Assessing the status, scope and trends of the legal and illegal international trade in marine turtles, its conservation impacts, management options and mitigation priorities in Mozambique.

*Implementation of CITES Decisions 17.222 and 17.223 on Hawksbill turtle (*Eretmochelys imbricata*) and other marine turtles (*Cheloniidae *and* Dermochelyidae*)*

Photo: J Williams, Artisanal beach seine fishery, Inhassoro, Inhambane May 2018.

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on behalf of the

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Suggested citation:
Pilcher NJ & J Williams, 2018. Assessment of the status, scope and trends of the legal and illegal international trade in marine turtles, its conservation impacts, management options and mitigation priorities in Mozambique. Report to the CITES Secretariat Project S-527. SSFA/2018/DKA. 69pp.

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List of Acronyms

AHP – Analytic Hierarchy Process

ANAC - National Administration for Conservation Areas

BANP – Bazaruto Archipelago National Park

CBD – Convention on Biological Diversity

CCP – Community Fishing Council

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora

CMS – Convention in Migratory Species

EEZ - Exclusive Economic Zone

EIA – Environmental Impact Assessment

FAO – Food and Agriculture Organisation of the United Nations

IDPPE – National Institute for the Development of Small-scale Fisheries

IOSEA MoU – Memorandum of Understanding on the Conservation and Management of the Marine Turtles and its Habitats in the Indian Ocean and Southeast Asia

IOTC – Indian Ocean Tuna Commission

IUCN – International union for the Conservation of Nature and Natural Resources

IUU - Illegal, Unreported and Unregulated (fishing)

IWT – Illegal Wildlife Trade

LNG – Liquefied Natural Gas

MRF – Marine Research Foundation

MPA – Marine Protected Area

MZN – Metical (10m MZN represents ten million Mozambican Meticals, or approximately 200,000 USD)

NGO – Non-Governmental Organisation

P&S – Primeiras & Segundas Islands (National Park)

POPNR – Ponta do Ouro Partial Marine Reserve

QNP – Quirimbas National Park

SSF – Small Scale Fisheries

SWIO – South West Indian Ocean

TED – Turtle Excluder Device

UNEP – United Nations Environment programme, now UNE – United Nations Environment

USD – United States Dollars

WIO – Western Indian Ocean

yrs – Years

Executive Summary

Sea turtles are protected in Mozambique via the Forests and Wildlife; the Recreational and Sports Fishing Regulation; the General Regulation of Maritime Fishing, and the Conservation and Biodiversity. Alongside these, sea turtles are also indirectly addressed via the National Constitution Article 37; The Environmental Law; the Environmental Impact Assessment Regulation; the Tourism Law; and the Strategy and Action Plan for the Biological Diversity of Mozambique. Mozambique is also party to a number of international conventions and agreements that also address the welfare of sea turtles and their habitats, including the Convention on International Trade in Endangered Species of Fauna and Flora (CITES), the Convention on Migratory Species (CMS), the Indian Ocean Sea Turtle MoU (IOSEA MoU) and the Nairobi Convention (see Section 1.2.1).

Mozambique has approximately 2,700km of sub-tropical coastline, with extensive coral reefs and island archipelagos in the northern part of the country, swamp and estuarine coastal areas in the middle, and parabolic dune coasts in the south. Five species of turtles: the green (*Chelonia mydas*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), Olive ridley (*Lepidochelys olivacea*) and leatherback (*Dermochelys coriacea*) are found along the entire coast, with large numbers of juvenile and sub-adult turtles in coastal foraging grounds. The north and south of the country are starkly different, and tensions exist across these geopolitical zones due to the disparity of wealth between the richer south and the poorer north, particularly as the extensive natural resources are found in the north (e.g. Liquefied Natural Gas [LNG] gas, precious stones and coal).

Large numbers of sea turtles are impacted by traditional and commercial fisheries in Mozambique, primarily as bycatch in semi-industrial, commercial and artisanal. In addition, there are impacts to sea turtles through illegal, unregulated and unreported fishing, the illegal wildlife trade, and large-scale industrial developments in northern region. The scale of these threats and their impacts are largely data deficient.

Despite being protected under national law and under international treaties, such as CITES and CMS, there is widespread directed take of the turtles in Mozambique. Interview surveys among fishers / fishery-related workers and management practitioners provided a rapid assessment of the turtle fishery and the potential impacts of commercial and artisanal fisheries on turtle stocks but given time and funding constraints, determining an overall national-level impact is problematic. An estimated 1,000 to 1,800 turtles may have been removed from the population among only the respondents to this survey, and extrapolations suggests that national level extraction could be of a magnitude of hundreds of thousands. Numerically, our estimate indicates the total take could reach ~800,000 turtles, with a quarter of those reportedly retained for consumption or trade and the balanced (reportedly) released alive. However, we recognise that the number may be unrealistic and suggest that the important aspect of this finding is the magnitude of the take of sea turtles (hundreds of thousands) rather than the exact number. The semi-industrial and industrial fleets likely contribute another ~4,000 to ~6,000 turtle mortalities each year but the magnitude of this take pales when compared to the directed take and bycatch in artisanal fisheries.

While Illegal, Unreported and Unregulated (IUU) fishing occurs, we have no way to assess its impact. Similarly, international trade occurs, but the magnitude of this trade is also unknown. We believe that domestic trade and consumption are likely far more extensive and of far greater impact than the international trade, given poverty levels and remote locations of many of the fishing villages. The curio trade in hawksbill-derived ornaments was also documented, but again due to coverage we do not have an understanding of the full impact of this market sector.

Nesting has declined in Mozambique and no beaches exist that would support the number of turtles that are taken in the fisheries, and thus we believe that these are being seeded from nearby rookeries in the Western Indian Ocean. It is unclear whether this is a sustainable level of extraction.

The turtle catch and bycatch problem is complex and widespread, and confounded by poverty levels, a lack of resources for enforcement, the wide geographical spread of the problem, and the varied fishery gears across the commercial and artisanal sectors. We believe there is a need to further evaluate the depth and breadth of the sea turtle take and trade, and to further evaluate illegal take and use of turtles and provide a more reliable estimate of take at the national scale, beyond the results of this rapid assessment

Solutions to the illegal trade and take of turtles are numerous and varied, and we suggest these include building capacity among officials who are involved in fisheries, enforcement and customs; allocation and provision of sufficient resources to vastly expand enforcement capabilities; building capacity for systematic gathering of information and reporting of illegal take and trafficking incidents; enhancing the effectiveness of the observer programme and logbook reporting in semi-industrial and industrial fleets; and enhancing and implementing bycatch mitigation programs in the semi-industrial and commercial fisheries, such as through the use of Turtle Excluder Devices (TEDs).

There is also a need for increased funding to address sea turtle management and conservation because at present there are insufficient funds dedicated to managing Mozambique's sea turtle populations, particularly those at sea. There is a great need for additional resources, staff and operational costs, both inside and outside of Marine Protected Areas (MPAs) to effectively manage impacts to sea turtles. There is additionally a need to build capacity and awareness across a wide range of stakeholders including local government representatives, the artisanal fishing community, local administrators, community leaders, and community fishing councils; and conduct campaigns among local communities to sensitise them on the conservation status of sea turtles, the legal protection status of sea turtles, and opportunities for minimising bycatch in local fisheries.

We believe that a suite of community-level solutions is also required, as the scale of the directed take and bycatch is beyond the scope of simply government enforcement. These may include alternative livelihoods that reduce pressures on sea turtle stocks, and micro-finance schemes to catalyse conservation action and enable communities to improve the standard of living and become less reliant on sea turtles for sustenance.

Importantly, in order to determine the sustainability of the on-going sea turtle take and bycatch, there is a need to determine the provenance of the sea turtles being taken out of Mozambique waters and to determine the overall productivity of these source rookeries. We also believe this should be coupled with a national-level assessment of nesting sea turtles in Mozambique, to better understand their contribution to sea turtle stocks in Mozambique's coastal foraging grounds.

Insufficient is known about the distribution of sea turtles along Mozambique's coast, and knowledge of this might allow the design of time-area closures of semi-industrial and commercial fisheries as a mitigation tool to address bycatch of sea turtles in these fisheries. That said, there is a need for a detailed study into the impacts of the semi-industrial and commercial fisheries sectors in Mozambique, including an evaluation of bycatch and the effectiveness of current logbook and fisheries observer schemes. Alongside this, there is also a need to understand the impacts and scale of IUU in the Mozambique Exclusive Economic Zone (EEZ) and understand how IUU fleet may interact with turtles and other protected species.

Finally, we see the need for a holistic regional survival probability model of sea turtle population dynamics which takes into account the threats from multiple countries (how many turtles of what age classes are being taken out of the population), limitations of source beaches (how many sea turtles are being produced each year), natural survival probabilities, and sea turtle biology to determine the sustainability of the current harvests.

1.0 Introduction

1.1 Background

The Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) contracted the Marine Research Foundation to assess the status, scope and trends of the legal and illegal international trade in sea turtles in Madagascar and Mozambique. This report addresses findings from this assessment for Mozambique.

The present assessment contributes to the implementation of CITES Decisions 17.222 and 17.223 on the Hawksbill turtle (*Eretmochelys imbricata*) and other marine turtles (Cheloniidae and Dermochelyidae). Particularly, the assessment contributes to determining the status, scope and trends of the legal and illegal international trade in sea turtles; determining the conservation impacts associated to this trade; identifying ways to improve the management of sea turtles in the context of this trade; and identifying areas (geographical and operational) where immediate mitigation efforts may be needed.

The Marine Research Foundation was contracted to compile information on the trade in sea turtles where updated, scientifically sound data are available, and conduct primary research to generate and collect data on the trade in sea turtles where it is non-existing.

1.2 Country overview – Mozambique

Mozambique has approximately 2700km of coastline, and extensive island archipelagos in the northern half of the country. The coastline can be split into three major marine environments from north to south (coral coast, swamp/estuarine coast and the parabolic dune coast; Pereira et al. 2014). Five species of turtles are distributed along the length of the coast, throughout Mozambican waters (see Fig 1. for details). Despite sea turtles having been protected in Mozambique since 1965, before Independence, illegal take is reported to be widespread throughout the country and understudied (Louro et al. 2006, Williams et al. 2016). The main nesting distribution in the south is for loggerhead turtles *Caretta caretta* and leatherback turtles *Dermochelys coriacea*. The northern nesting distribution is for green turtles *Chelonia mydas* and hawksbills *Eretmochelys imbricata*, both of which are primarily restricted to islands with some scattered, low-density nesting occurring along the mainland (Louro et al. 2006).

The north and south of the country have extremely different influences (i.e. Tanzania and South Africa). The north is predominantly Islamic whereas Catholicism is the dominant faith of the south. Languages / bantu dialects vary vastly throughout the country although Portuguese is the official language. Northern region peoples widely speak Swahili and Macua more than Portuguese, and traditional beliefs and black magic / voodooism / superstition are widely believed in. Strong political influences differ between north and south of the country: the central north is strong hold of Renamo, the opposition of Frelimo (the political party in power since independence). The south of the country, and the capital city of Maputo are considered Frelimo strongholds. Numerous political tensions exist due to the disparity of wealth between the richer south and the poorer north, particularly as the extensive natural resources are found in the north (e.g. LNG gas, precious stones and coal).

There are five marine protected areas (MPA) areas in Mozambique (Fig. 2), varying in effectiveness: some are essentially paper parks, lacking operational management plans, enforcement teams and financial means to operate. Artisanal fishing is legal in all MPAs. MPAs are supposed to have use zones, in which sanctuary areas are described. These areas could potentially provide refuge to turtles from fisheries pressures, if the sanctuary areas were respected or adequately enforced. However, while zones are designated, there is no enforcement directed at specific activities in specific areas.

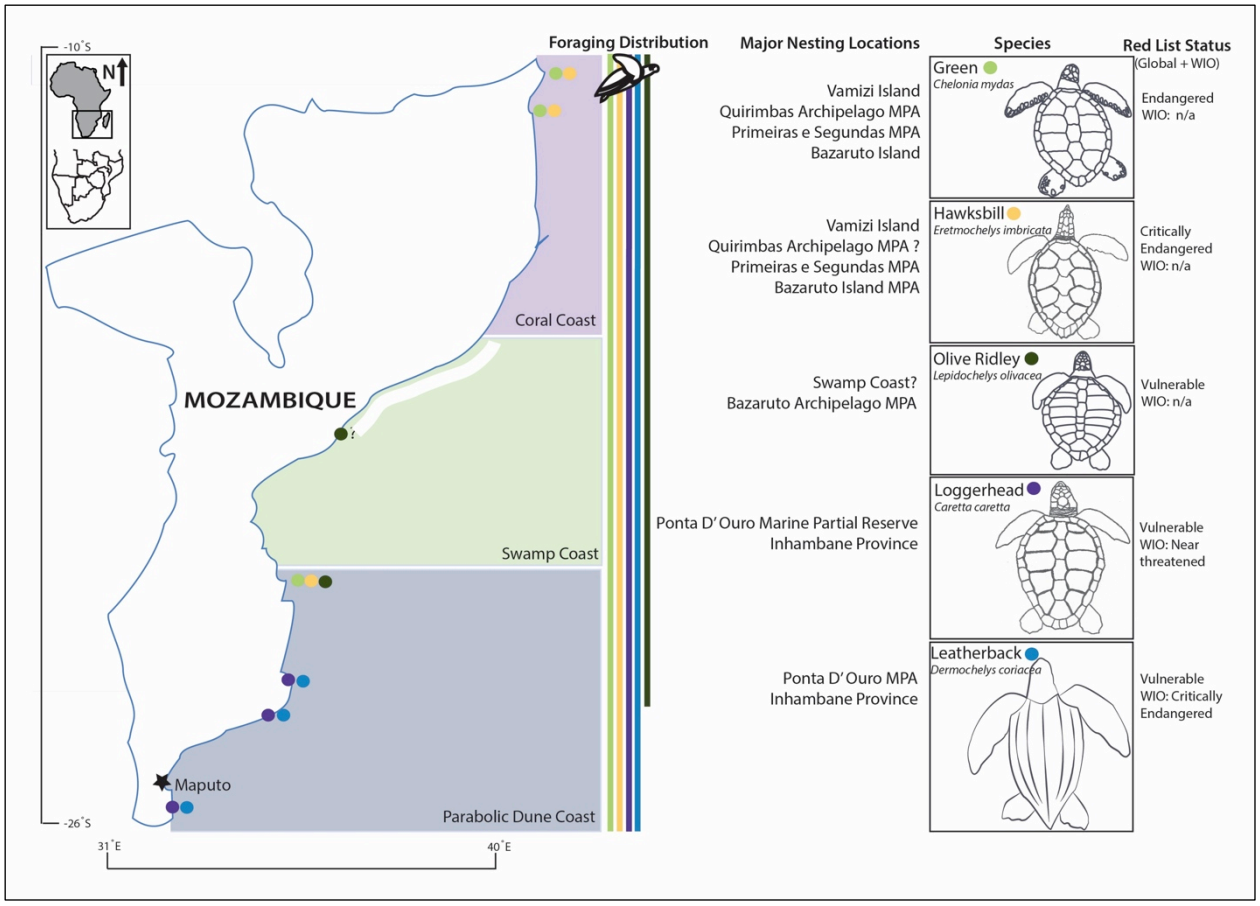

Figure 1: Distribution, nesting locations and regional conservation status listings for the five species of sea turtles found in Mozambican waters. Major marine coastal habitat types (parabolic dune coast, swamp coast, coral coast) are shown on map (colour coded). Maputo, the capital city, is represented by a star symbol and the Sofala Banks (the main commercial fisheries grounds), are shown as a white stripe. Foraging is likely to occur throughout the distribution range for each species. Adapted from Louro et al. 2006; with foraging and nesting information from Hamann et al. 2013, Fernandes et al. 2017, and Robinson et al. 2016; all presented in Williams 2017.

1.2.1 Legal status of sea turtles in Mozambique

Sea turtles are protected in Mozambique through a series of domestic regulations and via the country's participation in various international instruments. At a National level, sea turtles are protected directly via the Forests and Wildlife Regulation (Decree 12/2002) which protects all five species of turtles; the Recreational and Sports Fishing Regulation (Decree 51/99) which bans recreational hunting of turtles; the General Regulation of Maritime Fishing (Decree 43/2003) which requires Turtle Excluder Devices on trawl fisher vessels; and the Conservation and Biodiversity Law (Law 5/2017) which identifies threatened species and requires CITES permits for import/export (Table I). Other national mechanisms with direct relevance include the various Conservation Area Management Plans. Alongside these, sea turtles are also indirectly addressed via the National Constitution Article 37; the Environmental Law (Law 20/97); the Environmental Impact Assessment Regulation (Decree 45/2004); the Tourism Law (Law 4/2004); and the Strategy and Action Plan for the Biological Diversity of Mozambique (2015 – 2035).

Mozambique is also party to a number of international conventions and agreements that also address the welfare of sea turtles and their habitats, either directly or indirectly (Table II).

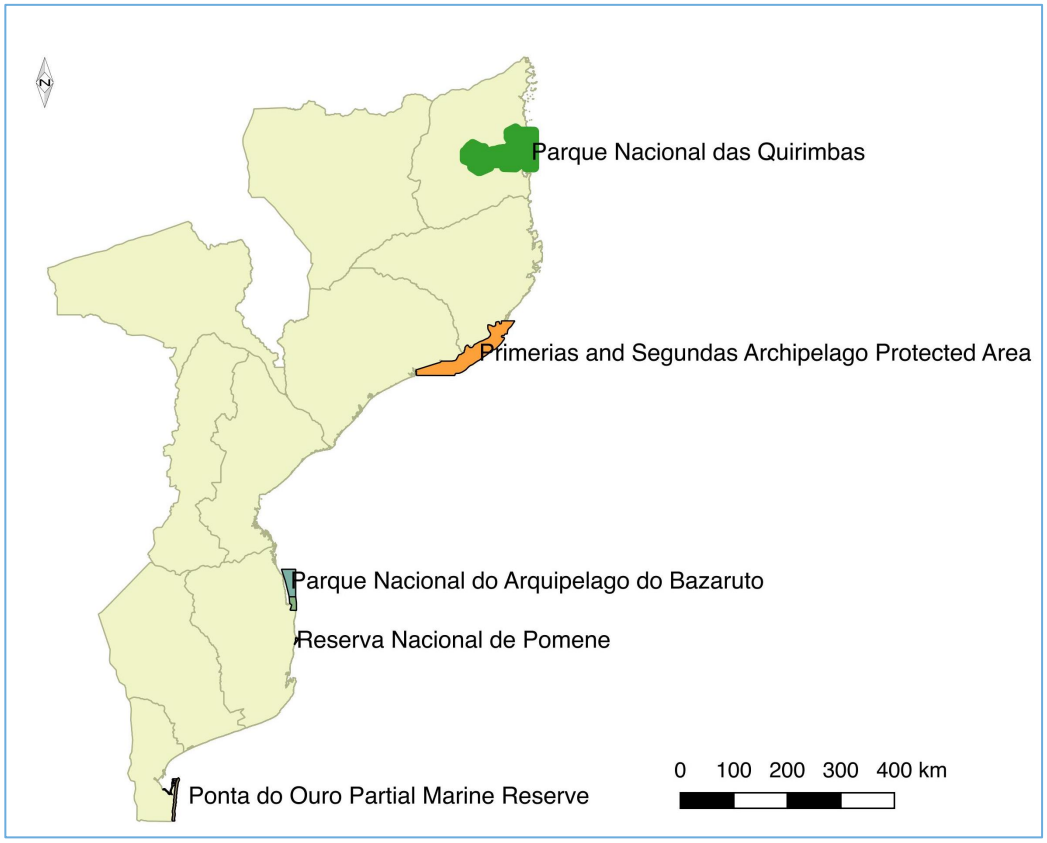

Figure 2: Location of MPAs in Mozambique.

Table I: National legislation and other binding mechanisms relevant to marine turtles, with regards to direct or indirect relevance (adapted from Louro et al. 2006)

Instruments with direct relevance to sea turtles in National legislation		
Statute	**Description / key goal**	**Relevance to sea turtles**
Forests and Wildlife Regulation (Decree 12/2002 of 6 June 2002)	Directly protects marine turtles, among other wildlife species. Articles 43 (5) and 44 (1a) fully protect the species listed in Annex II (of which all 5 species of marine turtle are included), and set the fine for illegal hunting of marine turtles at 25m MZN. The Regulation also predicts the aggravation of fines depending on the circumstances (e.g. hunting in a forbidden area, hunting with forbidden equipment, (Article 114, Annex III). In addition to this, aggravated fining mechanisms exist for a number of other scenarios. For instance, if the offender is an organised group (40% more) or an aggravation of 50% if the offender is a wildlife officer, community guard, police officer, military or public worker for 'Forests and Wildlife' or 'Tourism Services.'	- Hunting in forbidden areas (e.g. Parks and Reserves): 10m MZN - Hunting with forbidden means or instruments (e.g. gill nets in forbidden areas): 20m MZN - Hunting without license (the Regulation can issue special licenses for scientific research) Article 44 (2 & 3): 30m MZN - Hunting of protected species: 100m MZN - Trade, importing or exporting of wildlife specimens without a permit: 10m MZN - Actions against rare species or threatened with extinction, for which exploitation is forbidden: 1,000m MZN - Use of violence, threat or showing resistance to enforcement: total fine value plus 60%.

Recreational and Sports Fishing Regulation (Decree 51/99 of 31 August 1999)	This regulation is specifically for recreational and sports fishers and forbids marine turtle fishing (Article 14 and Annex II).	The fine for the capturing and possession of a protected species is 8m MZN to 10m MZN per piece.
General Regulation of Maritime Fishing (Decree 43/2003 of 10 December 2003).	This Regulation (Article 110.1) requires the use of Turtle Excluder Devices in all trawling fisheries aided by a motor, and states "Failure to use the device constitutes a serious fishing practice infringement in terms of section a) of Article 53 of the Fishing Law and is punishable in accordance with number 2 of the same article".	This has direct relevance to the shallow-water prawn fishery.
Conservation and Biodiversity Law (law 5/2017)	Article 46 and 47 describe the list of threatened species (to be determined by the council of ministers) and the conditions describing the requirement of a CITES permit to import or export threatened species. Article 62 describes stronger prison sentences (12-16 yrs) for criminals for slaughtering any protected species or prohibited flora and fauna including those listen on CITES Annex lists I and II. Article 63 C describes the correct procedure for storage and protection of confiscated wildlife products.	
Conservation Areas Management Plans	The management plans of coastal and marine conservation areas, namely the BANP, QNP, P&S and the POPMR (and its artisanal fisheries management plan), clearly forbid activities that might endanger marine turtles, their eggs, nests and their habitat.	Comment: Not all of these plans are necessarily implemented on the ground or in date.
Instruments with indirect relevance to sea turtles in National legislation		
Constitution Article 37	"The State promotes initiatives to guarantee the ecological equilibrium, conservation and preservation of the natural environment in order to improve the quality of life of the citizens." Therefore, the constitutional setting has been created and the State is responsible for leading environmental conservation actions.	
Environmental Law (Law 20/97 of 1 October 1997) Article 12 - biodiversity protection.	"All activities that endanger the conservation, reproduction, quality and quantity of the biological resources are forbidden". It is the Government's responsibility to ".... guarantee that appropriate measures are taken with the purpose of: a) maintaining and regenerating animal species, recover of damaged habitats (...), by controlling those activities or the use of substances capable of destroying wildlife and their habitats."	
Environmental Impact Assessment Regulation (Decree 45/2004 of 29 September 2004)-	Refers to development initiatives that might affect threatened species or sensitive ecosystems, stipulating that an Environmental Impact Assessment (EIA) must be done.	

Tourism Law (Law 4/2004 of 17 October 2004)	Article 9, No 2: “Tourism in conservation areas helps the conservation of the ecosystems, habitats and species of the referred area”.	
Strategy and Action Plan for the Biological Diversity of Mozambique (2015 – 2035)	"To ensure the conservation of biodiversity through, among others, integration, training, financing of biodiversity, and the strengthening of partnerships between the different sectors of society." Strategic objective B: Maintain and improve the status of biodiversity by preserving the diversity of ecosystems, habitats, species and genes: In terms of representation, “more attention should be given to turtle nesting hotspots”, including task 12.5 (2015-2018) to expand turtle monitoring sites to include the nesting places outside of protected areass under the responsibility of academic and research institutions.	Within this plan, a section describing known over-exploitation of certain species lists 7 key problem issues. The *Fifth National Report on Biological Diversity in Mozambique* examines in detail the over-exploitation of certain species. Of relevance to marine turtles are the final two points mentioned. 6. Bycatch by trawls and other rudimentary methods of marine mammals. 7. Capture of sea turtles to serve as food, crafts and jewelry, and destruction of their nesting habitats due to the movement of vehicles on the beaches.

Note: 10m MZN represents ten million Mozambican Meticals, or approximately 200,000 USD

Table II: Conventions, treaties and non-ratified agreements relating to marine turtles in Mozambique (adapted from Louro et al. 2006)

International Instruments / Conventions / Agreements with direct relevance to sea turtles		
Instrument / Convention	**Description**	**Date implemented**
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)	Regulates and controls the international trade of threatened species through the listing in Appendices according to threat level. Appendix I is where at currently all species of marine turtles are currently included. Therefore, any act of international trade of marine turtle (or their products) is illegal, including the import and export of jewellery pieces (e.g. necklaces, bracelets, rings, etc.).	Ratified in 1981 (Resolution 20/81 of 30 December 1981)
International Union for Nature Conservation (IUCN)	Aims to influence, encourage and support society in the conservation of the diversity and integrity of nature and ensure that the use of the natural resources is made equitably and sustainably. IUCN maintains a large range of programs on the conservation of species and ecosystems, develops and maintains the IUCN Red Data List and supports the Species Survival Commission Marine Turtle Specialist Group.	Ratified as a member state in 1981 (Resolution 21/81 of 30 of December)
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	Also known as the Bonn Convention, CMS is an environmental treaty under the aegis of the United Nations Environment Programme, and provides a global platform for the conservation and sustainable use of migratory animals and their habitats. All turtles species found in Mozambique are listed on Appendices I and II of CMS. Under the Convention, each Party is required to strictly protect endangered species, listed on Appendix I and strive to conclude international agreements to benefit species with an unfavourable conservation status, listed on Appendix II. Article III of CMS describes obligations to protect Appendix I species, and allows take in exceptional	Party since 2009

	circumstances, accommodating, inter alia, subsistence use by local communities.	
Memorandum of Understanding on the Conservation and Management of the Marine Turtles and its Habitats in the Indian Ocean and Southeast Asia (IOSEA-MoU)	The IOSEA MoU is an intergovernmental agreement concluded under the auspices of UNEP / CMS and aims to protect, conserve, replenish and recover marine turtles and their habitats of the Indian Ocean and South-East Asian region, working in partnership with other relevant actors and organisations.	MoU signatory since 2008

International Instruments / Conventions / Agreements with indirect relevance to sea turtles		
African Convention for Nature and Natural Resources Conservation	The main goal is to ensure the use, development and conservation of soil, water, flora and fauna resources of its member States in accordance with the scientific principles and interests of its people. However, it does not explicitly mention the conservation and protection of marine turtles.	Ratified in 1981 (Resolution 18/81 of 30 December 1981).
Convention of the Biological Diversity (CBD)	Pertains to the conservation of the biological diversity, sustainable use of its components and fair and equal sharing of the natural resources at a global level.	Ratified in 1994 (Resolution 2/94 of 24 August 1994)
Convention on the Management, Protection and Development of the Coastal and Marine Environment of Eastern Africa (Nairobi Convention)	Focuses directly on aspects related to the pollution of the marine and coastal environments.	Ratified in 1996 (Resolution 47/96 of 28 November 1996)

1.2.2 Key fisheries

1.2.2a Artisanal

Artisanal fisheries are widespread along the entire coast. It is an important fisheries sector both socially and economically (Pereira et al. 2014). Artisanal fisheries contribute to approximately 95% of total marine landings in the country. Infamously referred to as an open sector, management of the artisanal fisheries sector is considered extremely weak. Bycatch rates of turtles in artisanal fisheries are not well documented but interactions are thought to be substantial given the expansive/abundant nature of the artisanal fisheries sector. Within the Southwest Indian Ocean Region (SWIO), quantitative surveys of illegal take or bycatch are rare (Kiszka 2012, Bourjea 2015).

Mozambique's artisanal fishers use non-selective gear types, such as gillnets and long-lines. Fisher behaviour is varied, often driven by large-scale socio–economic drivers such as poverty and food security (Berkes et al. 2001, Finkbeiner & Basurto 2015), which influence the fate of bycaught turtles. Many fishers retain bycatch (Williams 2017). The prevalence and consequences of this fishery have not been thoroughly investigated in Mozambique or throughout the SWIO.

The use of gillnets (one of the gears that captures the most sea turtles) and other non-selective nets is increasing, with more than 43,000 nets thought to be in use by 2010 (IFAD 2011, IDPPE 2013, MIPE 2013). Difficulties in data collection and severe underreporting of Small-Scale Fishery (SSF) catches have been recognised and documented in Mozambique and throughout the SWIO region (Gillett 1995, Jacquet et al. 2010). Overall, artisanal fishing production levels have increased three-fold between 2005 and 2012 (Pereira et al. 2014).

The most extensive artisanal fisheries bycatch assessment for the SWIO region was completed in 2012 by Kiszka (2012) using an interview assessment with fishers, which involved 292 respondents from 10 communities (Angoche, Inhaca, Inhambane, Inhassoro, Macaneta, Machangulo, Maputo, Marracuence,

Matutuine, Vilanculous). Fishers perceived a decline in the rate of turtle bycatch (47% of respondents) however no clear trend in the overall turtle population could be determined (n = 107 perceived overall declines and n=106 perceived increases; Kiszka 2012). The highest turtle bycatch interactions were reported from artisanal beach seine fishers (Table III). Of these bycaught turtles in the beach seine fishery, the majority were identified as *Caretta caretta* (38%), *Lepidochelys olivacea* (21%), *Eretmochelys imbricata* (20%) and *Chelonia mydas* (14%) (Kiszka 2012).

Table III: Bycatch rates according to gear for Mozambican artisanal fisheries as presented in Kiszka 2012

Fishery	% of respondents reporting turtle bycatch	Quantity of bycatch: 1 -3 turtles in past year	Quantity of bycatch: 4 – 10	Quantity of bycatch > 20
Beach seine fishery	44%	53%	17%	6%
Monofilament drift gillnets + Multifilament drift gillnets	8%	Not presented	Not presented	Not presented
Bottom-set gillnets	34%	83%	17%	0
Hand line	4%	Only 33% of respondents reported bycatch but did not quantify	n/a	n/a

1.2.2b Semi-industrial & Industrial shrimp fishery

The continental shelf is generally narrow, but widens to 130 km in Sofala Bank, between latitudes 17°S and 21°S (UNEP/IUCN 1988). This is the area where most of the shallow water shrimp exploitation occurs (FAO 2007). The other area includes Maputo Bay. Since the early 1980s the shrimp trawl fishery was identified as a major source of turtle bycatch (Gove et al. 2001). Gove et al. (2001) also indicated that there were around 120 semi-industrial trawlers and about 100 industrial trawlers operating in the country, with accidental take rates of around 1-2 turtles per vessel per month in the winter, increasing to 4-12 turtles per vessel per month in the summer during nesting season.

Their work suggested that sea turtle incidental capture and mortality by the shrimp industry ranged from 1,932 to 5,436 sea turtles in 2001, and their report recommended that Turtle Excluder Devices (TEDs) should be mandatory in the fishery. The maritime fisheries regulation (Decree 43/2003) used those findings and the perception of at least part of the wider Sofala Bank operators and conservation organizations to make the use of TEDs mandatory by 2004. To date this has not been realised, although efforts have been made to introduce TEDs to local fishers.

A follow-up interview-based assessment was conducted by Brito (2012), reporting at least 1,735 ± 1,235 sea turtles bycaught each fishing season. This figure was based on data collected in 2012, and while the authors indicate they asked about captures in past years, no data is provided for the timeframe found among responses. Less than 54.8% of incidents occurred within a few miles of the Primeiras & Segundas Archipelago in the northern section of the Sofala Bank. The study concluded that about 86% of the animals were hauled alive and around 14% (265 ± 184) drowned in the net each fishing season due to long tow durations.

At a regional level, alarming estimates of marine turtle bycatch were revealed in Mellet (2015) from fisheries operating within the South West Indian Ocean (SWIO) region. From a bycatch dataset spanning between 2000 and 2011, the interaction (capture) and mortality rates from longline, purse seine, beach seine, prawn trawl and gillnet fisheries operating within the SWIO region were quantified. It was estimated that the industrial longline fishery caught 4,129 ± 1,376 turtles·y^{-1}, the purse seine fisheries captured 4,388 turtles·y^{-1}, and gillnet fisheries captured 40,264 turtles·y^{-1}. High interaction rates were also quantified in beach seines (9,171 turtles·y^{-1}) and prawn trawler (1089-2 795 turles·y^{-1}) fisheries. The longline fishery was deemed to be of special concern for the loggerhead and leatherback turtles (Spotila et al. 2000, Mellet 2015).

1.3 Intentional and unintentional take of sea turtles in Mozambique

The dynamics of illegal take of sea turtles is complex; related effort, motives and drivers can vary widely, even across small geographic areas. Quantifying the rates of illegal take in small-scale fisheries (SSF) has generally relied on two methods: direct observations and interviews with hunters. Both methods underestimate rates of capture and mortality due to the covert behaviours adopted by fishers, the capture techniques employed and underreporting of capture rates to reduce negative implications to fisher livelihoods (Williams 2017). Reports of high-density illegal take have been documented in the literature for numerous locations, particularly in the islands of the Quirimbas and Primeiras & Segundas Archipelagos in Cabo Delgado and Nampula Provinces (e.g. Gove & Magane 1996, Gove et al. 2001, Louro et al. 2006). Anecdotally referred to as 'turtle graveyards', these locations highlight major weaknesses/limitations in enforcement/patrols given that they have evidence of high-density illegal take of turtles in the form of 'turtle graveyards' full of discarded carapaces and bones. The locations are likely to represent semi-permanent or seasonal artisanal fishers camps that the fishers use as bases for fishing further offshore from the islands. In the form of bycatch, Guissamulo (1993) reported turtle captures in Maputo and Bazaruto Bays, and more recently Gove et al. (2001) analyzed the effects of the prawn fisheries on marine turtles in the Sofala Bank.

The following locations have been reported to host such 'turtle graveyards':

a) Mefunvo Island, Matemo Island, Ibo Island, Senkar Island in the Quirimbas Archipelago, and Arimba, Guludo and Palanguzi beaches on the mainland.
b) Fogo, Mafamede, Puga Puga and Goa Islands in the Primerias & Segundas Archipelago.
c) Mainland areas of Inhambane Province.
d) Red cliffs of Nhamabue to Chibo, Inhassoro.
e) Morrungulo – Massinga to north of Pomene.
f) Tofinho/ Praia da Rocha.

Transects of coastal dunes and mangrove areas (during low tide) are required to quantitatively document turtle mortality in these areas; however the sheer geographical scope of the region makes this a mammoth, long-term task. Mangrove areas near fishing communities are also reported by artisanal fishers as the best location to process illegal captures without being detected.

All five species of sea turtles found in Mozambique are subject to illegal take in the country and take is not size or species specific (Williams 2017). Evidence (carapaces and bones) of illegal take can be detected along the coast of Inhambane province all year round, suggesting that illegal take is not restricted to emerging females or their eggs (Williams et al. 2016). Data on sea turtle mortality / illegal take does not exist for the central provinces (Sofala and Zambezia), and reporting in both northern provinces (Nampula and Cabo Delgado) is infrequent and spatially limited (Louro et al. 2006, Fernandes et al. 2016; Table IV).

Using a combination of transects to survey for mortality events and opportunistic reporting of mortality events, 362 records of illegal take were compiled for Mozambique between 2009 and 2016 (Fig. 3; Williams 2017). An additional twenty-seven mortality events consisted of 2 skulls, 1 plastron and 24 carapace pieces detected along the Afungi peninsula, Palma district, Cabo Delgado in September 2017 (pers. comm. / unpublished data; JL Williams). Along with another 15 mortality events from Inhambane province, this raised the total mortality events detected in Mozambique to 404 just between November 2009 and November 2017 (unpublished data; JL Williams).

Louro et al. (2006) also reported on turtle captures in the Quirimbas Archipelago, Mozambique Island, Vilankulos, Bazaruto Archipelago, Maxixe, Tofo, Jangamo, Xai-Xai, Bilene, Macaneta, Inhaca and the Matutuíne coast. Besides using the meat for human consumption, at Inhaca Island, the raw oil of the leatherback turtle was reportedly used to paint boats and when boiled used for cooking (Impacto 1997). Also, pieces of carapace were used by witch doctors (Gove & Magane 1996) in the practice of traditional medicine. Little is known, however, about these practices that are restricted and conducted in secrecy.

Table IV: Species composition of illegal take detected across Mozambique from records in the literature and surveys, estimated annual nesting female population per species, and illegal take as a percentage of the estimated annual nesting turtle population from the SWIO (Source: Williams 2017). 'Remains' refers to identifiable carapaces, which possibly represent more than one individual.

Species	Total number of remains in literature *	% species compo-sition	Total number of remains (literature and surveys)	Nesting female population	illegal take as a % of nesting female population (2009-2016)	% take risk to nesting population (annual)
Loggerhead	27	16.16	62	> 590	10.50 %	1.32 %
Green	29	17.36	94	> 10 000	0.94 %	0.12 %
Hawksbill	7	4.19	9	> 2 500	0.33 %	0.04 %
Leatherback	12	7.18	12	< 100	12.0 %	1.50 %
Olive Ridley	2	1.19	2	> 1000	0.2 %	0.02 %
Unidentified spp.	90	53.89	183	n/a	n/a	n/a %

** Records derived from; Fernandes et al., 2016a; Fernandes et al., 2015; Fernandes et al., 2014; Louro and Fernandes 2013; Videira et al., 2011; Pereira et al., 2010; Pereira et al., 2009; Louro et al., 2006.*

Work from Williams (2017) details drivers and motivations for illegal take and use of sea turtles in southern Mozambique (Fig. 4). The primary reason cited by respondents for illegal take was for meat consumption. Respondents indicated opportunistic egg harvesting occurred, however, most noted a recent decline in encounters with nesting turtles or nests. Williams (2017) also reported that the majority of fishers were aware of the illegality of harvesting sea turtles but noted the risk of being apprehended by authorities was low and not an effective deterrent.

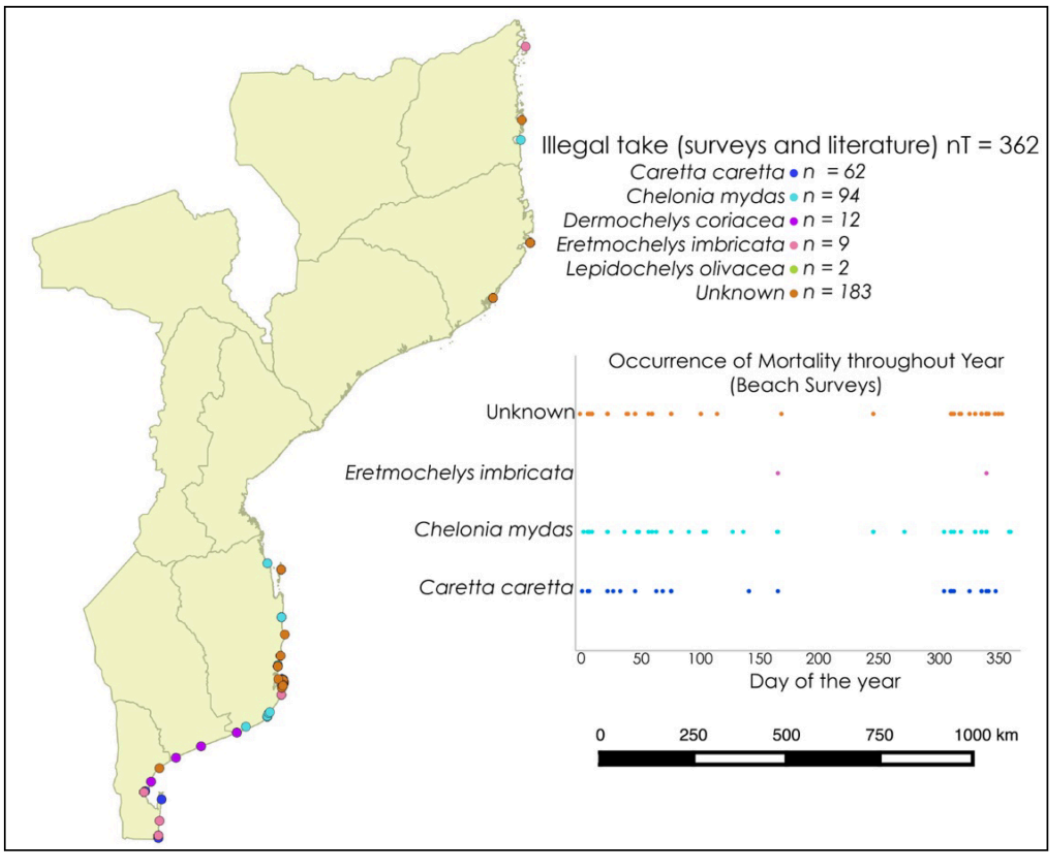

Figure 3: National distribution of illegal take of sea turtles by species from beach surveys and literature review between 2009-2016. Insert graph depicts temporal distribution (day of the year) of the detection of each mortality event for the beach survey dataset (Source: Williams 2017).

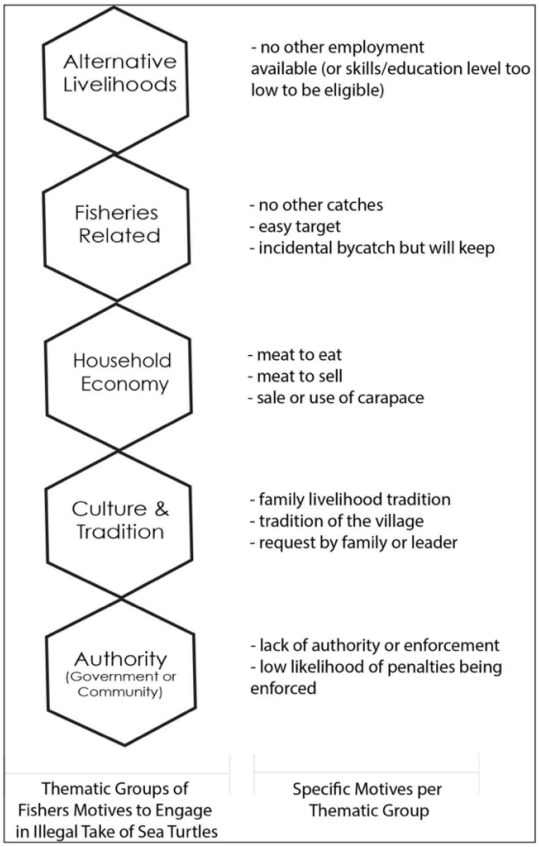

Figure 4: Motives for engaging in illegal take and use of sea turtles in southern Mozambique (Williams 2017).

2.0 Methodology

2.1 Literature review

Illegal take has been documented through most of the SWIO and is well known to occur within Mozambique (Louro et al. 2006). Fishers from across the SWIO region have been reported to retain bycatch (Okemwa et al. 2004, Kizska 2012, Mellet 2015), and the rate of illegal take across the SWIO is thought to have remained constant since the 1970's (Hughes 1970, Frazer 1980, Humber et al. 2016). Within the Western Indian Ocean up to 85% of all sea turtle mortalities are thought to be from illegal take (Muir 2005). Classifying the causes of sea turtle mortality from small-scale fisheries (SSF) is complex, and often not definitive because of the diverse and varied nature of SSF (Moore et al. 2010). One of the key issues in Mozambique (and Madagascar; Humber et al. 2011) is that SSF techniques (particularly gillnetting or long-lining, or other non-selective fishing gears) are adopted by fishers to target a multi-species marine fish and megafauna fishery (i.e. sharks, turtles, dugong, rays, cetaceans). Typically, sea turtles captured using gillnets or longline are classified as bycatch or accidental take, because the target catch is not turtles. Thus, the scenario of turtle 'bycatch' and illegal take is more complicated than the generally accepted 'accidental take' definition because fishers in Mozambique retain bycatch. The prevalence and consequences of this intentional, planned megafauna fishery has not been thoroughly investigated in Mozambique or the SWIO.

A literature review was therefore conducted to identify quantitative reports of illegal take of sea turtles within Mozambique which could be attributed to artisanal fishing or targeted hunting rather than bycatch from fishing fleets (artisanal or commercial). The primary source of information was the national status reports for sea turtles (e.g. Fernandes et al. 2014, 2015, 2016). National estimates of turtle bycatch for artisanal fisheries do not exist. Isolated case studies have been reported by Louro et al. (2006) and Chacate (2005). Bycatch estimates for the semi-industrial shallow water shrimp fisheries were proposed by Gove et al. (2001) and Brito (2012).

2.2 Online Survey

In May 2018 we conducted a rapid electronic survey searching for sale of sea turtle products originating from Mozambique, which included social media sources (Facebook, Instagram), and the main website search engines (Google) and content browsers (Firefox, Chrome). We used key words and combinations of key words such as 'turtle', 'sea turtle', 'Mozambique', 'sale', 'product' to search for evidence of publicly available online sales / marketing of any such products. We acknowledge we were in no position to search any dark web sources, nor did we have time to conduct exhaustive image recognition analyses, e.g. Di Minin et al. (2018). While surveys such as these may in the future provide links to online markets for sea turtles from Mozambique, given our findings (particularly lined to the lack of internet access throughout much of the area where sea turtles are landed), we feel these would be inconsequential to the on-going domestic capture and trade.

2.3 Fieldwork

Interviews were undertaken with artisanal fishers and conservation management practitioners across three coastal provinces of Mozambique during May and June 2018, namely Cabo Delgado, Inhambane and Nampula. Three key provinces were covered over a period comprising 32 days in field, 4534km in flights, 3620km by car and 170km by boat. The total distance covered was 8324 km (see Annex I).

2.4 Rapid assessment interviews

Measuring the effort and the impact that small-scale artisanal fisheries have on non-target species in a standardised and systematic manner has been a longstanding challenge. Knowledge gaps in these impacts are a major challenge to the effective conservation and management of threatened species such as sea turtles. Two questionnaires were developed to solicit information on illegal take and export or sea turtles. One questionnaire was used to engage with artisanal fishermen or small-scale vendors and the other was tailored for conservation management practitioners. Refer to Annex III and IV for copies of the questionnaires.

Interview surveys are considered to be one of the most inexpensive and practical techniques to derive fishery data (Aragones et al. 1997, Jones et al. 2008, Ortega-Argueta 2012), and many researchers now use interviews to quantify fishery effort and gather information on both targeted and incidental catch (Lewison et al. 2004, Moore et al. 2010, Ortega-Argueta 2012). The use of local and traditional knowledge derived via these interview processes is usually cost-effective and has been shown to be relatively accurate for fishery bycatch studies.

Moore et al. (2010) developed a questionnaire to record the two primary types of information needed to quantify and spatially characterize incidental catch in fisheries in developing countries: a measure of fishing effort and a measure of incidental catch. Pilcher et al. (2017) later expanded on the Moore et al. (2010) survey to document incidental capture of dugongs and fishery pressures throughout the Indian Ocean and Pacific Ocean region. Williams (2017) developed a semi-structured questionnaire to assess impacts to sea turtles by artisanal fishers in Mozambique, and Riskas (2018) also developed series of fisher interviews to improve the understanding of IUU fishing and wildlife crime in Malaysia. The survey questionnaire used for this study incorporates aspects of all of these tools, tailored to meet the requirements of the Terms of Reference for the project.

2.5 Sampling sites

Field surveys were conducted in Southern Mozambique from 16th to 20th May 2018 and in Northern Mozambique from 30th May to 24th June 2018 in the provinces of Cabo Delgado and Nampula. During this period, a total of 77 artisanal fishers were interviewed and 11 interviews were completed with conservation management practitioners (Table V). Surveys were also conducted (in the three provinces) in open air-outdoor markets and tourism craft market áreas to check for sale of fresh turtle meat and turtle Shell products.

Table V: Locations surveyed in three coastal provinces of Mozambique, Inhambane, Cabo Delgado and Nampula in May and June 2018. (Community Fishing Council abbreviated to CCP)

Date	Province	District	Location	Interview type	Sample size (n)
16/5/18	Inhambane	Vilanculous	Vilanculous	fishers/boat owners/ CCP	1
17/5/18	Inhambane	Vilanculous	Macunha	fishers/boat owners/ CCP	5
18/5/18	Inhambane	Inhassoro	BD point	fishers/boat owners/ CCP	1
18/5/18	Inhambane	Inhassoro	Nhamabue - Chibo	fishers/boat owners/ CCP	2
19/5/18	Inhambane	Inhassoro	Inhassoro	Management	1
19/5/18	Inhambane	Inhassoro	Tzontso	fishers/boat owners/ CCP	3
19/5/18	Inhambane	Inhambane	Mucucune	fishers/boat owners/ CCP	4
18/5/18	Inhambane	Inhassoro	Inhassoro	Management	1
19/5/18	Inhambane	Inhassoro	Inhassoro	Management	1
31/5/18	Cabo Delgado	Pemba	Pemba	Management	1
01/6/18	Cabo Delgado	Mecufi	Mecufi	fishers/boat owners/ CCP	5
01/6/18	Cabo Delgado	Mecufi	Mecufi - Murebue	Management	1
02/6/18	Cabo Delgado	Quissanga	Tandanhangue	Fishers/boat owners/ CCP	4
03/6/18	Cabo Delgado	Ibo Island	Ibo Island	Management	1
03/6/18	Cabo Delgado	Ibo Island	Ibo Island	Management	1
05/6/18	Cabo Delgado	Quirimba Island	Quirimba island	Management	1
03/6/18	Cabo Delgado	Matemo Island	Palossança village, Matemo Island	Fishers/boat owners/ CCP	4
04/6/18	Cabo Delgado	Ibo Island	Quirimbo Island	Fishers/boat owners/ CCP	4
05/6/18	Cabo Delgado	Quirimba Island	Quirimba island	Fishers/boat owners/ CCP	3
06/6/18	Cabo Delgado	Ibo Island	Ibo Island	Fishers/boat owners/ CCP	3
12/6/18	Nampula	Ilha de Moçambique	Sanculo	Fishers/boat owners/ CCP	1
12/6/18	Nampula	Ilha de Moçambique	Sanculo	Fishers/boat owners/ CCP	2
12/6/18	Nampula	Ilha de Moçambique	Sanculo Mercado	Fishers/boat owners/ CCP	3
13/6/18	Nampula	Ilha de Moçambique	Passomar fishing center	Fishers/boat owners/ CCP	1
14/6/18	Nampula	Ilha de Moçambique	Saua Saua	Fishers/boat owners/ CCP	5
14/6/18	Nampula	Ilha de Moçambique	Ilha de Moçambique mainland	Management	1
16/6/18	Nampula	Angoche	Kuiricudge	Fishers/boat owners/ CCP	2
16/6/18	Nampula	Angoche	Tamole fishing center	Fishers/boat owners/ CCP	2
16/6/18	Nampula	Angoche	Tamole village	Fishers/boat owners/ CCP	1
16/6/18	Nampula	Angoche	Praia Nova	Fishers/boat owners/ CCP	2
17/6/18	Nampula	Larde	Larde Sede	Management	1
17/6/18	Nampula	Larde	Larde CCP	Fishers/boat owners/ CCP	3
17/6/18	Nampula	Larde	Mulenlene fishing center	Fishers/boat owners/ CCP	2
19/6/18	Nampula	Angoche	Lipanda	Fishers/boat owners/ CCP	4
19/6/18	Nampula	Angoche	Lipanda	Fishers/boat owners/ CCP	1
19/6/18	Nampula	Angoche	Metepene	Fishers/boat owners/ CCP	4
21/6/18	Nampula	Moma	Pilivi	Fishers/boat owners/ CCP	4
21/6/18	Nampula	Moma	Malanzi	Fishers/boat owners/ CCP	3
21/6/18	Nampula	Moma	Moma	Management	1

3.0 Results

3.1 Respondents

The majority of respondents were fishermen, although many (if not all) respondents held multiple positions or had various forms of income generation (Fig. 5). For instance, it is very common for most coastal community members to have a *machamba*, or subsistence garden. Fishers were deemed those most suitable to comment on catch and bycatch of sea turtles given their intimate involvement with the sea.

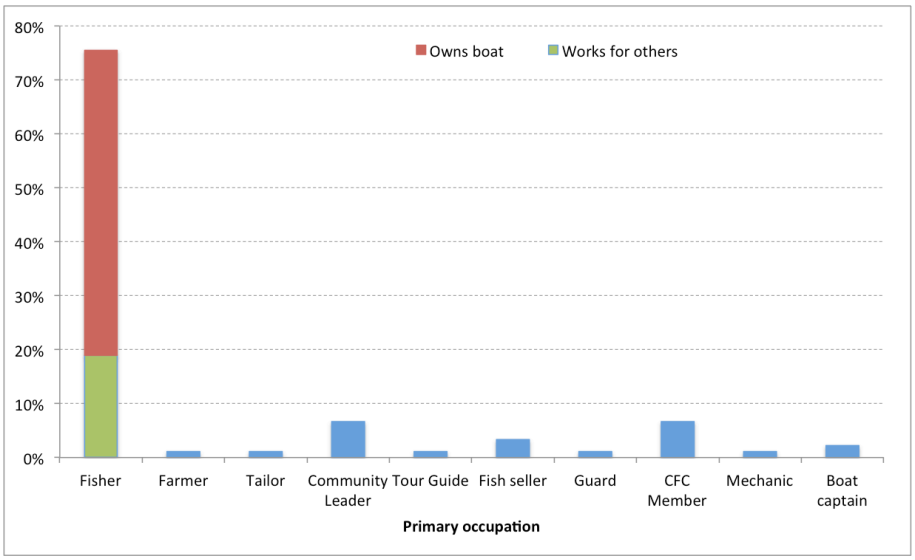

Figure 5: Primary occupations of interview respondents (n=77). CFC refers to Conselho Comunitário de Pesca; or community fishing councils.

Fishers all had substantial experience, with an average age among respondents of 41.5 years, and 30% of fishers being older than 50 (Fig. 6) - suggesting they were in an ideal position to describe the fishery and comment on catch and bycatch of sea turtles. Fishers were generally very experienced, with 79% of fishers having more than 10 years of experience, and an overall average of 20 years across all respondents (Table VI; Fig. 7).

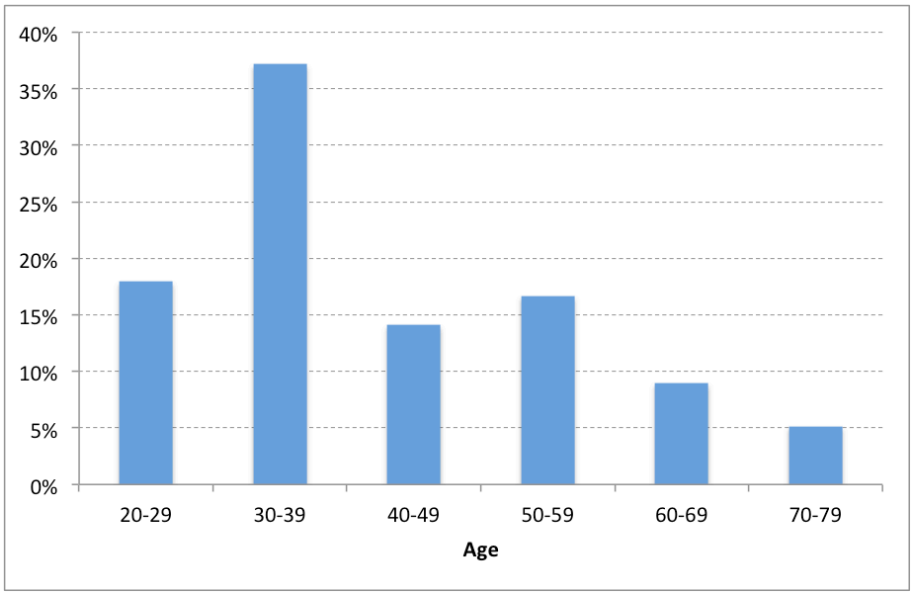

Figure 6: Age distribution of interview respondents (n=77).

Table VI: Summary demographics of respondents.

Fishers (n = 77)	Average + SD
Age (years)	41.5 ± 14.0
Experience (years)	19.7 ± 12.8
Gender	76/77 Male; 1/77 Female
Gear types	9 types (n = 82 gears total)
Boat Owners	81.8 % (n = 63)
Fishers who encountered turtles before	89.6% (n = 69)

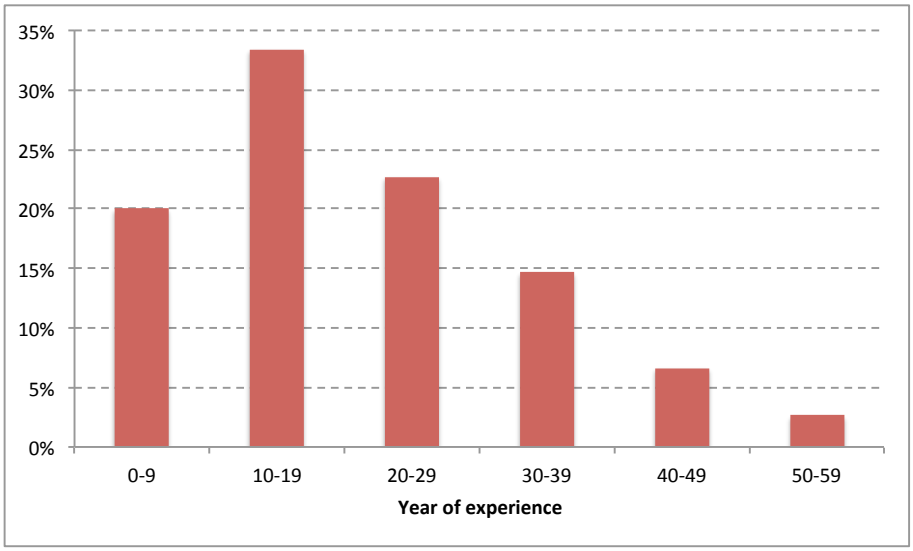

Figure 7: Years of experience of interview respondents (n=77).

3.3 Fishery description

The artisanal fishery is mostly small scale, with primary vessel types comprising canoes, dhows, Jangada (a local wooden flat-bottomed boat) and wooden boats. A small proportion of vessels were motorised. Vessels are mostly small, with lengths rarely exceeding 10m (Fig. 8, Table VII). The larger dhows and wooden boats carry crews of 15 to 30, while the smaller wooden vessels carry 5-10, and Jangadas and canoes carry only one to three crew members. Some of the non-motorised vessels use sails, with the balance simply using oars for propulsion. Given this, travel distances from shore for many of the vessels is limited. Table VII describes the size characteristics of the main vessels used in the Mozambique artisanal fishery.

Unfortunately, our survey did not allow us to sample some of the semi-industrial fishers who travel far to access the Primeiras & Segundas islands in more seaworthy vessels, and it is likely that this industry segment also represents a substantial impact on sea turtles – with several reports of poaching and smoking of turtle meat on the islands (anonymous respondents, pers. comm., May 2018). We provide only a rudimentary glimpse of the artisanal fishery, as the focus of the study centered on targeted and unintentional capture of sea turtles. It is presented here to provide context to the fishery, rather than attempt to be a thoroughly accurate depiction of the entire artisanal fishery sector. The artisanal fishery in Mozambique is mostly non-selective, and all catch is retained, irrespective if it was targeted or not. This is an artifact of both the non-selective gears that are predominantly used, and the low-income status of coastal communities.

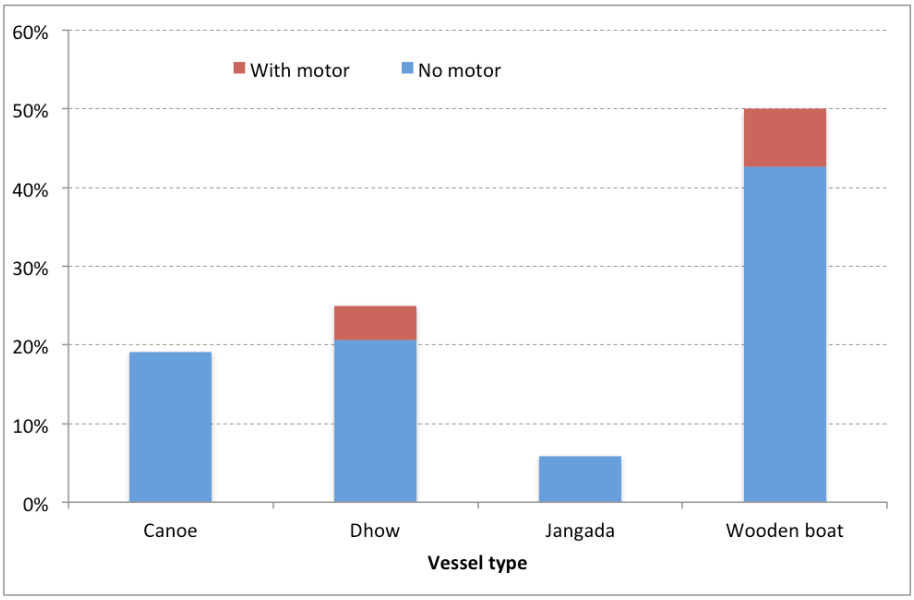

Figure 8: Vessel types in the artisanal fishery in Mozambique (n=60).

Table VII: Characteristics of the main vessels used in the Mozambique artisanal fishery

	Canoe	Dhow	Dhow w/motor	Jangada	Wooden boat	Wooden boat w/motor
Average	3.46	6.84	8.25	5.00	6.75	8.30
Min	2.5	3.5	8	3	4	6
Max	8	8.5	8.4	7.5	8.5	12
StDev	1.406	1.664	0.218	2.318	1.631	2.280
n	13	16	3	5	23	5

Many respondents indicated they used multiple gear types, with the differences in gear use generally being due to differing seasons and target species. Table XIII describes the main fishing gear types by vessel, sorted by most common to least common by both gear type and vessel type.

Table XIII: Artisanal fishing gear by vessel type

	Beach seine	Hook & line	Purse seine	Surface gillnet	Benthic gillnet	Spear	Gaiola	By hand	Quinia	*Total*
Wooden boat	16	10	2	1	2	0	0	0	0	***31***
Dhow	8	2	3	3	1	0	0	0	0	***17***
Canoe	1	4	0	2	0	3	3	1	0	***14***
Dhow w/motor	2	1	0	0	2	0	0	0	0	***5***
Wooden boat w/motor	1	1	3	0	0	0	0	0	0	***5***
Jangada	2	2	0	0	0	0	0	0	0	***4***
Total	***30***	***20***	***8***	***6***	***5***	***3***	***3***	***1***	***0***	

Target catches in Mozambique fish and shrimp fisheries comprised a wide range of species, reflecting the wide range of gear types being used in the varied fisheries in Mozambique. Many respondents indicated they targeted certain species, but acknowledged they kept nearly all catches, irrespective of species. This is demonstrated through the generally low-value of many of the species landed. Table IX describes the main species landed by gear type, sorted by most common to least common by both species and gear type.

Table IX: Predominance of main target species reported for each gear type, sorted by most-targeted catch followed by most common gear (e.g. Saddle Grunt was the most targeted species, and most often in Hook & Line fisheries). Data are distilled from responses to raw interview responses, in which respondents could indicate one or more species. Where only one species was listed, this was assumed to be the primary target. Where multiple species were listed, the first one was assumed to be the primary target, and the successive listings were assumed to be in diminishing order of priority. We provide these data as a guide to predominant catches by fishing gear type, rather than a definitive depiction of the artisanal fishery.

	Beach seine	Hook & line	Purse seine	Surface gillnet	Benthic gillnet	Spear	Gaiola	By hand	Quinia	*Total*
Saddle Grunt	7	11	4	5	2	1	2	0	0	***32***
Squid	17	4	0	5	1	1	1	0	0	***29***
Spanish Mackarel	11	7	1	5	1	2	0	0	0	***27***
Mackarel	11	3	6	0	0	0	0	1	0	***21***
Grouper	6	3	1	5	0	1	0	0	0	***16***
Croaker	9	3	0	3	1	0	0	0	0	***16***
Shrimp	9	3	0	0	0	0	0	2	0	***14***
Mixed Reef Fish	3	2	1	2	1	1	3	0	0	***13***
Sardine	4	1	4	0	3	0	0	0	0	***12***
Shark	5	3	0	3	0	0	0	0	0	***11***
Parrotfish	1	0	3	0	2	2	3	0	0	***11***
Jack	4	3	0	3	0	0	0	0	0	***10***
Ray	7	0	2	0	1	0	0	0	0	***10***
Tuna	4	1	2	2	0	0	0	0	0	***9***
Rabbitfish	3	2	3	0	1	0	0	0	0	***9***
Rabbitfish	3	2	3	0	1	0	0	0	0	***9***
Anchovy	6	0	0	0	1	0	0	0	0	***7***
Mullet	2	0	0	2	1	0	0	0	0	***5***
Marlin	1	2	1	0	0	0	0	0	0	***4***
Octopus	0	0	1	0	0	2	1	0	0	***4***
Marlin	1	2	1	0	0	0	0	0	0	***4***
Lobster	0	0	0	0	0	2	1	0	0	***3***
Shad	1	1	1	0	0	0	0	0	0	***3***
Needlefish	1	0	2	0	0	0	0	0	0	***3***
Emperor	0	2	0	0	0	0	0	0	0	***2***
Papai	2	0	0	0	0	0	0	0	0	***2***
Silver Silago	2	0	0	0	0	0	0	0	0	***2***
Flathead	1	0	0	0	1	0	0	0	0	***2***
Goatfish	2	0	0	0	0	0	0	0	0	***2***
Hairtail	1	0	0	0	1	0	0	0	0	***2***
Sea Cucumber	0	0	1	0	0	1	0	0	0	***2***
Molites	1	0	0	0	1	0	0	0	0	***2***
Scad	0	0	1	0	0	0	0	0	0	***1***
Kingfish	0	1	0	0	0	0	0	0	0	***1***
Vermhella	0	1	0	0	0	0	0	0	0	***1***
Pocari	1	0	0	0	0	0	0	0	0	***1***
Oyster	0	0	0	0	0	0	0	0	1	***1***
Fusilier	0	0	0	0	1	0	0	0	0	***1***
Eel	1	0	0	0	0	0	0	0	0	***1***
Unicornfish	0	0	1	0	0	0	0	0	0	***1***
Total	***142***	***61***	***49***	***35***	***23***	***13***	***11***	***4***	***1***	

3.4 Turtle interactions

The vast majority of respondents (89%) indicated they had seen turtles in the areas in which they fished, with a subset of these indicating they had seen turtles in the past but not recently (Fig. 9). This is likely an indication of population declines, but could also be a response out of concern that admission of turtle presence may put a focus on their fishery, given the illegality of turtle captures. The location of turtle sightings was generally aligned with the key fishing habitats frequented by fishers, who target reef fish and also larger pelagic species further offshore. A small subset (10%) of respondents, generally over 30-40 years of age, also reported seeing turtles on nesting beaches (Fig. 10).

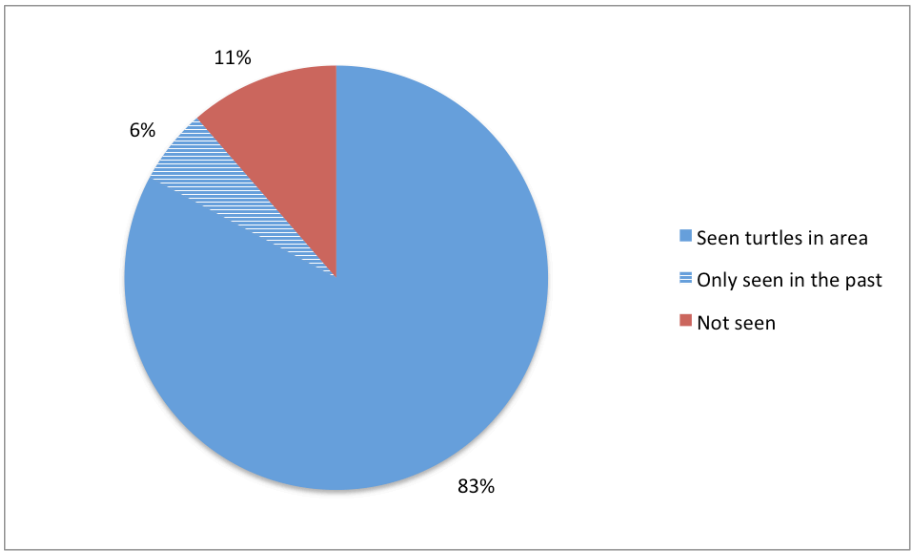

Figure 9: Proportion of respondents who indicated they had seen sea turtles (n=70).

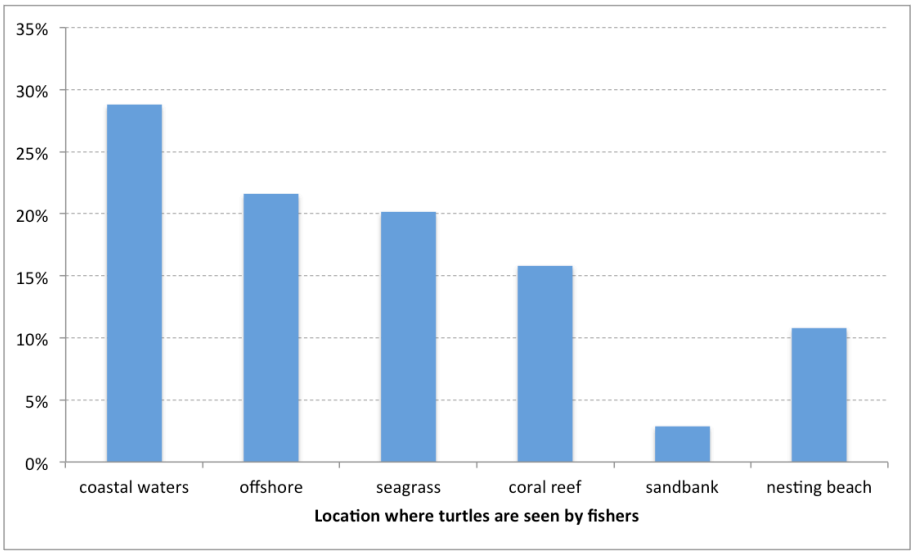

Figure 10: Locations of turtle sightings reported by interview respondents ($n_{(respondents)}$=71; $n_{(responses)}$=139; as respondents could identify more than one location).

Many fishers did not know turtles by species name, and these were shown photographs for clarification. Overall however, only roughly 50% of fishers reported being able to differentiate between species (Fig. 11), and given this, subsequent analysis of intentional and unintentional take do not differentiate by species. However, species distribution is such that hawksbill and green turtles are more frequently sighted / caught in the northern parts of Mozambique, with olive ridleys and leatherbacks sighted more often in the south.

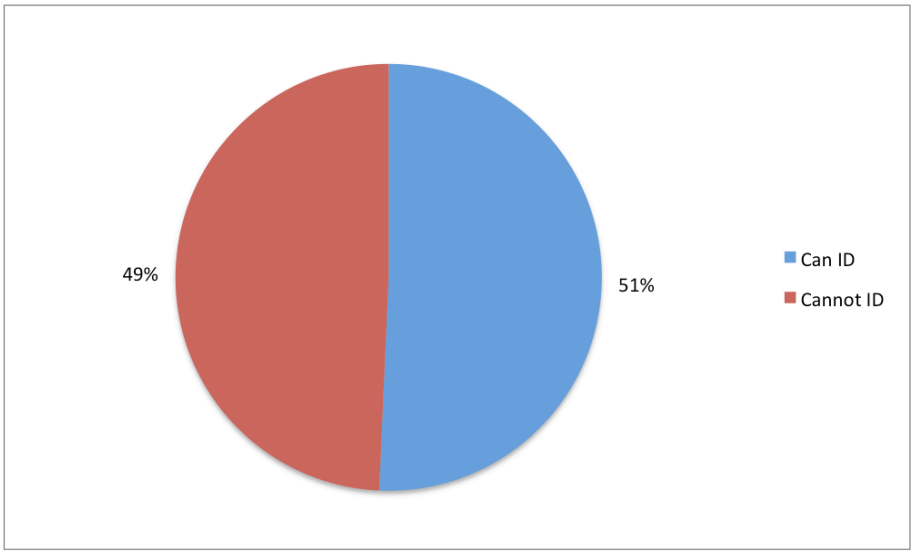

Figure 11: Proportion of respondents able to differentiate among species of sea turtles (n=71).

However, among those who were able to differentiate turtles by species, it was evident that the two most commonly sighted / caught species were green turtles and hawksbill turtles, comprising 71% of all sighting records. Importantly from these records is that 42% of fishers indicate they see the varied species daily, suggesting a high potential for intentional or unintentional interaction (Fig. 12). Across all sightings, leatherbacks and olive ridleys were most frequently seen in the south (Inhambane) and only once reportedly seen in Cabo Delgado. Green and hawksbill turtles were reported as seen at approximately the same frequency across all provinces.

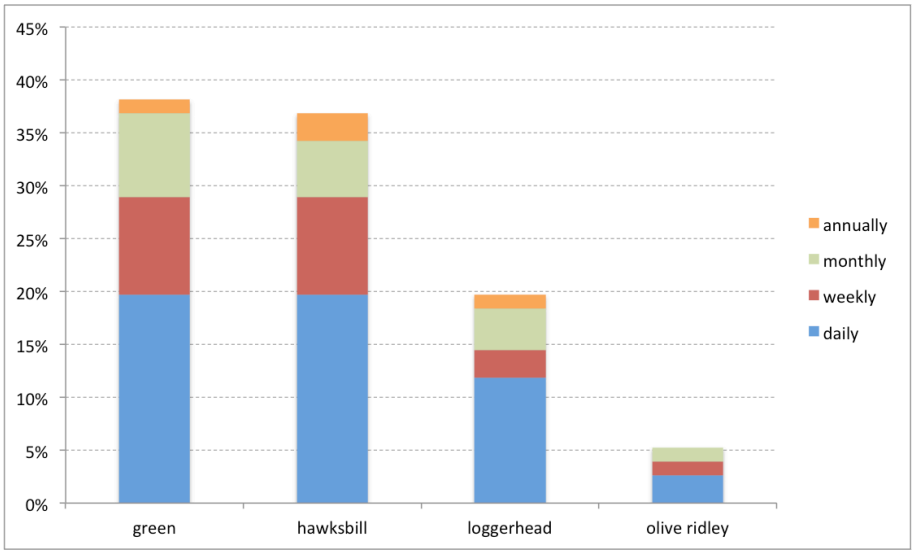

Figure 12: Species composition and frequency of sightings described by interview respondents ($n_{(respondents)}$=71; $n_{(responses)}$=1oo; as respondents could identify more than one species)

Surprisingly, a large proportion of the 77 respondents (~40%) suggested sea turtle populations were actually increasing in size, with only 20% of respondents suggesting populations were in decline (Fig. 13). These responses contrast significantly with the notion of excessive levels of catch and bycatch potentially leading to population declines, or (as discussed later) that high release rates and gear preferences do not lead to high individual turtle mortality. It is unknown if the perceptions by fishers reflect actual population increases, or simply an increase in sightings following an increase in fishing effort and a greater awareness of the protected status of sea turtles.

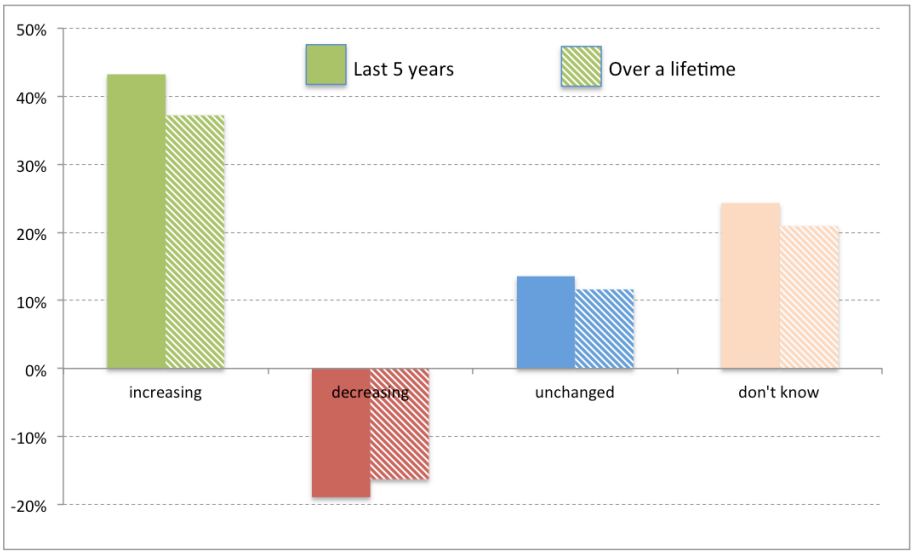

Figure 13: Perceived population trend in sea turtles described by interview respondents ($n_{(last\ 5\ years)}$=37; $n_{(over\ a\ lifetime)}$=43.

A subset of 20% of respondents indicated they had eaten turtle meat, with some of these suggesting this was a thing of the past, and others knowing it was illegal (Fig. 14).

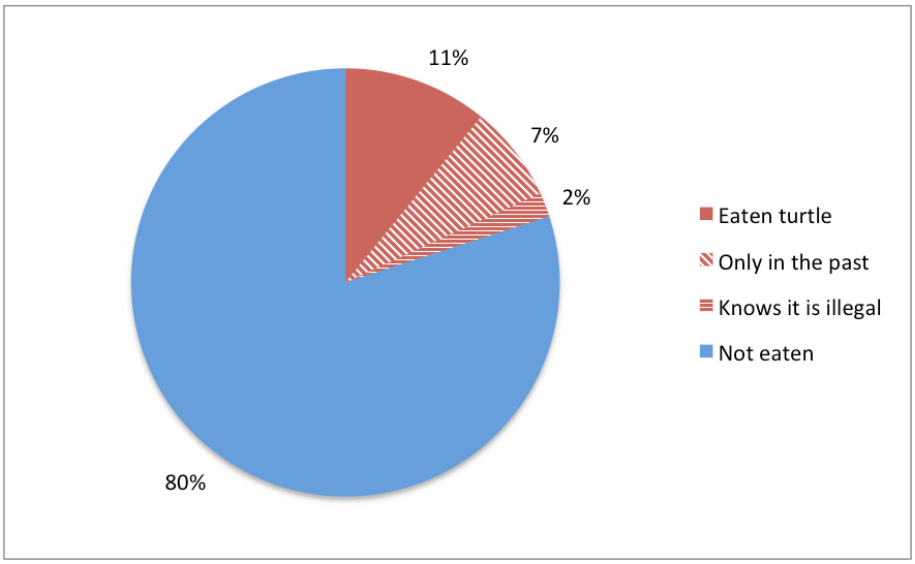

Figure 14: Proportion of interview respondents who reported consumption of sea turtles (n=55).

This finding is supported by a similar proportion (24%) of respondents who indicated that sea turtles were unintentionally landed as bycatch. It is likely that the proportion of respondents indicating they had not caught or eaten turtle meat at all is an underestimate of what occurs along the coast, but we could not tease this out of the data from the responses we received (Fig. 15).

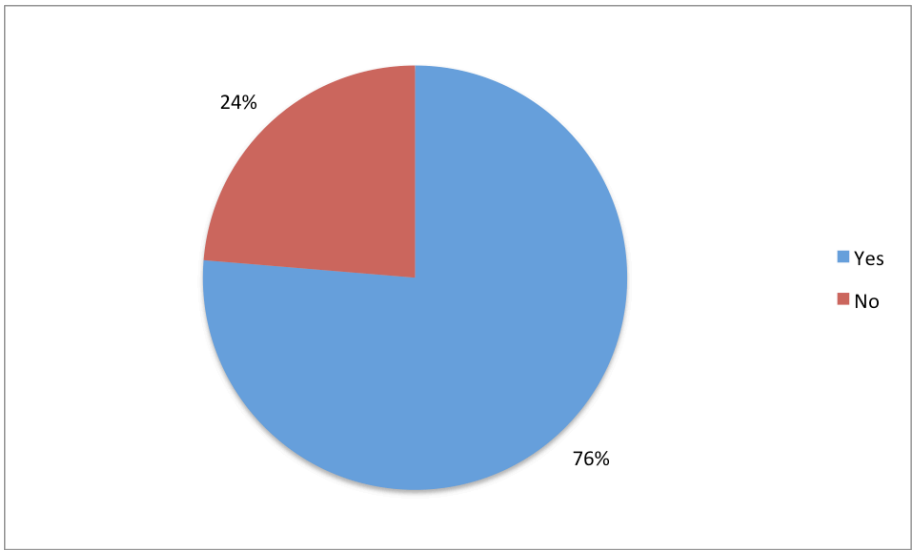

Figure 15: Proportion of interview respondents who reported sea turtles were mostly caught unintentionally (n=71).

Importantly, a follow-up question related to the fate of turtles that were accidentally caught arrived at a (only slightly) greater conclusion, with only 32% of respondents indicating turtles would be taken for food if caught accidentally in their gear (this includes being sold, as presumably this is also as food for someone else; Fig. 16). A far high proportion of respondents (~68%) indicated turtles were released (presumably alive given the gear types).

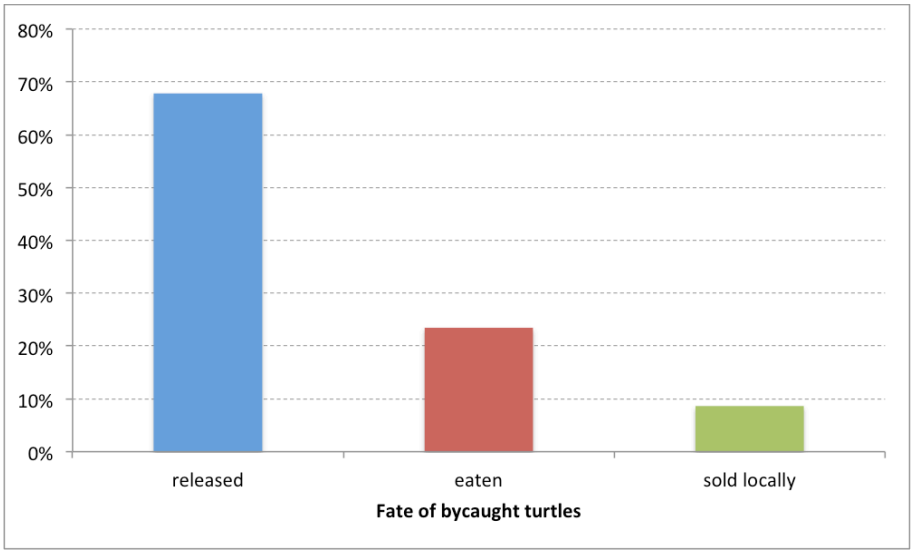

Figure 16: Reported fate of sea turtles that were caught unintentionally (n=81; note that respondents could indicate more than one fate).

When respondents were asked differently if meat from the bycaught turtles was consumed, a matching 30% of respondents indicated that this was the case. However, an additional 23% of respondents indicated that this had occurred in the past but was not the case at present (Fig. 17). This question supports the claims that close to 70% of turtles that are taken as bycatch may be released.

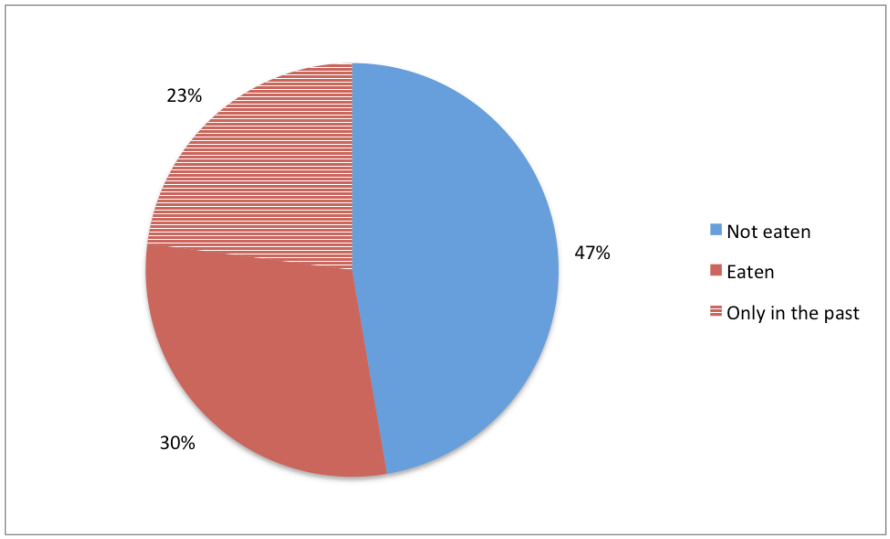

Figure 17: Reported consumption of sea turtles that were caught unintentionally (n=74; note that respondents could indicate more than one response e.g. eaten in the past but not any longer).

While the magnitude of incidental take of turtles in Mozambique is alarming, the proportion of respondents who indicated turtles were intentionally targeted (44%) is of concern, even with the caveat that a small proportion of respondents indicated this was a thing of the past – either before the Park was established and operational in the Quirimbas around 2005-2006, or the establishment of the Community Fisher Cooperatives established in the late 1990s in Nampula (Fig. 18). Given just under half of all sea turtle take is targeted, it is likely that a far greater proportion of turtles gets used as food than suggested by the responses related to eating turtle.

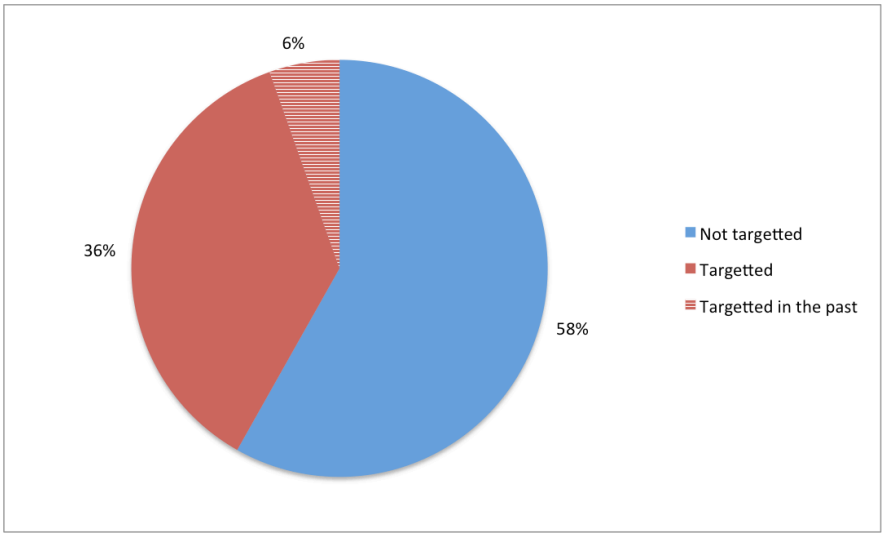

Figure 19: Proportion of interview respondents who indicated sea turtles were intentionally targeted (n=64).

There is also a regional variance in the levels of take, based on reports of degraded seagrass habitats and overfishing, with fishers in Cabo Delgado reporting slightly over double the levels of accidental / incidental turtle captures (average = 2,784 turtles) than reported for Nampula (average = 815 turtles), and fishers in Inhambane reporting captures somewhere in the middle of the two extremes (average = 1,485 turtles). These levels of take and the fate of sea turtles as bycatch are provided in scaled proportions in Figure 19. An important observation from these data is that while the national average or 'release' responses is close to 70%, this drops substantially in the Cabo Delgado region to 52%. Anecdotal evidence suggests there is an efficient smuggling route for all kinds of goods across the Mozambique / Tanzania border, and it is possible that the slightly higher proportion (15%) of turtles reported as 'sold locally' in Cabo Delgado are actually destined for international trade. Of note is that further south and away from the Tanzania border, the 'sold locally' proportion becomes lower and lower (6% in Nampula, and 0% in Inhambane).

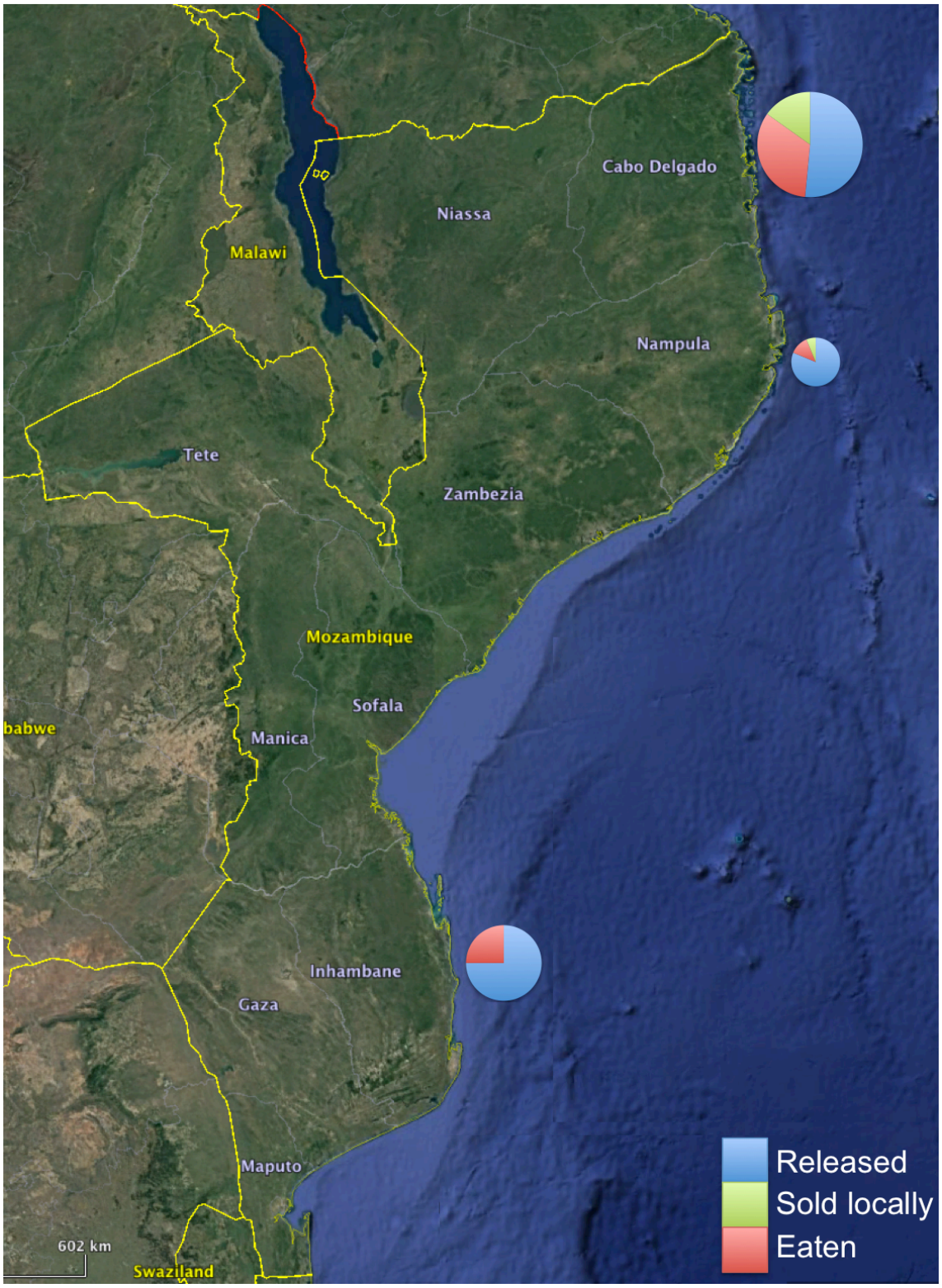

Figure 18: Proportional incidental catch and fate of the catch as reported by interview respondents.

Targeted take appears to be primarily for food and for local markets (with the understanding that a proportion of this likely crosses the border into Tanzania), although there was some confusion around this question among respondents (Fig. 20). Slightly over 20% of respondents indicated targeted catch would be released, highlighting the confusion between intentional and unintentional captures, and likely also reflecting concerns about the legality of the process, given that many of the interviews were conducted in the presence of fishery officers or community fishery cooperative members, potentially leading to false statements. Of interest is that a small proportion of fishers (~2.5% of 77 fishers) used turtle meat as bait in local fish traps for more valuable species.

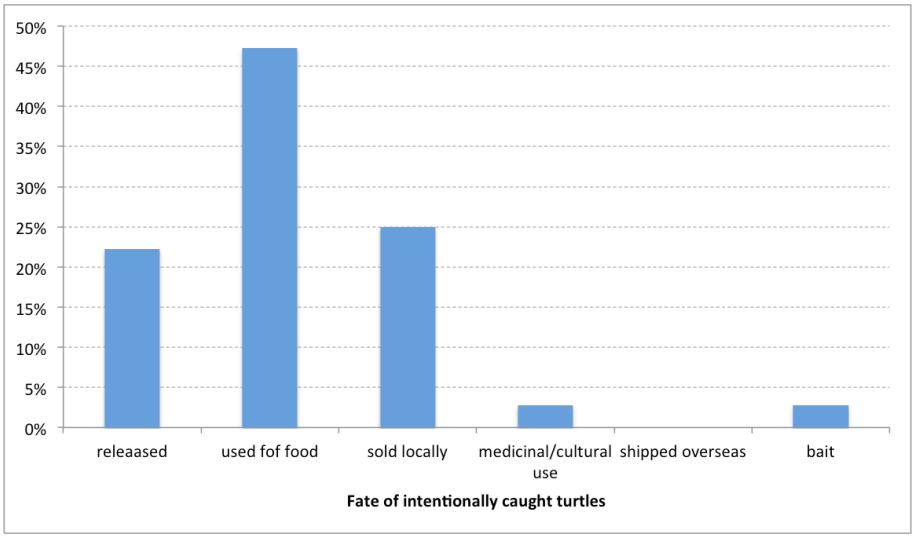

Figure 20: Reported uses of intentionally targeted sea turtles (n=36).

3.5 International trade

Evidence of intentional, targeted and presumably widespread international trade was documented during conversations with fishers and fishery management officers. Nearly 40% of all 77 respondents indicated they know of foreign buyers (Fig. 21) and a slightly lower proportion (28% of these) reported they knew of active international trade (Fig. 22). The majority of respondents, however, were not clear on the destination end points for the international trade (of turtles and also of other products such as holothurians, sharks etc.) (Fig. 23). It appears that there are not a large number of foreign buyers, given the limited response rate for respondents (across fishers and management) being aware of more than one or two buyers (Fig. 24). Indeed, the respondents in this case only represented 33% of all interview respondents, with the balance being unaware of foreign companies or individuals. A small proportion of respondents indicated foreign nationals actively participated in turtle captures, but the number of respondents to this question was low (only four interviewees) and thus we cannot draw any firm conclusions on the level of this practice.

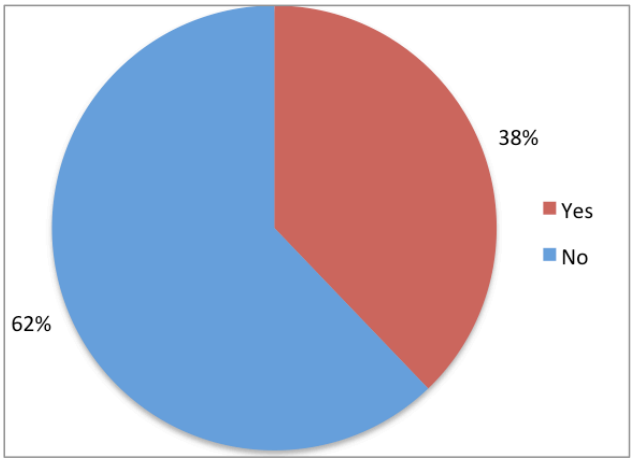

Figure 21: Proportion of respondents who reported knowing foreign buyers for sea turtle products (n=77).

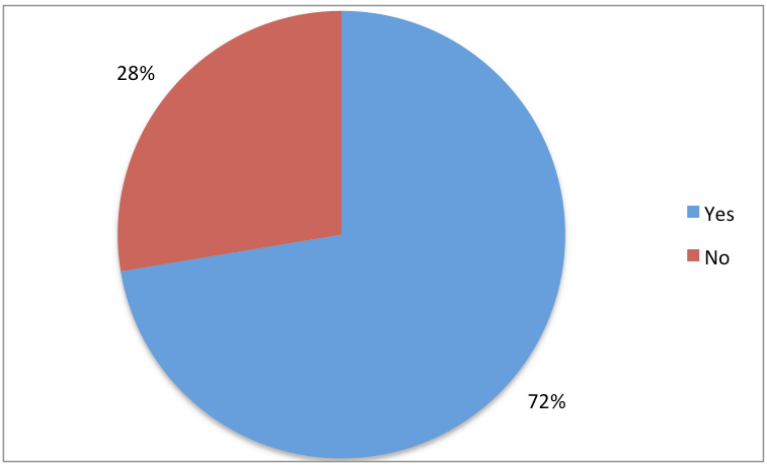

Figure 22: Proportion of respondents who reported knowing of foreign trade in sea turtles / turtle products (n=77).

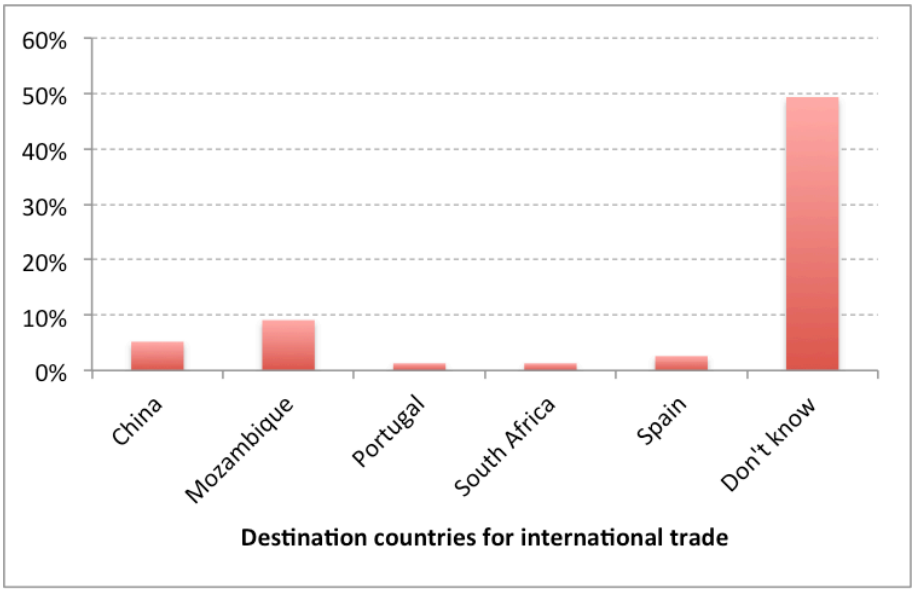

Figure 23: Responses to the question on where international trade was destined. Of note is the high proportion of fishers who responded 'Mozambique' highlighting a limitation of the study (familiarity with the subject); n=77.

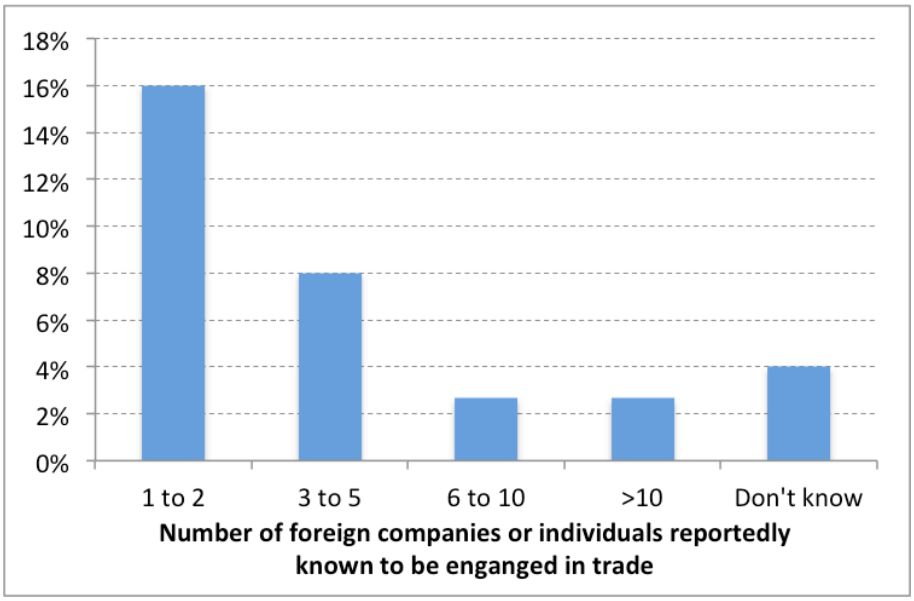

Figure 24: Responses to the question on possible numbers of companies or individuals involved in international trade known to respondents; n=75.

Given the small number of respondents who were aware of foreign trade or foreign buyers / operators, the data on numbers of turtles traded internationally from the artisanal fishery are inconclusive (see also section 7.0 on survey limitations).

3.6 Value of turtle products

Prices per kilo of turtle meat varied depending on the location of sale (Table X). Turtle meat was not sold at high value, with the meat most commonly being sold at 50 MZN per kilo ($1 USD), which is the equivalent to low quality or small fish or string ray meat.

We did not witness first-hand turtle meat being sold in local markets, but during the course of this study three recent events of turtle meat being sold at markets were reported to us: At the Muxara Market (on the main road into Pemba) a recent incident was reported where portions of turtle meat were found for sale (see Figure 25 for evidence; supplied by the local fisheries extension officer for the area). While local authorities attempted to prosecute this seller, the perpetrator fled the area and there has been no successful arrest to date.

A fisheries extension officer of Ilha de Mozambique reported a second incident in 2017-2018. The incident took place in Sanculo Market, in the district of Ilha de Mozambique, where a woman was caught buying turtle meat from a man selling portions of it in the market. The local authorities were involved and the woman was fined. It is not clear what happened to the turtle meat seller.

The third incident was reported on 17/6/2018 in Pilivi village, Moma district, Nampula. Portions of turtle meat and a turtle head were witnessed by two people, one who bought 5 kg and submitted it to the police in Moma town (where it remains in a freezer) and the second witness was an off duty fisheries extension officer who photographed the turtle meat being sold. The police came to investigate the matter on reports of 16 turtle heads being found in a bush area near the village, however they found nothing in the village and it was not clear if fishers assisted them in inspecting the bush area. Additional stories circulated prior to our arrival in the area on 21/6/18 indicated a fisher had informed the local authorities that there could be as many as 30 turtle carcasses in the area. The man selling the meat fled the area and the local authorities questioned the members of the Conselho Comunitário de Pesca; or community fishing councils (CCP), suggesting that they were either part of the illegal take or complacent to it occurring. The CCP was given 7-8 days to find the seller of the turtle meat, or they would be considered accountable. No further information was currently available for this case at time of writing.

Table X: Price variances in turtle meat sold for domestic use.

Location	Price of turtle meat (MZN)	Eggs	Whole Alive turtles	Data source
Praia do Tofo, Inhambane Province	50.0/kg	Not sold	No trade	Williams 2017
Sanculo, Ilha de Mozambique, Nampula Province	50 – 75/kg	10 MZN each	No trade	Interview data from this study MZ044
Quirambo Island, Quirimbas National Park, Cabo Delgado	50.0 kg^{-1}	Not sold	No trade	Interview data from this study MZ037
Quirimba Island, Quirimbas National Park, Cabo Delgado	30 – 50.0/kg	Sold until 2010 but price not specified	Alive large turtles 500 MZN each Alive small turtles 250 MZN each	Interview data from this study MZ041

Moma, Nampula	100/kg	Rare to find now.		Interview data from this study MZ090
Matemo Island, Cabo Delgado	Dried and salted meat traded with Tanzania until 1973 for capulanas (sarong or woven material) and beads	Eggs traded with Tanzania until 1973 for capulanas and beads	Whole turtles + carapaces traded with Tanzania until 1973 for capulanas and beads	Interview data from this study MZ036
Pemba, Cabo Delgado Quirimbas Archipelago	150/kg 50 MZN/portion	Not sold		Interview data from this study MZ032
Quirimba Island Mefunvo Island Mecufi	100-150 MZN kg^{-1} 150 – 200 MZN/kg 200 – 250 MZN/kg	n/a		Interview data MZ019

We requested to see the 16 heads in Pilivi, which at first seemed possible, but then several excuses came up about not knowing the exact place, or being able to access it with a car or at a certain time of day or tide cycle. The story then changed among the CCP members to not knowing specific places where illegal take was landed/hidden, but all generally agreed the thick mangrove areas surrounding the villages were a common location for this to occur. The facts of this specific incident remain unclear and it is possible, due to the timing of this event coinciding with the end of Ramadan and the Eid Murabak celebrations, that the whole, or a large majority of the, village participated in the consumption of turtle meat for the festivities. As of 1/7/2018 no perpetrators had been found, however the case had been escalated to the local prosecutors office and further investigations were underway (pers com JT Abacar, UAPAPAML Moma).

Anecdotal reports exist of turtle meat for sale in Vilanculous or Inhassoro markets, in Inhambane Province however we were unable to find evidence of this during the fieldwork. Figure 20 provides an example of the turtle meat on sale in Muxara Market, 15 km out of Pemba City, Cabo Delgado.

Figure 25: Turtle meat for sale in portions at Muxara market, Pemba District, Cabo Delgado (Photo Courtesy of DPMAIP- Mecufi).

Although respondents reported that turtle shells were not used or sold, turtle shell products were detected in tourist craft markets in Pemba and Vilanculous. In Pemba, one store (a Maconde Artisans Cooperative) had more than 200 pieces of turtle shell products for sale ranging in price from 200 to 500 MZN (USD 4 to 6) per piece (Fig. 26).

Figure 26: Turtle shell products on display for sale in Pemba, Cabo Delgado (31/05/2018) (photos J Williams).

3.7 Overall estimates of take in artisanal fisheries

Of grave concern is the sheer numbers of turtles being taken in the fishery, both accidentally (primarily) but and as targeted catch. Of note, while a large proportion of turtle take is unintentional, this does not mean that the turtles are discarded or released alive – indeed a substantial proportion of these are retained as food. The following estimates include both targeted catch (smaller in magnitude) and also accidental catch, of which a substantial proportion is retained for consumption.

Among all respondents - just the respondents to the questionnaire, not all fishers in Mozambique - the reported annual incidental and targeted take of sea turtles across all sizes ranged from 3,375 to 6,137 (dependent on ranges provided by 48 interview respondents), with a calculated average of 4,985. Even if 70% of these were released (presumably alive) then a potential 1,012 to 1,841 could have been removed from the population in a year, among *only* the respondents to this study. This does not include those areas that were not surveyed due to time limitations (Zambezia, Sofala and Maputo provinces) nor all of the smaller areas in between our survey locations. While the *actual* number is possibly irrelevant given the lack of accuracy of a National-scale extrapolation, what is of importance is the *magnitude* of the scale: the few fishers we interviewed were not removing tens or even hundreds of turtles per year, but thousands.

Estimating a total annual take (targeted and intentional) at a National level is problematic due to several key reasons, including but not limited to 1) it is unreasonable to extrapolate from a small number of interviews to an entire coastline; 2) it is impractical to access the entire coastline and all fishers; 3) fishers understand the illegality of turtle captures and thus under-report these when asked, or do not report them at all if not asked; 4) seasonal variances exist which preclude straight-line extrapolations; and 5) species distribution means that impacts vary by geographical region. Extrapolating linearly from the bycatch estimates derived from this survey is also problematic given the uncertainties in fishing effort over an entire year, and along the entire coastline.

This is not just restricted to Mozambique; across the entire Western Indian Ocean (WIO) region, inadequate scientific knowledge restricts effective management of artisanal fisheries (van der Elst & Everett 2015). While one previous estimate of mortality caused by artisanal fisheries in Mozambique reported 240 – 420 turtles per annum (75% of that *C. mydas;* Louro et al. 2006), this was subsequently refuted (Williams 2017): Beach seining alone (considered in Inhassoro, Inhambane Province) was estimated to impact 160-280 turtles annually over a single 8-month fishing season (Hughes 1971, Gove & Magane 1996, Magane et al. 1998). Similarly, although the impact of gillnet bycatch was hard to quantify, it was also expected to be high, given more than 43,000 nets were in use at the time (IDPPE 2013; MIPE 2013). Bycatch from the other artisanal fishing methods were also unquantified, leading Williams (2017) to believe impacts to turtles were substantially higher than those suggested by previous studies.

Williams (2017) consulted with experts in research, conservation and management of sea turtles (n = 18) who were asked to identify key threats and complete pairwise comparison matrices to determine the relative weight (w) of each perceived impact. Threats were calculated from scores given in the pair-wise matrix using Analytic Hierarchy Process (AHP). Bycatch from trawling, artisanal fishing, and hunting of nesting turtles were the top threats identified.

An additional complication in determining overall impact comes from interpreting fisher responses: When they say they catch turtles daily, do they really mean every single day of the year, or just in recent memory? Taking a conservative approach whereby fishing is restricted to only half of the year to account for inclement weather, and where levels of take are conservatively estimated, our surveys found that (numerically at least) there could be a potential catch / bycatch of over 800,000 turtles per year across all species and in all gears in artisanal fisheries, and this estimate only is reflective of the situation in the three provinces surveyed (Table XI). Again, due to the imprecision of National or even Provincial scale extrapolations, it is important to focus less on the actual number, and more on the magnitude of take.

We are confident that annual National take of turtles exceeds thousands of turtles, and very likely exceeds 100,000 turtles per year in the regions we have investigated. If these levels of catch are indeed realistic, it is worthwhile considering that they may double when expanded to the entire coastline of Mozambique, and higher when including the (negligible in comparison) estimated of bycatch from semi-industrial and industrial fleets (~4,000-6,000 turtle per year; Gove et al. 2001).

Respondents in our survey indicated that some 75% of the bycatch is released alive, which would suggest the total loss of turtles through the artisanal fishery in only the three provinces surveyed might be reach

over one hundred thousand turtles – not as unrealistic as it may sound given the number of fishers and the number of gears deployed.

Some evidence exists to support this large estimate of total bycatch: There have been major population translocations in Mozambique since the civil war, when people fled to coastal areas to seek safety, food and livelihoods. With no alternative livelihoods, fishing is often the only option. Interview respondents estimated 90-95% of the total population were fishers of some sort. This suggests the number of potential fishers is immense.

Earlier estimates for Inhassoro alone by Chacate (2005) suggested that 1,113 green turtless (32% juveniles and 68% adults) and 124 loggerheads (adults) were caught from October 2004 to February 2005 - only a five-month season and only in the beach seine fishery. Our surveys of two beach seine users in Inhassoro support these findings, with respondents indicating they catch 2-3 turtles per net daily during the fishing season, which lasts roughly from November to March. A conservative approach, whereby fishers only set their net three times per week over the 30 week period, would suggest these two nets alone could be responsible for bycatch rates ranging from 180 to 270 sea turtles (number of turtles × number of sets × number of weeks). When extrapolated to all fishing areas and gears, these numbers suggest extremely high overall estimates of bycatch in the artisanal fisheries (Table XI).

Table XI: Potential bycatch of sea turtles in artisanal fisheries in three provinces of Mozambique (Cabo Delgado, Inhambane and Nampula) derived from a linear extrapolation of responses during the interview process (we recognise a linear extrapolation is problematic due to inconsistencies in effort and impacts across the entire Nation, and suggest these be used as a guide to *potential* impacts rather than precise take estimates). Notes: †depicts take estimates adjusted by seasonal fishing effort; *depicts the number of gears provided by the Mozambique Census of Fisheries 2012.

Province	Gear type	Estimate of turtles taken per year†	Number of respondents	Number of gears*	Potential bycatch levels
Cabo Delgado	Beach Seine	174	3	684	39,672
Cabo Delgado	Gamboa	111	2	440	24,310
Cabo Delgado	Gillnets	680	4	1358	230,860
Cabo Delgado	Hook & line	207	3	3017	208,173
Cabo Delgado	Purse seine	345	4	108	9,315
Cabo Delgado	Spear	71	2	0	142
Inhambane	Beach seine	348	3	516	59,856
Inhambane	Hook & line	378	3	1012	127,343
Nampula	Beach seine	661	21	3699	116,430
Nampula	Gamboa	2	1	208	416
Nampula	Gillnet	1	1	2115	2,115
Nampula	Purse seine	4	1	139	556
				Total	**819,189**

Maputo and Gaza provinces in the south potentially have less bycatch - because Maputo has the Ponta do Ouro Marine Partial Reserve (POPMR) that is effective in enforcement (Gove & Magane 1996, Williams 2017), and this section of the coast has a lot more swell. Here fishers do not have the vessels to get into the open seas and often do not even fish from boats, because the beach launch is too dangerous with the swell in-coming. Sofala and Zambezia are blank spots for data - but this is where the fisheries have been exploited by all sectors for a very long time, and we suggest they are likely to be high impact areas. Also to note, Nacala is considered to have the highest density of artisanal fishers in Mozambique (Williams 2017) and is also where fisheries resources have been over-exploited (which is why there are a lot of migrant fishers from Nacala). Poverty in general is high in this area and crime is higher too (hence why we could not survey there on safety concerns). It is worth mentioning that that bycatch rates in Nacala would be an important data point to use to help guide provincial or National estimates better.

3.7 Management-level feedback

Interviews were conducted with nine management-related individuals (fishery officers, government district officers, and conservation practitioners). There was substantial disparity amongst responses, and this is reflective of the limited knowledge by some practitioners about what occurs outside of their local areas at the larger District and National levels, and possibly also because the respondents knew that turtles were protected but little was being done to enforce this. For instance, no respondents indicated knowing of local curio trading even though evidence was recorded at markets. However, eight out of nine respondents indicated they knew of local trade. Some confusion also arose out of lack of clarity over destination countries: all Asian countries were referred to as 'China', confounding responses by fishers. While trade may be headed elsewhere, respondents all labelled any Asian destination as 'China'. While the small number of respondents could not speak to the larger National scale of the turtle trade, a few generalisations can be drawn from their responses, as follows:

- All respondents were aware that killing sea turtles was illegal, although there were some who were unsure if this was the case if the turtles were killed unintentionally.
- Trade may be related to trade in sea cucumbers, sea horses, shark fin and other marine products.
- Respondents generally agreed that meat was sold and traded, but not whole turtles or eggs.
- Respondents generally agreed that international trade was on-going (Fig. 27)
- Respondents also agreed that it consisted primarily of turtle meat, as carapaces were too difficult to hide, and eggs were not common (Fig. 28).
- Most respondents indicated turtle meat was sourced by local fishers, with some suggesting fishers from outside areas also supplied meat, and in one instance that meat came from Tanzania (Fig. 29).
- Five of the six non-NGO respondents indicated they knew nothing of international trade. Both NGO respondents had heard of it, possibly going to Tanzania, but had not witnessed it.
- Drivers behind international trade are mostly to support livelihoods, as turtle meat is sometimes considered of higher value than fish.
- Most management responses indicated the trade was leading to declining turtle stocks, and that turtles and turtle eggs were less available in recent years than in the past. Only one respondent indicated that these might be increasing.
- Respondents generally agreed that some enforcement and increased awareness might have led to changes in the volume of trade, and that the decrease in nesting was the major reason why eggs were not traded.
- Most respondent indicated they believed the trade could lead to major declines in turtle stocks.
- There were conflicts however in how respondents felt about this change in turtle stocks: some thought the stocks would change because there was a lack of enforcement and lack of outside support, while others thought turtles were sufficiently distributed at sea to sustain current harvest levels.
- Respondents all acknowledged fishers were supposed to inform management agencies if turtles were captured, but that this was unlikely to occur for fear of persecution. Respondents indicated that to date, no cases of accidental mortality from bycatch had been reported voluntarily by fishers.
- Respondents generally believed that enforcement activities were carried out, with varying degrees of frequency, but that penalties were rarely, if ever, imposed.
- Most respondents indicated there was a need for greater sensitization of local communities on the status of sea turtles, additional and more effective enforcement (personnel, additional boats, operating costs, fuel, and ancillary equipment), and more substantial deterrents to protect turtle resources.
- Respondents in their individual jurisdictional areas that indicated they were aware of some 30-50 incidences of turtle capture each year, and that illegal fishing was a main source of turtle captures. However, none were able to provide a robust estimate of the total number of turtles at a District of National level.

- Respondents indicated that turtles were a high priority at the local levels, but possibly only a moderate priority at a National level.

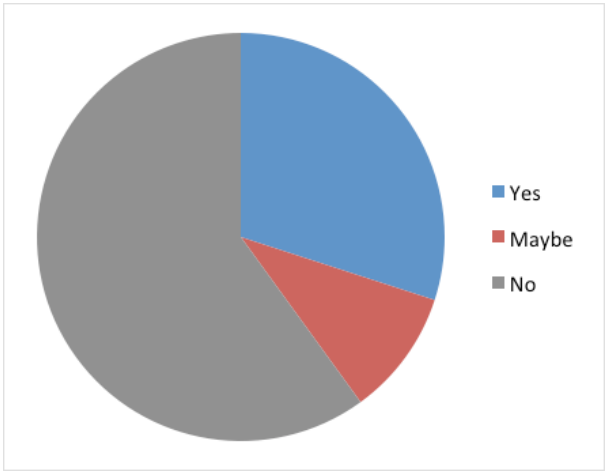

Fig 27: Management practitioners' awareness of sea turtle export in Mozambique (n=10).

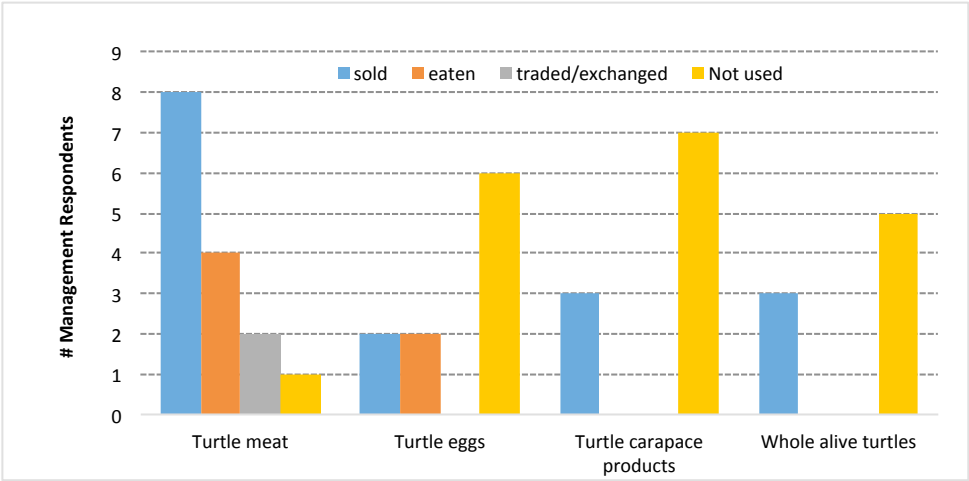

Fig 28: Management practitioner's responses on fate of sea turtle products (n=10 respondents, with multiple responses per respondent).

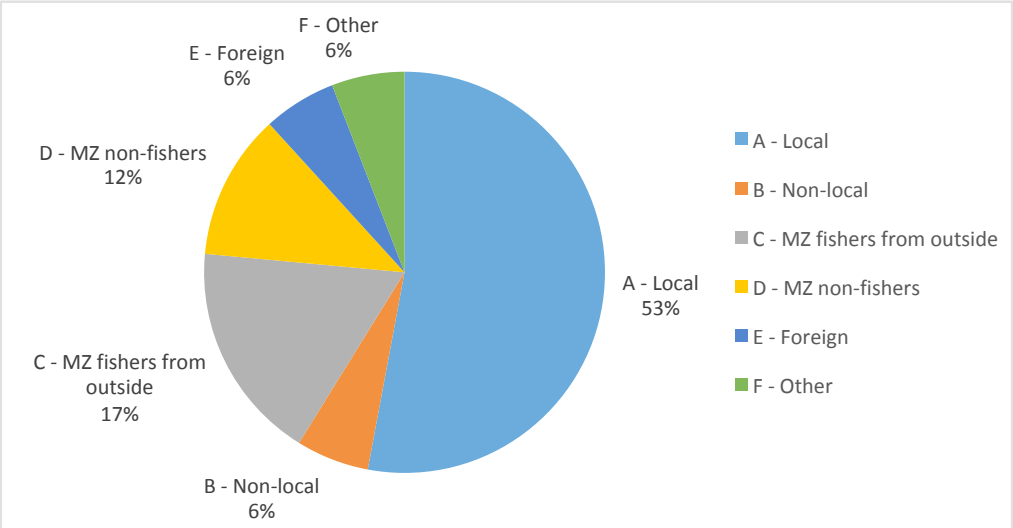

Fig 29: Managers knowledge of types of suppliers of turtle products (primarily meat). Where by a) Local fishers from the community, (b) Local non-fishers from the community, (c) Mozambican fishers from outside of the community, (d) Mozambican non-fishers from outside of the community, (e) Foreign fishers, (f) other (n=10 respondents, with multiple responses per respondent).

4.0 Discussion

4.1 Domestic use and trade

Mozambique lacks robust population size estimates for each of the five species of turtles found in its waters. However, its beaches no longer host the high densities of nesting turtles that would be needed to sustain the high rates of turtle take: A total of only 2,308 tracks and 1,160 nests were recorded during the 2016/17 nesting season (Fernandes et al. 2017). Amongst these, the most abundant were loggerhead turtles (1,971 tracks; 931 nests), followed by green turtles (168 tracks; 143 nests), leatherback turtles (98 tracks; 64 nests), and one hawksbill turtle that nested. An additional 70 tracks and 21 nests were from unidentified species (Fernandes et al. 2017). These numbers of nesting turtles could not produce sufficient eggs to sustain the current level of take by fishers in Mozambique.

Interestingly, a large proportion of respondents in this study indicated they believed turtle populations were increasing, which would suggest an abundance of turtles at sea, and while a large collapse in nesting turtles may have occurred on the beaches, possibly starting as early as 1975 and continuing through the civil war until the mid 1990's, it may be that Mozambique's waters are important development and foraging ground for turtles originating from elsewhere. It seems likely that the nearby green turtle population of Europa, Mayotte, Seychelles, for example, might be seeding the turtle stocks in coastal waters of Mozambique, and that Mozambique's coastal waters are home to developmental and foraging stocks of sea turtles originating from other major regional rookeries (Fig. 30).

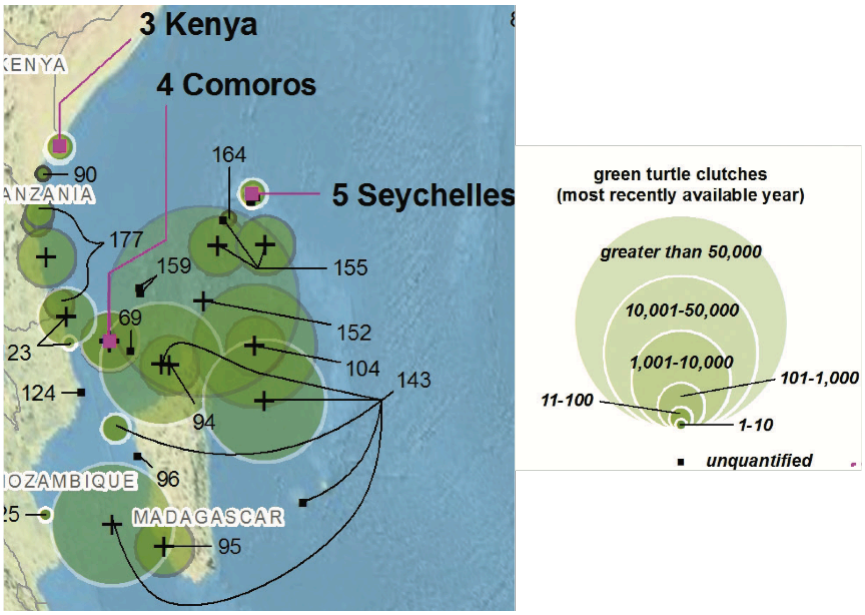

Figure 30: Extract from the global distribution of green turtle nesting sites in 2011 indicating average number of clutches per site per year. 152 – Seychelles; 104 – Mayotte; 143 – French Indian Ocean Territories (Source: SWOT 2011).

Habitat quality also seemed to influence rates of bycatch and anecdotal reports of destroyed seagrass meadows from heavy intensity fishing around Angoche may provide explanation for the low encounters between fishers and turtles in this area. It is also possible that turtles have been deterred from coastal areas in proximity to Sofala Banks (the country's main semi-industrial and industrial fishing ground) due to the longstanding presence of the fishing industry. It is also possible that turtle abundance is lower around Sofala Banks from the high rates of bycatch known to occur in these fisheries.

Evidence of substantial domestic use and trade of turtles was documented in this interview survey and has been reported in the past (Guissamulo 1993, Gove & Magane 1996, Gove et al. 2001, Louro et al. 2006, Williams et al. 2016, Williams 2017). Unfortunately there is no definitive way to determine what proportions of (illegal) bycatch are used for local consumption and local trade, although our surveys herein suggest this is in the region of 25-40%. Therefore, we discuss the nature of illegal take, its distribution and

characteristics in general and in reference to two sub-categories: targeted intentional illegal take as well as bycatch from artisanal fishers. Reports of high-density illegal take have been documented in the literature for numerous locations, particularly for the islands of the Quirimbas and Primeiras & Segundas Archipelagos in Cabo Delgado and Nampula provinces. Anecdotally referred to as 'turtle graveyards' (Fig. 31), these locations highlight major weaknesses / limitations in enforcement / patrols given that they have evidence of high-density illegal take of turtles. The locations are likely to represent semi-permanent or seasonal artisanal fishers camps that the fishers use as bases for their fishing further offshore from the islands.

4.1.1 Illegal retention of bycatch

Bycatch of turtles in artisanal fishers was found to be very high (76%), particularly in beach seines, purse seines and gamboas. Fishers reported up to 50 turtles could be caught in a single fishing event when using purse seines or gamboas in the Quirimbas Archipelago. An additional gear type - a large mesh, deep water net was reported by fishers to be used to target turtles, sharks and large fish. This net, known locally as 'jarifa' (Fig. 32) reportedly could capture some 30-40 turtles in a single event. The majority of bycaught turtles were (claimed to be) released (65-70%; Fig. 16, above), often before the question about the fate of the turtles had been asked. However, it was evident that there exists ample opportunity for artisanal fishers to illegally retain bycaught turtles, especially in remote areas or areas with infrequent enforcement. Respondents suggested that fishers may release three out of four turtles and keep the remaining one for food. This appears to be a more feasible strategy than retaining all 50 turtles from a single event given the risk of detection, unless in some instances the whole village is involved in the retention of the turtles. It is possible this may have been what happened on 17/6/18 in Pilivi, Moma, as part of a village celebration for Eid Murabak, the Islamic celebration of the end of Ramadan. This particular incident is currently under investigation and the case has just been escalated to the prosecutor's office for further investigation, as reported above.

Figure 31: Turtle graveyard on Mefunvo Island (photo courtesy of Bernard Adrien).

Figure 32: Jarifa nets in a fishing village of the Afungi Peninsula, Cabo Delgado (photo J Williams).

4.1.2 Intentional hunting

Specialist turtle hunters were reported by fishers in Mecufi, Murubue, Mefunvo in Cabo Delgado, and Nacala, Mucoroge, Sangange, and Moma in Nampula. Specialist hunters used either nets (primarily *jarifa*) or spears. Most fishers suggested that intentional fishing for turtles occurred in sporadic campaigns a few times per year rather than all year round. Such events could capture up to 30-40 turtles in a single event and thus fishers estimated that it was possible that 80-100 turtles per year could be removed by specialist turtle hunters. Unfortunately we do not have an idea of how many of these specialist hunters exist, and further documentation of this aspect of the fishery is required.

4.1.3 Sea turtle species involved in domestic sales

Primarily green, hawksbill and loggerhead turtles are used for domestic trade. A few reports suggest a low level of leatherback turtle use, and reports of olive ridley use were scarce. Reports of olive ridley encounters were low (9% off all fishers) and leatherback sightings were also reported by only 9% of fishers (n =77). While illegal take of leatherbacks has been documented previously (Williams et al., 2016), low encounter rates with fishers in this study suggest that availability is the limiting factor for use. A preference for hawksbill meat was described during the conservation management practitioner's interviews with hawksbill being desirable due to its similarity to goat meat. Leatherback meat was described as the least favoured by coastal communities.

There is no evidence to suggest turtles are actively selected according to species. This pattern was also documented in southern Mozambique by Williams (2017), who reported that artisanal fishers did not selectively target green turtles based on a taste preference. High rates of green turtles reported in illegal take suggest that small-scale fishers most frequently interact (intentionally or opportunistically) with green turtles, and that green turtles are the most abundant.

4.1.4 Features and characteristics of the domestic trade

Whilst fishers commented on several occasions that selling turtle meat in local markets would be too risky given the widespread knowledge of the illegality of such activities, evidence of three recent occurrences of this was detected. Fishers described turtle meat being sold in a secretive manner and hidden in private homes and also through a mobile street vendor, who walks around yelling 'awita', 'awita' or 'assane', code

words in the local dialect used to describe turtle meat in Cabo Delgado. In Moma, Nampula this word was reported as 'uanhink' but it was also made clear that there are many other terms that can be used interchangeably.

Domestic sales were more evident from interviews in Cabo Delgado, however we believe (from our fieldwork) that sales could be equally as high in Nampula Province. In Ilha de Moçambique fishers did not want to participate in the interviews, and at Sanculo fishing centre and market respondents answered sparingly, claiming they had never seen turtles alive or dead in 20-30 years of fishing experience. Our arrival in Moma was timely with a recent case being investigated for selling turtle meat in Pilivi village. However the responses in our interviews did not yield much information. Throughout our interviews in Angoche, Mucoroge was repeatedly named by fishers as a place where turtles were intentionally targeted and where meat wa eaten and sold. However, logistics impeded us from surveying this area and it seemed that due to the ongoing investigation in Pilivi, Moma we were unlikely to get accurate responses from fishers. The sale of turtle meat and eggs was only found in the north and it is likely that the lack of reported trade in the south is likely linked to the greater exposures to tourism and enforcement agencies rather than a complete lack of trade. Responses to interviews on prices (Williams et al. 2016) support this belief.

Domestic trade almost exclusively involves artisanal fishers. These are either local resident fishers or migrant fishers. While migrant fishers are evident throughout the country, the issue was recorded more frequently in the north. Migrant fishers originating from Nacala were frequently reported in Cabo Delgado and some of the southern districts of Nampula (e.g. Angoche and Moma).

There are also migrant foreign (Tanzanian) fishers with fishing camps that fish over seasonal campaigns in Mecufi, parts of the Quirimbas, Palma and Macomia districts. Whether they influence or contribute to illegal take or domestic use is not clear, but we have no reason to suspect they would not target sea turtles. No migrant foreign fishers were interviewed in our study.

The focus of our interviews was targeted towards artisanal fishers rather than fish resellers and thus our sample size of sellers provides much weaker evidence. However, there was suggestion that turtle products are sold to middlemen who take turtle products to cities further inland.

Although not sampled extensively in the current works it is important to note the role of community leaders or traditional chiefs in the use of sea turtles. The hierarchy of these traditional positions, dictates in some communities that turtle catches must be shared with appropriate village authorities. Williams et al. (2016) reported from southern Mozambique that both a village chief and a regulo (chief of the greater area) were formerly involved in turtle hunting. One fisher recounted, "my grandfather was the chief of the village so when someone caught a turtle, he had half of the animal." He went on to explain that the head of the turtle had to go to the "regulo" and that half of the turtle was for the chief.

Our results highlight differences in the trade in turtle meat between northern and southern Mozambique. The sale of turtle meat and eggs was only documented in the north, although turtle shell products were found in tourist craft markets in the north and the south. It is possible that the sale of turtle meat does not exist or is very rare in the south, and local beliefs seem to inhibit turtle meat being sold. For instance, in Dovela, Inharrime, Southern Mozambique, turtle meat was not sold for beliefs of 'turtles being a gift from god, to be eaten not sold' (Williams et al. 2016). Alternatively, it could be that turtles are not traded and simply consumed in the household in the south.

End products included of the domestic trade included meat in the form of '*pedaços*' or portions of fresh meat, sun-dried, salted meat and smoked dried meat. Fresh meat was eaten in coastal communities and rarely sold, whereas dried and smoked products were destined for sale in locations far from the place the turtle was captured. Most of the islands of the Primeiras & Segundas Archipelago host temporary fishing camps, where fishers cut, dry and smoke the turtle meat before bringing it back to the mainland for local sales. Ilha de Njovo, in Larde District was reported in 2015 for this type of smoking activity (http://www.noticiasmocambique.com/nampula-tartaruga-marinha-em-risco-de-extincao/). Whole live

turtles were captured to preserve the freshness of the meat, likely destined for long journeys and possibly for illegal export to Tanzania. All reports suggest trade or local use of eggs is becoming more infrequent as nesting abundance has declined since Mozambique's Independence in 1975, and more recent declines in 1990-2000s.

Interviews indicated that the price of turtle meat varied depending on location and availability of turtles. Management practitioners commented that turtle seasonality influenced prices, and where turtles were more accessible, the price was lower. The prices per kilo of turtle meat vary depending on location, but in general the price is not high. Meat is sold at 50 MZN per kilo, which is the equivalent low priced fish meat or ray meat. Game fish (e.g. tuna, billfish), crayfish, shark fin, and holothurians all sell at significantly higher prices per kilogram and make these legal products more financially appealing.

Hawksbill turtle shell products were abundant in Pemba in and artisanal arts and craft store. This store had more than 200 pieces of turtle shell products ranging from rings, bracelets, earrings, glasses frames and a small cylindrical box/ashtray. Artisanal fishers report not having the skills for making these products but the Maconde, an ethnic bantu group originating from Cabo Delgado and Niassa provinces, are known for these kinds of handicrafts (Rich 2012).

Two anecdotes arose during the interviews regarding tortoise shell product. The first explained that fishers who illegally take turtles within Quirimbas National Park and neighbouring areas often cut the meat off of the carapace, discarding the carapace overboard or into the mangroves. These carapaces often then wash up onto beaches with the tidal movements and it was speculated that Maconde artisans simply come and collect these carapaces or buy from local children, who gather them and sell them for a nominal fee. The second report came from interactions with a Maconde artisan in the above-mentioned store in Pemba. He described the carapace products, saying they come from a large marine animal that has a shell. He referred to the animal being large enough to feed his family and the neighbours by making it into a large curry and the shell is reserved for crafts.

Domestic use is reported by fishers as having declined drastically since the end of the civil war in 1992, and in Cabo Delgado and Nampula provinces fishers were aware of the laws and marine protected areas (i.e. Quirimbas Archipelago National Park) that were set up to safeguard sea turtles. It is likely that domestic use may have been more prevalent prior to 2006-2008 in Cabo Delgado due to the presence of the marine protected area. Whilst domestic use still exists, its magnitude is likely to be lower at present time given that it can only occur as a clandestine activity. In areas with limited capacity for enforcement or a total absence of enforcement, illegal take of turtles for domestic use is likely to be more abundant. Given the expansive length of the coastline, the opportunity for illegal take and use is widespread.

Along the red cliffs section of the beach north of Inhassoro we detected 16 mortality events (carapaces or bones) whilst in transit to interview sites. Fisheries officials were unaware of these mortality events. It is likely that fishers using beach seine nets close to the centre of Inhassoro town may release turtles alive but fishers operating further from town, i.e. Nhamabue, Chibo and Bartholomeu Dias Point have much more opportunity to retain bycatch for consumption. Chacate (2005) estimated that 1,113 greens (32% juveniles and 68% adults) and 124 loggerheads (adults) were caught in Inhassoro from October 2004 to February 2005, and in 2015, remains of at least 207 turtles were seen on the beach from Inhassoro to Nhamábue (Videira 2017b).

The survey work completed in this study, coupled with the illegal take records that were previously reported by Williams 2017, provide an initial baseline quantifying illegal take, use and trade. Illegal take trends are not clear, nor uniform and likely to vary at the district level. In order to determine trends in trade patterns a longer time series of data is required. To date, the lack of existing baseline data on the domestic use, mortality events or trade of turtles has prevented the detection of noteworthy changes in trends or changes to regional trade patterns specifically for sea turtles.

A number of trends among foreign buyers of other marine products is evident and may influence the local

use, sale or trade of turtles within the country. These influential fisheries are briefly summarised below:

Artisanal shark finning - Pierce et al. (2008) refer to temporary fishing camps that exist for catching sharks for the purpose of finning. Shark fining throughout Southern Mozambique is widespread and has been present for more than ten years (Pierce et al. 2008). Specialist shark fishers use longline and large mesh gillnets to capture sharks and are suspected to catch turtles as bycatch. Evidence of turtle mortality events surrounding these temporary fishing camps has been documented and it is suspected that the turtle meat sustains the fishers while they target sharks and rays (Williams 2017). Pierce et al. (2008) reported that the ~85 km length of coastline between Morrumbene and Pomene, Inhambane Province may have the highest concentrated artisanal shark fisheries of southern Mozambique. This fishery will require further investigation to confirm the impacts on turtle populations. Changes to this fishery are likely to influence domestic use and potentially export rates of sea turtles and we recommend it is monitored closely in its extent, drivers and trends.

Lobster (crayfish) collection - An emerging fishery for crayfish collected and sold exclusively to Chinese / Asian buyers was documented in the district of Ilha de Moçambique, Nampula province. This activity is also rumoured to exist in Pemba, Cabo Delgado. In Ilha de Moçambique, the boats are artisanal sized vessels, with a small cabin/hull area which houses an air compressor, reportedly made from a modified 'Tata' brand truck engine. The air compressor enables the crew to dive to depth, using hookah lines to collect lobsters and other large reef fish with harpoons. Fishing using artificial means of respiration is prohibited under the general marine fisheries regulations of 2003 (known as REPMAR 2003) but given the lower, sheltered compartment to house the air compressor, these boats (which are owned by foreign companies) are easily able to hide clandestine catches such as turtles.

Live crabs for export - In the Quirimbas National Park (QNP), fishers from Quirambo Island reported that in recent years they had been switching gear types from nets to gaiolas, a traditional woven trap/basket designed to catch crabs. The demand for live crabs has driven the price from 20 – 30 MZN kg^{-1} to 300 MZN kg^{-1} since the early 2000s. Fishers told us there were both Tanzanian and Chinese buyers for live crab. Fishers explained that in order to catch the greatest amounts of crab, they used turtle meat as it has a strong odour to attract the crabs, and lasts longer as bait than fish meat. Only one gamboa (traditional fishing area, a large tidal fence trap) exists nearby to Quirambo Island. Here, up to 50 turtles can be caught in a single tidal cycle and whilst gamboas are frequently inspected by QNP authorities and the owner of the gamboa releases any trapped turtles, other fishers wait and watch the gamboa. When the trap catches turtles and no one is nearby the turtles are poached. Fifty per cent of the turtle carcass is used for bait in their gaiolas to catch crabs (including the bones and the head, and the remaining 50% is eaten, with the carapace being carefully disposed of deep in the mangroves. Turtle meat being used as bait for fisheries has been reported before in other interviews in Quionga, Cabo Delgado, and Pomene, Inhambane Province for artisanal shark fin fisheries.

4.2 Illegal international trade

Trade of sea turtles to Tanzania was more prominent in the immediate neighbouring border province of Cabo Delgado. Green turtles were the most abundant species in the area, due to extensive sea grass meadows and close proximity to Europa Island. Hawksbill turtles were the second most abundant species reportedly encountered by artisanal fishers and thus are likely to be involved in illegal trade activities. Our interviews confirmed that the international trade of sea turtles from Mozambique to other neighbouring countries exists. No clear evidence of trade for export was documented in southern Mozambique, or found in the literature. In Cabo Delgado, the most northern coastal Province of Mozambique, interviews with fishers confirmed the existence of illegal trade of live turtles being sent from Mozambique to Tanzania. This activity was described on three occasions.

Evidence of illegal take of live turtles has also previously been detected by authorities and reported in the media. In the Primeiras & Segundas this occurred at at Fogo Island, Larde in 2015 where seven turtles were sized, with another four turtles from Ilha de Ponta Caldeira, Moma district in 2015. Prior to this nine live

turtles were seized from fishers in 2010,on Ilha Careca, Moma district. Since 2016, dedicated enforcement effort on the Primeiras & Segundas islands has been scarce or non-existent and thus the practice of capture and trade of live turtles may be on-going. Logistics to access the area hinder conservation, research and enforcement efforts. Limited availability of suitable boats capable of accessing the islands prevented us from surveying this area in the timeframe available. Surveying these islands periodically will be critical for future assessments.

An elder respondent confirmed that international trade of turtles from Mozambique to Tanzania used to occur also in the past. Turtles were sent to Mtwara (the closest city across the border). Large turtles would sell for ~500 MZN each and small turtles for ~250 MZN. Tanzanians would place an order with Mozambican fishers, who would fish at night using a jarifa net to catch up to 50 turtles (reported by interview MZ041, Quirimba Island, Cabo Delgado). Turtles were not chosen according to species, but size of animal (interview MZ042).

In Cabo Delgado, it is unclear if illegal take for the intention of export is decreasing due to strengthening in enforcement of Quirimbas National Park, or if illegal take effort has been displaced to areas outside the jurisdiction of the MPA. In March 2018, more than 20 Tanzanian fishers were arrested on the grounds of turtle poaching (https://www.ippmedia.com/en/news/tanzanian-fishermen-arrested-mozambique-turtle-poaching). Evidence (Zafra-Calvo et al., 2018; Haysom, 2018) suggests a number of trade pathways (i.e. transport via sea to Tanzania) exist and are active for other products either marine (e.g. sea cucumber, fish, shark fins) or non-marine products (e.g. building supplies, cement). Trade networks for high profile wildlife crime of terrestrial species such as elephant, rhinoceros, lions and pangolin also exist, but there is no clear evidence to date that the trade of sea turtles is linked to these terrestrial species.

4.2.1 Drivers and motivations for illegal international trade

In Tanzania, turtles reportedly sold for greater value than in Mozambique, although we have no records to substantiate this. It is not clear if the end destination of these turtles is the domestic Tanzanian market and private households, or if Tanzania is part of a larger trade route.

Shark finning is well established and spread throughout Mozambique. The quantities of finning, species involved, and population demographics of those shark species are not known, but evidence reported in Peirce et al. (2008) and Williams (2017) suggest that illegal take of turtles and shark finning are interconnected. We do not have evidence connecting the trade route and export of dried shark fins with turtle products, but it is likely that these are interconnected.

There is also an emerging market for dried sea horses throughout Mozambique. Beach seine fishers often land sea horses as bycatch when fishing in seagrass meadows. Trade of sea horses from artisanal fishers to Mozambican middlemen or directly to Chinese buyers was reported by respondents in Inhassoro. It was observed also on a larger scale in the Palma district, Cabo Delgado (pers obsvs. J Williams, September 2017). Bilene and Inhambane estuaries have also reported large-scale collection of sea horses for sale to Asian markets. In 2014, 67kg of sea horses were detected in Hong Kong in a sea container originating from Mozambique. Sea horses reportedly sell for 5 to 10 MZN each (https://coconuts.co/hongkong/news/67-kg-dried-seahorses-seized-container-ship-arriving-mozambique/). Whilst there are no confirmed connections between turtle and sea horse trade, the movement of sea horses from Mozambique to Hong Kong illustrates a well-established trade network. Fisheries management officials in Cabo Delgado reported that the Mozambican Customs Authority had recorded large movements of dried sea horses out of the country. Little is known on the status, species, distribution and abundance of sea horses within Mozambique and they are not protected by fisheries regulations, but it is possible that this trade facilitates the illegal movement of sea turtle products.

4.3 Semi-industrial and commercial fishing

In addition to high rates of bycatch in the artisanal sector, the semi-industrial and industrial sectors also have high rates of bycatch (Gove et al. 2001; Brito 2012). Alarmingly, a 2016 report from Mozambique to

the Indian Ocean Tuna Commission suggests that no interactions with marine turtles have been reported in mandatory logbooks or through the observer scheme program of 2015 (IOTC 2016) even though the gears in use are known to catch sea turtles. This finding contrasts with a 2014 report that suggested that take in this fishery was up to 5,000 turtles based on the earlier publications by Gove et al. (2001) and Brito (2012). None of the semi-industrial boats operating in Maputo Bay have TEDs installed despite these being mandated by law since 2004, and anecdotal reports suggest major capacity limitation in the fisheries observer scheme. Reports from semi-industrial fishers operating in southern Mozambique confirmed that the mandatory logbooks could be filled in and submitted to the fisheries department on a 'voluntary basis'. Two campaigns led by WWF Mozambique to implement TEDs in vessels operating out of Sofala Banks have been conducted, but the programmes have not been successful. Evidence suggests that there are no commercial or semi-industrial scale vessels have TEDs installed in Mozambique.

4.4 IUU fishing

It was not possible to quantify how IUU vessels contribute to illegal take, use or trade of turtles in Mozambique. Reports of IUU fishing were evident in statements made by artisanal fishers in Inhambane province, but we recorded no evidence of artisanal fishers collaborating / cooperating on illegal take of turtles. Artisanal fishers reported that previous interactions with Chinese / Asian IUU vessels had resulted in threats, gunfire and their vessels being rammed. In Inhassoro, a few cases of missing fishers on the high seas circulated among local fishers who believed their disappearance could be attributed to IUU fishing. Indeed, our superficial investigations into IUU fishing resulted in confirmation of two vessels in the area. A Taiwanese trawler 'Win Far 161' was seen laying 10km of gillnets off Bazaruto Island on 26 May 2018 (Fig. 34, left). Owners of a tourism lodge in Inhassoro photographed a second vessel in 2016, which is notably different in origins and design (Fig. 34, right). Louro et al. (2006) presented photographic evidence of green turtles being captured as bycatch and being discarded overboard as headless carcasses.

Figure 34: Suspected IUU vessels within three nautical miles at Bazaruto Archipelago (28/05/2018) and Inhassoro (30/06/2016).

Given that artisanal fisheries and the five species of sea turtle are widespread throughout the Mozambican coast, the rate of interactions (>75% or respondents) between fishers and turtles is of concern. Whilst this interaction rate does not always lead to illegal take and either consumption or trade, our results indicate approximately 30% of fishers could be engaging in illegal take. The prevalence of illegal take and use has been linked to large-scale socio-economic drivers, such as food security and poverty (Williams 2017). Increasing coastal populations and a heavy national reliance on fish protein (50% of nations protein consumption) could lead to sustained or increased rates of illegal take of turtles (Williams 2017). The sheer magnitude of the potential impacts of the artisanal fishery at the regional scale are staggering. It is likely that the domestic landings (and consumption) exceed the magnitude and impact of both IUU fishing (although this remains to be quantified) and international trade in sea turtles associated with Mozambique.

4.5 Management successes

General awareness of the turtle protection laws was evident, with the majority of coastal communities

being aware that sea turtles are protected species. In addition to this, the fisheries extension officers and management practitioners had a good level of knowledge regarding turtles and the legality of activities regarding turtles. The network of extension officers through the Direcção Provincial do Mar, Águas Interiores e Pescas (DPMAIP; or Provincial Directorate for Ocean, Inland Waters and Fisheries), the Administração Nacional das Pescas (ADNAP; or National administration of fisheries) and the Serviços Distritais de Atividades Económicas (SDAE; or District services for Economic Activities) offices is tasked with providing a 'legal' presence throughout most coastal districts. However, staff members have scarce resources to do their job and are generally lacking a support team.

Management respondents indicated that effective enforcement and protection of nesting turtles in the Ponta do Ouro Marine Partial Reserve (POPMR) has led to major reductions in poaching cases, and these are down to approximately only one event per year. This Marine Protected Area (MPA) also leads the way for the rest of Mozambique as it has its only five-year artisanal fisheries management plan, which aims to improve knowledge of artisanal fisheries inside the reserve and mitigate interactions this fishery has with protected species, whilst preserving the livelihoods of coastal resource users. Given the absence of a national artisanal fisheries management plan, it seems reasonable to suggest that the other MPAs adopt this process of developing and implementing a specific artisanal fisheries management plan.

Successful examples of community-based management (CBM) and conservation come from Vamizi Island, one of the northern Islands in the Quirimbas archipelago, and are described in Garnier et al. (2012). It would be beneficial to extend this CBM model throughout other locations in Mozambique. In addition to this, the WWF MOMs program appears to be having initial success in the Quirambas National Park.

4.6 Management challenges

A clear lack of enforcement is evident throughout Mozambique, with exception of the Ponta do Ouro Marine Partial Reserve, Maputo Province. This lack of enforcement is evident at fisheries landing sites, beaches and on islands, especially those of Primerias and Segundas Archipelago, and some parts of Quirimbas Archipelago. In Nampula province, for instance, several cases of illegal take of turtles and selling of meat have been detected by authorities, and some prosecutions have resulted in fines and jail sentences. But it is more common that perpetrators flee before prosecution can occur.

It may be beneficial to expand and develop community enforcement programmes such as the Management-Oriented Monitoring System (MOMs) program implemented by World Wildlife Fund for Nature (WWF) WWF in the Quirimbas National Park to supplement national enforcement. Additional support (financial, equipment and training) could also be provided to Conselho Comunitário de Pesca (CCP; or community fishing councils) to monitor and enforce sustainable fishing in their fishing areas. However, the legislation that describes CCPs (REPMAR 2003) currently falls short of providing CCPs with the jurisdiction to legally enforce sustainable fishing measures other than those described within general marine fisheries regulations.

There is also an apparent lack of enforcement to control movements over the sea border between Mozambique and Tanzania, and trade across this sea border is mostly open and unregulated. In addition to the open access via sea, the terrestrial border is also known to be difficult for authorities to monitor and enforce, given the remoteness, the Rovuma river and expansive tracts of forests. This area has become a trade route for illicit activities such as poaching and transport of elephant and rhino horns, illegal hardwood timber, rubies, human trafficking and drugs. Complicating matters, the northern Cabo Delgado district has experienced increasing issues of instability since October 2017, with radicalised attacks on the town of Mocímboa da Praia. Since April 2018 the frequency of these attacks has increased and attacks have occurred in local villages both inland and along the coast. The attacks have been carried out in barbaric ways (beheading by machete) followed by looting and then burning down houses in the villages. A recent report by Pereira et al. (2018) suggested that attacks were conducted by isolated cells of extremists, instructed and incentivised to cause instability throughout the province. The report also suggests that such activity may be partially financed by high profile Islamic extremists from Tanzania and other countries, and

that terrorism or extremists are being used to distract authorities in order to secure illicit trade routes. "*The first objective [of the armed groups] is to create a situation of instability in the region to enable the illicit business in which the leaders are involved*" and then "*from these businesses to feed other networks with which they have links, for example militias in Congo, Somalia and Kenya, as well as Tanzania*" says Pereira. The trafficking networks also include elements from Vietnam and China." (Club of Mozambique 23/5/18; http://clubofmozambique.com/news/groups-with-terrorist-links-in-mozambique-protect-illegal-trade-routes-to-the-north-study/).

Despite downplaying of the events by the government, the frequency of attacks does not seem to be decreasing. It is currently unclear if the illegal take and export of sea turtles is part of the illicit activities linked to recent events. This situation should be monitored closely, as it likely impacts on rates of illegal take and export either directly or indirectly as general exodus/evacuation from the area by companies, NGOs and local communities opens up great opportunities for unregulated and undocumented take and trade.

There is also evidence of incomplete interpretation of the turtle protection laws. For example, in Mecufi, Cabo Delgado and Moma districts, the local authorities claimed that after fish are seized from poachers and used as evidence, it gets distributed to jails, hospitals and student residences. While this is the official process designated for fisheries products seized during illegal fishing in closure periods, this process has been inadvertently extended to turtles, despite it fostering mixed messages about the consumption of protected species. Thus, at a district and local administration level further capacity building and training is needed to ensure these practices are discontinued.

While all management practitioners understand that reporting accidental mortality of a bycaught turtle is mandatory, to date there are no cases of reported take in any of the three provinces surveyed. In the Quirimbas National Park managers reported that some fishers were too scared to report such incidents for fear of being prosecuted. They also described fishers abandoning or cutting away gear in situations where a turtle was entangled rather than reporting it as an accident. Further studies to better understand stakeholder motivations and attitudes, along with increased awareness programmes among key stakeholder groups attitudes has the potential to increase reporting compliance rates (Sánchez-Mercado et al. 2008).

5.0 Conclusions

A worrying large number of sea turtles are being impacted by traditional and commercial fisheries in Mozambique. The bycatch situation is of immense proportions and complex (fisheries methods, motives and drivers all interplay) and a single solution is unlikely (Williams 2017). Both top-down and bottom-up approaches to the problem will need to be adopted.

Emerging threats within Mozambican waters and throughout the SWIO region include illegal unregulated and unreported fishing (IUU), illegal wildlife trade (IWT) and large-scale industrial developments in northern Mozambique (Obura et al. 2019). The scale of these threats, and their impacts are unknown and are generally extremely data deficient. Management efforts will need to focus on promptly addressing these deficiencies.

Our surveys across 77 fishers or fishery-related workers and eleven management practitioners have provided a preliminary source of information on the turtle fishery and the potential impacts of both the commercial and artisanal fisheries on turtle stocks, but the spatial coverage was lacking, and the challenges in determining a national-level of take mean that extrapolation of our limited data set may not be representative. Illegal take of sea turtles results more from retention of accidental bycatch than of direct hunting, although this practice also exists.

An estimated 1,000 to 1,800 turtles were removed from the population among only 48 of the 77 respondents to this survey, and extrapolations suggests that national level extraction could be of a magnitude of hundreds of thousands. Indeed, across the entire coastline the total take could be as high as 800,000, with a quarter of those reportedly retained for consumption (~200,000) or trade and the balanced (reportedly) released alive. While we acknowledge this number is likely an overestimate, it is important to note the magnitude of the take that lies in hundreds of thousands of sea turtles per year.

There is also direct hunting of sea turtles in addition to bycatch: specialist hunting events can capture up to 30-40 turtles in a single event and fishers estimate it is possible that 80-100 turtles per year could be removed by specialist turtle hunters. Unfortunately we do not have an idea of how many of these specialist hunters exist.

We believe the semi-industrial and industrial fleets contribute another ~4,000 to ~6,000 turtle mortalities each year and while this can be a major impact on sea turtles, the magnitude of this take pales when compares to the directed take and bycatch in artisanal fisheries. IUU fishing likely also contributes to additional turtle mortality and potentially trade, and while IUU fishing occurs, there are no records that would allow us to even suggest a level of impact.

International trade has been documented, although the magnitude of this trade is unknown. We believe that domestic trade and consumption are likely far more extensive and of far greater impact than the international trade, given poverty levels and remote locations of many of the fishing villages. We acknowledge trade is more prominent in the north into Tanzania, and suggest that (once the area is peaceful once more) surveys into this trade be implemented.

The curio trade in hawksbill-derived ornaments was also documented, but again due to coverage we do not have an understanding of the full impact of this market sector. We suggest however that it is not large, particularly given the much smaller number of hawksbills recorded in the surveys compared to green turtles.

Nesting levels have decreased in Mozambique and no beaches exist that would support the production of sufficient hatchlings and juveniles that are taken in the fisheries, and thus we believe that these are being seeded from nearby rookeries in the Western Indian Ocean. It is unclear whether this is a sustainable level of extraction, given as these rookeries are also seeding beaches in Madagascar, where similarly large numbers of turtles are extracted each year.

Marine Protected Areas have shown promise in successfully protecting marine environments but these are on a very limited geographical scale and unlikely to be the best option for wide-scale turtle management / protection.

Uncertainties in the relative abundance of sea turtles in Mozambican waters and a lack of robust information on the nationwide extent of the numbers of sea turtles (and size classes) killed by the artisanal fisheries make it difficult to conclude whether the current level of removal (illegal take) for any of the five sea turtle species is sustainable or not – although we believe that the levels of take of hawksbills and green turtles is unsustainable.

It is evident that there is much follow-up work required to expand on our results presented in this report. There is a need to know where the turtles being taken from Mozambique waters originate from, and to determine if the collective pressures on these stocks (for instance, coupled with the directed take from Madagascar) can be sustained.

Notwithstanding the current legislative status of sea turtles, the levels of poverty in Mozambique and the requirement for protein mean that sea turtles are a favoured and extremely common commodity. It is likely that sea turtles have been sustaining local communities for many years – what is unknown if the current

expansion to a commercial enterprise and transport networks to all of the major cities with their concomitant resource demands will be sustainable.

It is important to note that we do not know if the current level of take is sustainable; and neither where the source of the stock(s) is/are located (where are all the Mozambique turtles coming from). These two key biological questions are particularly relevant, as answers to these might inform management and conservation opportunities that are addressed in the following section.

6.0 Recommendations

Recommendations made herein are broken down into management and conservation related actions and biology / sustainability related issues. We have not ascribed individual recommendations to specific agencies based on the following: a) the opportunity exists for multiple agencies to undertake various aspects of individual recommendations, or to work together on accomplishing these, and ascribing them to one agency might be agency-constraining; b) access to and provision of funding will dictate which of these recommendations can be undertaken as priority activities, and by which agency, and c) the current fiscal situation in Mozambique dictates that many of these recommendations will need the support of external agencies and will require the establishment of strong partnerships which do not exist currently. At a minimum however, we feel that these recommendations should be implemented under the auspices of several international agencies, conventions and instruments (e.g. CITES, IOSEA MoU, FAO, the European Union, and the World Bank), local government agencies including the Ministry of Fisheries, the National Institute for the Development of Small-scale Fisheries (IDPPE), the National Administration for Conservation Areas (ANAC) and the Institute for Fisheries Management, and a broad range of national and international NGOs and outside agencies, along with local and foreign universities.

7.1 Conservation & Management

1. Conduct an in-depth assessment of the trade, rather than a rapid field / desktop assessment, to fully understand the depth and breadth of the sea turtle take and trade in Mozambique, allowing for full nationwide geographical coverage, sufficient time to assess the illegal cross-border trade, and the trade in curios and artefacts made from turtle products, particularly hawksbill turtles;
2. Further evaluate illegal take and use of turtles to provide more reliable estimates for a national scale as data from the current surveys limit our ability to extrapolate beyond the provinces that were sampled;
3. Conduct training of customs, port and Ministry officials who are involved in the permitting and inspection process of outgoing shipments (both fish and non-fish-related) to assess and control the export of illegal sea turtle products;
4. Build capacity among key authorities on the importance and protocols required for systematic gathering of information and reporting of illegal take and trafficking incidents into a central digital database in order to complete CITES Annual Illegal Trade Reports;
5. Conduct directed training for customs and enforcement officers at the border points to identify and recognise marine turtle meat and products, national laws and international (e.g. CITES) regulations, evidence handling, chain of custody, etc.
6. Conduct an independent review of effectiveness of logbooks on semi-industrial and industrial fleets and fisheries observers so that fishery sector can validate the interactions the semi-industrial and commercial fisheries sectors have with sea turtles;
7. Assess the accuracy of reports to the Indian Ocean Tuna Commission (IOTC) which suggest that no interactions with marine turtles have been recorded in mandatory logbooks since 2015, and implement a mandatory reporting system at a National level which can corroborate international reporting,

8. Review the effectiveness of the Mozambique observer program which must fulfill IOTC resolutions to estimate marine turtle interactions in the National EZZ, noting that IOTC is reportedly re-assessing all the onboard observer data and associated recommendations; and a new observer manual is currently being evaluated by the IOTC Working Party on Statistics, to be validated by the IOTC Scientific Committee.
9. Investigate the scale, extent and influence of foreign companies / buyers on the impact of sea turtles via artisanal fisheries;
10. Develop, enhance and implement bycatch mitigation programs in the semi-industrial and commercial fisheries, such as through the use of Turtle Excluder Devices, circle hooks and bait types in longline fisheries, and robust observer programmes;
11. Allocate resources to implement the mandated Turtle Excluder Device programme in the shrimp fishing fleet, and monitor the use and effectiveness of TEDs in reducing sea turtle bycatch. This programme will likely require a penalty system for non-compliance linked to licensing, and possibly a reward scheme for compliance through market access, preferential treatment in ports, and government recognition;
12. Increase funding support to address sea turtle management and conservation. Consistent, stable and long term funding mechanisms are essential, as at present there are insufficient funds dedicated to managing Mozambique's sea turtle populations, particularly those at sea;
13. Increase capacity building across a wide range of stakeholders including local government representatives, the artisanal fishing community, local administrators, community leaders, and community fishing councils (CCPs). These need to be targeted awareness programmes to deal with legal, biological, and enforcement issues. These may be accomplished through a series of outreach campaigns, and directed training;
14. Implement field campaigns among local communities to sensitise them on the conservation status of sea turtles, the legal protection status of sea turtles, and opportunities for minimising bycatch in local fisheries;
15. Increase resources for enforcement, such as in material, staff and operational costs, both inside and outside of Marine Protected Areas;
16. Allocate resources for marine enforcement facilities and staff, and station key resources at key fishery areas where sea turtles, sharks and other protected species are targeted;
17. Support and facilitate undercover investigations which may provide greater insight into any illegal sea turtle trade and export activities;
18. Develop programmes to eliminate corruption amongst enforcement officials to enhance implementation and enforcement of current existing national legislation;
19. Investigate the opportunities for regional collaboration amongst countries who share the sea turtle stocks on which Mozambique's fishers depend; to this end the IOSEA Marine Turtles MoU, especially the western MoU's Indian ocean Marine Turtle Task Force could provide advice and support;
20. Explore the potential for alternative livelihoods as a means to reduce pressures on sea turtle stocks;
21. Explore the potential for micro-finance schemes to catalyse conservation action and enable communities to improve the standard of living and become less reliant on sea turtles for sustenance;
22. Establish an emergency fund for government agencies to act on IWT related to sea turtles and other marine products;
23. Seek support from NGOs and donor agencies to strengthen current conservation approaches, expand awareness- and capacity-building activities.

7.2 Biology & Sustainability

1. Determine the provenance of sea turtles being taken out of Mozambique waters (through genetic studies) and determine the overall productivity of these source rookeries, and other regional impact areas (e.g. Madagascar);
2. Determine the use of foraging grounds by Mozambique nesting turtles and subsequently assess the impacts to turtles in those foraging grounds;
3. Implement studies on sea turtle abundance in marine habitats to assess the potential for time-area closures of semi-industrial and commercial fisheries as a mitigation tool to address bycatch of sea turtles in these fisheries;
4. Conduct a detailed study into the impacts on sea turtles by the semi-industrial and commercial fisheries sectors in Mozambique, including an evaluation of bycatch and the effectiveness of current logbook and fisheries observer schemes;
5. Conduct studies to understand impacts and scale of IUU in the Mozambique channel and Mozambique EEZ and understand how IUU fleet may interact with turtles and other protected species;
6. Develop a survey campaign to assess the overall contribution of specialist turtle hunters and fishing campaigns to the mortality of sea turtles in Mozambique;
7. Initiate and maintain long-term data collection programmes to detect trends and patterns in illegal sea turtle trade;
8. Conduct a comprehensive survey detailing the presence, scale and type of sea turtle products being sourced by foreign buyers;
9. Expand the current rapid survey to a greater geographical area in order to refine the estimates of total annual turtle take in Mozambique (see also Section 7.3, below). This survey should include transects along coastal dunes and mangrove areas to quantitatively document turtle mortality in these areas. Priority should be made to search mangrove areas nearby to fishing communities as this was reported by artisanal fishers as the best location to conduct poaching events without being detected. Drone surveys may also be a more suitable/effective way to survey for mortality events along the coast rather than conducting foot patrols;
10. Conduct a thorough and national-level assessment of nesting sea turtles in Mozambique to understand their contribution to sea turtle stocks in Mozambique's coastal foraging grounds;
11. Conduct an investigation into impacts of the shark fishery on the abundance and trends in sea turtle stocks in Mozambique;
12. Conduct regular and periodic expeditions to the Primeiras & Segundas islands to assess the nature and magnitude of illegal sea turtle take and address the findings through strengthened management measures;
13. Conduct studies on the bycatch and survival prospects of sea turtles in the shrimp fishing fleets, and on the effectiveness of the Turtle Excluder Device programme;
14. Conduct studies on the impacts of other industrial and semi-industrial fisheries such as longlines and purse seine fisheries on sea turtles;
15. Develop a holistic regional survival probability model of sea turtle population dynamics which takes into account the threats from multiple countries (how many turtles of what age classes are being taken out of the population), limitations of source beaches (how many sea turtles are being produced each year), natural survival probabilities, and sea turtle biology to determine the sustainability of the current harvests.

7.3 Additional priority survey areas

Our surveys were, by their very nature, rapid and limited in scope. Given the expanse of the Mozambique coastline, there is significant scope for additional baseline surveys in artisanal fishing villages and follow-up investigations on illegal trade networks. Table XII summarises key areas that could be addressed by future efforts.

Table XII: Areas in need of follow-up efforts

Area	Known situation/ Data Available	Efforts required
Mefunvo Island, Quirimbas Archipelago, Cabo Delgado	• Weak enforcement by QANP authorities • Intentional hunting of turtles • Possible Tanzanian migrant fishers • Limited data available	• Baseline data in Macomia • Regular enforcement
Quissanga, Cabo Delgado	• Intentional hunting of turtles • Possible Tanzanian migrant fishers • Limited data available	• Baseline data in Macomia • Regular enforcement
Macomia and Palma districts, Cabo Delgado	• Proximity to border with Tanzania. • Numerous immigrant fishers • Macomia district lacking baseline data due to instability	• Baseline data in Macomia • Regular enforcement
Memba District, Nampula Province	• Heavy fishing pressure • Lacking baseline • Suggested by other fishers to be a place where intentional hunting of turtles occurs	• Baseline data • Regular enforcement
Nacala Bay (including Nacala Port), Nampula Province	• Heavy fishing pressure • Port reported to be used for other illicit activities • No baseline data available	• Baseline data • Regular enforcement
Islands offshore from Ilha de Moçambique	• No enforcement presence • Illegal fishing (with hookah lines) • Intentional turtle hunting	• Baseline data • Regular enforcement
Primeiras & Segundas Islands (Puga puga, Fogo, Njovo, Caldeira)	• Logistically hard to access • No baseline data available • Used as fishing camps for immigrant and migrant fishers • Reported to be used for smoking and processing turtle meat • Very limited enforcement due to logistical restraints	• Baseline data • Regular enforcement •
Mucoroge, Moma to Zambezia Province boundary	• Known location of intentional turtle hunting • Isolated area • Limited enforcement • Not protected area	• Baseline data
Pebane, Zambezia Province	• Reported by fishers as a location of intentional turtle hunting • No baseline data available • Remote	• Baseline data
Sofala Province	• Hub for commercial fishing • Likely high rates of bycatch • Limited or no use of TEDs • Port maybe be used for in trade network	• Data on key turtle habitats • Data on turtle interactions with commercial and artisanal fisheries

Islands of Bazaruto Archipelago National Park, Inhambane province	• Bycatch interactions thought to be high • Traditional history of hunting turtles • Scarcity of alternative livelihoods for island communities • Potential site frequented by IUU vessels	• Baseline data in Macomia • Regular enforcement
Sao Sebastian, Inhambane province	• Potential site frequented by IUU vessels • Very limited enforcement due to logistical restraints • Suspected illegal fishing behaviours occur here (e.g. shark finning, turtle hunting, collection of turtle eggs)	• Baseline data in Macomia • Regular enforcement
Pomene, Inhambane province	• Potential site frequented by IUU vessels • Very limited enforcement due to logistical restraints • Suspected illegal fishing behaviours occur here (e.g. shark finning, turtle hunting, collection of turtle eggs)	• Baseline data in Macomia • Regular enforcement
Massinga, Inhambane province	• Remote coastline • No enforcement • Intentional hunting of turtles known to occur	• Baseline data in Macomia • Regular enforcement

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Annex I: Itinerary of completed works

Date	Province	Activity type	Itinerary	Distance (km)
16/5/18	Inhambane	Transit / Interviews	Tofo to Vilanculous	315
17/5/18	Inhambane	Interviews	Vilanculous via Macunha to Inhassoro	60
18/5/18	Inhambane	Interviews	Inhassoro to BD point via Nhamabue and Chibo (return trip)	75
19/5/18	Inhambane	Interviews	Inhassoro to Tzontso and Mucucune (return trip)	25
19/5/18	Inhambane	Transit	Inhassoro to Vilanculous	60
20/5/18	Inhambane	Transit	Vilanculous to Tofo	315
29/5/18	Inhambane to Maputo Province	Transit	Tofo to Maputo	502
30/5/18	Maputo Province to Cabo Delgado	Transit	Maputo to Pemba	2470 (flight)
31/5/18	Cabo Delgado	Interviews	Pemba, DPMIAP office	5
01/6/18	Cabo Delgado	Interviews	Pemba to Mecufi + Murebue	80
02/6/18	Cabo Delgado	Transit + Interviews	Pemba to Tandanhangue and Ibo Island	110 / 15 boat
03/6/18	Cabo Delgado	Interviews	Ibo Island and Matemo Island	20 (boat)
04/6/18	Cabo Delgado	Interviews	Palossança village, Matemo Island via Quirambo to Ibo Island	30 (boat)
05/6/18	Cabo Delgado	Interviews	Quirimba island	25 (boat)
06/6/18	Cabo Delgado	Interviews	Ibo Island	n/a
07/6/18	Cabo Delgado	Transit	Ibo Island to Pemba via Tandanhague	15 (boat) + 110
08/6/18	Cabo Delgado to Nampula	Transit	Pemba to Ilha de Mozambique	407
09/6/18	Nampula	Data entry + Logistics	Ilha de Mozambique	n/a
10/6/18	Nampula	Data entry + Logistics	Ilha de Mozambique	n/a
11/6/18	Nampula	Meetings w/ local authorities	Ilha de Mozambique	5
12/6/18	Nampula	Interviews	Ilha de Mozambique to Sanculo and Sanculo Mercado (return)	15
13/6/18	Nampula	Interviews	Passomar fishing center, Ilha de Mozambique	5
14/6/18	Nampula	Interviews	Ilha de Mozambique to Saua Saua (return).	24
15/6/18	Nampula	Transit	Ilha de Mozambique to Angoche	225
16/6/18	Nampula	Interviews	Angoche to Kuiricudge, Tamole fishing center, Tamole village and Praia Nova (return)	60
17/6/18	Nampula	Interviews	Angoche to Larde Sede, Larde CCP and Mulenlene fishing center. (return)	200
18/6/18	Nampula	Interviews	Angoche City to Angoche Island, via	65 km

			Lipanda and Metepene fishing centers	(boat)
19/6/18	Nampula	Data entry + Logistics	Angoche City	n/a
20/6/18	Nampula	Transit	Angoche to Moma	130
21/6/18	Nampula	Interviews	Moma to Pilivi and Malanzi fishing centers.(Return)	110
22/6/18	Nampula	Transit	Moma to Nampula City	280
23/6/18	Nampula	Data entry	Nampula city	n/a
24/6/18	Nampula to Maputo	Transit	Nampula city to Maputo	2064 (flight)
25/6/18	Maputo to Inhambane	Transit	Maputo to Tofo, Inhambane	502
Summary	3 Provinces	32 days in field	Flights = 4534 km; car = 3620 km; boats = 170 km	
Distance covered			Total distance = 8324	

Annex II: Interview questions for fishers

Interviewer name: _____
Location: _____
Date: _____
Survey number: _____

A. BACKGROUND INFORMATION

i. Your age:
ii. Occupation: fisherman □ boat owner □ fish seller □ other (please specify:_____)
iii. Length of experience in current role: _____ years _____ months
iv. Number of fishers in village
v. Total number of boats/nets/?

B. MARINE TURTLES IN MOZAMBIQUE

1. Have you seen marine turtles in your community and surrounding areas? (Y/N)
2. If Y, where? □ on the beach; □ coral reefs; □ coastal waters (< 3nm from shore); □ oceanic waters (>3nm from shore); □ other (please specify: _____)

3. Part one: Can you differentiate between species? Y/N

Part two:

a) Please indicate how frequently you have seen each species of marine turtle:
b) green (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
c) hawksbill (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
d) loggerhead (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
e) leatherback (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
f) olive ridley (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
g) All species / species not differentiated. (never, rarely, somewhat frequently, frequently, very frequent, N/A)

4. Please indicate how your sightings of marine turtles have changed in the last five years, if at all:
   a) Increased
   b) Stayed the same
   c) Decreased
   d) Don't know
5. Why do you believe this is so? _____

C. USE AND TRADE OF MARINE TURTLES

6. Have you ever seen or heard of marine turtle meat, eggs or products being sold or traded in your community and surrounding areas? (Y/N)
7. In your local waters, are marine turtles targeted *intentionally* by members of the community? (Y/N)
8. Please estimate how many marine turtles are caught *intentionally* by locals in your local community and surrounding areas? (give # per week, per month etc if easier to recall): _____ Is this continuous or sporadic? (circle one)
9. What do you believe happens to the turtles caught *intentionally* by members of the community?
   a) used for food
   b) sold locally
   c) used for traditional medicine and/or crafts
   d) shipped overseas (list countries: _____)
   e) other (please specify: _____)

10. In your local waters, are marine turtles caught *incidentally* by members of the community? (Y/N)
11. Please estimate how many marine turtles are caught *incidentally* by locals in your local community and surrounding areas? (give # per week, per month etc if easier to recall): _____ Is this continuous or sporadic? (circle one)
12. What do you believe happens to the turtles caught *incidentally* by members of the community?
    a) released alive
    b) used for food
    c) sold locally
    d) used for traditional medicine and/or crafts
    e) shipped overseas (list countries: _____)
    f) other (please specify): _____
13. In your local waters are there foreign fishers and do they target, are marine turtles targeted *intentionally* by foreign fishers? (Y/N)
14. Please estimate how many marine turtles are caught *intentionally* by foreign fishers in your local waters? (give # per week, per month etc. if easier to recall): _____ Is this continuous or sporadic? (circle one) and are those fishers from? _____
15. What do you believe happens to the turtles caught *intentionally* by foreign fishers?
    a) used for food
    b) sold locally
    c) used for traditional medicine and/or crafts
    d) shipped overseas (list countries: _____)
    e) other (please specify): _____
16. In your local waters, are marine turtles caught *incidentally* by foreign fishers? (Y/N)
17. Please estimate how many marine turtles are caught *incidentally* by foreign fishers in your local waters? (give # per week, per month etc. if easier to recall: _____). Is this continuous or sporadic? (circle one)
18. What do you believe happens to the turtles caught *incidentally* by foreign fishers?
    a) released alive
    b) used for food
    c) sold locally
    d) shipped overseas (list countries: _____)
    e) other (please specify: _____)
19. Please indicate how the following marine turtle items are usually exchanged (select all that apply):
    a) meat (bought/traded/both/don't know)
    b) eggs (bought/traded/both/don't know)
    c) products (bought/traded/both/don't know)
    d) whole turtle ((bought/traded/both/don't know)
20. Please indicate how frequently marine turtle meat, whole turtle, eggs or products are sold/traded for each of the following locations in your community:
    a) aboard fishing boats (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
    b) at the port (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
    c) fish markets (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
    d) other markets (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
    e) at homes in the community (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
    f) other location: _____ (Never, Rarely, Somewhat frequently, Frequently, Very frequently, N/A)
21. If there is any turtle trade in your community and surrounding areas, please rank the marine turtle species in order from 1 (most commonly traded) to 5 (least commonly traded):
    a) green ____
    b) hawksbill ____
    c) loggerhead ____
    d) leatherback ____

e) olive ridley ____
f) NO TRADE

22. Who are the MAIN suppliers of marine turtle meat, eggs and products in your community and surrounding areas? (circle the MAIN supplier, note others if mentioned)
    a) local fishers from the community
    b) local non-fishers from the community (please list likely occupation: _____)
    c) Mozambican fishers from outside of the community
    d) Mozambican non-fishers from outside of the community (likely occupation: _____)
    e) foreign fishers (please specify which countries: _____)
    f) other (please specify: _____)
23. Does the marine turtle meat, eggs and products from your community get sent to other parts of Mozambique? (Y/N) please list destinations: _____
24. Please list the types of items sent to other parts of Mozambique (e.g. meat, eggs, carapaces, whole turtles, etc):_____
25. Why do you believe people would choose to trade locally in marine turtle meat, eggs and products? _____
26. Please indicate how the trade of marine turtle meat, eggs or products in your community and surrounding areas has changed in the last five years, if at all:
    a) meat (Increased, Stayed the same, Decreased, N/A)
    b) eggs (Increased, Stayed the same, Decreased, N/A)
    c) products (please specify: _____) (Increased, Stayed the same, Decreased, N/A)
    d) whole turtles (Increased, Stayed the same, Decreased, N/A)
27. For the item(s) where you believe trade has INCREASED, please suggest a reason as to why this might be happening: _____
28. For the item(s) where you believe trade has STAYED THE SAME, please suggest a reason as to why this might be happening: _____
29. For the item(s) where you believe trade has DECREASED, please suggest a reason as to why this might be happening: _____
30. Do you believe that the local trade of marine turtle meat, eggs and products will cause the marine turtle populations to DECREASE within the next 10 years? (Y/N)
31. Why do you believe that this is so? _____

D. MARINE TURTLE EXPORT

32. Does the marine turtle meat, eggs and products from your community get sent to other countries outside of Mozambique? (Y/N) please list destinations: _____
33. Please list the types of items sent to other countries (e.g. meat, eggs, carapaces, whole turtles, etc): _____
34. Please estimate how many turtles (or eggs) (or kgs or meat) are exported (e.g. daily, weekly monthly, etc): _____
35. How often does this happen? E.g. daily, weekly, monthly, etc: _____
36. How do people export the turtles/turtle parts? _____ _____
37. Please indicate how the export of marine turtle meat, eggs or products has changed in the last five years, if at all:
    a) meat (Increased, Stayed the same, Decreased, N/A)
    b) eggs (Increased, Stayed the same, Decreased, N/A)
    c) products (please specify: _____) (Increased, Stayed the same, Decreased, N/A)
38. For the item(s) where you believe export has INCREASED, please suggest a reason as to why this might be happening: _____
39. For the item(s) where you believe export has STAYED THE SAME, please suggest a reason as to why this might be happening: _____

40. For the item(s) where you believe export has DECREASED, please suggest a reason as to why this might be happening: _____
41. Why do you believe people would choose to export marine turtle meat, eggs and products? _____
42. Do you believe that the export of marine turtle meat, eggs and products will cause the marine turtle populations to change within the next 10 years? (Y/N)
43. Why do you believe that this is so? _____

E. OTHER QUESTIONS:

44. Have you seen foreign fishers or fishing vessels in your area?
45. Are there foreign buyers in your area
46. Where does the fish from your catches get sold?
47. Have you seen any tagged turtles
48. Have you seen any stranded sick or dead carcasses? Y/N what happened to the carcasses/turtles and what state were they in.

Annex III: Interview questions for management officials

Conservation and Management Practitioners

Date:
Location:
GPS coordinates:
Waypoint No:

Interviewee background information

1. What is the name of your organisation?
2. What is your current position here?
3. How long have you been in your current position
4. Your expertise comes from which of the following sectors? Choose all that apply:

a. Academic research
b. Government research
c. Fisheries management
d. Policy making
e. NGO (non-governmental organisation)
f. Consulting
g. Other (please specify):

Export of marine turtles and their products in Mozambique

1. Have you ever seen or heard of marine turtle meat, eggs or products being exported to other countries outside Mozambique? (Y/N)
2. Please indicate how the following marine turtle items are usually exchanged (select all that apply):
    a) meat (bought/traded/both/don't know)
    b) eggs (bought/traded/both/don't know)
    c) products (bought/traded/both/don't know)
3. Do you know who are the MAIN suppliers of marine turtle meat, eggs and products that are exported (choose one, rank the others 2: next biggest supplier to 5: smallest supplier)?
    (a) Local fishers from the community
    (b) Local non-fishers from the community (please list likely occupation:
    (c) Mozambican fishers from outside of the community
    (d) Mozambican non-fishers from outside of the community (likely occupation:
    (e) Foreign fishers (please specify which countries:
    (f) other (please specify:
4. Please list the types of items sent to other countries (e.g. meat, eggs, carapaces, whole turtles, etc):
5. Why do you believe people would choose to export marine turtle meat, eggs and products?
6. Please indicate how the export of marine turtle meat, eggs or products has changed in the last five years, if at all:
    (a) meat (Increased, Stayed the same, Decreased, N/A)
    (b) eggs (Increased, Stayed the same, Decreased, N/A)
    (c) products (please specify: _____) (Increased, Stayed the same, Decreased, N/A)
7. For the item(s) where you believe export has INCREASED, please suggest a reason as to why this might be happening:
8. For the item(s) where you believe export has STAYED THE SAME, please suggest a reason as to why this might be happening:
9. For the item(s) where you believe export has DECREASED, please suggest a reason as to why this might be happening:

10. How do you believe that marine turtle populations are affected by the export of marine turtle meat, eggs and products?

(a) Severe decrease of marine turtle populations
(b) Moderate decrease of marine turtle populations
(c) Slight decrease of marine turtle populations
(d) No effect on marine turtle populations
(e) Slight increase of marine turtle populations
(f) Moderate increase of marine turtle populations
(g) Severe increase on marine turtle populations
(h) No opinion or don't know

11. Do you believe that the export of marine turtle meat, eggs and products will cause the marine turtle populations to change within the next 10 years? (Y/N)

12. Why do you believe that this is so?

Knowledge of legislation:

13. Is it illegal to intentionally kill sea turtles

What about by accident (maybe caught in a net unintentionally)?

14. Are any areas routinely / periodically patrolled? Frequently Infrequently Never Don't know

15. If yes, are penalties ever imposed? Frequently Infrequently Never Don't know

Management of sea turtle capture and trade

16. Does your agency have specific programs in place to deter, mitigate and/or manage sea turtle capture and trade?

i. Yes
ii. No *(go to question 20)*
iii. Don't know *(go to question 20)*

17. If you answered Yes to the previous question, please select the programs that are in place to deter, mitigate and/or manage sea turtle capture and trade. Choose ALL that apply:

i. enforcement of license/permit system
ii. vessel monitoring system (VMS)
iii. catch monitoring programs for target and non-target species
iv. maintaining publicly available sea turtle capture and trade vessel blacklists
v. port inspections
vi. awareness and education campaigns
vii. other (please specify):

18. In your opinion, how effective have these programs been in reducing the number of incidents of sea turtle captures and trade in Mozambique? Choose **one** only:

a. Completely ineffective
b. Somewhat ineffective
c. Somewhat effective
d. Very effective
e. Don't know

19. Please provide an explanation as to why you think this is so:

20. What additional programs or measures do you think are needed to reduce sea turtle capture and trade?

21. If funding was available and unlimited, which three (3) actions would you recommend be taken by your agency to reduce sea turtle capture and trade? Please list 3 actions:

22. Please estimate how many incidents of sea turtle capture and trade occur yearly in Mozambique:

a. Never occurs
b. One incident a year
c. Fewer than 10 incidents a year
d. Between 10 and 50 incidents a year

e. More than 50 incidents a year
f. Other:

23. To what extent do you believe that illegal fishing represents a threat to the health of marine turtle populations in your country? Choose ONE only:

a. No threat to turtles
b. Minimal threat to turtles
c. Moderate threat to turtles
d. High threat to turtles
e. Very high threat to turtles
f. Don't know

24. How important is it to your agency to address the sea turtle capture and trade problem? Choose ONE only:

a. Not a priority
b. Low priority
c. Moderate priority
d. High priority
e. Very high priority
f. Don't know

25. To what extent do you believe that reducing sea turtle capture and trade is a government priority in Mozambique?

a. Not a priority
b. Low priority
c. Moderate priority
d. High priority
e. Very high priority
f. Don't know

26. In your opinion, when people are caught doing sea turtle capture and trade, how often are they formally punished? Choose ONE only:

a. Never
b. Rarely
c. Sometimes
d. Frequently
e. Very frequently
f. Don't know

27. What do you believe is the most important action that needs to be taken to reduce sea turtle capture and trade in your country?

Other questions

28. Are there laws related to *domestic* trade in sea turtles and/or their products?

a. If so, what are these?
b. If so, who is in charge of implementing / enforcing these laws?
c. Are there any challenges to implementing these regulations? (Y/N)
i. If yes, what are these?

29. Are there laws related to *international* trade in sea turtles and/or their products?

a. If so, what are these?
b. If so, who is in charge of implementing / enforcing these laws?
c. Are there any challenges to implementing these regulations? (Y/N)
i. If yes, what are these?

Annex IV: Survey constraints

This section describes process limitations to the present survey, and indicates where these limitations may influence the types of data collected and conclusions we have drawn. A number of these limitations to the study must be discussed:

One major issue with the survey methodology was that we had to be accompanied by fisheries officers or fishing association representatives in order to gain access to fishers, and respondents may have felt that they could not speak openly about illegal activities without fear of future consequences to their livelihoods. Given these people are responsible for enforcement measures it is likely that fishers omitted incriminating information in their presence, which would lead to underestimates of bycatch, consumption or trade (domestic or international). This is a common issue when conducting interviews of a sensitive nature or on clandestine topics and therefore the data should be considered a conservative estimate. In addition to this, rapid assessments are not the most suitable method to understand such a sensitive topic as typically the researcher would be 'embedded' within the community for a lengthy period before gaining the full trust of respondents.

Working among fishing communities requires seeking appropriate approvals from authorities at provincial and district levels. This process often takes considerable time and can only be conducted in-person on site at each location, limiting time available for interviews.

The extremely limited timeframe allocated to conduct this work significantly impeded our ability to conduct a rapid assessment over such a large geographic area, where many existing data gaps were evident.
With regards to logistics, whilst in the field our survey efforts each day were limited by poor quality access roads, conditions not being safe to travel at night, alongside limited hours of sunlight in winter season (i.e. sunset at 16:50).

Unfortunately, we were limited in our opportunity to survey offshore islands, especially in the Primeiras & Segundas Archipelago due to lack of suitable high speed boats available for hire that are fit for open ocean/ travelling outside of estuary/lagoons or bays. In addition to this, tidal times and fishing hours also limited our ability in some locations as these influenced our ability to access certain places by boat, or when driving on the beach, which limited us to either travelling only at high tides, or the opposite. Also finding suitable interview times to suit the schedule of fishers and their planned activities proved challenging at times.

Our fieldwork occurred throughout the religious month of Ramadan, which impacted the periods available to conduct interviews as people made several trips to the mosque each day. Ramadan is a month of fasting in daylight hours and likely influenced the attitudes of interview participants, especially by late afternoon or in hot weather. It is possible this influenced the quality of data from fishers. In order to respect religious practices, we tried where possible to respect the Muslim communities by not surveying in communities on Fridays. Mosque day is Fridays in northern Mozambique and Sunday is church day in Southern Mozambique. It is difficult to conduct interview work on these days as they are considered family days.

Unfortunately, we were also constrained by recent security issues and the escalating security risk in Cabo Delgado limited the places that were considered safe to survey. We also suggest that due to the timing coincidence of the terrorism threats and our survey, it limited openness of community members to participate in interviews. In light of recent events, the general atmosphere of coastal communities was tense, scared and hesitant to welcome strangers. Fieldwork for this project was interrupted by this issue in early June, as we were caught in between attacks in the village of Naude and Quissanga whilst in transit from Ibo Island back to Pemba. We cancelled plans to conduct interviews in Mahate and Quissanga. Days later, police caught one of the suspected attackers, on Ibo island amongst the refugees that fled from the attack villages to the islands for safety and shelter. The recent instability in the north may have impeded the quality of information coming from interviews as the area is tense, many people have fled the area and there are tightened security measures in the communities, it was not appropriate to survey in some areas and it was crucial to have community focal points or local fisheries authorities to accompany us to ease

each village, as the arrival of strangers in remote communities is being closely scrutinised given recent events.

Qualitative survey methodology do not always render well to producing quantitative estimates which can be extrapolated to provincial and national scales, especially when interviewing participants with low literacy levels. For example, fishers often could not answer how old they were, some simply did not know and others had memorised the year of their birth as the number printed on their national identification cards. There were some difficulties finding suitable ways to phrase questions to ensure that fishers understood the question. Often questions needed to be phrased in several similar or repetitive ways in both Portuguese and the local dialects to facilitate comprehension of the question. It is important to note that participants come from a culture of storytelling rather than relaying quantitative facts in a linear timeline or logical order. This difference often led to confusion when retelling events and several versions of a similar story but each with varying facts, or quantities. This was especially the case, when trying to confirm the facts and chronological timeline of the on-going illegal take case being investigated in Pilivi, Moma.

Annex V: Descriptive statistics of artisanal fishing gears and vessels

Table AV1: Description of artisanal fishing gears reported during the present survey.

Artisanal fishing gear used	Primary gear	Secondary gear	Total (n)	%
Beach seine	30	5	35	42.7
Gaiola *(crab/fish basket trap)*	4	0	4	4.9
Intertidal collection	1	0	1	1.2
Spear fisher w/ harpoon	3	1	4	4.9
Line	17	1	18	22.0
Purse seine	8	1	9	11.0
Quinia net *(small net fixed to poles pulled through shallow water by 2 people)*	2	0	2	2.4
Surface gillnet	6	1	7	8.5
Benthic gillnet	0	2	2	2.4
Total (n)	**71**	**11**	**82**	
%	86.6	13.4		

Table AV2: Description of artisanal fishing vessels reported during the present survey.

Boat types	N
Canoe	13
Dhow	13
Lancha	14
Jangada	5
Wooden boat with motor	4
Dhow with motor	1
Wooden boat unspecified type no motor	13
Total	**63**

Annex VI: Acknowledgements

Province	Location	Name	Surname	Organization	Position	Support Provided
Cabo Delgado	Pemba	Isabel	Marques da Silva	UniLurio-Faculdade das Ciencias Biologicas	Directora	Info
Cabo Delgado	Pemba	Acacio	Mussa	DPMAIP	Chef do Dep dos Assuntos do Mar	Info + personnel
Cabo Delgado	Mecufi	Cipriano	Gilberto	DPMAIP	Extencionista	Community Focal Point
Cabo Delgado	Tandanhangue	Fransisco		DPMAIP	Extencionista	Community Focal Point
Cabo Delgado	Ibo Island	Assane	Mussa	PNQ	Director de Bloco	Info
Cabo Delgado	Ibo Island	Said	Navati	DPMAIP	Extencionista	Community Focal Point
Cabo Delgado	Ibo Island	Jörg		Miti Mwiri Lodge	Owner	Info
Cabo Delgado	Ibo Island / Pemba	Aniceto		Unilurio/Oikos	Lecturer/Consultante	Boat ride from ibo to tandanhague
Inhambane	Vilankulos	Sandy		Machilla Magic	Owner	Info
Inhambane	Vilankulos	Dennis		Casa Babi	Owner	Info + free accomodation
Inhambane	Vilankulos	Sabrina		Casa Babi	Owner	Info + free accomodation
Inhambane	Macunha	Domingos		Machilla Magic	Skipper	Community Focal Point
Inhambane	Inhassoro	Martin		Dugongo Lodge	Manager	Info
Inhambane	Inhassoro	Joaquim	Macamo	SDAE	Repartiçao da Agricultutra e das Pescas	Info + personnel
Inhambane	Inhassoro	Hafo	Hafo	SDAE	Tecnico/Fiscal das Pescas	Community Focal Point
Inhambane	Inhassoro	Herculano		IIP	Tecnico	Community Focal Point
Inhambane	Inhassoro	Xadreque		PNBA	Fiscal	Info + Photos
Maputo	Maputo	Bernard	Adrien	Free-lance	Consultant	Info + contacts + Photos
Maputo	Maputo	Urszula	Stankiewicz	Blue Ventures	PHE support officer	Info + contacts
Maputo	Maputo	Marcos	Pereira	Centro Terra Viva	Director	Info
Maputo	Maputo	Eduardo	Videira	WWF	Project Coordinator	Info + contacts
Maputo	Maputo	Lara	Muaves	WWF	Project Coordinator QNP	Info + contacts
Maputo	Maputo	Dalila	Sequira	WWF	Project Coordinator P & S NP	Contacts

Maputo	Maputo	Miguel	Goncalves	POPMR	Park Warden	Info + contacts
Nampula	Ilha de Moçambique	Dalila		Municipio	Vareadora Actividades Economicas	Info
Nampula	Ilha de Moçambique	Cassimo	Abduremar	Associoçao dos Pecadores da Ilha de Moçambique	Presidente	Community Focal Point
Nampula	Ilha de Moçambique	Nazario	Cancala	SDAE	Tecnico	Community Focal Point
Nampula	Ilha de Moçambique	André		Oikos	Project Coordinator	Info
Nampula	Ilha de Moçambique	Denis	Chembene	Oikos	Project Coordinator	Info
Nampula	Nampula	Antonio	Mutoua	SoldMoz	Director	
Nampula	Angoche	Cremildo		WWF	Marine Officer	Info
Nampula	Angoche	Gladys	Nhagumele	WWF	Marine Officer	Info
Nampula	Angoche	Sabino	Omar	Associoçao dos Pecadores de Angoche	Presidente	Community Focal Point
Nampula	Moma	João Tito	Abacar	Associoçao dos Pecadores Artesanais de Moma	Presidente	Community Focal Point