THE NORTHERN MOZAMBIQUE CHANNEL

Setting the foundations for a regional approach to marine governance

Background Document

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Disclaimer

This publication brings together key information sources on the northern Mozambique Channel subregion, to assist in the development of a regional initiative. In order to show geographic information, names are used reflecting common and published usage in the literature and United Nations system in recent decades. Lines showing administrative, national and EEZ boundaries are approximate, and make no statement on jurisdiction of the territories depicted.

Executive Summary

The Northern Mozambique Channel (NMC) includes parts of the Exclusive Economic Zones of Madagascar, Mozambique, Tanzania and France, and the whole of the Comoros, covering an area of approximately 450,000 km^2. The coastal population of the NMC is currently 10 million and is largely dependent on its healthy and productive ecosystems through fishing, coastal agriculture, tourism and other activities. With natural gas discoveries adding to the riches of the NMC, the region is likely to go through an economic and population boom in the next 2-3 decades, the last great one for countries in Africa emerging from histories of poverty and conflict. This document describes the foundational assets of the NMC region that will support growth and development in a way that could be sustainable and beneficial for all countries and sectors of society, through a holistic approach to development.

While the natural assets that fuel development and growth are clearly in the focus of development agents, corporations and governments, there is a risk for unsustainable exploitation practices to dominate, and deliver a future where wealth is not shared equitably, and the region repeats the development errors of the 20th century in most of the mineral- and energy-rich economies in Africa. To counter this risk, the Capitals Approach is presented, which recognizes the importance of integrated action across five principal assets or capitals for sustainable development – natural, economic, social, human and institutional. The document outlines the principal assets of the NMC in each of these areas, as well as current and future threats to them, and concludes with outlining an approach to regional partnership that could deliver sustainable and equitable ocean-based development for the region.

The natural assets of the NMC include diverse and valuable coastal and pelagic ecosystems including coral reefs, mangroves, seagrasses, open waters and coastal habitats. These support productive fisheries, and sectors such as tourism and coastal development are already expanding. The natural gas fields in the NMC are among the largest globally, and with production horizons of 40-50 years can fuel the region's development over multiple generations. The economic assets of the region build on the natural assets, many of which are only at early stages of exploitation – hydrocarbon and other mining sectors are set to expand exponentially, the Mozambique Channel is a strategic maritime highway of both regional and global significance, and coastal/urban development and tourism are already growing. Coastal fisheries support a large proportion of the coastal communities and are thus of great social value, and while the resources of some locations are heavily to over-exploited, the potential for greater output in well-managed coastal, shelf and pelagic fisheries is high, and could deliver broader economic benefits sustainably.

The social and human assets of the region are diverse, the peoples of the region share four major languages – French, Portuguese, Swahili and Malagasy – with many tribal languages spoken throughout the coastlines. The institutional or political capital of the region reflects a difficult and fractured history, with new models of democracy and inter-governmental cooperation emerging from, in some countries, decades of conflict and hardships. Regional institutions such as the Nairobi Convention and Indian Ocean Commission, and economic and sectoral bodies such as the Southern Africa Development Community (SADC), the Common Market for Eastern and Southern Africa (COMESA) and several Regional Fishery Management Organizations provide a template for building a regional approach to ocean governance.

Education, health and social services in the region are generally poor, reflecting the low income levels and Human Development Index of four of the five countries. Nevertheless, these indicate the enormous potential for growth that the region has: the combination of low income, a youthful population and high population growth rate coinciding with the information age and globalized economy of the 21st century will likely deliver the last major economic and social boom that the world will see. Information and technical capacity in the region is perhaps the weakest of all its assets, yet is of critical and increasing importance for advancement in coming decades. Both local cultures and modern trends are coalescing

to strengthen the role and potential of civil society at all levels of governance in the region, setting the stage for the complex partnership and governance arrangements that 21st century growth and governance will require.

The challenges to development, and drivers of change, in the NMC have been well-described at larger levels for the WIO, through a series of Transboundary Diagnostic Analyses, with ten root causes being identified: population pressure, poverty and inequality, inappropriate governance, inadequate financial resources, inadequate knowledge and awareness, climate change and natural processes, economic drivers, cultural traditions and personal attitudes. Immediate threats particularly relevant to the NMC, that emerge from these drivers, include: destruction and degradation of critical habitats, overexploitation of living resources, population growth enhanced by immigration and attitudes that don't reduce fertility rates, urban and coastal development, short-term profit-maximization as the driving force in economic development, lack of investment in formal, informal and technical education and capacity building, lack of a common ground for institutionalized decision-making across the five countries, and two key cross-cutting issues: maritime and political security, and coping with climate change.

Two opposing scenarios of change are presented to contrast the opposing outcomes that good vs. weak governance may have in delivering a long term (25-50 year) future for the people and economies of the NMC. In the Fuelled Business-As-Usual scenario, weak governance and hydrocarbon riches result in short-term profit maximization by individuals and corporations for their own economic gain, resulting in erosion of natural, social, human and institutional assets. This scenario fails to meet the challenges of managing the commons in favour of private and corporate interests in the distribution of wealth and benefits. The outcome of this approach has been well-documented in energy and mineral-rich locations such as the Niger Delta and the eastern Congo basin. The even higher wealth that can be extracted from the Mozambique Channel's natural gas reserves, and massive populations in the five countries exceeding 500 million people by 2100, may result in even higher social inequalities, crime, corruption and environmental destruction than has occurred elsewhere to date.

The Green/Blue Economy scenario focuses on maintaining and enhancing the health and productivity of renewable natural assets, wealth is shared more equally, governance and social institutions are strengthened and human development and capacity are valued. In this scenario the rapidly expanding pressures of population and economic growth are tempered by policies that limit growth and lead to equitable sharing of wealth from the regional commons. The vast wealth derived from hydrocarbons is reinvested in political, social and welfare institutions that benefit all peoples in the region, while releasing fair profits to corporations. In this scenario, the Capitals Approach provides a framework that facilitates thousands of small and large decisions in many different sectors that reinforce and build on one another, transforming threats into opportunities, and delivering the desired outcome of sustainable and equitable development.

The report concludes with an outline of a strategic approach to build a regional initiative for the Northern Mozambique Channel that uses the Capitals Approach and partnership across governments, the private sector and civil society to deliver a 'Green Economy' future characterized by sustainable generation of wealth and prosperity, and conservation of the oceans.

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The Northern Mozambique Channel (NMC) is bounded by northern Madagascar, northern Mozambique and southern Tanzania, with the Comoro archipelago at its heart. It extends from about 9° S near Aldabra Island in the north, to 17° south at the narrowest part of the Mozambique Channel in the south. It is entirely covered by the Exclusive Economic Zones of the countries in the region – Mozambique, Madagascar, Tanzania, Comoros, Seychelles and France. The NMC is a specialized sub-region of the Western Indian Ocean (WIO), which is at the western extreme of the vast Indo-Pacific. The distinctness of the WIO as a biogeographic province is a result of the equatorial currents that flow across the Indian Ocean from Indonesia, along with aspects of exchange of waters with the northern regions of the Red Sea and Gulfs (see section 2.1).

The NMC countries include three large countries - Mozambique, Madagascar, Tanzania – each with 3-4 administrative provinces bordering the subregion (fig. 1, Table 1). Madagascar is the 4th largest island in the world, and a section of continental crust of Gondwana, and in other aspects of size and marine habitats is closer to the mainland countries. By contrast, the Comores and French territories are small islands. The islands of the Comorian archipelago are high volcanic islands and densely populated, while the other islands are low-lying coral banks and atolls, with no resident human populations. The Seychelles island groups of Aldabra and Farquhar/Coëtivy are closely adjacent to the NMC region.

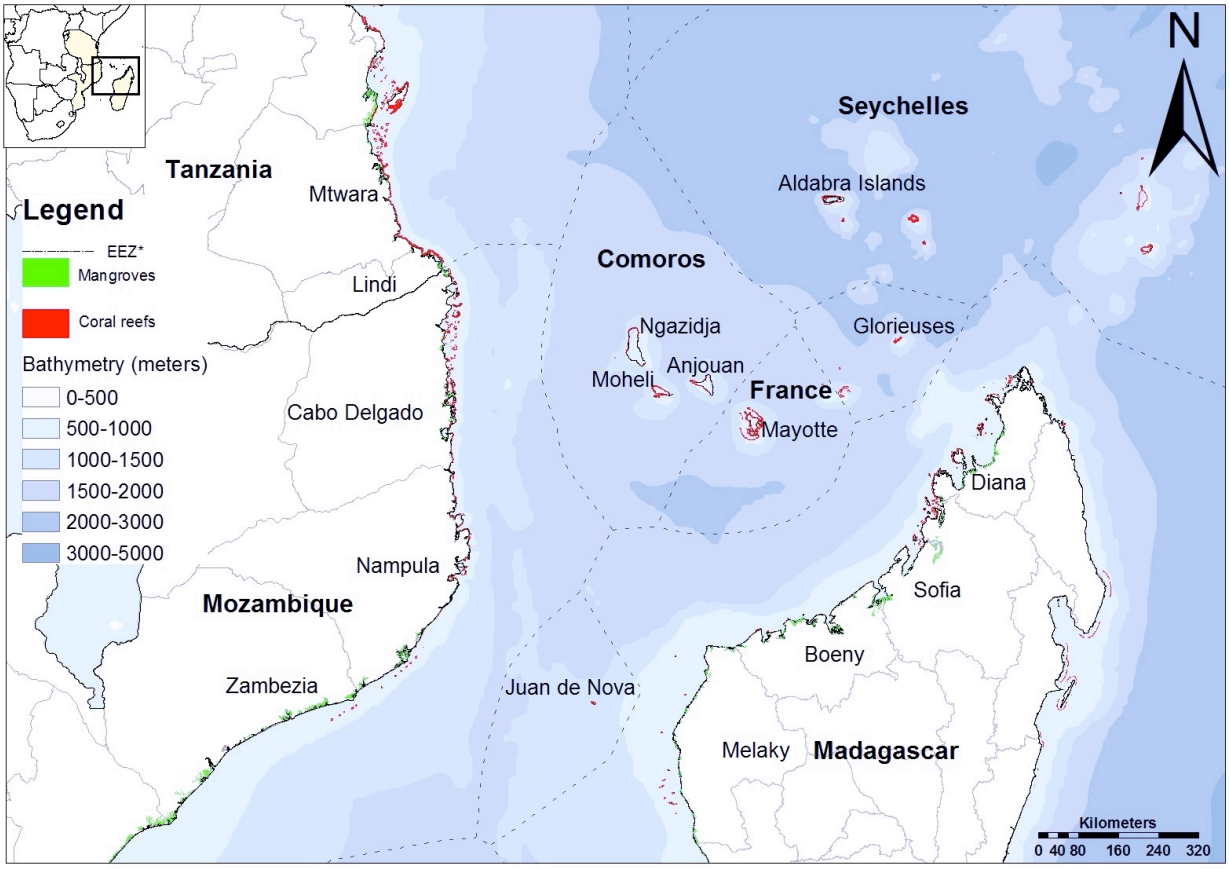

Figure 1. The northern Mozambique Channel, showing the countries and province-level boundaries, principal shallow water habitats, and bathymetry. Approximate positions of the EEZs of countries bordering the Channel are shown for illustration.

The boundaries of Northern Mozambique Channel are not yet defined, and may differ based on different features – the geology and ocean currents give one particular configuration, biodiversity and ecosystem patterns may give another, and the administrative, economic and political characteristics of the coastal states may indicate another set of boundaries. The precise boundaries of the region encompassed within the NMC Initiative will be determined in the future, when the countries and major

partners of the initiative undergo a planning process that will include boundary-setting. For the moment, a loose description of the NMC is followed, encompassing the region shown in fig. 1, extending from Mafia Island in the north, to the Primeiras/Segundas Islands (Mozambique) and Barren Islands (Madagascar) in the south.

Table 1. The countries and higher level administrative regions and around the Northern Mozambique Channel.

Comoros	France	Madagascar	Mozambique	Seychelles	Tanzania
Islands	***Islands***	***Regions***	***Provinces***	***Island groups***	***Provinces***
Anjouan	Isles Glorieuses	Boeny	Cabo Delgado	Aldabra	Lindi
Grande Comores	Juan de Nova	Diana	Nampula	Farquhar	Mtwara
(Ngazidja)	Mayotte	Melaky			Pwani
Moheli		Sofia			

The coastal people and economies of the region are intimately dependent on its marine and coastal resources, through fishing, tourism and other economic activities, making its management and protection of key importance to the countries. This document characterizes the multiple dimensions of the region, presenting a foundation for an initiative to secure the assets of the region for a sustainable future for all the peoples of the region.

2. Capitals and assets of the Northern Mozambique Channel

"There are five types of sustainable capital from which we derive the goods and services we need to improve the quality of our lives".[1]

The "Five Capitals", developed under the Sustainable Livelihoods Approach[2] recognises that wealth is generated from a range of complementary assets, across multiple dimensions that include natural, economic, social, human and political. The five capitals provide a synthetic framework for summarising the assets of the NMC in a way that facilitates development of a strategy for sustainable development to benefit current and future generations of people dependent on the channel. This section introduces these assets or capitals under the five categories of natural, social, human, economic and institutional, setting the stage for later sections of the document that establish a roadmap for action to assure this sustainable future.

2.1. *Natural capital*

Natural capital *(also referred to as environmental or ecological capital) is the natural resources (matter and energy) and processes that provide products and deliver services to people.* This includes the physical environment (including geological and oceanographic features); resources, both renewable (e.g. Fish, wood, crops, water), and non-renewable (fossil fuels); sinks that absorb or recycle wastes (e.g. mangrove forests, oceans); and processes, such as climate regulation and the carbon cycle.

2.1.1. Geology

The Mozambique channel is bounded by deep basins to the north (Somali basin, 5100 m deep) and south (Mozambique Basin, 5000 m deep), with shallower seafloor 3000 m deep at its centre[3] (fig. 2a). The channel is an ancient rift, formed over 180 million years ago when Madagascar (joined to Australia, India and Antarctica) separated from Africa (fig. 2b). Unexpectedly, it is the oldest part of the Indian Ocean, and one of the oldest passive continental margins on the planet[4]. By contrast, relatively recent geological activity has uplifted the centre of the channel, a result of faulting along the Davie Fracture Zone, creating the Sakalave seamounts, or Davie ridge (running north-south between about 13 and 18°S), down the centre of the channel[5]. The origins or the ridge appear to be old continental or lithospheric fractures left over by the initial separation of Madagascar from the African continent. While currently reaching up to 300 m below sea level, peaks on the Davies Ridge have at times formed emergent islands about 30-60 mya.

The Comoro archipelago may have formed from these lithospheric fractures, or from volcanic activity during the Miocene, from about 10 mya, in a series from the oldest island (Mayotte, 5.4 mya), to the youngest island (Ngazidja/Grande Comore, ≈130,000 ya). Currently, there is a shallow subsea mountain to the west of Ngazidja representing the next island under construction over the hotspot. Older volcanic activity is associated with Montagne d'Ambre, in N. Madagascar, as well as Leven Bank and Glorieuses islands, the result of hotspot activity starting about 15 mya.

Hydrocarbon deposits in the channel are in rock formations of diverse ages, from the Jurassic (>144 mya), Cretaceous (144-67 mya) and Cenozoic (< 67 my), resulting from deposition of organic matter from the African and Madagascan land masses in river sediments, trapped in the basins and shelves in the channel. The depth of these sediments exceeds 3000 m in the northern and southern basins of the channel[6]. The great age and stability of the seafloor of the channel may be a key feature in the presence of these abundant deposits, preventing them from being destroyed or altered by geological activity.

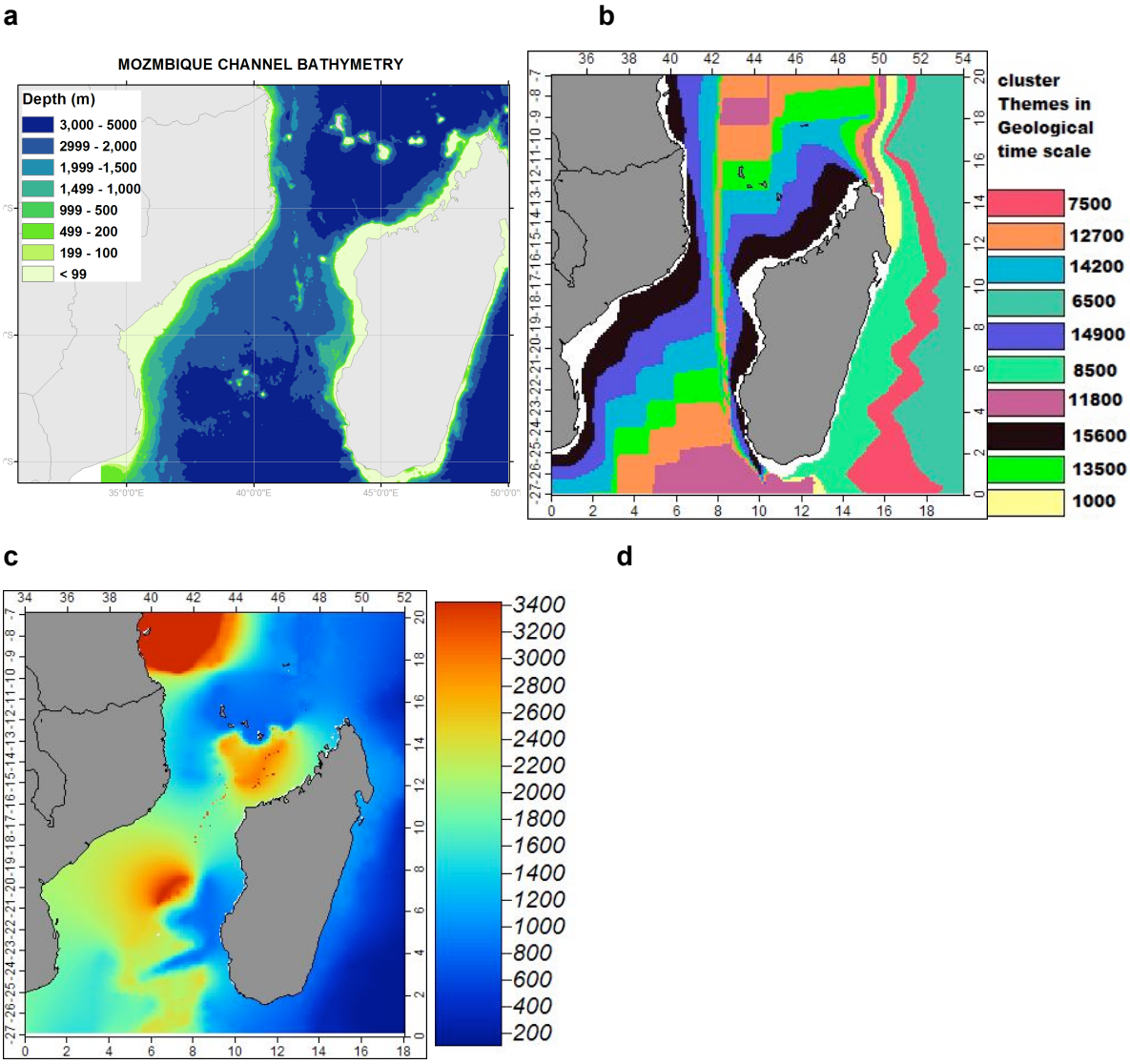

Figure 2. a) Bathymetry, b) age of the ocean floor and c) sediment depths of the Mozambique Channel.

2.1.2. Oceanography

The South Equatorial Current (SEC) is the principal ocean current influencing the Western Indian Ocean, hitting the Madagascar coastline just below its northern tip. Here, it is splits south and north, the northern flow being forced to curl around Cap d'Ambre, the northern tip of Madagascar, imparting a rotation that interacts with the Comoros-Glorieuses islands at the "Glorioso Front". This creates a series of clockwise and anti-clockwise eddies and an intermittent gyre around the Comoro archipelago[7] (fig.

3b). At the mainland coast, divergence of the SEC waters to the north and south occurs within a zone in the northern part of the Quirimbas islands in Mozambique, and Lindi/Mtwara in S. Tanzania. The Glorioso Front and the northern limit of the divergence of SEC waters in southern Tanzania likely define the northern boundary of the NMC in oceanographic terms.

The highly energetic and variable circular currents[8] (eddies, approx. 100-300 km across) cause water to flow in all directions – north, south, east and west - though with a net southward movement, eventually feeding into the Agulhas Current off South Africa. While waters may flow in almost any direction within the channel[9], the shape of the channel and dynamics of the eddies result in a faster southward stream adjacent to the Mozambique coastline (see fig. 3), and high levels of connectivity among all shorelines within the channel. In oceanographic terms it is likely that the narrowest part of the Mozambique channel at about 17°S results in different currents north and south of it, forming a natural boundary for the boundary between the northern and 'southern' Mozambique Channel.

a **b**

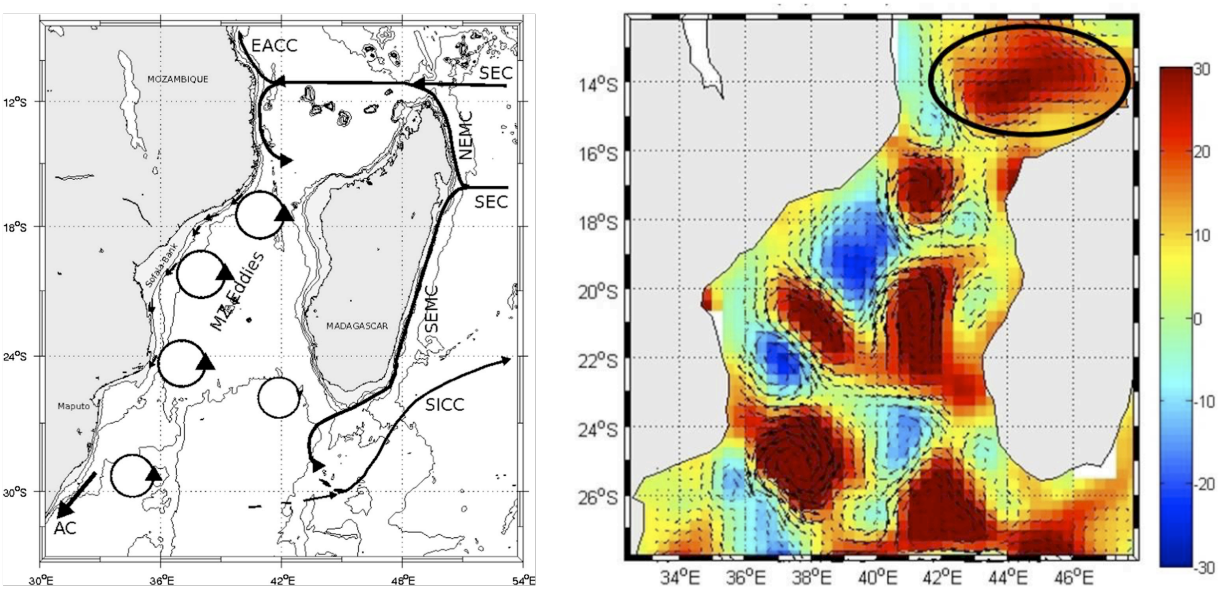

Figure 3. a) Schematic diagram of the oceanography of the Mozambique Channel, showing the main current features, from[10], and b) relative sea surface height (legend in cm, on right) showing the structure of the Comoros gyre in the north (circled), and anti-cyclonic (anti-clockwise, in red) and cyclonic (clockwise, in blue) eddies propagating through the channel[11].

Knowledge of the oceanography of the Mozambique Channel has been completely transformed by research in the last 15 years[12], with the result that now it is understood that there is no "Mozambique Current", and instead the energetic dynamics of the channel and the resulting ecosystem and productivity consequences may constitute grounds for description of a 'large marine ecosystem' (LME), along the lines used by the original identification of LMEs in the 1980s and 90s[13].

The currents have a profound influence on the biological oceanography of the channel including the productivity and distribution of phytoplankton and micro-nekton and therefore also of higher trophic levels from zooplankton to fish to megafauna such as whales and whalesharks[14]. The northern part of the channel is on the annual migration routes of the Indian Ocean tuna stocks[15], though it is not known at present how this may be related to the oceanography.

2.1.3. Marine biodiversity

The Mozambique Channel contains a large proportion (35 %) of the entire Indian Ocean's coral reefs[16] (ca. 11,000 km^2 in the Channel[17] ~ 4% of the global coral reef area)[18], ca. 5% of world's mangrove forests[19] (ca. 7,300 m^2 in the Channel)[20] and seagrass beds. Recent studies show a peak in the diversity of reef taxa (including hard corals[21] and stomatopods[22], but also a range of other species)[23], in the

northern part of the Mozambique Channel, above levels of diversity in the entire Indian Ocean west of the Andaman Sea. Detailed surveys of corals suggest that the highest diversity sites extend from Mafia Island to Nacala (Mozambique) on the mainland coast, and from Diego to Nosy Be in Madagascar, with lower diversity to the south (Primeiras/Segundas and Barren Islands, in Mozambique and Madagascar, respectively) and north (N. Tanzania/S. Kenya) (fig. 4).

The high and unique biodiversity of the NMC is hypothesised to be a result of high levels of connectivity due to the South Equatorial Current and Mozambique Channel eddies, the retention of species there due to its stable coastlines and marine climate, and an evolutionary history preserving unique relict species from the Tethys Sea some 25-40 mya[24]. Consequently, the northern Mozambique channel may be the second peak of shallow marine biodiversity in the world, after the Coral Triangle.

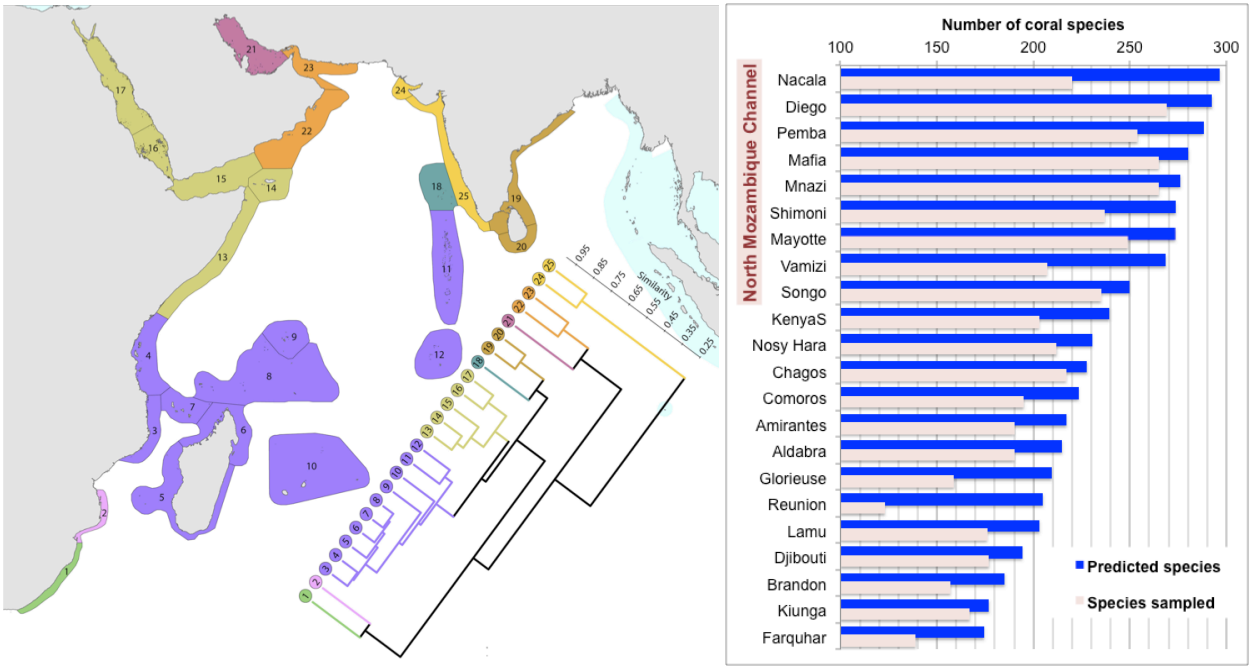

Figure 4. Diversity patterns of corals and in the Indian Ocean, showing the importance of the northern Mozambique Channel as a center of diversity. Left, the Western Indian Ocean (purple regions) is at the core of the biogeographic patterns for the Indian Ocean, shown by the central position of regions in the cluster analysis (Veron et al. 2015) and Right – all of the most diverse sites of the WIO are in the NMC, ordered by the predicted number of species (Obura 2012).

2.1.4. Flagship species/megafauna

Owing to its high productivity, the Mozambique Channel is one of the most important breeding and foraging areas for key indicator and flagship marine species and functions as a corridor for migratory species, such as sea turtles, sharks, marine mammals and tuna. Surveys of the eastern and central parts of the channel have shown several regions of prime importance for foraging megafauna[25], while recent work on the Mozambique coastline has revealed high concentrations of whale sharks and manta rays in the south[26], and humpback whales in the northern part of the channel.

The Mozambique Channel and East African coast are also the prime habitat of the coelacanth[27]; perhaps because the old and steep coastlines (going back 180 million years) and stable configuration of the Channel have provided the long term habitat stability needed for a 'living fossil' of this type to survive over this long period. The combination of flagship species and dynamics of the Mozambique Channel were among the key features that make the channel unique globally, and potentially meeting the standards of outstanding universal value required for World Heritage recognition[28].

2.2. Social capital

Social capital *refers to organisation of society and economic production by human relationships, partnerships and co-operation*. This can include communities and cultural networks, families and kin relationships, communication channels, businesses, trade unions, schools and voluntary organisations. It can also include the set of social norms, values and trust that define how well people interact with one another.

2.2.1. Population and demographics

Table 2. Population statistics for northern Mozambique Channel countries, and estimate of population within 100 km of the coastline within the NMC.

Country	Population (2010) National	Growth rate (%)	% < 20 yrs	Population - Northern Mozambique Channel
Tanzania	44,973,000	2.9	55	1,500,000
Mozambique	23,967,000	2.9	56	3,900,000
Madagascar	21,080,000	3.2	54	3,500,000
Comoros	683,000	2.7	52	720,000
Mayotte	204,000	3.7	55	210,000
Total	***90,909,010***	***3.1***	***54.4***	***9,830,000***

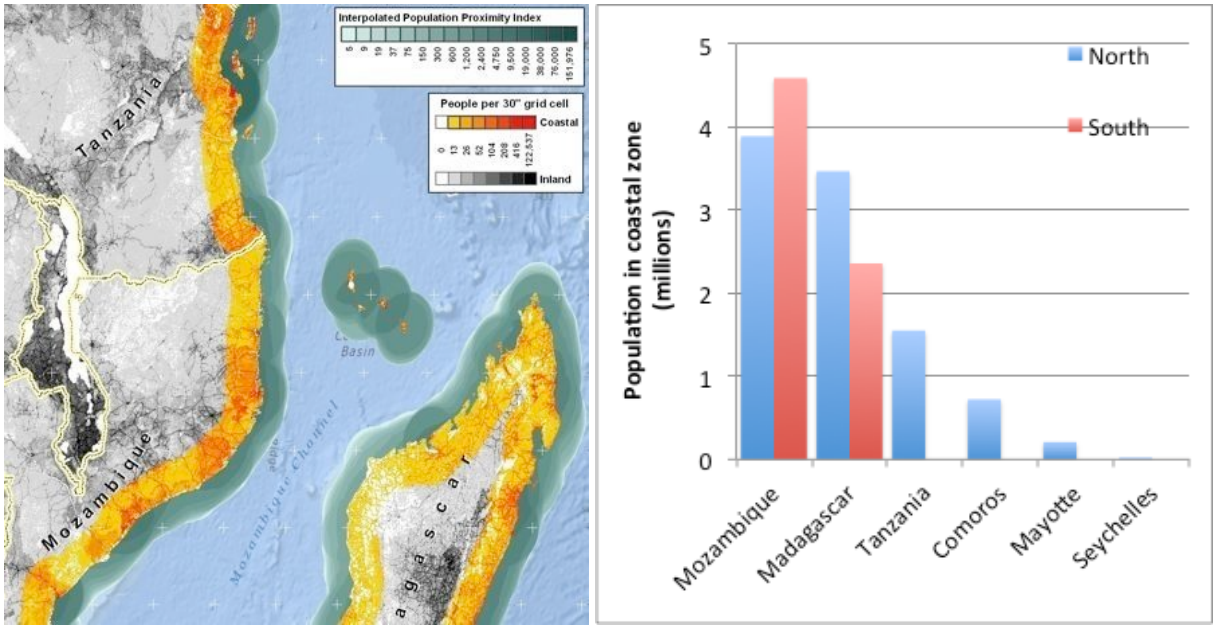

Figure 5. Population within 100 km of the coastline in the Mozambique channel/East African coast, and (right) total population in the northern and southern parts of the channel. Density is coded in the map from yellow (low) to red (high, see legend for details). Shading in the sea illustrates a population proximity index in the sea, indicative of human pressure. Population numbers for the Seychelles and the French Iles Eparses are not shown, as the islands adjacent to or in the NMC only have worker/administrator populations.

The total population of the countries bordering the Mozambique channel were estimated at 90.9 million in 2010 (Table 2)[29], and projected to grow by 2014 to 104.5 million. Population growth rates are relatively high in all the countries, the mean of 3.1% resulting in doubling of national population every 24 years. The countries' populations are youthful, with >50% under 20 years of age. According to the demographic transition model[30], east and southern African countries are transitioning from stage III to stage IV, where high mortality rates have declined quickly due to improved opportunities and medicine, but fertility rates remain high for some time. As a result of this, and of a large population of children maturing into young adults in the next decade, population growth is likely to remain high for several decades to come.

Information on demographic patterns within the coastal zones of the WIO are only estimated, however, as statistics are reported nationally. About 60 million people are estimated to live in the Western Indian Ocean's coastal zone[31]. For the Mozambique channel itself, an estimate of 15 million living in the "coastal zone" has been made, which corresponds to a modeled estimate of 16.7 million living within 100 km of the coast[32]. The northern part of the channel has a larger population, with 9.8 million people, compared to 6.7 million in the south of the channel (fig. 5).

2.2.2. Income and welfare

The countries of the Mozambique channel have the lowest Human Development Index (HDI) and Gross National Income (GNI) among the countries of the WIO, and have a low life expectancy (fig. 6). Poverty levels in the coastal populations of the NMC are extremely high. For example, 92% of Madagascar's population lives on less than $2 per day, with remote coastal regions being among the poorest on the island[33]. Many of the coastal communities throughout the NMC region are highly dependent on marine ecosystems for their survival. Thus local coastal communities arguably have the greatest vested interest in the health of the NMC's ecosystems, since their basic ability to feed themselves and clothe and educate their children is intimately bound with the sustainability of these coastal resources.

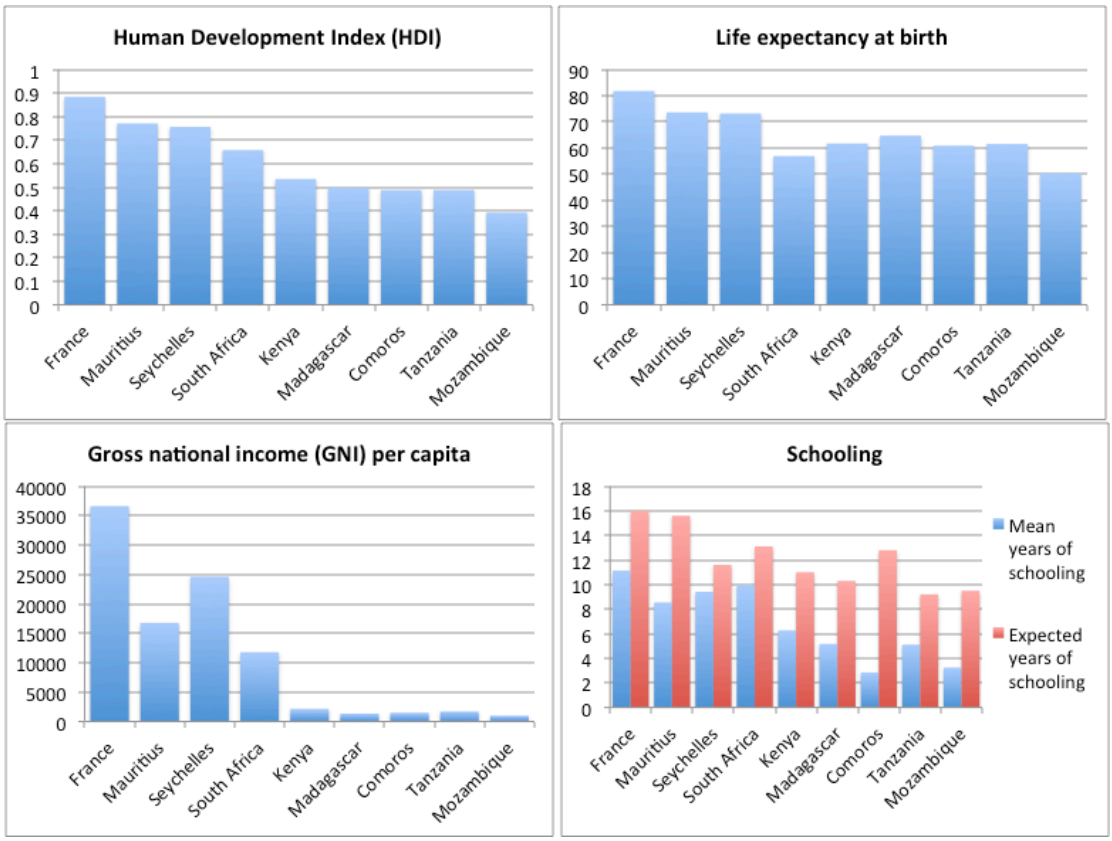

Figure 6. A selection of statistics for countries of the WIO ordered by HDI from left to right: Human Development Index (HDI) and Gross National Income (GNI) per capita on the left, and life expectancy at birth, mean and expected years of schooling on the right. Source: UN population statistics[34].

2.3. *Human capital*

Human capital *includes the knowledge, skills, intellectual outputs, motivation and capacity for relationships of the individual*. It can also include aspects such as health, as well as quality of life and elements such as joy and spirituality. Through knowledge and the freedom to explore, the capacity for innovation and generation of new ideas is included here.

2.3.1. Education

The development of individual members of society, who can contribute to advances in that society is a critical component of development. In relation to this, education, health and the rights of people are fundamental to societal welfare. Given the focus of this initiative on sustainability, two key aspects can be considered as indicative of the region: education/training levels and opportunities and aspects of health related to population growth.

Education levels in the NMC region are likely lower than national averages (see fig. 6), and there are currently just 4 higher learning (university level) institutions in the NMC (Universidad de Lurio, Pemba, Mozambique; University of Comoros, Moroni, Comoros; University of Mahajanga and University of Diego, Madagascar). Of relevance to the marine systems of the NMC the Centre National de Recherche en Oceanographie (CNRO) in Nosy Be, Madagascar, was among the first marine research institutes in the entire WIO in the 1970s, however has faced significant staffing and funding challenges in recent decades. The Centro de Pesquisa do Ambiene Marinho e Coseiro (CEPAM) in Pemba, Mozambique, a research and training center established under the Environment Coordination Ministry (MICOA), has faced chronic shortages of research finance. While Mozambique has a strong focus in its higher education system on fisheries, the other countries of the NMC have a strong terrestrial bias in higher education systems, resulting in an unmet need for technical staff at all levels of marine management and governance.

2.3.2. Health

Human health is intimately linked with environmental health[35], particularly in low-income settings where people derive much of their livelihood from the environment, and live in close contact with it. The Population-Health-Environment (PHE) approach is relevant, in that it works on the premise that the three sectors are interdependent, and that interventions in one must consider and develop outcomes in the others for maximum benefit. Poor environmental management in high density populations in NMC urban areas will lead to poor public health, and vice versa.

Table 3. Family planning indicators – national averages and coastal provinces and regions in the NMC.[36]

Province / region	Total fertility rate	Wanted fertility rate	Contraceptive prev. rate	Unmet family planng needs
Mozambique	5.9	5.1	11.3%	28.5%
Nampula	6.1	5.1	5.0%	25.0%
Cabo Delgado	6.6	6.3	2.9%	12.1%
Tanzania	5.4	4.7	27.4%	25.3%
Mtwara	4.4	4.0	36.8%	23.9%
Lindi			38.5%	23.7%
Comoros	4.3	3.2	14.2%	31.6%
Madagascar	4.8	4.2	29.2%	18.9%
Diana	3.7	3.2	29.1%	19.7%
Sofia	4.4	3.4	17.9%	17.2%
Boeny	4.5	3.9	34.4%	17.0%

Human population dynamics are a key driver of change in all other sectors (see population estimates in 1.2.1) and deserve particular attention, particularly fertility rates and reproductive health. Table 3 summaries the unmet family planning needs of women living in coastal provinces / regions within the NMC. More than 1 in 5 women in the NMC who would like to space or limit their births are not currently using any contraceptive method, and as few as 2.9% of women are currently using a modern contraceptive method despite wanting fewer children than they are having (see Cabo Delgado). To steer population growth towards the median to low trends projected by the UN, aggressive outreach and increases in access to family planning tools by women will be necessary.

2.4. Economic capital

Economic capital *includes the financial and material goods and infrastructure that contribute to production and service provision*. It can include many things, such as financial instruments and reserves, buildings and manufactured goods, infrastructure (transport networks, communications, waste disposal systems), and technologies (from simple tools to ICT and biotechnology).

2.4.1. Economic activity

Economic growth in coming decades in east and southern Africa is expected to be among the highest in the world[37]. This is due to a number of factors: it is the last major world region with low levels of development (i.e. a high potential for growth), it is the last major world region to face a large population boom (ie. a growing market for corporations), the economy of the region is transforming from primarily agricultural, fishery and tourism sectors, to a more diverse mix including manufacturing, mining, service and information sectors, and the natural assets of the region are not yet significantly depleted, new ones are being discovered, and technological innovation will make more assets accessible.

The economic importance and potential of the NMC, as a future driver of national and regional development on a scale not previously realized in East Africa, is emerging. Most directly, this is due to the natural gas reserves recently discovered in the Channel, though it is also supported by the high diversity and productivity of other natural assets (such as fisheries, coral reefs etc, see section 1.1) in the channel, and growing capitalisation of these assets.

Economic activity throughout the NMC region, from artisanal/subsistence to large scale industrial, is directly dependent upon the natural resources in the region. On the whole, the economies of the region are still at low levels of development, with low scores for most important human and economic development indicators (fig. 5). The total value of the NMC economy is not currently known, though a recent estimate of the economic value of the coastal ecosystems of the Western Indian Ocean returned a value of roughly US$ 25 billion per year, with fisheries and tourism contributing most in terms of direct financial benefits[38].

2.4.2. Fisheries

The rich fisheries in the Channel, particularly obvious in the northern part, including major prawn fisheries and a regional tuna stock, are exploited not only by domestic fishing industries but also by foreign fishing fleets. However this is not always to the benefit of the countries of the region. Furthermore, near-shore fish stocks support centuries-old artisanal fishing industries and significantly contribute to the livelihoods and food security of the region's population.

Marine resources account for approximately 5% of the GDP of all South Western Indian Ocean (SWIO) Island States[39] (around 8% for Comoros, 6% for Madagascar and 9% for the Seychelles), with potential for socio-economic improvement with appropriate fisheries management. While these numbers are modest, the low level of technology in small-scale fisheries translates to significant employment in the fisheries sector, with many households gaining their principal livelihood from fishing. For example, approximately 8500 people are directly employed in fishing in the Comoros, 100,000 in Madagascar, and 2000 in the Seychelles[40]. In Madagascar for example, small-scale artisanal and subsistence fishers accounted for 72% of total catches in the 2000s[41].

The tuna fisheries of the Western Indian Ocean alone are valued at over 2 billion US Dollars per year[42], and for the Seychelles tuna fisheries account for about 83% of exports[43]. The total value of tuna and other species in the NMC is not yet known, with great potential for development. Island States such as Comoros or Madagascar have low or negligible industrial capacity to exploit the tropical tunas in their waters, and currently rely on fisheries agreements with long distance fishing nations[44]. One of the biggest challenges is to maximize socio-economic returns from the tuna fishery to the region, and ensure that the appropriate management measures are taken to allow for sustainable exploitation.

The shrimp fishery is well developed in the region, particularly in Madagascar and Mozambique[45]. In Madagascar, shrimp represented 68% of seafood exports (in terms of value) in 2008, and about 7% of all Malagasy exports between 2008 and 2012. However, shrimp stocks are showing signs of overexploitation, with catches decreasing by half from 8645 t in 2002 to 4015 t in 2011. Industrial fleet capacity also declined, from 61 vessels in 2006 to 30 in 2010. This over-exploitation is a threat for the industry, but also for the local communities depending on the fishery (in Ambaro Bay, northwest Madagascar, a stretch of 350 km of mangrove coastline has an estimated 37,000 fishers). One of the biggest challenges in this fishery is related to the complex life cycle of prawns, migrating between the open sea where adults are caught by industrial trawlers, and nearshore mangrove-rich areas, where smaller individuals and juveniles are caught by artisanal gears.

Signs of overexploitation of marine resources are spread through the region, while many local communities in these countries, which are amongst the poorest in the world, depend on seafood for their food security and livelihood. The region therefore offers a good opportunity to further develop a community-based approach for local fisheries management.

2.4.3. Tourism

Tourism in Africa has traditionally focused on inland and wildlife features, though new government policies are emphasizing diversification and growth in coastal tourism attractions and marketing, e.g. for sports fishing, beach, reef diving and ecotourism. In Tanzania, a Southern Coast and Mafia Island Zone that is partially linked to a more traditional Southern Wildlife Area that includes the Selous, is being promoted. Madagascar has a tourism development strategy focused on 'economic poles of attraction' with the primary areas being in the northwest on the island of Nosy Be and the regional capital Antsiranana (Diego). Mozambique has identified priority areas and zones with potential for development (Priority Areas for Tourism Investment - PATis). Increasingly, national policies call for lower volume higher quality tourism that is less damaging to local cultures and biodiversity, while also offering new opportunities for local co-management where this is appropriate.

Mafia Island (Tanzania) was the first marine park in the region, created in 1994. However it still only manages to attract fewer than 1,000 visitors per year. More recently, major new marine parks for biodiversity and tourism have been designated, such as the Mnazi Bay and Ruvuma Estuary Marine Park (Tanzania, 2000), Quirimbas National park (Mozambique 2002), Moheli Marine Park (Comoros 2001), Nosy Tanikely (Madagascar, 2011), Glorieuses (2012, designated as a Strict Nature Reserve), Mayotte Natural Marine Park (2010, including the whole EEZ of 68,381 km^2), Europa (1975), the Primeiras and Segundas Islands as Mozambique's newest and largest MPA[46], and the Barren Islands as Madagascar's newest and largest protected, under a co-management regime with fishers[47]. Increases in national protected areas have been matched by interest in cross-border collaborations, such as between Tanzania and Mozambique proposed by the TRANSMAP project in 2005[48] and the Trans-Frontier Conservation Area (TCFA) that was the precursor to the initiative presented here[49].

While the region has faced significant challenges that have impeded tourism, such as civil strife and insecurity, the first steps of development can be astronomically fast – for example, in 2003 tourism accounted for just over 1% of GDP in Mozambique, but increased to 37% by 2005; between 1990 and 2008 the number of international arrivals in Madagascar rose by an average of 11% annually[50]. Other countries have yet to gain from such growth, such as the Comoros, which in 2006 earned an estimated USD 39 million from 29,000 arrivals. Development aid has played a significant role in developing the natural assets and infrastructure for tourism, such as in the Quirimbas National Park (Mozambique) and the Moheli Marine Park (Comoros).

2.4.4. Extractives - oil and gas

The sedimentary plains occupying parts of the seafloor of the Mozambique Channel have long been recognized as having potential to store trapped hydrocarbons, with exploration for oil and gas starting in the 1950s[51]. However it is only since 2010 that natural gas discoveries in the Rovuma basin (Cabo

Delgado province) have been large enough to support significant investment in extraction and processing infrastructure. Anadarko (an American company) and Eni (an Italian Company) have led exploration activities in their offshore license areas called Area 1 and Area 4, containing the Prosperidade and Golfinho/Atum Complexes, or gas fields[52]. These fields hold about 17-30 Tcf (trillion cubic feet) and 15-35 Tcf of recoverable gas resources, respectively. Two smaller fields (Mamba and Coral fields) contain roughly 62 Tcf and 13 Tcf of gas, respectively.

To extract and process these gas fields, the two companies have oscillated between joint and independent processing plants, in response to multiple drivers including oil prices and government guarantees. One of the options considered, a shared onshore LNG facility at Palma estimated to cost USD $50 billion, would be the largest LNG facility yet to be constructed in the world. Early projections by Anadarko were to start selling LNG in 2018, with production reaching full operational capacity by 2030-32, though these timelines may be delayed with the decrease in oil prices in late 2014.

So far, most of the natural gas discoveries are off northern Mozambique and southern Tanzania in the blocks roughly due west of the Rovuma-Rufiji region, but further exploration for both oil and gas is also under way off the coast of Madagascar, the Comoros, and in the French Iles Éparses. It is possible that additional massive finds may be made. These discoveries could be "game changers" for the region's economies and development. This puts the Mozambique Channel area on the threshold of a resource driven 'bonanza' period, which will require comprehensive preparations to ensure both sustainable economic benefits and environmental protection.

Virtually the entire Mozambique Channel coastline has been divided into exploration blocks[53], including areas currently having protected status, wildlife migration corridors, areas demarcated for tourism development and areas that support fish/ prawn breeding and nurseries - mangroves, coral reefs, sea grass beds, lagoons etc. The Environmental Impact Assessment of the Anadarko/Eni consortium, including mining, onshore processing and transfer to LNG carriers was completed in September 2013[54], initiating the process within Mozambique to consider environmental and social impacts and how to mitigate them. With the potential for additional large hydrocarbon finds throughout the Channel, a regional strategic approach will be essential to manage impacts at this scale, and the application of Strategic Environmental Assessments to coordinate among country policies is being advocated by the Nairobi Convention[55].

The fossil fuel extraction industry has the potential to drive economic expansion in the region for decades to come[56], drawing people into the region attracted by jobs and support services for the growing industry and urban centres. Population growth estimates presented in section 3.4.1 don't take this factor into account, nor is there any current analysis of the impact of increasing wealth and GDP from the oil/gas sector on demand and impacts to the environment. Concommittant with oil/gas expansion will be an increase in shipping and dredging activities, as well as patterns of change such as through growth of development hubs in urban centres, fuelling rural-urban migration.

Extraction of other minerals from the seabed of the Mozambique Channel has not received significant investment or exploration, due to generally disappointing results. The relatively passive nature of the coastlines and seabed may contribute to the lack of exploitable minerals on the seafloor, in contrast to the focus for resources such as Manganese nodules near active spreading ridges.

2.4.5. Maritime transport and trade

The Mozambique Channel forms an important trade route from southern Africa and the South Atlantic to and from the Indian Ocean. The Channel is a strategic trade route for the Southern Africa Development Community (SADC), carrying more than half of the region's merchandise exports and imports. Each of the countries bordering the northern Mozambique Channel has at least one significant sea port, in some cases more: Mtwara (Tanzania), Nacala, Pemba and Angoche (Mozambique), Mahajanga and Antsiranana (Madagascar), and on each of the Comorian islands – Moroni (Grande Comore), Fomboni (Mohéli), Mutsamudu (Anjouan) and Dzaoudzi (Mayotte). There are also smaller ports that are important in regional trade due to poor road networks on the mainland and Madagascar

coasts, and as primary linkages among the Comorian islands. For Madagascar, an estimated 60% of all vessel transport is international (long-distance) with 40% related to domestic port-to-port transport.

The Mozambique Channel is important in global terms, for vessels taking a sheltered route to/from the Cape of Good Hope – 30% of global tanker traffic passes through the Channel, carrying significant risk of oil spills and environmental damage. Comoros is on this route, with more than 500 million tonnes of oil passing close by, representing more than 5,000 tanker-voyages per year. To regulate this, the countries of the region participated in the design of a maritime highway through the IMO[57], though entry into force of this highway has not received its final acceptance. With the development of oil and gas exploitation in the Channel, the scale of shipping operations will be significantly increased, with existing plans for construction of an LNG facility on the northern coast of the Cabo Delgado Province, adding a node for maritime trade at Palma. In addition, increasing inland extraction of coal and other minerals in Mozambique will drive expansion of the ports of Nacala and Pemba, with similar expansion likely to occur in the future for Madagascan mineral exports.

2.4.6. Ecosystem services

Many of the economic sectors above depend on natural assets, which are either renewable, so need management to ensure their regeneration capacity is not undermined, and/or are vulnerable to impacts from use. In addition, there are many indirect or intangible benefits derived from nature that are difficult to include in standard economic analyses. zThe concept of ecosystem services in four main categories provides tools for assessing the comparative value of multiple very different natural assets, and the need to maintain their health and natural resilience to provide for future generations (fig. 7) [58]. This approach has also driven increasing interest in Natural Capital[59], where the value of nature as the foundation for economic activity is recognized and put in an economic framework, whereby the goal is to enhance and increase the value of capital, not reduce or damage it. A recent global analysis calculates that 70% of wealth generated from the oceans is derived from ecosystem services (as compared to minerals/non-living resources)[60].

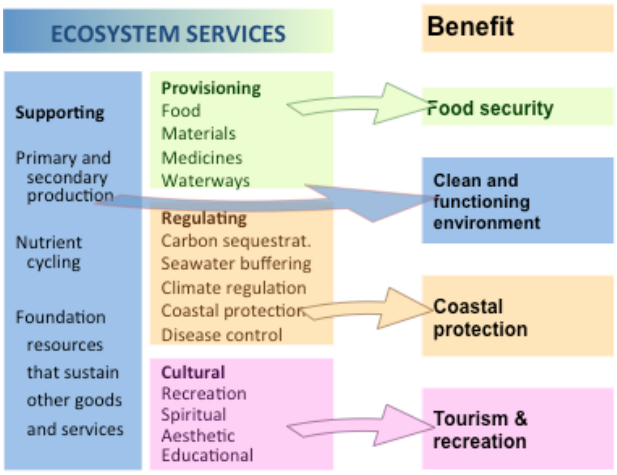

Figure 7. Ecosystem services that provide benefits to society.

A recent study on the countries surrounding the Mozambique Channel explored the comparative ecosystem service values in six key sectors: coastal tourism, coastal recreation, fisheries, mariculture, carbon sequestration and coastal protection[61]. Values are estimated at the level of administrative units (provinces) in each country, reflecting the coarse levels of data currently available (though even at this level gaps are apparent), and provide a first indication of relative value among sectors. Thus, fisheries and mariculture value (ie. provisioning services) are most highly capitalized in NW Madagascar, coastal tourism is less developed within the NMC than in other parts of the countries (e.g. SW Madagascar), and Mozambique shows large differences in coastal protection (regulating services) among provinces. The analysis gives a strong foundation for further work, and in particular to identifying gaps and approaches to improve information on ecosystem service provision and used in the different countries of the NMC, and to generate this at finer resolution to facilitate Marine Spatial Planning in the initiative.

2.5. *Institutional & political capital*

Institutional capital *refers to the governance capabilities and resources that are necessary to govern and allocate rights, access to and use of the other capitals*. Though this may be considered a part of

social capital, in a multi-country initiative such as this, institutional relationships among countries, and among varied stakeholders, are of critical importance, and in themselves can be viewed as a primary asset. Reflecting the three main partners necessary for this partnership, this section outlines government, civil society and private sector institutional assets.

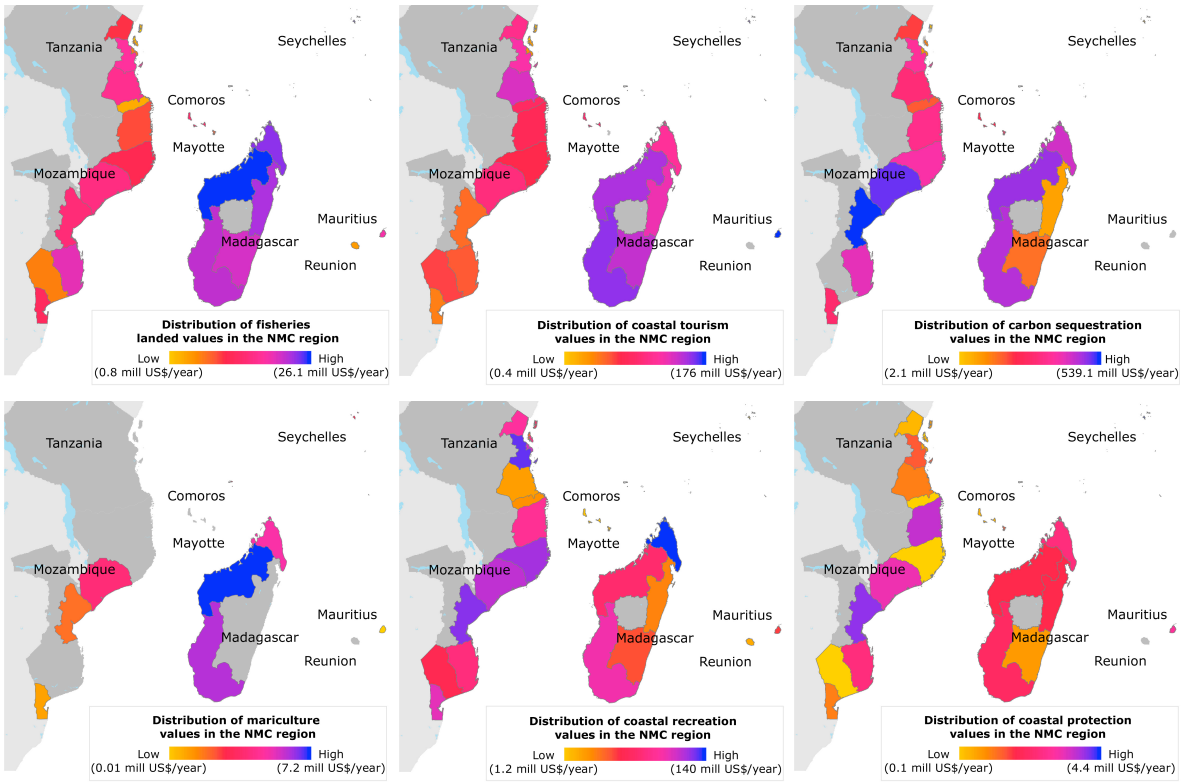

Figure 8. Summary of estimated ecosystem service values in the Western Indian Ocean, aggregated at administrative levels. Source: Nunes and Ghermandi (2014).

2.5.1. National Governments

The NMC is bordered by five countries – Comoros, France (French territories including Mayotte and the Iles Éparses), Madagascar, Mozambique and Tanzania – with some degree of overlap with a sixth – the Seychelles, depending on the eventual definition of the NMC region (Table 4). The entire Comoros territory and EEZ are contained within the NMC region, while for all the other countries, only a part of their territories and EEZs are within the NMC (see fig. 1). National institutions in the NMC countries originate in a diverse set of legal systems, including English, Arabic/Islamic, French and Portuguese (and Dutch)[62], and four major languages are spoken – French, Portuguese, Swahili and Malagasy. The populations of the countries have diverse origins including multiple African ethnic groups and others from the Middle East, SE Asia and Europe. As a result, there is significant variation in policies across the countries, making regional integration a challenge.

Table 4. Countries bordering Northern Mozambique Channel (NMC) and the extent of coverage of their EEZs.

Country	Coverage in NMC	NC	IOC	SADC	COMESA
Comoros	Whole EEZ	✔	✔		
France	Mayotte, Eparses Islands	✔	✔		
Madagascar	Partial, northwest coast	✔	✔	✔	✔
Mozambique	Partial, north coast	✔		✔	✔
Seychelles	Partial, Aldabra group	✔	✔	✔	✔
Tanzania	Partial, south coast	✔		✔	✔

2.5.2. Intergovernmental agreements, conventions and programmes

A broad overview of national institutional structures, and regional agreements and conventions, are provided in the ASCLME Transboundary Diagnostic Analysis[63], and listed here:

Intergovernmental Agreements: The Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (The Nairobi Convention), Indian Ocean Tuna Commission (IOTC), South west Indian Ocean Fisheries Commission (SWIOFC), South Indian Ocean Fisheries Agreement (SIOFA), Indian Ocean MOU on Port State Control

Regional Economic Organisations: African Union (AU), The Southern African Development Community (SADC), The Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC), Indian Ocean Commission (COI/IOC)

Two key regional institutions are relevant to marine/maritime governance in the NMC given their focus on the marine environment:

The Nairobi Convention - was ratified by the ten countries of the Western Indian Ocean region in 1985, emerging from the UNEP Regional Seas programme. It is coordinated at a Secretariat hosted by UNEP under the Division of Environmental Policy Implementation (DEPI). It works through national focal points, and, as needed, various thematic and technical task forces (including a Coral Reef Task Force, Marine Turtle Task Force, group on Marine Protected Areas and a Legal and Technical Working Group). The Secretariat also works closely with collaborating partners such as regional NGOs and various national and research institutions.

The Indian Ocean Commission - was created in 1984 by the General Agreement of Victoria, Seychelles. It is an intergovernmental organization between Comoros, Madagascar, Mauritius, France (on behalf of Réunion) and the Seychelles to encourage diplomatic, economic and commercial cooperation between member States. It has a Secretariat in Mauritius and maintains close coordination through a Memorandum of Understanding with the Nairobi Convention Secretariat, on marine environmental affairs. The Western Indian Ocean Coastal Challenge (WIOCC) was first proposed by President James A. Michel of the Seychelles in 2007 as a "platform to galvanize political, financial and technical commitments and actions at national and regional levels on climate change adaptation, promoting resilient ecosystems (marine and coastal resources), sustainable livelihoods, and human security". It was formally launched with an announcement by President Michel of Seychelles at the Small Island Developing States (SIDS) summit in Samoa, September 2014.

The existence of three regional fisheries organizations illustrates the importance of fisheries economically to the countries of the region, as well as in political and governance dynamics with distant-water nations and their fishing fleets. The Southwest Indian Ocean Fisheries Commission covers the broader southwest region, from a Secretariat in the FAO Subregional Office for Southern Africa (SFS), in Harare, Zimbabwe. The Commission has a Scientific Committee to consider the state of fisheries in the area of competence and to advise on the scientific basis for possible regulatory measures to be considered for adoption by the members of the Commission. The Commission may also establish on an ad hoc basis committees or working parties it may consider necessary. The Indian Ocean Tuna Commisstion (IOTC), based in the Seychelles, is open to Indian Ocean coastal countries and to countries or regional economic integration organisations which are members of the UN or one of its specialized agencies and are fishing for tuna in this ocean. The Southern Indian Ocean Fishery Agreement (SIOFA) primarily deals with demersal fish, overlapping the areas of the IOTC and SWIOFC. These, and the organizations/associations that govern other economic sectors – e.g. martitime trade and shipping, oil and gas industries, and others, provide key frameworks for regional integration in the NMC.

A number of other regional programmes have contributed significantly to the inter-governmental and governance context of the region. Principal among these are technical cooperation programmes funded by the Global Environment Facility (GEF), in particular three 'sister' programmes focused on land-based sources of pollution, marine ecosystem management and fisheries. Reflecting their successful contribution to regional governance and development, all three are in various stages of preparation of second-based projects, for further funding by the GEF[64]. Other donors, whether multilateral (e.g. EU),

bilateral (e.g. FFEM, DfID etc) or from development banks (e.g. AfDB) play a significant role in developing the institutional capital of the WIO. Most recently, an initiative led by the President of the Seychelles, the Western Indian Ocean Coastal Challenge (WIOCC) is building top-level political leadership in marine, climate change and sustainable finance in the WIO, with an official launch at the SIDS Summit in Samoa in October 2014. The programmes listed in this paragraph play a particularly important role in the development of the NMC initiative, as they have developed many strategic plans, built capacity and provided guidance on how to move forward. However given their large regional scope, they often have limited practical application on the ground. Hence, this integrated approach within the NMC can provide a mechanism to implement and integrate the outcomes from these multiple programmes.

2.5.3. Civil Society

Civil society organisations (CSO) provide a key platform for representing the interests of the general public, and cover a broad range of interests from culture and religion through to e.g. Conservation. Non-Government Organizations are an example of civil society organisations, already active in the NMC in the conservation/environment sector, acting from local to national to regional levels. The Consortium for Conservation of Coastal and Marine Ecosystems in the Western Indian Ocean (WIO-C) includes the major NGOs active in marine conservation in the Western Indian Ocean. It was formed under the umbrella of the Nairobi Convention to facilitate engagement of the non-government sector in the processes of the Convention. As of mid-2014, membership of the WIOC comprised the following, *Birdlife International (BI), *Blue Ventures (BV), *Coastal Oceans Research and Development in the Indian Ocean (CORDIO), *Conservation International (CI), East Africa Wild Life Society (EAWLS), Fauna and Flora International (FFI), Intergovernmental Oceanographic Commission (IOC-UNESCO), *International Union for the Conservation of Nature (IUCN), Rare , The Nature Conservancy (TNC), Western Indian Ocean Marine Science Association (WIOMSA), Wetlands International (WI), Wildlife Conservation Society (WCS), and *Worldwide Fund for Nature (WWF)[65].

Less engaged at the larger regional scale, though often with greater involvement at local to national levels, are CSOs and Foundations representing the interests and rights of various sectors of the public, particularly the poor and disadvantaged, in health, education, religion, culture and other social sectors. Strengthening the CSO sector will provide a key mechanism for improved engagement of the public in governance and institutional frameworks in the NMCi. To this end, a consultancy on CSO strengthening is being commissioned by WWF in the NMC region[66], to inform further steps in building CSO involvement in the NMCi.

2.5.4. Private sector

Institutional assets in the Private Sector may be in the form of the values and constitutions of individual organisations and their commitment to compatible outcomes with this initiative, but also in associations, that tend to form around sectoral interests. For example:

- In the oil and gas sector, the Oil and Gas Association of Tanzania (OGAT), a private sector association of major companies is active, with strong links to government. In Madagascar, the Extracting Industries Transparency Initiative (EITI) brings together the industry and government, with a role for other stakeholders, in maintaining standards in the sector. Variants of these in the other countries, joined in a regional network may provide an appropriate institutional framework for engagement at the scale of the NMC.

- In the tourism sector, eco-labelling and standards can provide a mechanism for regional integration through market-based mechanisms. Alternatively, initiatives such as the Long Run Initiative[67], in which destinations align under a particular set of values, may provide novel incentives for a more holistic approach to development (see also Blue Flag beaches and others).

Each of the major economic sectors identified in section 1.4 has a strong constituency of actors that may be more or less organized in representative associations

2.5.5. Biodiversity management and conservation

Institutions for biodiversity management and conservation from an important sub-sector of the governance/ institutional landscape of the countries of the NMC. Historically, biodiversity management has been mandated through government institutions with a primary focus on conservation and protection. However, in line with the global shift towards diversification of the goals for protected areas and biodiversity conservation, institutional goals have broadened to include fisheries management, income generation and livelihood support. In parallel with this, and driven by growing focus on human rights and community-based empowerment and ownership, community-based and civil society institutions have gained in strength to implement Locally Managed Marine Areas[68] (fig. 9). While generally local in focus, networking among community institutions to national and now regional levels is occurring, with an increasing area designated as LMMAs (11,329 km^2), about one third of the total area under management in the region (43,321 km^2)[69]. For both government and community-led management

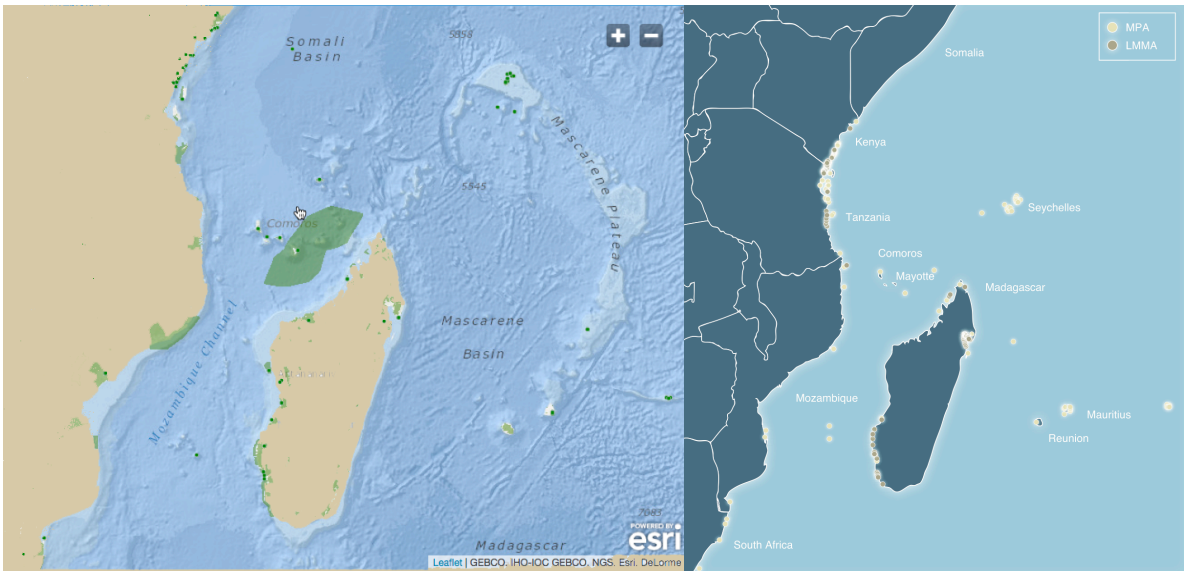

Figure 9. Protected areas, both national and community-run, in the Western Indian Ocean. Left: MPA polygons from the World Database on Protected Areas, emphasizing the size of recent MPAs in Mozambique and France; source: UNEP-WCMC Ocean Data Viewer; Right: location of MPAs and LMMAs, emphasizing the number of individual sites. Source: Rocliffe et al. 2014[70].

areas, laws and regulations are passed by the respective national governments, though capacity for implementation varies greatly among countries, as well as among institutions and locations within countries

The potential of the northern Mozambique Channel as a transboundary site for regional conservation was first identified by experts during a regional workshop organized through the Indian Ocean Commission (IOC) in November 2009, in Antananarivo, Madagascar[71]. Such transboundary networking of management areas would build on individual sites already in place and under multiple different management entities and authorities. In 2012, an assessment by the UNESCO World Heritage Centre Marine Programme identified the Mozambique Channel as the highest priority region meeting the design criteria for a serial World Heritage Site[72], comprising multiple sites of potential Outstanding Universal Value. Also in 2012, the NMC was described as meeting the criteria for Ecologically or Biologically Significant Areas (EBSAs) under the Convention on Biological Diversity, accepted by the Parties to the Convention in 2014[73].

3. Long term change in the NMC

This section outlines the drivers of change in the NMC and how these may lead to two opposing futures for the region. Both futures are characterized by greater wealth, but in one this is captured by the elites, inequality increases among people in the region and insecurity and vulnerability affect the larger

proportion of society. In the other the wealth is shared more equitably, leading to a more harmonious and sustainable future.

Classically, drivers of change are viewed through an opportunities vs. threats framework, such as the DPSIR framework commonly used in large project planning[74]. However, one projects opportunity may be another's threat, leading to conflict between actors – this is the typical case between development and conservation. Rather than taking this approach, we present both the opportunity and threat, seen from the perspective of the Capitals Approach – where interventions should build capitals and assets, not undermine them, and also applying an equity principle such that no sectors of society are disadvantaged by another's activities (see section 3.1.1).

3.1. Drivers of change in the NMC

The preceding sections list significant assets of the Mozambique Channel that will be the engines of development in the near future. However, the ecosystems, the resources they provide and the services that people benefit from are already under significant pressure from the very human activities they support, resulting in habitat degradation, pollution and over-exploitation of resources. Risks are expected to increase in the future as pressures escalate from population growth, urban development, migration to the coast and from rural to urban areas, terrestrial runoff, overexploitation of critical habitats such as coral reefs and mangroves, unregulated fisheries, tourism, oil and gas development, shipping and climate change[75]. Inappropriate, and particularly short term and sectoral goals can result in exploitation that significantly erodes the value of the targeted and other assets, as has been demonstrated in many countries with vast natural wealth but weak governance systems[76].

The three regional marine programmes funded by the Global Environment Facility (GEF)[77] identified root causes driving negative change in the WIO, and key areas of concern resulting from these. These are summarised in the following tables (4-6).

Table 5. Generic root causes of trans-boundary problems, from the WIOLAB and ASCLME-SWIOFP Trans-boundary Diagnostic analyses (Sources: Table 6, WIOSAP 2009; ASCLME/SWIOFP 2009)

A. Population pressure	Rapid population growth and associated urbanization in the WIO Region has increased generation of waste and concentration of waste streams. Also, population growth has led to increased demand for ecosystem goods and services.
B. Poverty and inequality	The WIO region is characterized by high poverty levels resulting in increased reliance on the exploitation of natural resources. The consequent lack of financial resources has led to problems such as inadequate sanitation infrastructure, and institutions and regulatory bodies lacking capacity.
C. Inappropriate governance	In the countries of the WIO region there exists a weakness in policy, legal and institutional structures and building blocks for effective management of the coastal and marine environment.
D. Inadequate financial resources	Most countries in the WIO region do not have adequate financial resources, whether in absolute terms or through inadequate priority setting, for effective management of the coastal and marine environment.
E. Inadequate knowledge and awareness	Gaps in knowledge base and inadequate awareness of the value of ecosystem goods and services provided by a healthy coastal and marine environment are a major cause of management inefficiencies by coastal communities and policy makers in the WIO Region.
F. Climate change and natural processes	Climate change and natural variability in the WIO Region is already influencing rainfall patterns, the flow patterns of rivers impacting on floodplains, deltas and coastal ecosystems, as evidenced by the bleaching of corals.
G. Economic drivers	The demand for ecosystem goods and services, including from export markets, is exceeding the availability and regeneration capacity of elements of the ecosystem in the WIO Region.
H. Cultural traditions	In some cases, cultural traditions that were appropriate to historical contexts and population size are no longer appropriate to the current situation, thus need to be changed. At the same time, valuable traditions from the past are increasingly lost through rapid urbanisation and demographic changes.
I. Personal attitude	Among many in the region, there is a culture of entitlement, whereby people believe they have a

	right to resources, regardless of the status of those resources. Associated with a culture of blame shifting, not taking responsibility for one's actions. Other underlying causes associated with which this root cause was associated included bribery, greed and corruption and negligence

Table 6. Key areas of concern, identified by the WIOSAP (2009)

Habitat degradation	Water quality/pollution	Alteration of river flows	Governance/policy
Degradation of mangrove forests	Microbial contamination	lows and water quality	Policy and legislative inadequacies
Degradation of seagrass beds	High suspended solids	Alteration of sediment loads	Limited institutional capacity
Degradation of coral reefs	Chemical pollution		Inadequate awareness
Degradation of coastal forests	Marine litter/solid waste		Inadequate financial mechanisms
Shoreline changes	Eutrophication (harmful/nuisance algal blooms)		Poor knowledge management

Table 7. Main areas of concern, identified by ASCLME/SWIOFP (2009)

Main Area of Concern	Issue
Water quality degradation	Alteration of natural river flow and changes in freshwater input and sediment load
	Degradation of ground and surface water quality (fresh and estuarine, not marine)
	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources
	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources
	Oil spills (drilling, exploitation, transport, processing, storage, shipping).
Habitat and community modification	Shoreline change, due to modification, land reclamation and coastal erosion
	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)
	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)
	Disturbance, damage and loss of mangrove habitats
	Disturbance, damage and loss of coral reef habitats
	Disturbance, damage and loss of seagrass habitats
	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)
	Introduction of exotic non-native species, invasives and nuisance species
Declines in living marine resources	Decline in populations of: sharks and rays, large and small pelagics, reef and demersal fish, sea cucumbers, prawns and shrimp, and lobsters
	Excessive bycatch and discards

3.1.1. Opportunities vs. threats

The above root causes result in direct threats and impacts in all of the five capitals listed in section 2. The following sections detail threats to, or emanating from, each of these capitals. However, threats and adversity may also be viewed as opportunities for change or innovation. Thus part of the solution for the NMC will be the ability for countries and non-government actors to transform the drivers of negative change to opportunities for positive change. As a Regional Seas programme, the WIO can derive lessons from other Regional Seas, in this case the experience of the Baltic Regional Seas programme, under the

Helsinki Commission, to turn threats and pressures into opportunities for innovation, new business opportunities and a trajectory of sustainable development (fig. 10)[78].

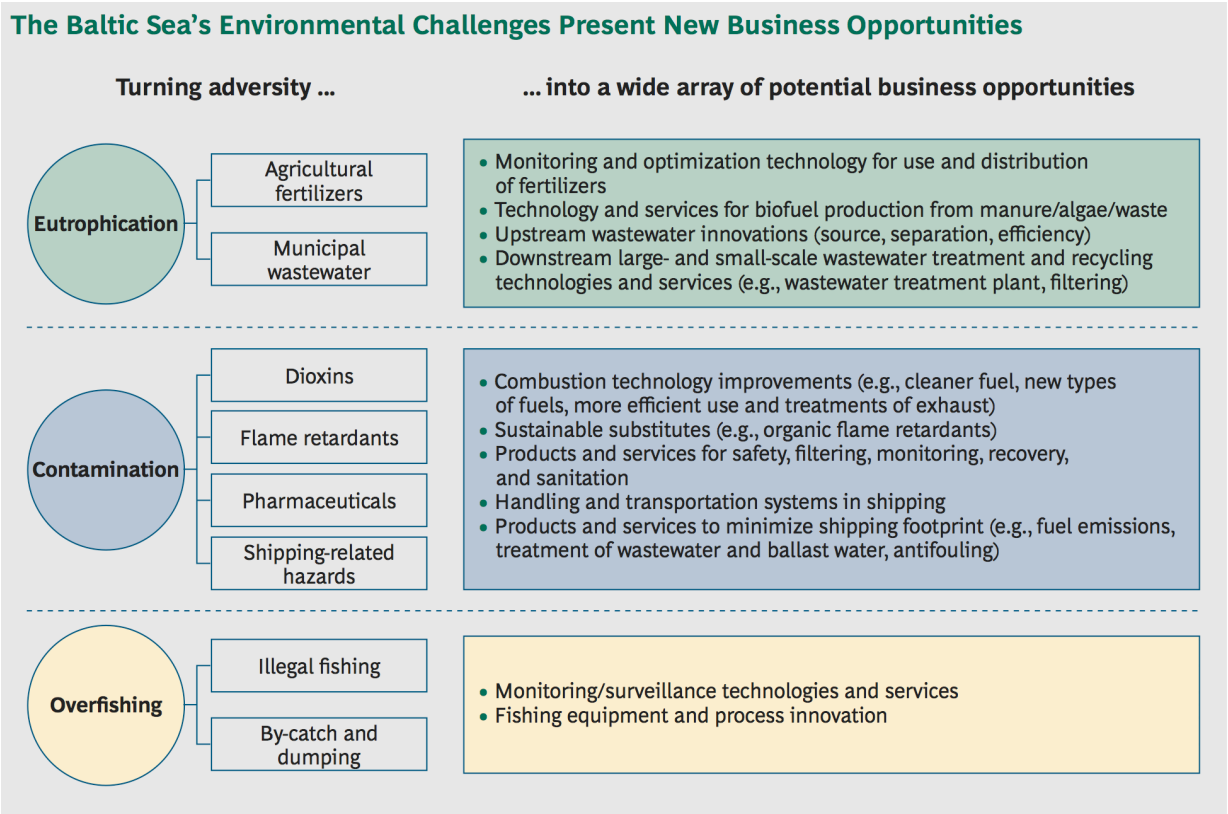

Figure 10. Turning adversity or problems into opportunities. Source: Lind & Kallström (2014).

Taking this approach into the broader context of the five capitals in the NMC, the realities of population growth and need for development (Social and Human capitals), and the extreme pressures for private sector growth in natural gas and other sectors, will need to be intricately balanced with the realities of sustainable use of natural capital, and the need for equitable economic development and growth (Economic and Governance Capitals). To the private sector, the population growth and demographic transition

3.2. Scenarios of change in the NMC

Understanding opportunities for change, in order to make better decisions, is fraught with high levels of uncertainty. To facilitate this process and better-understand the sources and importance of this uncertainty, it is useful to develop scenarios as 'pictures' of how the future may look, based on different choices and circumstances along the way. A simplified path for thinking about scenarios is presented by the Natural Capital project[79].

At the first stages of scenario development, use simple 'vision scenarios' which are constructed by participants/stakeholders and express their ambitions about how the future may look. These are simple scenarios, and mostly narrative/descriptive, but are helpful in framing overall directions, and leading towards more explicit and quantitative scenarios.

At later stages, use more explicit scenarios based on specific choices, or interventions, for example on a specific tax rate, legislation on allowable practices, etc. These enable exploration of the future outcomes of these specific choices, usually with a quantitative basis, and are often called 'intervention' or 'policy' scenarios. They can be used, for example, to explore how different decisions (switches) may transform from one scenario to another, or among different outcomes within a major scenario.

At some point, exploratory scenarios may be used, which may be targeted at major events that may not be controllable, for example natural disasters, a war, political or economic turmoil, etc. These are useful for exploring the consequences of unforeseen events, particularly where policy or interventions can be amended to minimise exposure to, or impacts from, these events.

At this early stage in development of the NMC programme, two simple vision scenarios may be most useful, to be evolved into more explicit and multi-dimensional intervention/policy scenarios once the countries and institutional arrangements for the initiative are in place. Though they are vision scenarios, they are built up from simple action/no-action or two-option actions in multiple sectors important in the NMC. They represent one future based on amplification of current realities that have played out in African economies fuelled by oil/gas extraction over the last 30-50 years, vs. explicit decisions to choose green/blue economic options at each possible step:

Box 1 – Africa Environment Outlook scenarios

The four scenarios of the AEO, which were derived from a set of six scenarios in the GEO[1] can be described as vision scenarios - though they are founded on some numbers and analysis, they frame peoples' perspectives on the trajectory they want to move down. In many ways it may be simpler to have fewer scenarios to explore opposite outcomes. For our purposes we might group the AEO scenarios as follows:

The 'Market forces' and 'Fortress world' scenarios identify futures where the focus of decision-making is narrow - either to the narrow constraints of capitalist markets and the pricing of goods and services, trusting 'the market' to allocate resources and effort efficiently accordingly, or to the constraints of nation states and boundaries, where nationalism or narrow 'us vs. them' considerations dominate decisions. In the AEO both of these lead to similar envelopes of development, in terms of GDP and economic sectors, as well as environmental impacts.

The 'Policy reform' and 'Great Transitions' scenarios identify futures where decision-making takes on a broader purpose, either in evolutionary terms, in the former, where policies and institutions are incrementally built up and diversified to deal with a more complex world, or in revolutionary terms, where a new paradigm of decision-making is adopted that is holistic.

3.2.1. Scenario 1) Fuelled Business As Usual – natural gas/hydrocarbon extraction.

In this scenario, the experience of Africa's fossil-fuel rich economies is played out in the NMC's emerging economies, in a future characterised by globalisation and strong competition between national, social and corporate actors over the vast wealth to be generated from a mining approach to natural asset exploitation. This combines the Market Forces and Fortress World options of the AEO, where decisions about the largest and most valuable assets of a country are made with the interests of political and corporate elites in the forefront. Social welfare and the public good suffer, and poor planning and lack of long term investment may lead to deficiencies of infrastructure (roads, railways, IT, sewage disposal, housing, power, water, etc). Social and demographic issues are not dealt with proactively, and national populations take on the high-growth trajectories presented by the United Nations (see fig. 8, next section). Factors that supported rapid growth in emerging economies, and greater equality of incomes in the 1990s-2000s have recently reversed[80], so greater inequality in incomes within countries is expected.

3.2.2. Scenario 2) Green/Blue Economic Development

In this scenario, the governments and corporate leaders make individual choices that are consistent with sustainable development (in a deep sense) and growth in economic, social and environmental benefits in synergy with one another. In macro-economic terms these options are encapsulated in the 'green economic' model, and given the primacy of the ocean and its resources in the future of the NMC, the region can define a 'blue economic' model that fits its context. While visionary in terms of the sustainability and equity this scenario strives to achieve, it must be constructed from thousands of individual choices in each sector and every economic decision from the smallest scale of village waste disposal to the largest scale of regional energy policy. It encapsulates the enlightened world view of the

AEO Policy Reform scenario as a basis for the transformation in values envisioned in the Great Transitions scenario that is necessary to justify and maintain this Scenario.

Table 8 illustrates the dichotomy between these two scenarios, emphasizing the multiple sectors and decisions within each of those sectors that can lead to one or the other scenario outcome. A visioning process for the NMC will need to identify and express the overall vision that the initiative hopes to achieve, and based on this, the vast array of individual actions that need to be put in place to achieve it.

Table 8. Two opposing scenarios for future outcomes in the Northern Mozambique Channel.

	Fuelled Business as Usual	Green/Blue economy
Description	Business as usual, with fossil fuels	Green/Blue economic development
AEO/GEO	Market Forces meets Fortress World	Policy Reform meets Great Transitions
Economy	Profit and market forces control distribution of income	Policies to support welfare, education, health
Population	Most families do not implement family planning, economic growth is swallowed up by even faster rates of population growth, rural-urban migration high.	Family planning choices are accessed by all families, reducing growth rates and thus additional pressure on resources, balanced rural/urban populations
Agriculture	Intensive, led by large corporate structures	Mixed, with high level of agro-ecological agriculture for the poor
Energy	Fossil fuel extraction drives the economy, profit in corporate and elites	Fossil fuel extraction blended with emerging/renewable technologies
Health	Weak and dysfuntional public health and services	Strong public health system, providing varied services
Fisheries	Degraded fish stocks, low production, only large corporates and poor fishers	Sustainable fish stocks, diversified fisheries supporting small, medium and large scale operations
Aquaculture	Large corporate firms, high environmental impacts, driven by export demand	Extensive rural/SME aquaculture, providing protein for local and foreign markets, minimum impacts

3.3. Natural capital

Direct and indirect threats to natural capital act through two principal processes – habitat degradation and destruction, and over-exploitation of natural resources[81].

3.3.1. Destruction and degradation of critical habitats

The most intense pressures on coastal and marine resources and habitats are concentrated in and adjacent to population centers, from a combination of extraction (principally fishing) and coastal development (including pollution impacts highlighted in the previous section). Mozambique Channel countries fall into two categories - the large ones (Madagascar, Mozambique, Tanzania) with low population densities and relatively low proportional impact to coastal habitats, and the islands (Comoros, Mayotte) with high population densities and very limited coastlines, and therefore high proportional impacts to date.

Limiting impacts to coastal habitats is the goal of many area-based management tools such as Marine Protected Areas (MPAs) and Integrated Coastal Zone Management (ICZM). In high-density situations comprehensive management of the entire coastal zone through ICZM and similar practices has been attempted (IZCM references), but these have had limited success in reducing habitat damage. More successful has been the implementation of Marine Protected Areas (MPAs), though these are relatively small, don't address many of the complex social and economic drivers in more high density settings. At present, the areas of LMMAs and MPAs in the WIO, as well as in the NMC, falls far short of national and global targets of 10%[82]. Where MPAs are effectively managed and contain significant no-take zones, pressure in these zones is light. But outside of the core zones, including in exploited zones within the broader MPA boundaries, pressures can be extremely high. In all cases, the effectiveness of management may be severely eroded by poor governance and implementation, and compliance of

stakeholders is often low, driven by corruption in some cases, but often poverty, cultural factors and need[83].

Community-based MPA management and co-management of local areas with government has started to grow in the region, led by a rapid expansion of Locally Managed Marine Areas (LMMAs) in Madagascar (with over 40 LMMAs now reported on the west coast), with examples in Mozambique, Tanzania and Kenya[84]. The incentives for LMMAs, where communities can establish ownership to limit fishing by outsiders are clear, giving them rights and incentives for more sustainable extraction of fish over the longer term. At the larger scale, trans-boundary management of critical ecosystems has been proposed in Trans-Frontier Conservation Areas (TFCAs)[85]. Tese have not yet to come to fruition, with the Northern Mozambique Channel being among the lead candidates for establishment.

3.3.2. Overexploitation of resources

The current strain on living resources is illustrated by many publications showing the decline in catch per unit effort in fisheries, and either stagnating or even declining total catch even with increasing entry into fishery sectors[86]. Other marine resources such as mangroves have shown similar evidence of decline from extraction, fuelled by a large increase in demand from population growth and often these resources are exploited as common property where people have limited access to other resources (e.g. fuel for cooking).

Opportunities to reverse declines in resources, such as fisheries catch exist, but are challenging to realise. Shrimp stocks have been severely overexploited in Madagascar and the once-high foreign currency revenues have fallen sharply. However, positive steps are being taken to restore the fishery across the market chain: local communities and industrial fishers are beginning to seek ways to restore shrimp stocks and obtain MSC and ASC certification[87]. Rights-based approaches, focusing on community rights and poverty alleviation may provide options, but population growth and increasing density of settlement on the coast pose significant challenges.

3.4. Social capital

Human society and economic activity are the drivers of change in this new era of world history called the Anthropocene[88], thus factors affecting the number of people and levels of economic activity and impact are the primary variables driving change in the NMC.

3.4.1. Population growth

Population statistics for the NMC countries are derived from the Population Division of the UN Department of Economic and Social Affairs[89]. Countries of the NMC are mostly classified as having low HDI, and have correspondingly rapidly growing populations (fig. 11). Currently (in 2015) total population of these countries is at 105 million people. The median estimate of population size for NMC countries in 2100 is almost 500 million, with ranges of 300-800 million (±80% margins) and 225 million to 1 billion (±95 margins). The low variant might be equivalent to the Green Economy scenario (see section 2.2), while somewhere between the median and 80th percentile might be equivalent to the Fuelled Business As Usual scenario. A key observation is that even at the median estimate of growth, population will still be increasing in 2100.

Population growth rates in NMC countries are high, with national averages (medians), from 2.9-3.7% per year for 1995-2010 being reported (Table 9). Median growth rates drop to an average of 2.1% in 2050-65, and 1% in 2085-2100. The lower estimates of growth do end in negative rates (ie. population declines) by 2100, but this is only in the small islands, than the large countries. High estimates of growth continue at 2-3% per annum in the large countries at the end of the century. Throughout the NMC, as in most of Africa, the population is young (with 42-46% under 15 years). This will pose a great challenge as large numbers of youth enter the workforce in the next 10-20 years, and demand will increase significantly as they mature and look for employment and livelihoods, and have their own families.

Improvements in health care will exacerbate the 'population bulge' as a drop in birth rates typically lags behind the drop in death rates[90].

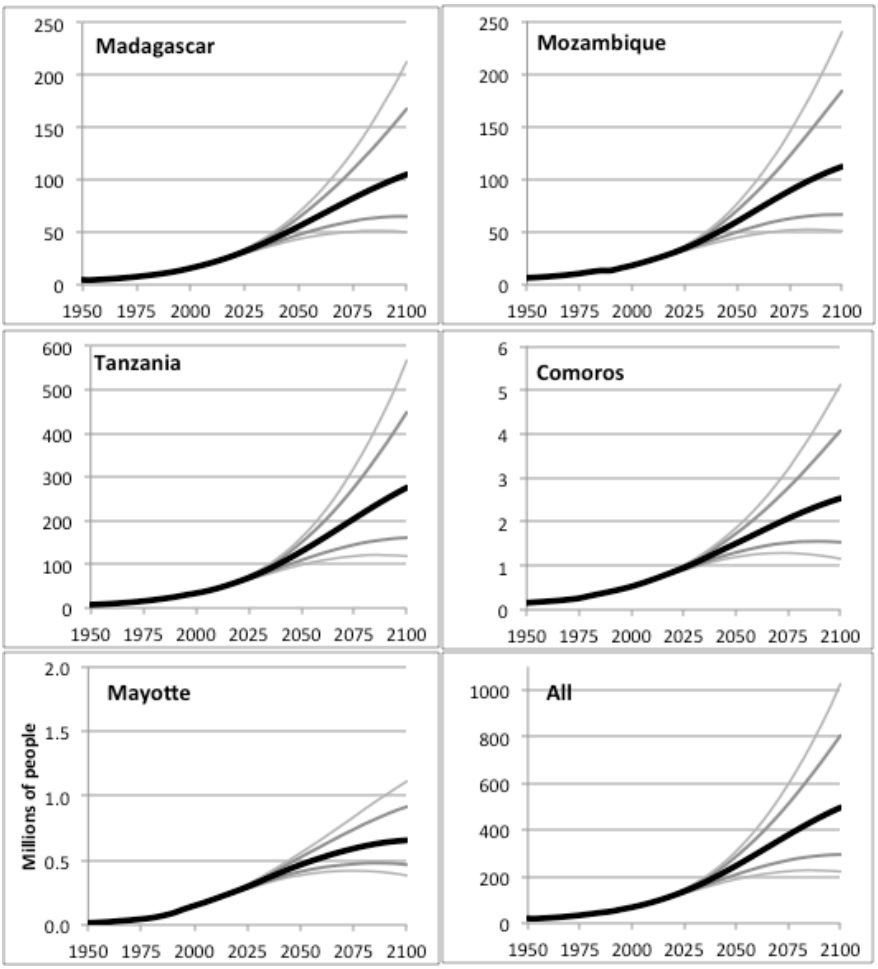

Figure 11. Population trends, 1950 - 2100 for the countries of the Northern Mozambique Channel (Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2012 Revision, http://esa.un.org/unpd/wpp/index.htm)

Of importance to the NMC is also the population density in the coastal areas of the region. This is very low on the mainland and Madagascar coastlines, except in urban centers, and along road networks (see fig. 5[91]). By contrast, islands in the Comores Archipelago have very high population densities with some locations exceeding 1,000/km^2. Combining the coastal populations estimated in fig. 2 with potential projected growth rates (fig., 8; Table 10), and assuming no additional immigration to the NMC, the population of the NMC can be projected to growth from today's level of 10 million to 19, 22 or 25 million in 2050 (respectively, for the lower 80%, median and upper 80% variants) (Table 10). By 2100 the difference between these projections becomes extremely stark, at 26, 42 or 68 million, respectively. Initial assumptions can be made that:

1. the upper 80% population projection may be equivalent to Scenario 1, "Business as usual, fuelled by natural gas/hydrocarbon extraction", where poor social policies, corruption, inequality of incomes and immigration, fuelled by the wealth from natural gas, result in massive population growth in the NMC coastal zones. The middle variant is generally taken as the current situation projected forwards, but given the fact that hydrocarbon extraction WILL occur at some point over the next 3-5 decades, the high variant is more likely than the middle variant. These projections do not take into account immigration drawn by the wealth and development created by natural gas extraction, which may greatly increase growth rates throughout the first half of the century.

2. The lower 80% population projection may be equivalent to Scenario 2, "Green Economy" where the benefits of energy and other wealth are derived, but in a context of social policies and equality that temper population growth rates to minimize the footprint of population numbers and economic activity.

Table 9. Population growth rates derived from fig. 10. The average growth rate over three 15-year periods is shown (1995-2010, 2050-2065 and 2085-2100), for each population trend (median, ±80%, ±95%).

Years	*-95*	*-80*	*Median*	*+80*	*+95*
			Madagascar		
1995-2010			3.2%		
2050-2065	0.9%	1.3%	1.9%	2.5%	2.8%
2085-2100	-0.2%	0.2%	0.9%	1.7%	2.1%
			Mozambique		
1995-2010			2.9%		
2050-2065	0.9%	1.2%	2.0%	2.6%	3.0%
2085-2100	-0.2%	0.1%	0.8%	1.6%	2.0%
			Tanzania		
1995-2010			2.9%		
2050-2065	1.1%	1.5%	2.2%	2.8%	3.2%
2085-2100	-0.2%	0.3%	1.1%	1.9%	2.3%
			Comoros		
1995-2010			2.7%		
2050-2065	0.6%	0.9%	1.5%	2.1%	2.4%
2085-2100	-0.5%	-0.1%	0.7%	1.5%	1.9%
			Mayotte		
1995-2010			3.7%		
2050-2065	0.6%	0.8%	1.3%	1.7%	1.9%
2085-2100	-0.5%	-0.2%	0.3%	0.8%	1.1%
			Total		
1995-2010			3.0%		
2050-2065	1.0%	1.4%	2.1%	2.7%	3.0%
2085-2100	-0.2%	0.2%	1.0%	1.8%	2.2%

3.4.2. Urban development and inland-coastal migration

Growth rates in coastal provinces of the countries are likely higher than in inland provinces, following the general pattern demonstrated globally of migration to urban centres and the coast. This will be accentuated by oil/gas development in the NMC region, drawing people from NMC countries and beyond for opportunities within the sector, demand for services around it, and a general sense of opportunities.

At present, NMC populations are predominantly rural and agricultural, but with expected economic changes will become more urban and with a greater dependence on manufacturing and other non-agricultural sectors for employment. The production of gas and fossil fuels will further drive an energy-dependent urbanisation, putting greater strain on resources. Growth in key urban areas in the NMC will be a primary driver of change, as well as opportunity. Coastal development, also driven by tourism, trade and shipping, will be strong pull factors increasing migration as people move to coastal areas in search of employment.

Migration is also a driver of change in how it changes economic activities. Particularly for Tanzania, Mozambique and Madagascar migration of fishers along their coasts has been practiced for many years, and is intensifying due to overfishing around growing population centers. At present, where migrant fisher concentrations are high, significant damage to marine ecosystems, overfishing and poaching illegal species such as turtles, occur[92].

Table 10. Projections for population in the Northern Mozambique Channel for 2050 and 2100, combining the analyses from Landscan (section 1.2.2) and UNDP population projections. Note - statistics for Seychelles are not included, as the populations bordering the Mozambique Channel are administrative units in the Aldabra group of islands.

	Countries UNDP (flrom fig. 10)			Northern Mozambique Channel (100 km coastal zone/LandScan)		
	2015	2050	2100	2013	2050	2100
Median (Business as Usual)						
Mayotte	0.2	0.5	0.7	0.2	0.5	0.7
Comoros	0.8	1.5	2.5	0.7	1.5	2.5
Madagascar	24.2	55.5	105.1	3.5	7.9	15.0
Mozambique	27.1	59.9	112.0	3.9	8.6	16.0
Tanzania	52.3	129.4	275.6	1.5	3.8	8.2
Total	104.7	246.8	496.0	9.8	22.3	42.4
Upper 80% (Fuelled Business as Usual)						
Mayotte	0.2	0.5	0.9	0.2	0.5	0.9
Comoros	0.8	1.7	4.1	0.7	1.7	4.1
Madagascar	24.5	64.0	167.6	3.5	9.0	23.7
Mozambique	27.4	70.4	183.8	3.9	10.0	26.0
Tanzania	52.9	150.1	447.9	1.5	4.4	13.1
Total	105.8	286.8	804.4	9.8	25.7	67.8
Lower 80% (Green/Blue economy)						
Mayotte	0.2	0.4	0.5	0.2	0.4	0.5
Comoros	0.8	1.3	1.5	0.7	1.3	1.5
Madagascar	24.0	47.6	65.1	3.5	6.9	9.4
Mozambique	26.8	50.0	66.5	3.9	7.2	9.6
Tanzania	51.7	109.6	161.1	1.5	3.3	4.8
Total	103.8	217.7	332.7	9.8	19.1	25.9

As well as being a threat, population growth, urbanisation, greater access to fossil fuels and increased industrialisation of the region can be an opportunity (see 2.1.1). Good governance of the process can result in many millions of citizens accumulating wealth and investing it in lifestyles and economic practices that are not damaging to their environment and broader context. With the vast pool of youth coming of age and the increase in employment that the rapidly growing energy sector will drive, there is an opportunity provided by this much larger market and source of skills and innovation to build economic growth.

3.5. Economic capital

The economic sectors of the NMC are both drivers of change, and vulnerable to it. All of the major sectors are starting from low levels currently, providing immense scope for growth. However all economic assets are limited, and inappropriate development may damage the primary assets on which they are reliant. Some of the key sectors are described below.

3.5.1. Fisheries and other living resources

Fisheries in the NMC are principally artisanal or small-scale, of local fishers plying coastal and reef waters with relatively basic gear, and industrial offshore, of Distant Water Fishing Nation (DFWN) fleets targeting tuna. The artisanal fisheries of the region are very poorly reported, with unreliable statistics on the number of fishers, vessels and their catch. National statistics submitted to the FAO are generally too aggregated and general for meaningful interpretation at relevant scales for local management, while a large proportion of the catch is unreported. Mozambique, Madagascar and Tanzania have strong policies promoting co-management with local fishers, and support is growing for local management areas that include some closures to protect fish stocks. However, because most catch feeds into local

markets and fish form a significant proportion of household protein, limiting catch and use of over-efficient gears is difficult, and population growth is and will continue to lead to exponentially increasing pressure on limited inshore fishing resources. Achieving sustainable small scale fisheries for the NMC will be among the greatest challenges, while also being of significant importance to downstream regions outside of the NMC which are reliant on larval supply and ecosystem processes within the NMC.

Large scale fisheries in the NMC fall under the mandates of overlapping Regional Fishery Management Organizations (RFMOs), including the IOTC, SIOFA and SWIOFC. Tuna are the primary target but almost none of the catch is landed within the NMC countries, being landed in the Seychelles and Mauritius where large canning factories are located. The dynamics of the NMC eddies and Comoros gyre support unusually productive food webs leading up to the top fishery species[93], which may be a factor controlling the seasonal migration of tuna into the NMC[94]. As pressures increase on regional stocks within and outside the NMC, effective transboundary management of effort will become increasingly important. The countries of the NMC are yet to negotiate from a strong position in the fishery agreements controlling fishing activity, emphasizing the benefits a joint sub-regional approach may bring to enhance their motivation to manage the fishery resources sustainably. No part of the NMC is in High Seas, thus control of fishing effort can be fully controlled by the countries and the RFMOs.

Dependence on and use of other biological resources of the NMC is high, and population growth and economic development will similarly drive up demand and extraction of these. Fisheries provide the most clear example currently, but in the medium term transboundary management for all living resources and ecosystem services in the NMC will be required.

3.5.2. Natural gas and energy

Oil and gas development is already a game changer in coastal East Africa and may become a significant factor affecting Madagascar within the foreseeable future. Indirect pressures from development are already evident, in the form of migration to coastal areas that is likely to increase pressure on local ecosystem services, and rapid infrastructure and coastal development in centers such as Pemba, Mocimbo da Praia and Palma, in Mozambique. These towns are rapidly developing with new roads, construction of industrial facilities and housing, and rapid in-flux of workers. Future direct risks include inappropriate infrastructure development, pollution, and governance problems associated with rapid development and wealth creation. This is the “curse” of many countries blessed with rich mineral or energy deposits which lead to dependency on commodity export revenue, vulnerability to price volatility and exchange-rate appreciation.

East African coastal countries are aware of the challenges and the potential mitigating solutions, having several negative examples to behold from Africa, Asia and South America, and some positive examples relatively close to home, e.g. Botswana. Key strategies to avoid these problems include improved governance processes in general, investment in information and technical resources, adherence to the best practice standards such as in the Extractive Industries Transparency Initiative (EITI), identifiecation of no-go zones, and oil spill/pollution rapid response measures.

The economies of the NMC will modernize at a dizzying rate with scale of investment and incomes from natural gas extraction that will materialize. However, the energy sectors of the countries of the region are at present extremely impoverished, based mainly on firewood, charcoal, oil and some hydro-electric power. Paradoxically, the natural gas finds could leapfrog the energy sector into the 21st century in two ways: first, by financing a diversification of the energy sector with a focus on renewable sources for small scale users, particularly for decentralized generation and high employment content to improve rural energy access (e.g. hydro-power, wind, solar PV, solar thermal power (water heating), geothermal, ocean and bioenergy). Second, the region currently plays a limited role in global climate mitigation debates. Yet, the scale of the natural gas deposits offers the opportunity for transformative low-carbon electricity generation options and powering low-carbon industries. The potential of carbon credits, both on the marine side (e.g. mangroves and seagrass beds) and on land (coastal forests) is also high, which modernization of the energy sectors could help to monetize.

3.5.3. Maritime trade

The Mozambique Channel is a high-risk area for marine pollution from shipping, as approximately 30% of the world's crude oil passes southwards through the Channel with around 5,000 tankers carrying 500 million tons per year. This traffic has intensified in recent years, prompting a major project supported by the GEF to establish a marine highway route (fig. 12) to avoid environmentally sensitive areas and build capacity for oil spill response[95]. The highway is still under consideration by the IMO. Building capacity in the countries of the region to detect and cope with oil spills both in port and at sea, is a top priority for managing marine impacts. Piloting remote detection of oil spills may provide significant early warning capability, with some initial steps having been trialed under the auspices of the marine highway project.

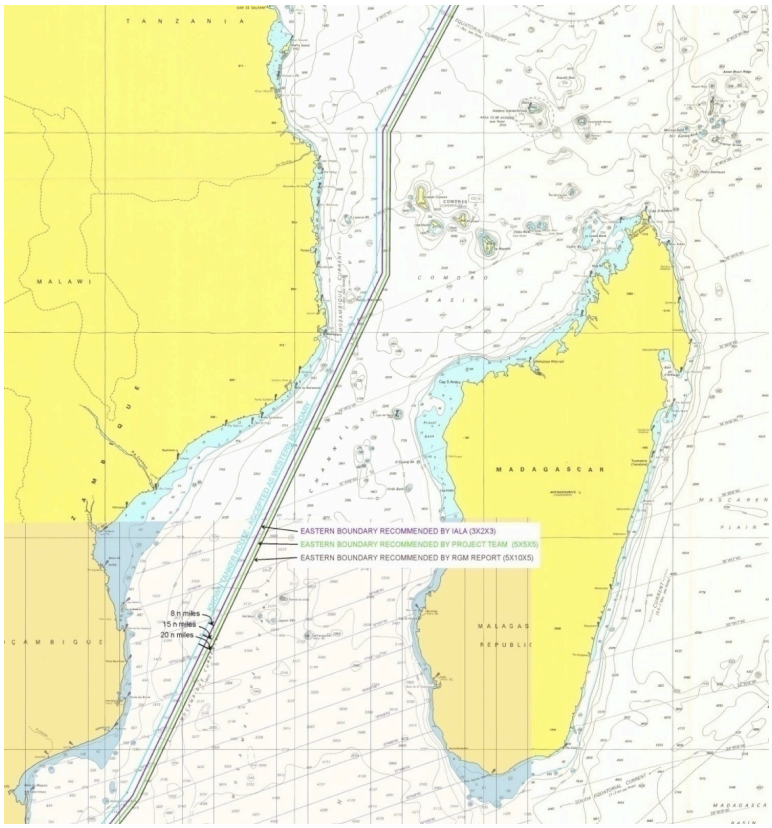

Figure 12. The proposed marine highway, restricting transiting vessels to a 20 nm wide corridor passing down the Mozambique Channel.

Maritime transport from ports within the Mozambique Channel will expand rapidly in coming years, for example to export coal from massive new coal finds in Mozambique's land-locked Tete Province, through the port of Nacala. Wood and other product experts from here and NW Madagascar are also important economically, and proposals are advanced for expanding several ports in the NMC, including Nacala and Pemba in Mozambique. Other ports with significant potential for expansion include Mahajanga and Diego (Antsiranana) in northern Madagascar. In the context of global security (see Piracy section, 2.8.2) the volume of shipping in the Mozambique Channel is primarily controlled by the Suez Canal. If for any reason transit through the Canal is restricted, e.g. by conflicts that further reduced safety in its access routes, then shipping through the Mozambique Channel will multiple many times[96], with concomitant increase in risks and threats.

3.5.4. Coastal development and pollution

Land-based pollution was the subject of the WIOLaB project also funded by the GEF, with a second phase project in final stages of approval, dubbed the WIOSAP[97]. Primary pollution sources are from land clearing resulting in high runoff, urban centers, and unregulated, illegal or accidental discharges in ports and industrial developments. Three main areas of land-based impacts to the sea were assessed, with the main one being water and sediment quality degeneration. Five main types of impacts were

identified: microbial contamination, high suspended solids, chemical pollution, marine litter/solid waste, and eutrophication/harmful algal blooms. Hotspots of these pollution impacts were identified, with the main ones in the MC being all the principal ports (Moroni, Anjouan, Diego, Nosy-Be, Mahajanga, Tulear and Maputo). At the time of the study (2009), Pemba, Nacala and Beira were rated as emerging hotspots, and Mtwara was not mentioned.

Alteration of fresh water flows and sediment watershed impacts to the coastal zone have been significant. The four most frequent reasons for flow alterations: (i) overall reduced flow due to consumptive uses of water, (ii) increase of river surface area along sections of the river due to impoundment/damming, (iii) changed seasonal flow patterns (e.g. releases for hydropower-generation during the dry season), (iv) increased floods due to wetland losses (loss of water retention capacity) are all projected to intensify with population growth and economic development in all the watersheds. A corollary of these, alterations in sediment delivery to the coastal zone, whether increases, decreases or increased variability are also expected to intensify. Larger scale drivers, such as from climate change are also expected to magnify impacts of terrestrial runoff to the MC. Interactions of the large freshwater drainage basins with the marine environment are contained in the Global International Waters Assessments studies from the region[98].

All sources of pollution to the MC are expected to intensify with development and population growth, the main difference among scenarios of change relate to how well potential impacts are minimised, mitigated and compensated for. Risks from pure pollution impacts (e.g. from shipping, spills, runoff) need to be curtailed through regulation, while some aspects of waste management represent opportunities through recycling. The outcome of water use agreements in watersheds will determine how upstream-downstream rights and responsibilities are traded among different stakeholders, with potential positive benefits for all, if freshwater flows are fully accounted for.

3.5.5. Tourism

Increased and higher quality tourism is seen as a way to open new economic opportunities favoring national and local development in coastal Tanzania and Mozambique. The tourism development strategies in these countries emphasize the importance of conserving biodiversity, natural esthetic values and MPAs. Nature-based tourism is a focus for small-scale development of tourism, with clear policies encouraging this on Mohéli (with a marine park and its satellite terrestrial reserves), in Mayotte, and in the Diana Region in northern Madagascar (in part based on protected areas). Numerous individual investors have taken measures to minimize negative impacts in order not to damage their primary assets, providing scope for improved practices throughout the region.

However access by air, poor tourism infrastructure and services, and in some places local resistance to private sector-community collaboration are significant barriers to tourism development. Weak governance processes, including in environmental auditing and rates of growth in tourism establishments occurs, particularly where air access improves. The Pemba and Nacala areas in Mozambique illustrate this; as access improves for trade and oil/gas exploration, a rapid growth in tourism facilities to accommodate and entertain visitors is occurring. In Madagascar there is no tourism policy or strategy in effect, so developments show significant variation in quality and environmental respect. Finally, insecurity, whether due to political events, piracy and terrorism, or localized crime related to income inequalities and inequitable development paths all threaten tourism growth.

A regional approach for tourism has not yet been realized within the NMC – to date investment in tourism has come from the West (Mozambique, Madagascar, Tanzania), South Africa (Mozambique and the Comoros), or France (Mayotte), with little attention to networking, travel links and infrastructure that links sites within the NMC itself. This reflects greater interest in biodiversity and ecosystem-based management based on networks of protected areas designed with the currents and oceanographic system in mind, and would likely bolster tourism growth. It is clear that coastal and marine tourism in the NMC is greatly underdeveloped relative to its potential. The current national strategies in Mozambique and Tanzania will soon need renewal and there is as yet no strategy for either Madagascar or the Comoros. In general, the countries recognize the linkages between conservation areas and

sustainable tourism development, and the contribution of both to poverty reduction and economic growth, especially regarding local communities. An interest in regional tourism is developing[99], alongside some initiatives to develop low-impact high-revenue destinations that can spearhead the development of a tourism industry that meets the goals of the five capitals approach.

3.6. Human capital

The problems related to Human capital and technical capacity pervade the countries of the region, with education resources stretched by the rapidly growing populations of the last 3-4 decades and inadequate investment in educational resources, infrastructure and staff. Useful insight may be obtained by identifying models for educational advancement that have worked, and the most relevant may be South Korea, which has advanced from a position similar position after the Korean war in the late 1950s, to now being rated as the country most supportive of innovation in the world[100].

3.6.1. Formal education

Formal education in NMC countries, with the exception of France (Mayotte), faces many challenges. Madagascan, Tanzanian, Comorian and Mozambican children experience less than 5 years of schooling, even though laws are in place for them to complete 8-10 years (fig. 5). In all these countries, the increasing number of children means that a large proportion of students never get to attend secondary or higher levels of education, and enter the workforce with few employment skills. Taken out of their local environments for those years of school, they often lack the practical and traditional knowledge their parents had for agriculture and other such activities. With increasing urbanization, more and more children leave school in an environment where there is no access to land and water for them to farm or make a livelihood from.

Investing in formal education is also increasingly necessary with the onset of the information age, where interaction with technology (mobile phones, the internet) increasingly defines modern life and is magnifying the divide between rich and poor[101].

3.6.2. Technical and advanced capacity building

The Trans-boundary Diagnostic Analyses of the three sister GEF programmes identified capacity as a major gap in technical areas: “Limited and often inadequate human capacity is also common to nearly all of the sectors and encompasses, for example, inadequate governance capacity, research capacity and capacity for fulfilling financial, operational and human resource functions. Security concerns, political instability, weak service delivery, conflicts between sectors and centralised control and over-regulation were also identified as problems in some sectors and countries”. These gaps were incorporated into National Training Plans and contributed to development of the Strategic Action Programmes (SAPs) [102]. Similar studies in other sectors single out technical capacity as among the most consistent and largest constraints to successful development and advancement.

Of critical important to the NMC will be the development of capacity building programmes across all relevant technical levels – in private sector areas, natural and social areas, in governance and more. Given the vast array of topics, suffice it to point out that a tiered approach building the foundations of basic education in the school systems and in adult/informal education (section 3.6.1) linked to technical and advanced education to build the professional cadres needed for successful development, is essential. Undertaking this in a partnership context recognizing the role of the state in formal education, but also of the private sector and non-government sectors, may provide the most targeted approach to building capacity in areas most useful to delivering sustainable economic growth. Turning the threat of low technical capacity to advantage through targeted capacity building will require focused capacity assessments and investment in training with sufficient lead-times to when national and regional capacity is required to be fully developed, to deliver on a complex set of targets across the five capitals.

One area that is of critical importance for the five capitals approach is the ability to assess information from multiple and different disciplines relevant to each capital, and that this information must be geographically specific over the five countries of the NMC. Marine Spatial Planning (MSP) is an approach that has recently developed and defined as "*a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process*"[103]. In many ways it is akin to Integrated Coastal Zone Management approaches but explicitly over ocean space. Building capacity in MSP is among the first priorities for enabling the approach advocated here to develop.

3.7. Institutional capital

The institutional mechanisms needed for multi-country governance of the EEZs in the Mozambique Channel are not as yet developed. With a primary requirement to align the interests and sovereignty of the relevant countries, plus integrate the interests of the private and civil society sectors within and across the countries, this institutional capacity cannot yet be defined. The Nairobi Convention and other inter-governmental institutions (section 2.5.2) provide a foundation for this, but not as yet a template for how to move forward. A key consideration is the need to develop the rationale for governance of the shared space, and mechanisms through which to do this[104].

Examples of possible institutional frameworks can be found in other regions (Table 11), but each country and region of the world has its specificity, and early work in the NMC initiative will be needed to identify what the countries and stakeholders are comfortable with in moving forward. The academic world can also recommend various forms of governance, and the nature of threats to come (e.g. section 3.8) will impose certain characteristics that are desirable to meet, such as adaptive capacity in the face of climate and global changes, inclusiveness and accountability. The range of possibilities could extend across a full scope from loose agreements to align policies and decisions across country borders, to a formal commission with representation from each state and authority to make decisions on uses in the defined region.

Table 11. Some case studies/examples of institutional mechanisms selected by participating states in governing common ocean regions.

Baltic Sea – a highly enclosed marine region of great importance to the surrounding countries (N. Europe), with several linked inter-governmental mechanisms underway[105]: • Convention on the Protection of the Marine Environment of the Baltic Sea Area, or Helsinki Commission (HELCOM), resulting from the UNEP Regional Seas Programme's and sister convention to the Nairobi Convention, ratified by 9 countries. First established in 1980 and updated in 2000. • Vision and Strategies around the Baltic Sea (VASAB) – a Ministerial Co-operation forum for spatial planning and development, covering 11 countries, initiated in 1992. • The HELCOM-VASAB Maritime Spatial Planning Working Group, established in 2010 and co-chaired by HELCOM and VASAB to ensure cooperation among the Baltic Sea Region countries for coherent regional Maritime Spatial Planning processes in the Baltic Sea.
Caribbean Sea – a broad range of inter-governmental institutions have mandates in the Caribbean, often of sectoral nature. For example, the Cartagena Convention and CARICOM are two of the broadest, the former being a UNEP Regional Seas programme, like the Nairobi Convention, the latter a community and common market across the member states. Arguments for integrated governance linking these institutions and in a global context with other regions have been made to build a truly integrated Regional Ocean Governance Framework (ROGF)[106].
Celtic Sea – the Celtic Seas partnership focuses on an area of sea in the northeast Atlantic involving England, France, Northern Ireland, Republic of Ireland, Scotland and Wales. It is a partnership of government and economic sectors, initiated through a specific mechanism and funding brought together by the Celtic Seas Partnership. It aims to bring together governments and stakeholders to deliver 'Good Environmental Status' for the shared systems in the Celtic Sea. While the partnership leads on engagement and involvement, it puts responsibility for achieving success in the hands of governments and economic sectors[107].

The value of the MSP framework that is presented for initial steps is that the nature of the agreements that countries and partners wish to take in reconciling activities across the capitals, countries and sectors, will help identify the 'political process' or institutional mechanism that effective MSP requires[108]. Thus in facilitating the MSP process, the countries and principal stakeholders will over time come to define the institutional mechanisms they jointly want to put in place.

3.8. Cross-cutting issues

3.8.1. Climate change

Climate impacts in the broader East African and WIO regions have been widely documented, including changes in seasons and rainfall patterns resulting in floods and droughts, and increasing seawater and air temperatures. However, the complete absence of long term climate datasets from the NMC region, including of air and sea temperatures, rainfall records, sea level, ocean pH and other factors, preclude firm conclusions on the degree of climate change. The most well-reported climate impact is coral bleaching[109], which has been reported widely in the NMC, a clear indication of the impacts of higher temperatures and/or greater fluctuations such as from the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD)[110]. However the degree of impact of coral bleaching within the NMC is varied, with some studies reporting very low impacts at some sites, while others report very high impacts at other sites. Attempts to explain the low degree of impact at some sites result in uncertain conclusions of the NMC being a climate refuge due to low rates of warming there, though other interpretations of the same results would suggest the low exposure to warming puts the region at high risk under future inevitable change. The high degree of connectivity in the NMC suggest, however, that reefs in the region may have a high capacity for regeneration due to larval connectivity from healthy reefs, a hypothesis supported by high observed rates of coral recruitment at many sites in the NMC as well as observed high recovery from bleaching[111] and modeling of ocean currents[112].

Other climate change impacts that are equally or more serious from socio-ecological and economic perspectives include sea level rise, ocean acidification, changes in agro-ecological regimes, changes in weather and rainfall regimes including storm frequency and intensity, habitat/species migration, terrestrial runoff, and coastal erosion. Climate change impacts also exacerbate other anthropogenic direct stress such as overfishing, habitat degradation/loss, inappropriate coastal infrastructure development and pollution. Those studies that have been conducted (e.g., in Tanzania[113]) indicate that climate change impacts may have major economic and social impacts if not addressed, including massive displacement of coastal residents, severe flooding, major land loss to sea level rise and erosion, and many billions of dollars of residual loss each year.

At the regional level, the threat of climate change is taken seriously, with the major intergovernmental initiatives all taking stock to develop climate change strategies. The Nairobi Convention commissioned a policy paper based on a regional conference for its 7th Conference of Parties[114], to identify a climate change strategy for implementation, in the context of Integrated Coastal Zone Management. The Western Indian Ocean Coastal Challenge (WIOCC) has climate adaptation as one of its priority themes, together with promoting resilient ecosystems, sustainable livelihoods, and human security. This combination of goals underlines the value of the Capitals approach, by considering multiple capitals in synergy, to achieve balanced development.

3.8.2. Security and piracy

Piracy in the Indian Ocean emerged in 2009 as a major threat to maritime trade, then subsided in 2012 as a result of anti-piracy efforts by the international community. While the drivers of piracy are poorly described, its impact has been severe. Pirates operating in the Gulf of Aden have made about $120 million per year in net profits, cost the shipping industry between $900 million and $3.3 billion per year in direct costs (e.g. security personnel, etc) and cost the global economy $18 billion dollars per year[115]. Countries of the WIO have been particularly affected as far as 12^{o}S, into the northern Mozambique

Channel and east of the tip of Madagascar. Tourism, trade and other ocean-bound activities have either been stopped or suffered increased costs, and development prospects such as from offshore oil and gas deposits have been delayed by the pulse of piracy.

The threat of piracy has been relevant to this initiative in the northern Mozambique Channel as countries and other stakeholders may be reticent to invest in long term development where unpredictable risk is high. Nevertheless, some aspects of a regional initiative such as this (see next section) can assist in combatting lawlessness on the sea through investment in transparent information systems as needed for Marine Spatial Planning. Nevertheless, the most significant factor that led to a decline in piracy was the presence of armed security personnel on ships, providing a strong deterrent against attacks[116]. This emphasizes the need for an initiative such as that proposed here to be aligned/integrated with other leu components such as the security apparatus of states, the right level of deterrence and equipment for such a coastal/enclosed marine region[117], and inter-governmental agreements that maintain security for long term stability.

4. A Strategic Framework for Securing benefits from the natural assets of the NMC

4.1. Foundations for an initiative

The previous sections demonstrate that the Northern Mozambique Channel (NMC) holds natural assets of both great importance and vulnerability. Much of the economic activity in the region is directly dependent on the natural assets of the sea and coastlines – whether living (e.g. fishing) or mineral (e.g. natural gas) resources, or based on its geography and beauty (e.g. tourism), with a tight inter-dependence of society and environment. The region faces alternative futures, which can be directed by policy choices. At the dawn of a coming phase of exponential growth in resource use, wealth and population, now is a critical time for the countries and major stakeholders to make choices about which future to realise.

4.1.1. Vision

A major initiative requires a vision to guide the choices and actions of all involved, and the formulation of one relevant to the NMC must be developed by the partners involved. Under the umbrella of the Nairobi Convention, three GEF-funded regional programmes have undertaken national and regional assessments and strategic actions focused on land-based impacts to the sea, marine ecosystem processes and fisheries (see section 3.1). These contributed to the development of a Strategic Action Programme for the WIO (WIOSAP), declaring the vision “People of the region prospering from a health Western Indian Ocean”, which was endorsed by the member countries to the Convention. To succeed, an initiative to secure the future of the NMC needs a vision focused on its specific needs and opportunities. By building on the vision of the WIOSAP identified by the countries, the NMC initiative can assure it remains consistent with broader processes, while focusing on its specific priorities.

4.1.2. Approach

Implementing a vision that delivers on social, economic and environmental goals requires approaches that are focused jointly on people, to achieve their prosperity, and the environment, to assure the base on which prosperity is founded is not degraded. With high levels of poverty in the region, and economic sectors both local and international vying to make the most of the region, a perspective is needed that focuses on wealth generation and livelihood security, across short and long time scales, from small to large scales, and across different sectors. Globally, the ‘triple bottom line’ for sustainable economic development - social equity, environmental health and wealth creation has been widely accepted[118]. Achieving all three together is challenging, especially where large sectors of society are dependent on environmental goods and ecosystems services (i.e. wild fish, rain and river water, etc.) all public goods that are traditionally seen as limitless but increasingly in short supply, including in the NMC. Two

approaches build a foundation for achieving success in this context - the Sustainable Livelihoods/Capitals approach and the Green/Blue Economy approach - because they recognize the value of natural processes that sustain economic productivity, but equally importantly, recognise the needs and perspectives of people.

4.1.3. Five Capitals

The Capitals Approach recognises that wealth is generated from assets, and that it is necessary to nurture and even enhance these assets to maximise benefits. Financial capital and manufactured capital are the typical assets that are recognised in traditional business and economic models, here labelled Economic Capital, but the Capitals Approach recognises that these are just one of a set of key assets - the others include natural capital (from which all manufactured goods are derived), social capital (e.g. community networks and institutions), human capital (e.g. education and health) and institutional capital (e.g. institutions and governance arrangements)[119]. The value of this approach is that financial and manufactured capital or gains are not prioritised over and above the others, particularly when maximising them alone results in degradation and lost value in one or more of the other capitals. This approach has been applied successfully in economies highly dependent on natural resources and with a low proportion of economic activity in the cash economy, through the Sustainable Livelihoods Approach[120]. It has typically also focused on smaller scales, such as at village levels, but is equally applicable to regional scales of ocean management[121] and is the foundation for new thinking in the banking sector on long term financial investment at the World Economic Forum[122].

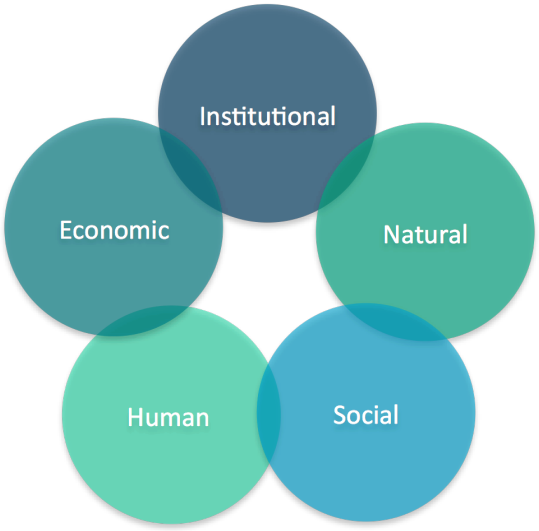

Figure 13. The five capitals of the Capitals Approach, adapted from the Global Partnership for Oceans' Blue Ribbon Panel.

This framework has been used here to describe the major sectors or assets in the NMC region (Section 2) as well as to present threats and potential opportunities to them (Section 3). Using this approach the goal to maximise wealth is provided with tangible statements for improving conditions across the five assets rather than just a focus on economic growth. The approach also internalises the concept that an activity must not undermine or degrade any capital, thus meeting the environmental and social goals of conservation, equity and justice, to ensure balanced growth.

4.1.4. Green and blue economic approaches

At national levels, the Green Economy approach is committed to development paths that maintain, enhance and, where necessary, rebuild natural capital as a critical economic asset and as a source of public benefits, especially for poor people whose livelihoods and security depend on nature. This makes it compatible with the Capitals Approach. Already Mozambique has committed to a Green economic path for development, launching a Roadmap at the RIO+20 Conference in Brazil, and currently finalizing a Five Year action plan that underpins its Five Year Master Plan for development[123]. All the countries of the region expressed their commitment to the Green Economy approach at the 7th Conference of Parties to Nairobi Convention in December 2012[124].

The Blue Economic approach has become popular in recent years, including in the Western Indian Ocean[125]. Typically, the approach focuses on two principal axes - the role of the oceans in national and global economic affairs, and thus a need to develop national and international policies that ensure the health of the ocean, and the importance of the oceans and marine ecosystems in carbon sequestration and mitigation of climate change drivers. Of great importance, however, is that 'Blue Economy' does not just relate to extraction of wealth from marine resources, e.g. through unsustainable fishing, or high-impact mining/oil extraction – the term implies an approach that is beneficial and low-impact for the Oceans. For maritime countries committed to a green economic approach, the terms blue and green economy may be interchangeable, both encapsulating the need to incorporate ocean health and sustainability into national policy-making, and transformation from Business as Usual scenarios to ones with positive environmental/social outcomes.

Box 2 - five recommendations from the Helsinki Commission for turning adversity to opportunity

(See Section 2.1.1)

Focus on high-impact initiatives. In each sector and capital, what are the strategic priorities to focus on? E.g. Habitat degradation, minimize nutrient and contaminant inputs, and damaging practices. To reduce overfishing develop long-term management plans for all major fisheries, set a target of zero for unwanted catches and discarded fish. In tourism, focus on standards, incentives and marketing/branding; in the energy sector, focus on accountability, pollution/discharge standards, and clear procedures and finance for mitigation/

Empower regional bodies and increase accountability. Without authority and ac- countability, meaningful progress is unlikely. For the NMC, develop a governance system amongst the countries that is inclusive of the private sector and civil society in a partnership that ensures mutual accountability.

Take an integrated, coordinated approach. With such a complex socio-economic and environmental system as in the NMC, and interest groups at very different stages and capacities for involvement, the Capitals approach ensures that progress in one sector does not undermine the condition or progress in other sectors. With a well-functioning partnership structure, an integrated approach to developing the NMC should be possible.

Drive innovation with commercial incentives. Not just sanctions for polluting or bad practices, but commercial incentives need to be used to drive innovation and investment. Unnecessary hurdles and bureaucracy should be removed.

Transform the region into a hub for blue and green technology. The financial and investment strength of the region, as a result of oil/gas development as well as other sectors, can drive strategic investments to raise the rate of innovation and commercialization of ideas. Through a holistic perspective on environmental and social sectors, public- private partnerships can be encouraged to leverage resources and share risks, to develop the knowledge/innovation capital of the region.

4.1.5. Ecosystem services

A significant challenge for effectively considering natural capital in national and larger scale economic planning, and effectively implementing a green/blue economic approach, is how to measure the value of natural capital. In recent years the concepts of ecosystem goods and services have grown to replace the historic focus on 'resource extraction', given momentum by the Millenium Ecosystem Assessment[126], and now culminating in the formation of the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) as a global forum for bringing ecosystem service concepts into global decision-making processes. However tools for accounting for the value of natural capital (as well as the other 3 capitals other than economic capital) are rudimentary or theoretical, and little data exists especially at local and sub-regional scales.

A recent analysis of the total annual economic value of coastal ecosystem goods and services in the wider WIO estimated that half of these may be attributed to the area designated as the NMC alone, at a

value of over 12.5 billion US$ per year[127]. However to have a chance to deal with the complex issues highlighted in this document, across the multiple sectors and capitals, finer scale data on ecosystem service values is required. Further, this data must be consistent across the countries of the NMC, and ideally in comparison to other parts of the WIO outside of the NMC. To this end, a report on ecosystem services of the NMC was commissioned[128], parts of which are already quoted here (section 1.4.6), and to be used as a foundation for next steps in building the NMC initiative.

4.1.6. Five Principles for sustainable ocean development

Drawing together the small scale of the Capitals Approach and the large scale of the Green Economic approach is a challenge, and one that is addressed for oceans and marine systems in advice developed by the Blue Ribbon Panel (BRP) of the Global Partnership for Oceans[129]. In it, five Principles are identified, adapted from the classical 5-capitals approach, and emphasizing the relevance of the Capitals Approach across all scales of governance for marine systems.

The BRP emphasized that a key problem of the oceans is that of common pool resources, or 'public goods'[130]. Historically, access to ocean resources has been open and all members of society have or feel a right to exploit and derive benefits from this public good, particularly as a last resort when other options fail. The problem occurs where impacts to the public good cause it to degrade and/or the person causing the impact bears little or no cost, while wider society, or the most vulnerable sectors of society, do. Key to the BRP advice is the institutional and governance framework necessary to address the problems of common pool resources integrated across the five principles, through partnership between all major stakeholders.

4.1.7. Partnerships

Emerging best practice finds that public-private partnerships – of governments, public and civil society organizations, the private sector and NGOs/academia – are a necessary platform to optimize the generation and sharing of benefits from the abundant resources of a region, while ensuring that the primary assets are not degraded through individual or sectoral approaches. This finding matches the elements of Institutional Capital presented in this document, of the importance of national and international institutions, private sector bodies, civil society organisations, and others, in the NMC.

An additional example of this type of partnership approach is the move toward co-management in small scale fisheries[131]. Most NMC countries have implemented policies and regulations to facilitate this, where government departments relinquish some level of control and authority to local fisher associations, and both partners play a role in the joint management of fishing resources. The ownership and empowerment this gives to community groups has helped to build a sense of stewardship, and the desire by communities to manage their natural capital sustainably by protecting key areas, banning damaging practices, and limiting open access to resources.

These approaches are consistent with global trends to increase the participation and responsibility of citizens groups in management and democratic institutions[132], and may be a foundation for success in a NMC initiative. Accordingly, Institutional Capital has been identified as one of the priority pillars for moving forward, treating the governance agreements between multiple partners as a key asset that must be built up, alongside the others.

4.1.8. Marine Spatial Planning for the NMC

All these elements describe a complex initiative involving multiple countries, decision-making processes, economic sectors, sectors of society, knowledge systems and more. The ability to generate sufficient information and knowledge, and to process it in ways that support rational decisions (ie. the Knowledge Capital of the initiative) will be a fundamental factor affecting success in the initiative. To this end, Marine Spatial Planning (MSP) is growing in recognition globally as an approach that could satisfy this need. Most importantly for this initiative, MSP has two primary pillars:

a) it requires participants to agree on a shared vision that will guide all negotiations and decisions, and

b) it provides an informatics basis (through the geographic display and analysis of information) that is intuitive and understandable by all, while having the tools to deal with complex and very different datasets and relationships.

MSP can thereby be a primary foundation for the initiative, bringing together the diverse data on each Capital and other relevant factors, to be compared against one another to support decisions. Investing in MSP is thus a prime foundation for the initiative, as it directly supports Governance and Knowledge/Human capitals, while providing a common ground for monitoring and data across all the capitals.

4.2. A Strategic Framework for change in the NMC

4.2.1. A working vision

The working vision for the NMC can interpret the WIOSAP vision to make it explicit to the geography, natural resources and people of the Northern Mozambique Channel, and guide the countries towards a sustainable future in a green/blue economic model, rather than the 'fuelled business as usual' scenario that is otherwise very possible. This would make the NMC programme a place-based initiative to deliver on the priorities established under the WIOSAP and related regional SAPs of the GEF projects, as well as other national and international processes. A draft vision, for further development by the countries and partners can be stated as "***the people, countries and economies of the Northern Mozambique Channel prosper in a sustainable future founded on the natural and cultural assets and diversity of the region***".

4.2.2. Theory of Change and Outcome Mapping

To address the problems and opportunities in the NMC, a Strategic Framework has been developed that provides for an inclusive framework for involvement of all stakeholders, from smallest to largest, to achieve sustainable growth for the region. It is based on a Theory of Change which holds that:

- ✓ all stakeholders, from largest to smallest, and of all cultures, must be engaged in an inclusive and transparent partnership;
- ✓ the future well-being and wealth of all depend on maintaining and enhancing the primary assets that support human society;
- ✓ nature provides irreplaceable services and assets on which we all depend;
- ✓ It is thus in the interests of all stakeholders and economic sectors to assure the protection and sustainability of nature-based enterprises and broader services provided by nature.

The objectives for a large, complex and long term partnership are developed through a process of mapping 'pathways of change', or identifying long term outcomes. These identify what success will look like, in the eyes of the members of the partnership. These pathways enable the partnership to identify the cascade from long term to short term outcomes and thereby to specific actions that need to be implemented to achieve the vision.

The WIOSAP and NMC visions are focused on the inextricable links between:

People *– to deliver wealth, livelihood security, welfare, equity, and justice, for all cultures and religions, over short and long time scales;*	***Nature/environment*** *– our planet through healthy ecosystems, is the core provider for all aspects of human and economic wealth, through living resources, as well as mineral/fossil ones.*

4.2.3. Five Capitals for building a green economic approach/sustainable ocean use

Combining the Capitals Approach and the Global Partnership for Ocean's Blue Ribbon Panel's advice for large scale ocean management[133], five long term outcomes to achieve the vision can be described:

1) the Institutional Capital of the NMC is built, through a Partnership between the countries, private

sector and civil society that enables shared decision-making and sustains commitments that deliver a viable partnership and the means to build the other capitals.

2) the Economic Capital of the NMC is grown, assuring food and livelihood security, and delivering wealth and prosperity equitably to the peoples of the region and into the future.

3) the Natural Capital of the NMC is enhanced, such that critical ecosystems, species and ecological processes are protected and enhanced, supporting the people and economies of the region into the future.

4) the Human and Knowledge Capital of the NMC is built, providing for the decision-making and technological progress that will assure the future of the region, and an informed and knowledgeable society.

5) the Social Capital of the NMC is enhanced and celebrated, ensuring the health, well-being and freedoms of the people of the region in a harmonious and just society.

These five strategic outcomes, on a time scale of over 25 years, can guide the planning process and identification of shorter term outcomes and key results, that will enable partners to identify activities to implement. Further steps in the development of the partnership will need to refine the outcome statements, updating them to reflect the aspirations of all in the partnership, and to ensure they are specific, measurable, assignable, realistic and time-bound.

4.3. Current status and next steps

At the time of publication of this document work is focused on building the partnership necessary to deliver the Five Capitals framework for marine governance outlined here. This involves engaging with the countries to identify their priorities and ownership and leadership of the initiative from government partners. At the same time, institutionalizing the NGO/civil society contribution is underway, with growing interest in participation from a broad range of NGOs, programmes, organizations and individuals from within the NMC countries and internationally.

The 8th Conference of Parties to the Nairobi Convention, to be held in late June 2015 in the Seychelles marks a watershed when it is hoped the country endorsement for the initiative will be registered, opening the doors to an integrated approach across the countries, and to multi-lateral finance for building the next stages in the initiative. At the same time, this will empower the NGO/civil society engagement in support of the initiative and facilitate approaches to the critical commercial sectors and the actors within those.

Financial support for the initiative has to date been raised from private donors, with in-kind support from a range of partners. A major goal for 2015-16 is to prepare the documentation to obtain multi-lateral funding for the initiative, as well as national commitments and identification of programmes that deliver on the goals of the NMC initiative.

4.4. The scope of a Northern Mozambique Channel initiative.

Geographically, what should be included within the boundaries of a regional initiative for the Northern Mozambique Channel must be determined by the key partners in the initiative – the countries primarily, but also with consideration for the principal stakeholders and partners from civil society and the private sector. Two basic options (smallest and largest) are suggested by they biophysical properties of the region, as well as certain administrative boundaries: the smallest option is indicated by the red dotted outline, while the largest option by the red dotted outline (fig. 11). Determining which of these, or another solution intermediate between these can be done by the partners in early stages of development of the initiative.

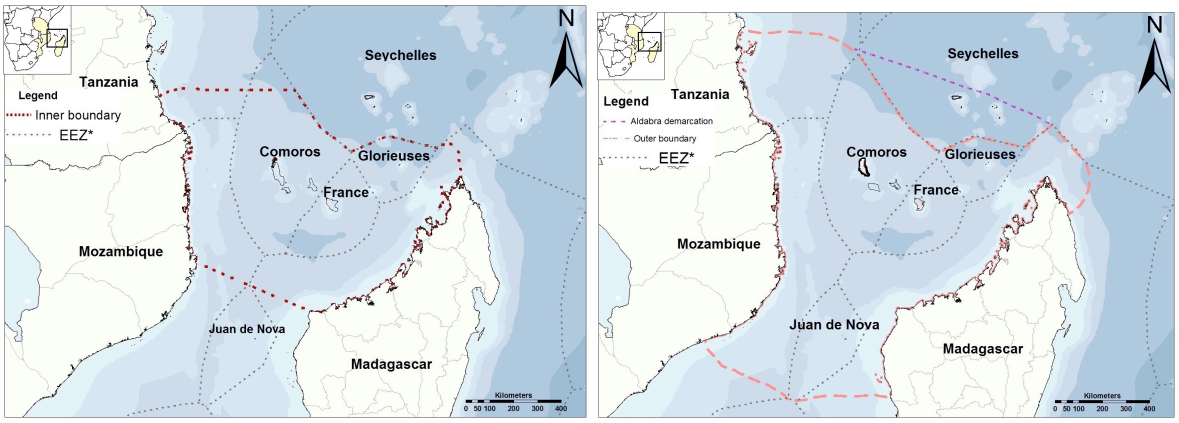

Figure 14. Two options for boundaries of a Northern Mozambique Channel initiative. Left: the smallest delimitation of the Northern Mozambique Channel, based entirely on ocean currents and dynamics; Right: possibilities for more inclusive boundaries of the Northern Mozambique Channel, including considerations based on broader biophysical properties, biogeography of species, and administrative considerations, and inclusion or not of the Aldabra group of islands.

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