

# UNDERSTANDING AND VALUING MARINE ECOSYSTEM SERVICES IN THE NORTHERN MOZAMBIQUE CHANNEL



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Summary of the study conducted  
by P. Nunes and A. Ghermandi and  
commissioned by WWF International  
(January 2015)



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This summary is based on: Nunes P and Ghermandi A (2015).  
Understanding And Valuing Marine Ecosystem Services In The Northern  
Mozambique Channel. Consultancy report commissioned for the  
Northern Mozambique Channel initiative. WWF International.

# Introduction

The Northern Mozambique Channel (NMC) region is one of world's outstanding terrestrial and marine biodiversity areas and a biological reservoir for the entire coastal area of East Africa. The coastal communities and economies of the countries and islands bordering the channel are intimately dependent on its marine and coastal resources, through fishing, tourism and other economic activities, making their management and protection of key importance.

The NMC region is currently at a crossroad regarding its future socio-economic development and environmental status. Four key features of the region will influence its future trajectory: (1) rich natural assets, as yet only moderately impacted by human activities; (2) rapidly evolving socio-economic drivers and pressures, such as demographic change, present and future growth of economic sectors such as tourism, oil and gas, shipping and fisheries; (3) the majority of its population living in relative poverty and directly dependent on ecosystem services for survival; and (4) inadequate framework of standards for environmental governance.

## **Box 1. Facts and figures on the Northern Mozambique Channel.**

### **Nature**

- Contains 35 % of Indian Ocean coral reefs
- Contains 5% of world's mangrove forests
- Is the 2<sup>nd</sup> peak in biodiversity of hard coral species
- Is a key corridor for humpback whales
- Is on the migration route of WIO tuna and tuna-like species
- Contains large carbon sinks (seagrasses, mangroves, coastal wetlands)

### **Economics**

- marine resources account for approximately 5% of GDP in small Island States.
- small-scale artisanal and subsistence fishers account for 70-80% of total catches.
- NMC provides a significant part of WIO tuna fisheries (\$2 billion/yr)
- NMC supports industrial fishing/mariculture of growing importance
- tourism is among fastest growing sectors/high potential (11% annual growth in Madagascar, annual arrivals)
- NMC holds natural gas reserves, over 100 Tcf\* as currently known
- NMC supports 30% of global tanker traffic, over 5000 tanker-trips annually

### **Geography**

- is home to 10 million people in the coastal zone
- Is bordered by 5 coastal states and comprised of Exclusive Economic Zones (EEZ) only (no areas beyond national jurisdiction)

\*trillion cubic feet

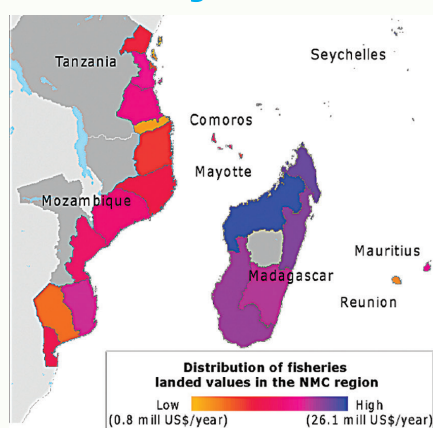
## Ecosystem Values and Services in the NMC

Valuing ecosystem services is useful in helping create better outcomes for nature and people. It has the potential to reconcile and integrate the three pillars of sustainable development (social, environmental and economic). In the past, these were considered to be mutually exclusive, but their interdependence is now increasingly recognized. Ecosystem services concept places functional ecosystems as a foundation for social and economic development. At the same time, it helps communicate the link between direct human needs, such as productive fisheries and a clean environment, and management responses such as fisheries management and coastal zone protection. In the face of competing interests by different users and stakeholders, economic valuation of the benefits provided by coastal and marine ecosystems can help improve the integration of sectoral policies.

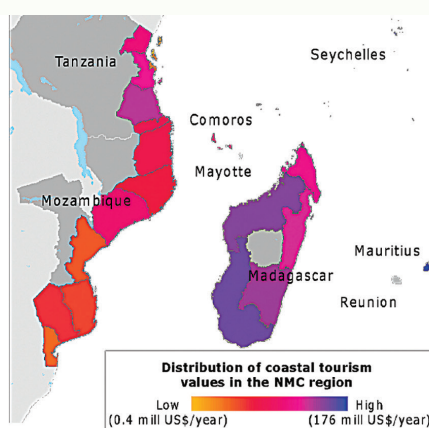
In the NMC region, valuing ecosystem services can help bring together national and sectoral policies in a regional context, and safeguard the natural capital that underpins the economies of all countries. The study by Nunes and Ghermandi (2015) compiled and synthesized data on marine ecosystem services to help identify key ecosystem values of the NMC. Though data on ecosystem services in the Western Indian Ocean is relatively rudimentary, the authors compiled statistics in six key sectors across three ecosystem service groups: cultural (coastal tourism, coastal recreation), provisioning (fishery and mariculture), and regulating services (carbon sequestration and coastal protection).

# Marine Ecosystem Service Values

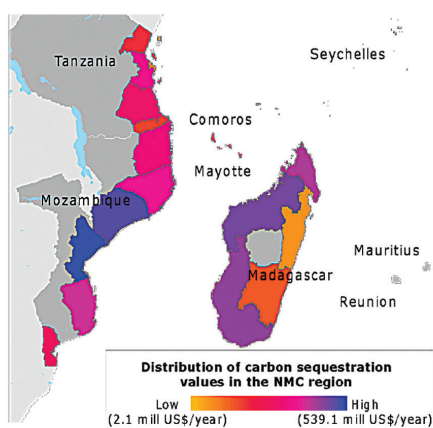
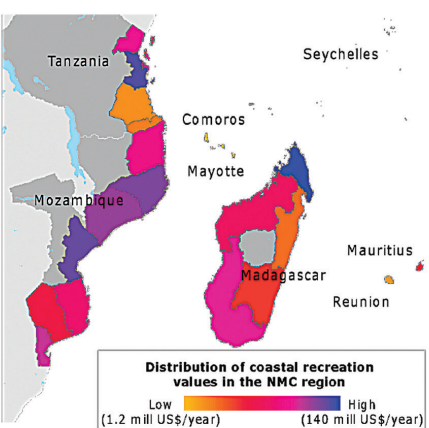
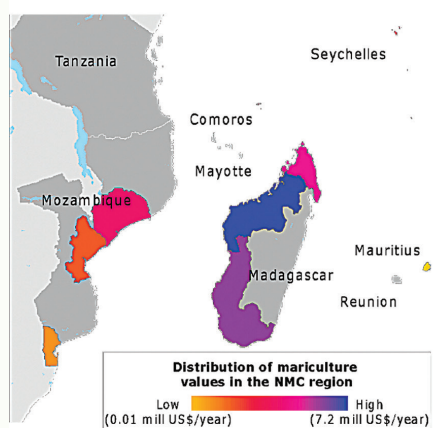
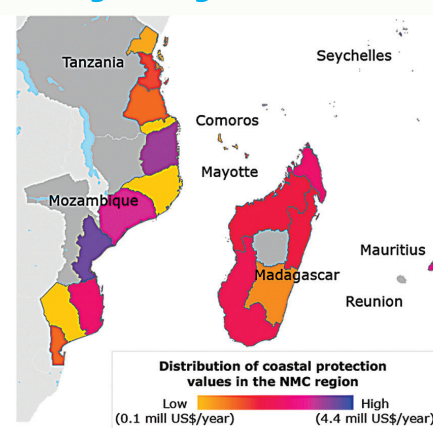
## Provisioning services



## Cultural services



## Regulating services



**Figure 1.** Summary of estimated ecosystem service values, using data available at provincial levels in the Mozambique Channel. In US\$ per year.

Figure 1 shows how ecosystem service values are unevenly distributed across coastal provinces. High provisioning values, for instance, are concentrated in the northwest region of Madagascar (Mahajanga/Boina) (i.e. as mangroves provide nursery and feeding grounds for many fish species), along with high carbon sequestration values, a result of the extensive mangrove forests in this region. High regulating service values are estimated for several regions in Mozambique (Sofala and Zambezia), also due to mangrove and estuarine systems that sequester carbon. Cultural service values are highest in Mauritius, the Antsiranana and Toliary provinces of Madagascar, and Pwani province in Tanzania, as a result of well-developed tourism sectors in those countries and provinces.

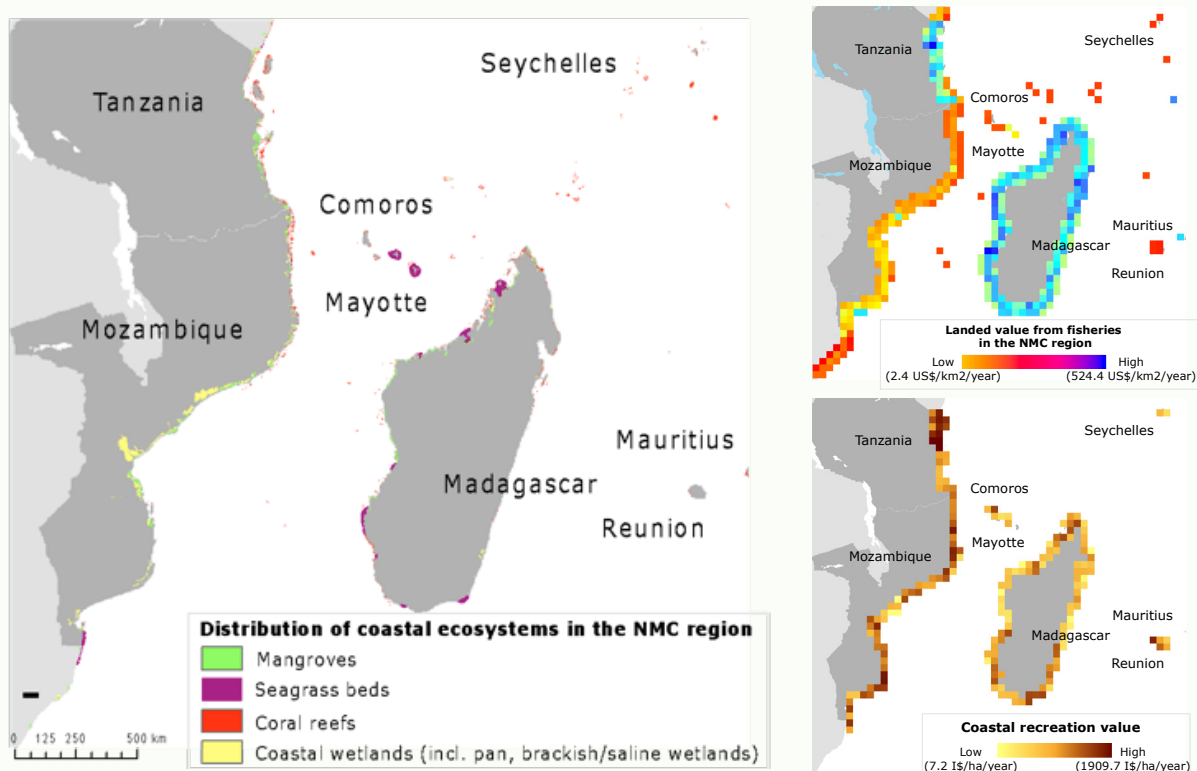
The information compiled in Figure 1 can provide guidance for national and regional policy-makers who, for instance, may be interested in identifying the areas that deliver the highest estimated flows of different ecosystem

service values. This can help identify priority areas, which may be selected for relevant sectoral development in conjunction with spatial planning tools that help segregate incompatible activities and minimize impact to value flows (e.g. Ehler and Douvere 2009, Sale et al. 2014).

The maps of ecosystem service value can help identify gaps (e.g. some provinces had no data), target more in-depth studies for ecosystem service valuation, and provide a platform for starting stakeholder dialogue. The maps also highlight the need for a more integrated approach to ocean management; in some cases the differences in values between countries may reflect different economic and planning histories and levels of sectoral development, rather than differences in the intrinsic value of the ecosystems.

## Habitat-based mapping of Ecosystem Services in the NMC

Where ecosystem service values can be obtained from habitat data, maps of the distribution of key habitats, such as coral reefs, mangroves and seagrasses, can provide finer resolution estimates of ecosystem service value (fig. 2). This often requires combination with other data (e.g. coastal and urban populations or development), enabling extrapolation of estimates over the extent of each habitat. The resulting maps can then be useful for planning at smaller, more local scales, such as in assigning different types of service use to specific habitats and locations.



**Figure 2.** The distribution of coastal ecosystems and habitats in the Mozambique Channel (left) can be used to estimate certain ecosystem services, such as landed value of fisheries (above right) or coastal recreation value (bottom right).

## What affects Ecosystem Service Health?

Ecosystem services are affected by the wider environmental and human systems in complex ways. We therefore need to assess interactions with the broader social, economic and ecological environment to take into account their current health and future prospects. The Driver-Pressure-State-Impact-Response (DPSIR) framework is useful in doing this<sup>1</sup>. Drivers are the demographic, economic, cultural, socio-political or technological forces that underlie the Pressures exerted by human activities. These pressures modify the State of the environmental systems leading to Impacts. Such Impacts may elicit policy Responses to adapt to the environmental changes or mitigate them. The next stages of work will require assessing these alongside finer scale quantification of ecosystem service value.

## Major Ecosystem Services of the NMC

**Provisioning: large scale fishing** – while the coastal fisheries of the NMC are exploited by the coastal states, the higher value oceanic resources (e.g., tuna and tuna like species) are harvested mainly by foreign fishing vessels from Europe and Eastern Asia, with trans-shipment and canning in the region, primarily for export (FAO, 1997).

**Provisioning: small scale fishing** – is performed with small boats, close to shore and mainly for local markets and consumption. Some fishermen sell their catch to middlemen for export. Although typical individual daily catches per fisher are no more than a few kilograms, the collective amount of catch by artisanal fishermen in the region is considerable, and the social benefits are very high (Box 3). In Tanzania, Kenya, Comoros and Madagascar, artisanal/small scale fishers account for more than 80% of their countries' total marine catch.

**Box 2. Major ecosystem services valued in the Nunes and Ghermandi study.**

| Category     | Final services                 |
|--------------|--------------------------------|
| Provisioning | Large scale fishing            |
|              | Artisanal fishing              |
|              | Mariculture                    |
| Cultural     | Coastal tourism and recreation |
| Regulating   | Carbon sequestration           |
|              | Coastal erosion prevention     |

**Box 3. Economic value of small-scale fisheries: evidence from Madagascar**

In Velondriake, a remote rural region in the Toliara province, in the Southwest of Madagascar, a study found that the small-scale fisheries sector employs 87% of the adult population, generates an average of 82% of all household income, and provides the sole protein source in 99% of all household meals with protein. In particular, the study reported that 5,524 metric tons of fish and invertebrates were extracted annually by small-scale fishers, primarily from coral reef ecosystems, of which 83% was sold in the markets, generating fishing revenues of nearly 6.0 million USD (2010, PPP). Furthermore, when accounting for subsistence catch, total annual landings had an estimated value of \$6.9 million USD (2010, PPP).

**Source:** Barnes-Mauthe M, Oleson KLL, Zafindrasilivonona B (2013) *The total economic value of small-scale fisheries with a characterization of post-landing trends: An application in Madagascar with global relevance. Fisheries Research 147: 175-185*

<sup>1</sup>The DPSIR framework has been applied in the Nunes and Ghermandi study but results are not discussed here. For more information, please refer to the full report.

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**Provisioning: mariculture** - total mariculture production in the NMC region was estimated at 10.3 million tons in 2005<sup>2</sup>. Crustaceans (shrimps, lobster and crabs) make up the vast majority of this production (9.6 million tons) followed by demersal fish (0.6 million tons) and oysters (3,000 tons). Most of the shrimp production is concentrated in Madagascar (7.7 million tons) and Mozambique (1.2 million tons).

**Cultural: coastal tourism and recreation** - the annual welfare contribution of coastal recreation benefits in the NMC region is estimated at 763.3 million US\$/year (PPP), ranging from 20% (Tanzania, 2009) to 39% (Seychelles, 2009) of national revenues. Tourism accounts for approximately one third of total exports for Comoros and Seychelles. The average hectare of coastal land in the region is valued at 390.5 US\$/ha/year (PPP) as far as support of recreational activities is concerned. In 2011, 45% of the 130,000 jobs in Inhambane, Mozambique, where approximately 80% of the population lives in conditions of extreme poverty, could be traced back to marine tourism and recreation. Such jobs include employment as beach traders, boat and dive operators, and other activities involved in sport fishing, snorkelling, diving, surfing, kayaking and boating.

High local biodiversity and unpolluted land and sea are important for tourism, and so are iconic species – for example, marine megafauna (dolphins, whales, whale sharks, manta rays) are the primary driver of dive tourism in southern Mozambique, underlining the greater economic benefit of free ranging, alive animals versus dead animals on the market place.

**Regulating: carbon sequestration** - the largest extent of mangrove forests are in Mozambique (3,054 km<sup>2</sup>), Madagascar (2,059 km<sup>2</sup>) and Tanzania (809 km<sup>2</sup>), with those in Mozambique constituting the third largest mangrove area in Africa. Per unit area, mangroves provide on average the highest carbon sequestration service, with seagrasses not far behind, making these ecosystems of key importance in global climate mitigation. The implementation of payment for ecosystem services schemes targeting habitat protection/restoration and blue carbon sequestration in coastal areas represents an important opportunity for the NMC region, as it may provide a win-win situation for environmental conservation and funding sustainable development through financial inflows.

**Regulating: coastal erosion prevention** – coastal protection is worth between 0.5 and 59.8 US\$/ha/year<sup>3</sup>, with highest values in built-up areas, such as in the Seychelles, followed by Toamasina province in Madagascar and Mauritius. The majority of coastal protection values are accrued by the presence of coral reefs (54%) and decrease as the reefs move farther offshore. The overall aggregated monetary estimate of the coastal protection value of coral reefs, mangroves and coastal wetlands in the NMC region amounts to 27.4 million US\$/year (2013, PPP).

## Recommendations

The study supports the following recommendations:

- Ecosystem services, or the value provided by functioning ecosystems, are a foundation for multiple economic sectors and for millions of people living on the shorelines of the Northern Mozambique Channel.
- These are available alongside other resources, such as mineral and energy resources, extraction of which may impact on the ability of ecosystems to regenerate and provide services into the future.
- Valuing ecosystem services as primary national assets to be sustained and enhanced, rather than overexploited and degraded, provides the greatest benefit to national economies and local communities.

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<sup>2</sup> Year of maximum production according to the Sea Around Us project's Global Mariculture database ([www.seaaroundus.org](http://www.seaaroundus.org) accessed December 2014).

<sup>3</sup> in 2013 dollars and corrected for purchasing power parity (abbreviation: 2013, PPP).

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- Compiling and communicating spatial and quantitative/qualitative data on ecosystem services such as that initiated in this study, should be encouraged and engage all actors in a dialogue for developing future scenarios for the region.
  - Marine spatial planning (MSP) is a tool that can be used to maximize the value and sustainability of ecosystem services, while minimizing impacts from their use and shepherding good industry practices.
  - MSP – informed by the valuation of ecosystem services - can provide for an essential framework for future development and growth in the Northern Mozambique Channel.

Key resources for further information on ecosystem service valuation and marine spatial planning include:

#### **Ecosystem service valuation**

- Guerry A.D., et al. (2012) Modeling benefits from nature: using ecosystem services to inform coastal and marine spatial planning. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 8, 107–121.
- TEEB (2013) Guidance Manual for TEEB Country Studies. Version 1.0.#
- <http://www.teebweb.org/resources/ecosystem-services/>

#### **Marine spatial planning**

- Ehler C. & Douvère F. (2007) Marine Spatial Planning - A step by step approach toward Ecosystem-based Management. 1–99.
- Sale P.F., et al. (2014) Transforming management of tropical coastal seas to cope with challenges of the 21st century. *Marine Pollution Bulletin*, 1–16. 10.1016/j.marpolbul.2014.06.005
- Marine Planning website: <http://marineplanning.org/index.html>
- US Government Coastal and Marine Spatial Planning resources: <http://www.cmsp.noaa.gov/>

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The following organizations have committed support to the Northern Mozambique Channel initiative:

Birdlife International  
 Blue Ventures  
 Conservation International  
 CORDIO  
 Fauna and Flora International  
 International Union for the Conservation of Nature  
 RARE Conservation  
 The Nature Conservancy  
 Wildlife Conservation Society  
 World Wild Fund for Nature  
 Zoological Society of London