Therefore, we assume that conservation plans in the area would be more effective if they prioritize the protection of fish nursery grounds (Sagoe et al., 2019).

Recommendations:

In order to assess the benefits of NIMPA on habitat functions, further data on the species present within and around NIMPA and their habitat is needed, hence we suggest to:

- Conduct further research on the presence of marine mammals, elasmobranchs, and fish species within the NIMPA, and their abundance over time.
- Partake in stakeholder engagement to assessing priority species for local the local community and economy.
- Conduct additional research on the use of the area by species (breeding, feeding, migratory route etc.).
- Conduct a feasibility assessment of the potential of habitat restoration for key habitat such as kelp, and the impacts on supporting services.

3.4 Regulating Ecosystem Services

Regulating services are the advantages provided by ecosystem processes that mitigate natural events. These include decomposition, water purification, erosion and flood control, carbon storage, and climate regulation (National Wildlife Federation, n.d.). For this section, we will be focusing primarily on climate regulation and carbon sequestration and storage services within the NIMPA.

Blue Carbon

Areas of the Namibian marine environment and adjacent coastlines have the potential to act as active carbon sinks as they contain large stores of carbon accumulated over thousands of years.

Blue Carbon work, to date, has primarily focused on coastal habitats, especially salt marshes, mangroves, and seagrass beds. These, however, are less applicable to Namibia, as Namibian waters are cold, which prohibits the growth of seagrasses and mangrove forests. Further from the shore, carbon can be sequestered in fauna such as cold-water corals, gelatinous plankton, fish, large whales and benthic sediments of the ocean.

In recent years, the blue carbon potential of macroalgae and the seabed has been increasingly recognised which are habitats more applicable to Namibian waters and NIMPA. The Benguela is highly productive and is host to phytoplankton, kelp forests, gelatinous plankton (jellyfish), and historically small pelagic fish. However,

due to anthropogenic pressures, these habitats and populations are being degraded and therefore their capacity to sequester and store carbon is being reduced (Elwen, Ingledew, 2023; Elwen, Pelembe, 2023).

The NIMPA has the potential to protect and manage these habitats and species, whose carbon sequestration potential can be leveraged. Indeed, models suggest that within there is an estimated 5837.23km2 of kelp (Eckolonia and Laminaria species). It is estimated that the total value of Namibia's kelp forests for carbon sequestration and storage could reach US$1,235,814.11 per 100km2, which would amount to an estimated value of US$72,137,305.60 within the NIMPA (Elwen, Ingledew, 2023; Khan, 2022). However, it is likely that within the NIMPA, the majority of the blue carbon is stored and sequestered in the seabed but this has not been quantified.

Case Study: Hauraki Gulf Marine Park, New Zealand

Researchers estimated the value of carbon standing stock in kelp forests through the restoration offered by MPA enforcement in a New Zealand marine park. Under MPA no-take rules urchin predators increase, allowing urchin barrens areas to turn into kelp forests, in turn increasing carbon storage. Currently, only 0.28% of the total 13,900m2 park area is protected. Based on 2021's carbon prices, the potential value of restoring the kelp forests within the park could reach a total value of $NZ7.9million, or approximately NAD88,000,000 (Qu et al. 2023).
However, it is worth noting that the majority of methodologies evaluating carbon capture in the marine space, are centred on mangroves, saltmarshes and seagrass, and hence not directly applicable to NIMPA.

Recommendations:

In order to assess the benefits of NIMPA on carbon removal, we recommend:

- Accurately map and quantify important areas for carbon sequestration and storage within NIMPA and map threats to these sites.
- Assess restoration potential around existing kelp forests within the NIMPA
- Include the monitoring of blue carbon habitats in NIMPA management
- Develop a domestic methodology for carbon capture quantification by Namibian kelp habitats, in line with international carbon credit standards.

3.5 Cultural and Amenity Ecosystem Services

Cultural ecosystem services are non-material benefits that enhance the cultural development and enrichment of people. In the context of marine ecosystems, these services encompass the influence of oceans and coastal areas on local, national, and global cultures, the creation and sharing of knowledge, and the inspiration for creativity in music, art, and architecture. Marine ecosystems also offer recreational activities such as surfing, diving, snorkeling, and coastal tourism, and also constitute a type of cultural and amenity services (National Wildlife Federation, n.d.).

Recreational Activities and Tourism

Recreational activities emerging from the coastal environment include wildlife and bird watching, recreational fishing, off-road driving, sandboarding on dunes, skydiving, kayaking, surfing and sailing. Both locals and tourists engage in these activities, with significant economic impact. Coastal and marine tourism, for instance, though less developed and documented than inland tourism, is significant in Namibia's economy. In 2006, coastal tourism provided approximately 8,300 jobs, with employment growth in this sector averaging 7.6% annually between 2007 and 2011 (Alberts, Barnes, 2008). Cruise tourism in Namibia remains minimal, with only 300 ships visiting for one or two days in 2023 (Walvis Bay Port Captain pers. comm.) A 2008 study estimated that coastal tourism contributed about N$2 billion to the national income in 2020 prices, representing roughly 1% of the Gross National Income (Alberts & Barnes, 2008). Most coastal and marine tourism activities are concentrated around Swakopmund and Walvis Bay, which both possess a resort town atmosphere attracting both tourists and locals. Lüderitz, on the other hand, attracts a smaller number of visitors, likely due to its remote location.

In Lüderitz, the sector currently offers limited job prospects. Ecotourism around Lüderitz focuses on wildlife, including boat tours to see seals, whales, dolphins, and penguins. However, the town's tourism industry is small, with only two boat charters employing around 10 people, and no dedicated tourism centre. The two local catamaran companies offer boat trips to view African penguins on Halifax Island and Heaviside dolphins, which are endemic to the area. Some actors in the tourism industry have had to diversify their income streams in the last few years, due to insufficient revenue. Additionally, around a dozen cruise ships stop in the area each year. Due to Lüderitz's distance from major southern attractions, most tourists come from South Africa or Europe. Hence, tourism opportunities in Lüderitz are currently underutilized, despite the area's unique biodiversity.

Although Lüderitz has not reached its tourism potential, it hosts three significant annual events attracting masses of people and boosting the local economy. Every April, Lüderitz hosts the Crayfish Festival to mark the end of the crayfish season. This significant seasonal event attracts visitors (15,000 in 2018; Shuuluka, 2019) from all 14 regions of Namibia, boosting retail and tourism and creating temporary job opportunities for many Lüderitz residents. The Snoek Derby, also takes place in Luderiz, with around 200 participants aiming to catch the largest snoek fish over a day (New Era, 2016). Additionally, the Lüderitz Speed Challenge, an annual speed sailing event, attracts international participants and visitors. To date, the extreme speed sailing event has produced 95 national and 14 World Records. The Lüderitz Second Lagoon (7.5 kms from town) and en-route to Diaz Point, has become the world's top kite surfing and speed sailing spot. However, the local community has little involvement with this event, and related tourism opportunities remain underdeveloped.

Recreational fishing is a socio-economically important sector which occurs mainly around Walvis Bay, Swakopmund and Henties Bay. The expenditures associated with recreational fishing along the Namibian coast estimated to reach N$1 billion per year (Khan, 2023). A study from 2002 estimated the number of recreational anglers along Namibia's coastline at about 8,300 per year, totalling 173,000 days of angling every year, mostly coming from inland and coastal Namibia as well as South Africa (Barnes et al. 2002). Additionally, recreational harvesting of rock lobster takes place seasonally. However, limited information is available on the current state and potential of the angling sector in Lüderitz.

Enhancing the management of the NIMPA could have a significant positive impact on the underdeveloped tourism industry and more broadly recreational activities,

including recreational fishing, in Lüderitz. Studies from MPAs worldwide suggest that effective management can lead to increased attractiveness of the region, bringing in higher market revenues, entrance fees, and job opportunities (Davis et al. 2019). Indeed, the establishment and management of MPAs can enhance ecosystem conditions, making these sites more attractive to tourists by improving ecosystem quality and increasing wildlife enjoyment. Regulation of professional fishing within MPAs can improve recreational fishing opportunities. Additionally, the "designation effect"[1] of MPAs increases awareness and reputation, drawing more visitors regardless of the state of the ecosystem (Pantzar et al. 2018).

While diving and snorkeling are typically the primary attractions in MPAs, these are not feasible activities in the NIMPA due to murky waters and strong currents. However, NIMPA could draw tourists in alternative ways. For instance, by focusing on increasing populations of iconic species like the African penguin, and dolphins, NIMPA could offer unique wildlife viewing experiences. Areas like Guano Bay could potentially be developed to host eco-friendly activities such as kayaking tours, providing visitors with immersive experiences in nature. The future of cruise ship tourism in NIMPA remains uncertain, as Lüderitz is often a secondary stop to Swakopmund, with fewer ships choosing to dock due to unpredictable weather conditions. However, the increasing wildlife sightings in NIMPA and better marketing of the biodiversity could make it a more appealing destination for cruise lines. Lastly, initiatives surrounding NIMPA aim to further expand tourism potential. These are grouped under the umbrella NIMPA+ project, whose overarching objective is to enhance NIMPA's management, ensuring the preservation of biodiversity and marine ecosystem services. Initiatives include, for instance, developing the Namibian Foundation for the Conservation of Seabirds (NAMCOB) Centre. This centre will showcase the biodiversity in the MPA, and function as a tourism destination, including a coffee shop, souvenir shop and traveler information, further increasing the town's attractivity.

If done in accordance with certain criteria, angling is allowed in NIMPA waters. As regulation of professional fishing will reduce disturbance from commercial fishing, the zone might become a prime area for recreational fishing activities, with a comparative advantage to other coastal locations in Namibia.

Despite being designated in 2009, the NIMPA has not benefited from the MPA "designation effect", due to lack of effective management and marketing, resulting

[1] The "designation effect" refers to the changes and impacts that occur as a result of assigning a status to a particular area, resource, or entity.

in low public awareness. In this context, increasing visibility of the NIMPA is likely to boost tourist interest.

Visits around the marine resources through the mechanisms described above could have a ripple effect on the annual events hosted in Lüderitz, further increasing their scale and associated benefits.

The realized monetary benefits of the MPA derived from tourism and recreational activities will depend on various factors, such as effective marketing, infrastructure development, and ensuring that practices remain sustainable to protect the fragile marine ecosystem of NIMPA. The weather conditions in Lüderitz might however remain a constraint for large tourism development.

Case study: Pondoland MPA, South Africa

The Pondoland MPA, a 1237.3 km2 area off the South African coast, has generated large tourism revenues, mainly due to diving opportunities. Despite being in a remote region, the area's biodiversity, in particular the sardine run taking place every year, enhanced by the MPA, attacts a large number of tourist visit. The direct value of tourism from the MPA is estimated at USD765800. The benefits are not only found within the MPA, but have rippled through the surrounding coast and local economy. However, critics highlight the proliferation of operators, with an adverse impact on the marine environment (Costello, 2024; Dicken, 2010).

Case Study: Lyme Bay UK

Three years after the designation of the Lyme Bay MPA, studies demonstrate a positive income effect on the tourism industry. Indeed, the income generated within the MPA had increased by £2.2 million. Specifically, expenditures by anglers and divers rose by £1,544,068 and £488,613, respectively, due to increases in visits by 19% and 35%. Additionally, the turnover for charter boat operators and dive businesses increased by £108,427 and £39,864, reflecting activity increases of 51% and 201%. This growth may be partly attributed to a decline in activities outside the MPA, where expenditures by anglers decreased by £1,544,068, and the turnover for charter boat operators fell by £108,427. Conversely, divers' expenditures and dive business turnover outside the MPA increased by £488,613 and £39,864 (Rees et al. 2015, cited in Pantzar et al. 2018).

Recommendations:

In order to assess the benefits of NIMPA, a combination of perception data collected via survey or interviews and empirical data on jobs and income is needed. Ideally, these are to be collected before the enforcement of the NIMPA operational management plan, as well as a few years into it to assess progress. These data include:

- Willingness to Pay (WTP) study for tourism activities in Lüderitz
- Interviews with local tourism actors
- Collection of monthly or yearly visitor numbers to Lüderitz
- Room and bed occupancy in Lüderitz (Hospitality Association of Namibia)
- Average daily visitor expenditures at the coast

Research and Education

The endemic and near endemic species found along the coast of Namibia, as well as the nature of the ecosystem, give rise to a wide range of scientific services, in particular research opportunities. The Coastal and Near-Shore zones of Namibia provide the opportunity for educational services surrounding the coastal and marine environment, while the continental shelf, shelf break and slope and deep-sea ecosystem provide the opportunity for research activities on marine resources and ecology.

The NIMPA specifically is host to a number of Benguela endemic species and is an important location for research and education on these species, particularly, the endemic African Penguin, Bank Cormoran, the Cape Cormorant and the Cape Gannet that are, as mentioned above, listed as globally Endangered and locally considered Critically Endangered (Namibia Biodiversity Database, n,.d.). Research in this area is particularly important because the Namibian populations of African Penguins, Cape Gannets and Bank Cormorants breed exclusively within the NIMPA. Alongside species specific research, academic institutions like UNAM, the Nelson Mandela University's Institute for Coastal and Marine Research use the NIMPA for specific research programmes related to the Benguela Current.

As mentioned above, the NIMPA+ initiative project aims to develop the NAMCOB Centre, aiming to safeguard and showcase the biodiversity in the MPA. As well as a centre to enhance tourism, it will function as a marine conservation training and education centre, supporting youth clubs, beach clean ups and local career development by providing skills training on financial literacy and professional development. This could lead to increased education in and engagement with the

Namibian marine wildlife and contribute to the awareness raising of the NIMPA marine environment. Furthermore, the development of the Ocean Literacy Toolkit - a knowledge product including Ocean Literacy principles adapted into the Namibian context and an array of case studies - as a part of the NIMPA+ project will help insert marine education into a broader Namibian curriculum, using research and information gathered from the NIMPA to connect Namibians around the country to their coastline.

NAMCOB is also developing its Young Professionals Marine Biodiversity Managers Programme (YPMBMP), to sustainably build conservation leadership skills in Namibia. The YPMBMP supports the professional development of young adults, providing them with valuable exposure to the workforce, while ensuring a source of income for participants and their families. The program will enrol two university graduates, alongside two community members annually, mentored by locally experienced ranger and conservation experts from NNF, NAMCOB, and SANCCOB, and further, capacitated by an international consortium of partners.

Cultural heritage

There are significant heritage, historical, and cultural services associated with the Namibian coastline. The coastal towns represent the home or the place of birth of some Namibians, as well as being the first landing point of Europeans centuries ago. Many shipwrecks along the coast offer historical sites to be visited. The coastline is also the ancestral land of the Topnaar community. The Topnaars started settling in the Walvis Bay area and along the Kuiseb River at the beginning of the 19th century. Initially, they inhabited the region at the mouth of the Swakop River, where the city of Swakopmund is now located, and then moved southward beyond Walvis Bay to the mouth of the Kuiseb River between 1820 and 1830. In addition, the coast generates aesthetic and symbolic services, as well as bequest and existence services derived from the species, landscapes and ways of life that it represents.

Within the vicinities of NIMPA, a location of significant historical importance is Shark Island. Part of Lüderitz town, it was the site of an internment camp between 1904 and 1908, where up to 3,000 Herero and Nama people died. There is potential for a harbour extension that may impact this historic site.

Being located within and near the NIMPA may ensure protection by proxy to these cultural services and important historical locations by decreasing disturbance and limiting possible damaging activities, therefore preventing further degradation of these areas.

Case study: Existence value of Cape Three Points, Ghana

According to Rodrigues, et al., as of 2017 no marine and coastal cultural ecosystem services were assessed in any country of the African continent so far. However, Sagoe et al., 2017 found that existence values played a vital role in how the community valued their marine protected area. The Cape Three Points community's final important ecosystem service—landing site/existence value—was selected due to the crucial role the sandy beach plays in local fishing activities. Participants noted that landing, sorting, smoking fish, mending nets, and building canoes are all fishing-related activities carried out on the Cape Three Points sandy beach. Additionally, the beach serves as a recreational area where fishermen and other community members engage in various leisure activities. This choice emphasizes the value of the beach and the MPA given by just simply existing.

Recommendations:

While education, research and cultural benefits are non-market benefits and difficult to quantify, the following would support such process:

- Engage stakeholders from different community groups to assess priority cultural services. This could be done via stated or revealed preferences methods described above.
- Assess and combine tourism use data with local use data of the NIMPA to understand similarities and differences between the importance of these ecosystem services to these different groups.
- Participate in knowledge exchanges with other areas where cultural ecosystem services have been measured and assess feasible techniques.

4. Conclusion and limitations

This report set out to highlight ecosystem services are substantially affected by NIMPA, providing high level considerations of their scale and guidance on the data required to proceed to quantification. This exercise helps inform the research needs relating to ecosystem services in the NIMPA going forward, and potential steps to quantifying and valuing these services to demonstrate impact. Quantifying the economic values of protected areas can reveal where goods and services are currently undervalued. This process can also translate the benefits of protected areas into cash or monetary values and generate revenue.

Ecosystem benefits protected and/or enhanced by the enforcement of NIMPA include fisheries, kelp, habitat for a range of species, carbon capture, tourism and recreational activities, education, research and important cultural heritage.

However, several challenges to quantification of these benefits arise. Firstly, although the principles are straightforward, quantifying the extent of MPA benefits is complex. MPAs were not designed as experiments, often making it difficult to separate the ecosystem service effects due protection from those due to varied habitats or other factors. The marine environment also poses challenges for empirical research, partly because techniques like visual sampling, which are used to measure abundance and species diversity, have high imprecision. Additionally, there's uncertainty about the connectivity of marine areas through species movement and seasonal migrations. This does not negate MPA benefits but highlights the challenge in measuring them (Sanchirico et al., 2002). Secondly, while there is a significant amount of research on ecosystem services from the marine environment, they are location-specific, and it is not always possible to transfer values from one area to another.

In the case of NIMPA, additional data on the ecosystem characteristics and stakeholder preferences and behaviour in and around Lüderitz would be needed to implement ecosystem valuation methodologies. Each type of benefit would require additional data collection, as highlighted throughout this report via the recommendations sections, ideally collected before and at several timestamps during NIMPA implementation. When this data is collected and quantified, the benefits of the NIMPA will be appropriately demonstrated and communicated leading to enhanced recognition of the importance of protecting Namibia's waters for biodiversity, climate, and people.

References

Barnes, J., Alberts, M. (2008). Sustainable Natural Resource Use on the Coast of Namibia. DEA Research Discussion Paper, 78.

Barrett, N. S., Buxton, C., & Gardner, C. (2009). Rock lobster movement patterns and population structures within a Tasmanian Marine Protected Area inform fishery and conservation management. Marine and Freshwater Research, 60(5).

Basurto, X. (2017). Linking MPA effectiveness to the future of local rural fishing societies. ICES Journal of Marine Science , 1193-1194.

Beaumont, N. J. (2007). Identification, definition and quantification of goods and services provided by marine biodiversity: Implications for the ecosystem approach. Marine Pollution Bulletin, 54(3), 253-265.

Blue Action Fund. (2023). Grant Fact Sheet, Strengthening and Expanding Namibia's MPA network (NIMPA+). Retrieved from https://www.blueactionfund.org/wp-content/uploads/2023/06/Grant-Fact-Sheet_NNF_Namibia_A4.pdf

Carbon Trust. (2018). Ocean Economies in Southern Africa: The State of Play in Mauritius and Namibia.

Cavcic, M. (2024). Another 'significant' oil discovery springs up offshore Namibia. Retrieved from Offshore Energy.

Costello, M.J. (2024). Evidence of Economic Benefits from Marine protected Areas. Scientia Marina. 88(1). https://doi.org/10.3989/scimar.05417.080

Currie, H., Grobler, K., & Kemper , J. (2008). Namibian Islands' Marine Protected Area. WWF South Africa Report Series , Marine/003.

Davis, K. J., Vianna, G., Meeuwig, J., Meekan, M. J., & Pannell, D. (2019). Estimating the economic benefits and costs of highly-protected marine protected areas. Ecosphere.

Dicken, M. (2010) Socio-Economic Aspects of Boat-Based Ecotourism during the Sardine Run within the Pondoland Marine Protected Area, South Africa. African Journal of Marine Science. 32(2):405-411 DOI:10.2989/1814232X.2010.502642

Edgar, G. J., Stuart-Smith, R., Willis, T., Kininmoth, S., Baker, S. C., Banks, S., Thomson, R. (2014). Global conservation outcomes depend on marine protected areas with five key features. Nature, 216-220.

Elewen, S., Pelembe, T. (2023). Blue Carbon Potential in Namibia. Environmental Research Institute South Atlantic.

Elwen, S. H., Ingledew, J. (2023). Blue Carbon Potential in Namibia Blue Carbon Habitat Mapping Report. A report for the One Ocean Hub.

GIZ. (n.d.). Managing and protecting the Benguela Current marine ecosystem. Retrieved March 20, 2023, from https://www.giz.de/en/worldwide/128746.html

Groot, R. d., Brander , L., Ploeg, S., Costanza, R., Bernard, F., Braat, L., Beukering, P. (2012). Global Estimates of the value of ecosystems and their services in monetary units. Ecosystem Services, 50-61.

Iitembu, J. A., Erasmus, V. N., Uanivi, U., Nakawaya, D., Hoared, R., Nangolo, E., Mwandemele, O. (2021). The hits and misses of Namibia's attempt to implement the Ecosystem Approach to Fisheries (EAF) Management. Ecosystem Health and Sustainability, 7(1). doi:10.1080/20964129.2021.1920340

Johnston, R. J., Waigner, L. (2015). Benefit Transfer for Ecosystem Service Valutation: An Introduction to Theory and Methods. In Johnston, R.J., Rolfe, J. Rosenberg, R. S. Brouwer, R. *Benefit Transfer of Environmental and Resource Values*, 237-273.

Kelp Blue. (n.d.) Re-wilding the Oceans. https://kelp.blue/

Khan, U. (2022). Economic Valuation of Blue Carbon Protection and Restoration in the Namibian EEZ: The Case of Kelp. South Atlantic Environmental Research Institute.

Khan, U. (2023). Economic Value of Marine Recreational Fishery in Namibia. South Atlandic Environmental Research Institute.

Khan, U., Perche, J. Matjila, S. Ingledew, J., Pelembe, T. (2021). Understanding the current, and assessing the future Natural Capital of Namibia's Marine Environment. South Atlantic Environmental Research Institute.

Leenhardt, P., Low, N., Pascal, N., Micheli, F., & Claudet , J. (2015). The Role of Marine Protected Areas in Providing Ecosystem Services. In T. R. Services, Aquatic Functional Biodiversity: An Ecological and Evolutionary Perspective (pp. 211-239).

Lester, S. E., Halpern, B., Grorud-Colvert, K., Lubchenco, J., Ruttenberg, B., Gaines, S., Warner , R. (2009). Biological Effects within no-take marine reserves: a global synthesis. Marine Ecologuy Process Series, 33-46.

Ludynia, K., Jones, R., Kemper, J., Garthe, S., & Underhill, L. G. (2010). Foraging behaviour of bank cormorants in Namibia: Implications for conservation. Endangered Species Research, 12(1), 31-40.

Ludynia, K., Philips, J., Brady, R. (2024). Report to MFMR on NIMPA Seabird Census – Nov/Dec 2023.

McCook, L. J., Ayling, T., Cappo, M., Choat, J., Evans, R., Freitas, D. M., . . . Williamson, D. (2010). Adaptive management of the Great Barrier Reef: a globally significant demomnstration of the benefits of networks of marine reserves. PubMed, 18278-85.

Namibia Biodiversity Database (n.d.). *List of Namibian Species with the IUCN Red List Status.* Retrieved from: https://biodiversity.org.na/redlistspp.php

Namibia Nature Foundation (NNF). (2023). The Namibian Islands' Marine Protected Area Operational Management Plan (unpublished).

National Wildlife Federation. (n.d.). Ecosystem Services. Retrieved June 2024, from https://www.nwf.org/Educational-Resources/Wildlife-Guide/Understanding-Conservation/Ecosystem-Services

New Era. (2016). Schoombee Scoops Snoek Derby. *New Era*. Retrieved from: https://neweralive.na/schoombee-scoops-snoek-derby/

Pantzar, M., Russi, D., Hooper , T., & Haines, R. (2018). Study on the economic benefits of Marine Protected Areas. European Commission .

Pisces Environmental Services. (2007). *Project BEHP/CEA/03/04 : Assessment of cumulative impacts of scouring of sub-tidal areas and kelp cutting by diamond divers in near-shore areas of the BCLME region.* Final Report to the BCLME mining and petroleum activities task group.

Rodrigues, J. G., Conides, A., Rivero, S., Raicevich, S., Pita, P., Kleisner, K. M., Villasante, S. (2017). Marine and Coastal Cultural Ecosystem Services: Knowledge gaps and priorities. One Ecosystem Ecology and Sustainability Data Journal.

Roux, J.-P., van der Lingen, C., Gibbonds, M., Moroff, N., Shannon, L., Smith, A., & Cury, P. (2013). Jellyfication of Marine Ecosystems as a Likely Consequence of Overfishing Small Pelagic Fishes: Lessons from the Benguela. Bulletin of Marine Science, 89, 249-284.

Sagoe, A. A., Aheto, D. W., Okyere, I., Adade, R., & Odoi, J. (2021). Community participation in assessment of fisheries related ecosystem services towards the establishment of marine protected area in the Greater Cape Three Points area in Ghana. Marine Policy.

Sanchirico, J. N., Cochran, A. K., & Emerson, P. (2002). Marine Protected Areas: Economic and Social Implications. Resources for the Future.

Shuuluka, O. (2018). Appraisal of the Economic Potential for the Rock Lobster (Jasus Lalandii) Fishery in Namibia. United nations University Fisheries Training Programme. Retrieved from https://www.grocentre.is/static/gro/publication/680/document/Olivia18prf.pdf

South African Association for Marine Biological Research (SAAMBR). (n.d.). Silver Kob Fact Sheet. Retrieved from ORI Fish App: https://saambr.org.za/wp-content/uploads/2023/03/ORI-Fish-Fact-Silver-Kob-ZC-LB.pdf

Qu, Z. Thrush, S., Blain, C. Lewis, N. (2023), Assessing the Carbon Storage Value of Kelp Forest Restoration in the Hauraku Gulf Marine Park, New Zealand: Lessons from No-Take Marine Protected Areas, *Marine Policy,* 154. https://doi.org/10.1016/j.marpol.2023.105682

The Namibian. (2021). Fish Consumption and Food Security. Retrieved from: https://www.namibian.com.na/fish-consumption-and-food-security/

UNESCO World Heritage Convention. (2016). Benguela Current Marine Ecosystem Sites. Retrieved 2023

Zarate-Barrera, T.G., Maldonado, J.H. (2015). Valuing Blue Carbon: Carbon Sequestration Benefits Provided by the Marine Protected Areas in Colombia. PLoS ONE, 10 (5). https://doi.org/10.1371/journal.pone.0126627