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 Madagascar.

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

Photo: Jess Williams

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On behalf of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES)

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List of Acronyms

ASH – Agence Sanitaire Halieutique
BRD – Bycatch Reduction Device
CBD – Convention on Biological Diversity
CCL – Curved Carapace Length (of sea turtles)
CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLP – Comité Locaux de Peche
CMS – Convention in Migratory Species
CPUE – Catch Per Unit Effort
CSP – Centre de Surveillance des Pêches
EEZ – Exclusive Economic Zone
EIA – Environmental Impact Assessment
FAO – Food and Agriculture Organisation of the United Nations
IHSM – Institut Halieutique et des Sciences Marines
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
LMMA – Locally Managed Marine Area
LNG – Liquefied Natural Gas
MEEF – Ministry of Environments and Forest
MGA – Madagascar Ariary – 1000 MGA = approximately 28 USD
MMA – Marine Managed Area
MNP – Madagascar National Parks
MPRH – Ministère de la Pêche et des Ressources Halieutiques
MRF – Marine Research Foundation
MPA – Marine Protected Area
NGO – Non-Governmental Organisation
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
WCS – World Conservation Society
WIO – Western Indian Ocean

Executive Summary

Madagascar is home to five species of marine turtles: the green (*Chelonia mydas*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), Olive ridley (*Lepidochelys olivacea*) and leatherback (*Dermochelys coriacea*), which are protected by national law and under the international treaties Madagascar is a Party to. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists all species of marine turtles on Appendix I and the Convention on the Conservation of Migratory Species of Wild Animals (CMS) lists all species found in Madagascar waters on Appendix I and II. These listings oblige Madagascar to: 1) ban international trade in the species and 2) to ban taking of the wild animals for any commercial purposes and reduce threats to the survival of these species, seeking to strengthen international cooperation on protecting them. For the purpose of enhancing international cooperation, amongst others, the CMS Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA Marine Turtles MoU) was also signed by Madagascar. The conservation and Management Plan of the MoU calls upon the Signatories to ban direct harvest of turtles with exceptions for traditional harvest, provided that the turtle populations in question can sustain that harvest.

Despite the legislative frameworks in place to safeguard marine turtles in Madagascar, these are regularly and abundantly caught accidentally or are targeted illegally by artisanal and commercial fishers. Commercial fisheries of concern include the shrimp trawl and the tuna longline fishery, both of which are known to impact turtles in the absence of bycatch reduction measures. Turtle Excluder Devices are mandated on shrimp trawlers, but no measures to safeguard turtles are in place in the longline industry in Madagascar. In addition, there is widespread illegal, unregulated and unreported (IUU) fishing in Madagascar waters which likely also impacts marine turtles. However, the main concern lies with the rampant collection of marine turtles for food and trade by the approximately 100,000 fisher-strong artisanal fishery.

Legal structures are in place to protect marine turtles in Madagascar, and while there are legislative instruments that govern the fisheries sectors, these are largely ineffective at managing the small-scale fishery sector that is the norm along much of Madagascar's coastal regions. Coupled with this, a lack of resources, funds and staff means that enforcement is severely lacking, and illegal collection, sale and consumption of marine turtles is rampant.

Our surveys support earlier findings that the artisanal fishery sector is extracting thousands of marine turtles from Madagascar coastal waters each year. Among the 153 respondents to our survey we estimate these respondents alone were responsible for some 3,500 turtles, both as bycatch and mostly as directed take. Very few respondents indicated bycaught turtles were ever released. While extrapolations from limited reach rapid assessments are problematic on various fronts, such as uniformity of effort distribution, varying customs and beliefs, and regional differences in each fishery, we estimate that the potential to remove approximately 150,000 to 300,000 turtles per year exists given the size of the country and number of fishers in the artisanal fishery sector. Of importance here is the magnitude of the total take, which is not in the hundreds or thousands, but which exceeds 100,000 turtles.

Over 90% of marine turtles caught in Madagascar are destined for local consumption or for local trade. We found no evidence of any systematic export market, and suggest that if this occurs it is opportunistic and infrequent, and of a far lesser scale than the domestic trade. A number of local customs including *Dina* and *fady* (traditional bans) exist which could protect marine turtles from local exploitation, but erosion of social norms means that these are less effective today than in the

past. Our survey we found that less than 20% of fishers would release turtles back to the sea if they were accidentally caught in fishing gear, and these responses were usually linked to local fady.

Effective measures to address the illegal capture, consumption and trade in marine turtles in Madagascar are likely to include strengthening local traditional management approaches such as Dina and fady, and providing opportunities for local communities to support enforcement of national legislation. In addition to this we believe there is a need for increasing exposure of incidences of poacher captures and turtle releases amongst coastal communities; raising awareness on the legal status and conservation / management needs of marine turtles; building capacity for enforcement amongst fishery and trade Ministry officials, alongside provision of funding and resources to effectively combat illegal turtle trade; revising fishery legislation to adequately address the artisanal fishery sector; addressing Illegal, Unreported and Unregulated (IUU) fishing and implementing bycatch reduction programmes in licensed commercial fisheries; eliminating corruption amongst enforcement officials; and exploring the potential for alternative livelihood and incentive programmes to lessen dependence on marine turtles among coastal communities.

From a biological perspective there is a need to understand the provenance of marine turtles being taken out of Madagascar waters and determine the overall productivity of these source rookeries taking into account other regional impact areas (such as Mozambique); and to expand the current rapid survey to a greater geographical area and refine the estimates of total annual turtle take in Madagascar. These data can then contribute to more effective management of turtle stocks.

1.0 Introduction

1.1 Background

The Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in cooperation with the Secretariat of the Convention in Migratory Species (CMS) contracted the Marine Research Foundation (MRF) 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 Madagascar.

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.

This assessment has been funded under the US-National Oceanic and Atmospheric Administration (NOAA) project *Strengthening CITES implementation for selected marine species* (US-NOAA Award NA17NMF0080186).

1.2 Country overview – Madagascar

Madagascar hosts some of the most biologically diverse marine life in the Western Indian Ocean (WIO; Koopman 2008). The country has a coastline of 5,697km (MEEF 2014), including extensive

island archipelagos (270 islets). Extensive fringing coral reefs and mangrove systems occur along the west coast (MEEF 2014), which is characterized by a broad shallow continental shelf and is home to the majority of the artisanal or subsistence fishers (Le Manach et al. 2013). However, while most subsistence fishers operate in the west, the eastern part of the island has the highest human population density (SEDAC 2000).

Five species of marine turtle occur in Madagascar: the green (*Chelonia mydas*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), Olive ridley (*Lepidochelys olivacea*) and leatherback (*Dermochelys coriacea*). The systematic collection of eggs and nesting females has led to significant declines in nesting activity on the mainland of Madagascar (Rakotonirina & Cooke 1994, Walker & Roberts 2005, Humber et al. 2016). It's thought that there is a minimum of approximately 1,200 nests deposited per year in Madagascar (mostly greens ~75% and hawksbills ~24%), with the largest recorded nesting aggregation (approximately 1,000 nests per year) found on islands off the west and northern coasts (Humber et al. 2016). Humber et al. (2016) report more than 40 sites where nesting has not been recorded since 2000.

There are 56 Marine Protected Areas (MPAs), including small Locally Managed Marine Areas (LMMAs) and three Marine Managed Areas (Madagascar MPA Atlas 2018; Fig. 1). Proposals to increase management efforts and plans for an extensive network of MPAs (Allnut et al. 2012) have been developed but implementation has varied in success. MPA management can be best described as a collection of multiple resource-use restrictions and its implementation relies strongly on outside support (Rakotoson & Tanner 2006, Cinner et al. 2009).

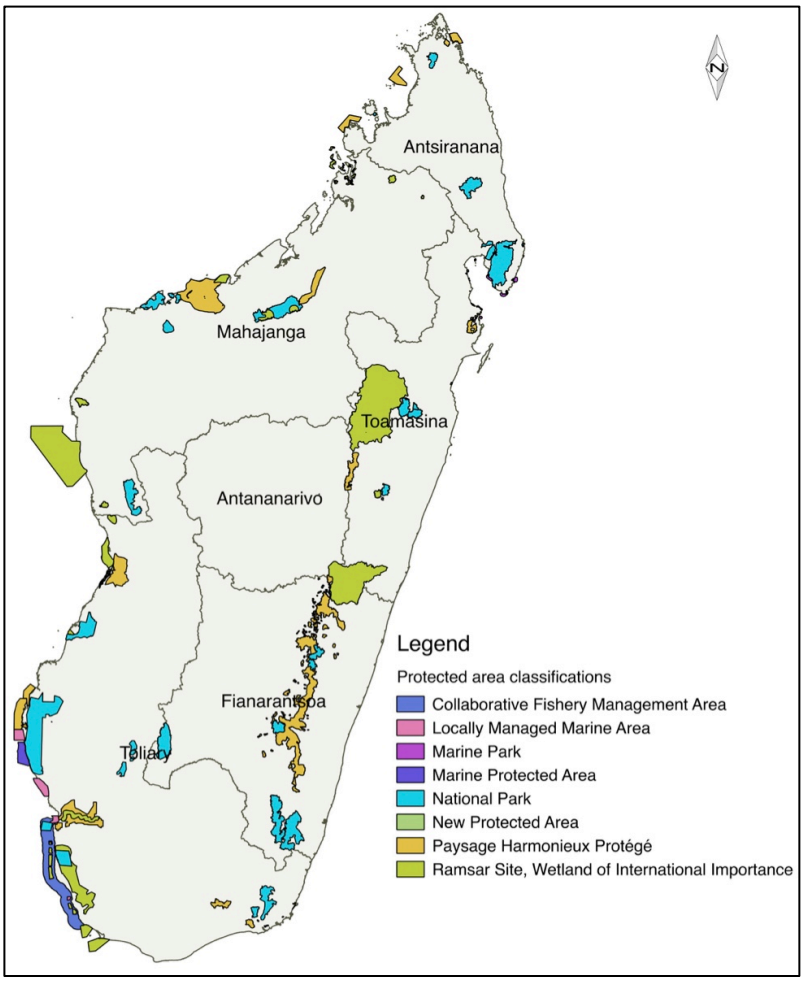


Figure 1: Protected / managed / conservation areas in Madagascar (data source: UNEP-WCMC 2018)

1.2.1 Artisanal fisheries

Small-scale fisheries are widespread throughout Madagascar, with the bulk of fishing effort focused on the western and south coasts (Fig. 2). Robust monitoring of the fishing effort, stock statuses and trends of the artisanal fishing sector are severely data deficient, and enforcement of traditional zones against Malagasy commercial operators remains problematic. Numerous sources have suggested some stocks are close to fisheries collapse (i.e. elasmobranchs, sea cucumbers) while others have already undergone significant catch declines (shrimp fishing): serious concerns about declining catches and stocks of invertebrates, mainly collected through reef-gleaning (Cripps 2009, 2010), have been noted in several cases (Rasolofonirina & Conand 1998, Sabatini et al. 2008, Anderson et al. 2010). Increasing pressures (political instability, climate insecurity) are driving the migration of artisanal fishers at unprecedented rates to increasingly remote and isolated regions and islands of the west coast as a direct response and coping mechanism of declining catch rates (Cripps 2010).

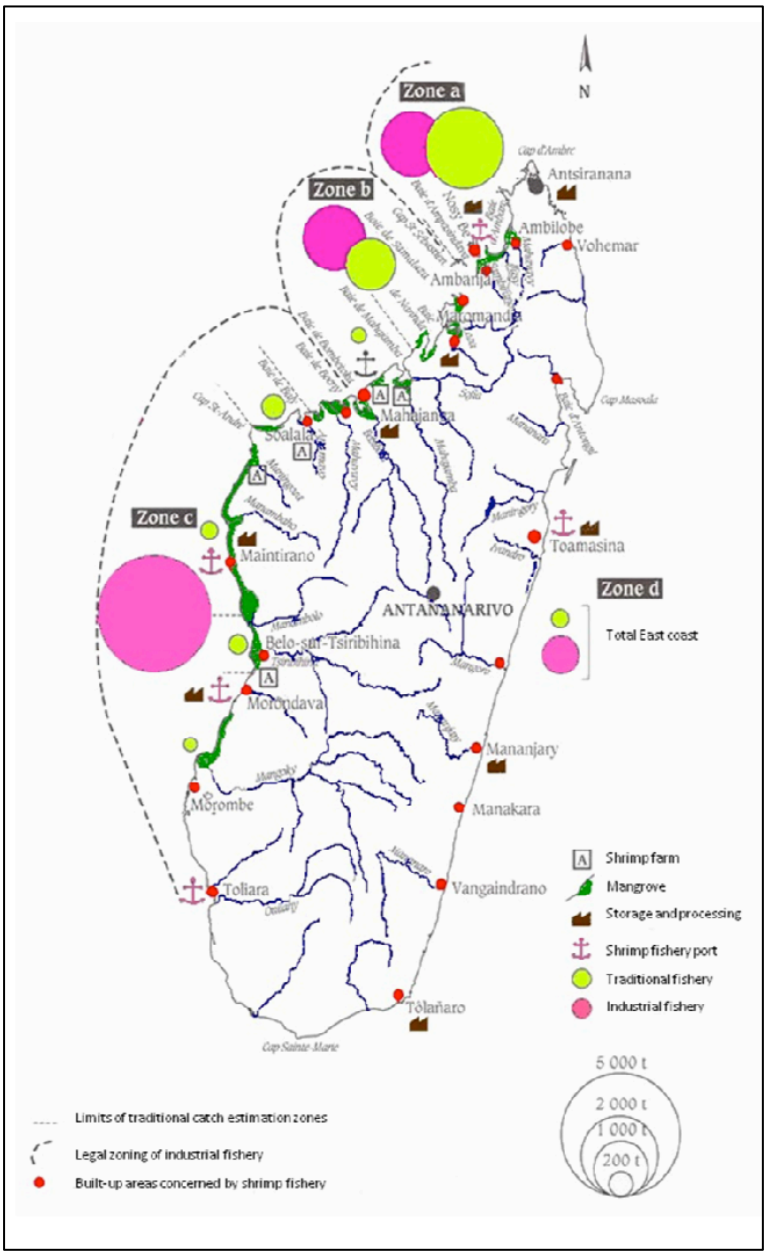


Figure 2: Commercial fishing grounds, mangrove habitats and major fishing ports of Madagascar (as presented in Razafindrainibe 2010).

The traditional fisheries are typically carried out from dugout canoes using oars and sails and exploit marine mammals, marine turtles, fish, sharks and rays, echinoderms, molluscs, crustaceans and some sea weeds. In addition, non-edible resources such as aquarium fish, corals and sponges are also periodically collected. The collection of sea cucumber from deeper waters is also a growing industry (Kasprzyck 2008).

1.2.2 Commercial fisheries

The majority of Madagascar's commercial fishing consists of shrimp fishing. The shrimp fleet operates along the west coast in waters between 5 to 30 m deep, focusing on adult Penaeid shrimp (Razafindrainibe 2010). Five shrimp fishing ports are located along the west coast (from north to south): Nosy-Be, Mahajanga, Maintirano, Morondava and Toliara. Landing sites are located in nearby processing units operated by shrimp companies in Nosy-Be, Mahajanga and Morondava (Razafindrainibe 2010). The overall catch per unit effort (CPUE) of the shrimp fisheries is decreasing. This decline in the ecological sustainability and economic viability of this fishery is now causing owners to reduce their fleets (Razafindrainibe 2010, McNeish 2011).

Since the early 1980s, tuna purse seines have become more common, landing some 25,000t in 2010, and this fishery is required to report landings to the Ministry of Fisheries and Halieutic Resources (Ministère de la Pêche et des Ressources Halieutiques, or MPRH). Since 2010, mud crabs and demersal fish have also been targeted commercially, although there is not yet a robust observer programme to detail catch and bycatch records in any of these fisheries (MPRH 2012).

Turtle Excluder Devices (TEDs) have been a legal requirement (under Decree 2003-1101 of 23rd November 2003) and this Decree includes the use of Bycatch Reduction Devices (BRDs) that reportedly have resulted in reduced incidental bycatch of marine turtles (Razafindrainibe 2010). TEDs are reported to have reduced the bycatch of turtles in the entire shrimp fleet from 120 turtles from 64 vessels in 2004 to two turtles from 63 vessels in 2005 (Razafindrainibe 2010; Table I). In 2007, 20 turtles, mostly green, were reported as bycatch between February and July among five vessels operating off the East coast (Razafindrainibe 2010). The Fisheries Surveillance Centre (Centre de Surveillance des Pêches, or CSP) claims that trawlers operating off the west coast are highly compliant with the TED regulation, reporting more than 85% compliance (Razafindrainibe 2010). It is estimated that 30% of the west coast fleet carry on-board observers from the CSP programme, however it can not be confirmed whether crews use TEDs and bycatch reduction devices (BRDs) when not under supervision (Le Manach et al. 2012).

Discarded bycatch (including discards, juveniles, and endangered species) from the shrimping sector is thought to equate to 12,300 tons or about 2.5 million USD per year that is either discarded or illegally sold in Asian markets (Le Manach et al. 2013).

Table I: Incidental catch of turtles observed by CSP in Madagascar in 2004 and 2005. Zone A: Ambaro Bay; Zone B: Narindra Bay, Mahajamba Bay and north of Majajanga Bay; Zone C: south of Mahajamba and Cape St. Andre; Zone D: west coast (presented in Razafindrainibe 2010).

Zones	2004 (99 trips)			2005 (53 trips)		
	Total	Live	Dead	Total	Live	Dead
A	30	24	2	0	0	0
B	16	14	1	0	0	0
C	63	56	6	1	1	0
D	11	8	3	1	1	0
Total	120	102	12	2	2	0

1.2.3 Fisheries management and legislation

Legal ambiguity and confusion is systemic in Madagascar's fisheries sector (Le Manach et al. 2013, Carver 2018). "The policy and legal framework governing the sector is incoherent and ambiguous," a World Bank (2013) report states. "There is no official document that states the Government's fisheries sector policy." A new fishing code was drafted in 2015, but the rules remain uncertain. A comprehensive review of relevant fisheries legislations is detailed in Razafindrainibe (2010), Le Manach et al. (2013) and Breuil & Grima (2014), and a brief summary of the key fisheries decrees is presented in Table II.

The fisheries sector is currently governed by the Ministry of Fisheries and Aquatic Resources (MPRH). MPRH comprises over 40 directorates, services and agencies and has 184 employees: 87 at central headquarters in Antananarivo, and 97 staff spread across the 22 regions (Le Manach et al. 2013).

Table II: Overview of key fisheries legislation in Madagascar, sorted by fishery sectors.

Instrument	Description	Details
Commercial/ Industrial Sector		
Decree No. 2007-957	Defines the exploitation rules for the shallow water shrimp fishery.	Effort control and individual tradable permits are two mechanisms specifically mentioned in the decree
Ordinance 93-022 (4 May 1993) and its associated Decree 94-112 of 18 Feb 1994	Is the main regulations governing the fisheries and aquaculture sectors.	Ministry of Fisheries and Aquatic Resources Ministère de la Pêche et des Ressources Halieutiques (MPRH) prepares and maintains fisheries management plans and stock conservation plans
Decree 71-238 of 18 May 1971	Allows trawling in coastal waters	Established that the zone within 2 nautical miles of shore is not exclusively reserved for small-scale fishing
Decree 73-171 of 22 March 1973	Prohibits motorised trawling in coastal waters.	Trawling by boats over 25 horsepower in the 2-mile area was again prohibited in 1973
Law 90-033 of21 Dec 1990 accompanied by Decree 99-954	The Malagasy Environmental Charter - Fisheries sector must comply with associated environmental legislation	There is a lack of compatibility between investment initiatives and environmental concerns
Decree 2010-137 of 23 Mar 2010	Fisheries sector must comply with associated environmental legislation	Integrated coastal zone management.
Decree 2000-415 of16 Jun 2000	The number of trawling licenses was frozen in 1999. 20-year licenses were granted to existing trawler users in 2000	New licenses cannot be issued until 2019, although the licenses can be sold.
Traditional / Artisanal Sector		
Arrêté 10404/97 of 13 Nov 1997	Requires authorization to fish or collect lobsters, crabs, sea cucumbers, algae, shrimp, shellfish, octopus, squid, shark fins, fish, eels, and gobies	This regulation has never been applied in practice (Le Manach et al. 2013).
Decree No. 2056/2009	Registration and licencing of commercial fishers and gleaners.	Every commercial fisher and gleaner is required to have a professional card, supplied for free by MPRH

Effective fisheries management is also hindered significantly by a lack of robust data on stock resources, catch landings and economic values of the fisheries resources (Le Manach et al. 2013). There are no stock assessments available for Madagascar's fisheries except for initial estimates for shrimp stocks (up to 2008; Le Manach et al. 2013) and larger pelagic species required under the Indian Ocean Tuna Commission (IOTC) agreement (Breuil & Grima. 2014). Official reports to the FAO by MPRH fail to account for bycatch, finfish or sharks and are thought to underestimate actual landings up to 30% (Le Manach et al. 2012, Le Manach et al. 2013). Worryingly, the fisheries

licensing system for foreign fleets allows opportunities for exploitation, with management regulations prescribing a limit to the total number of license agreements or vessels rather than limiting total catch volumes (Le Manach et al. 2013).

Finally, the artisanal and subsistence sector has not received the same managerial or legislative attention as the more profitable commercial and industrial sector. Subsistence fishing is generally unregulated, unknown, and unmonitored (Breuil & Grima 2014). The only measures addressing this sector include artisanal fishers and vendors being required to register through a program run by the MPRH, and fishing with mosquito nets is illegal in only 2 of 13 coastal regions (Le Manach et al. 2013).

1.2.4 Marine turtle legislation in Madagascar

While marine turtles are protected through several legislative measures (Tables III & IV), there are currently no government initiatives to manage their capture and use (Humber et al. 2011). In southwest Madagascar in particular, a prolific directed take of marine turtles is well-documented, notwithstanding national decrees prohibiting exploitation (Frontier Madagascar 2003, Jones 2012, Gibbons et al. 2013, Golding et al. 2017). Table III summarises the direct and indirect legislative tools that apply to marine turtles in Madagascar, while Table IV details international Instruments and Conventions.

Table III: Legislation related to marine turtle protection in Madagascar (adapted from Humber et al. 2015).

Instruments with direct relevance to marine turtles in National legislation		
Statute	**Description / key goal**	**Relevance to marine turtles**
Ordinance no. 93-022 on 4th May 1993	Sets out Regulations for fishing and aquaculture. Article 9) text on prohibited activities has not been adopted	Prohibited activities: killing, injuring and catching of any endangered species.
Decree no. 94-112 on 18th February 1994	Decree concerning the general organisation of marine fishing activities. Regulation of bycatch in fishing licenses (Article 16.3.c and Art 27.c) Recording of bycatch (Article 28)	The Ministry of Fisheries determines the quantity of each species allowed within fishing licenses including restrictions on permissible bycatch. Boat captains are required to record in a logbook the quantity of species, including bycatch species.
Decree no. 2003-1101 on 25th November 2003	Turtle Excluder Device (Article 12) regulating the practice of trawling in the Malagasy territorial sea	Shrimp trawlers on the west and east coast are required to have Turtle Excluder Devices.
Law no. 2005-018 on 17th October 2005	International Trade in Endangered Species of Wild Fauna and Flora addressing trade (Article 29) Penalties (Article 30,32,33)	Prohibition of trade activities: the possession, buying, offer to buy, acquisition for commercial use for profit, exposure to public for commercial purposes, sale, detaining for sale, offering for sale or transporting for sale. Six months to ten years imprisonment and a fine of 10 million to 200 million Ar. The amount of the fine and the size of the penalty is doubled if the species are on CITES Appendix I.
Decree no. 2006-097 on 31st January 2006	Addresses the rules for the implementation of the law on International Trade in Endangered Species of Wild Fauna and Flora and issue of International trade permits (Articles 6 & 11)	The management body, after consultation of the scientific authorities, issues permits, certificates and authorizations under the provisions of CITES and the national law on CITES, especially hunting, collection or capture permits.
Decree no. 2006-400 on 13th June 2006	Decree on the classification of wildlife species detailing those with Absolute protection (Article 2)	Prohibited activities: hunting, capture and detention.

Order no. 12.666/2014 on 28th March 2014	Relates to the conservation of marine turtles caught by fisheries (applicable to national longline vessels). Care of injured marine turtles (Article 2) Bycatch equipment (Article 3) Recording of incidents (Article 4)	The boat captain shall take on board, where possible and as soon as possible, any caught/inanimate/inactive turtle during the fishing operation, and do everything possible to release it alive. Boats must have onboard hook-cutters to facilitate quick handling and release of any marine turtles hooked or entangled. This should be done in compliance with the handling guidelines in the identification sheet of marine turtles of the Indian Ocean Tuna Commission (IOTC). The boat captain shall record in the fishing logbook all incidents involving marine turtles during fishing operations. This information should include the species, location of capture, conditions, actions taken on board and the place of release.
Draft fishery code of 27th November 2014	Harvest restrictions (Article 9)	It is prohibited at any time, any place, fishing, taking, detention and sale of all kinds of protected species including marine turtles (under adoption).

Instruments with indirect relevance to marine turtles in National legislation		
Statute	**Description / key goal**	**Relevance to marine turtles**
National Constitution of Madagascar 2010	Hierarchy of international treaties and national laws (Article 137-4)	Treaties or agreements duly ratified, upon publication, have an authority superior to that of laws.
Decree no. 2010-137 on 23rd March 2010	Regulates the integrated management of coastal and marine areas of Madagascar. Caution duty (Article 6e) Sustainable management (Article 26)	Each actor needs to avoid causing irreparable damage to the natural resources and risk to themselves and for future generations. Actors and local authorities to commit to rationally and sustainably managing coastal and marine resources.
Strategic Action Plan for the Biological Diversity of Madagascar. National Biodiversity and Strategy Action Plans 2015-2025. Decree no. 2016-128 of February 23 2016, adopting the National Biodiversity Strategy and Action Plans for Madagascar 2015 to 2025	OBJECTIVE 12: «By 2025, the extinction of endangered species is reduced and their conservation status improved»	Reduce the extinction factors of endemic, migrating and threatened species as well as the factors of destruction/degradation of their habitats.

Table IV: Conventions, treaties and non-ratified agreements relating to marine turtles in Madagascar (adapted from Humber et al. 2015).

International Instruments / Conventions / Agreements with direct relevance to marine turtles		
Instrument / Convention	**Description**	**Date implemented / Notes**
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Regulates and controls the international trade of threatened species through the listing in Appendices according to threat level. Has been enacted into national legislation through Law 2005-018 and Decree 2006-097 that details the rules for the implementation of Law 2005-018.	Ratified in 1975. Currently all species of marine turtles are included on Appendix I. International trade of marine turtles (or products) is illegal, including the import and export of jewellery pieces (e.g. necklaces, bracelets, rings, etc.).
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	Aims to conserve migratory species and their habitats throughout their range. 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 listed on Appendix II. Article III of CMS describes obligations to protect Appendix I species, and allows take in exceptional circumstances, accommodating, inter alia, "the needs of traditional subsistence users" but the term has not been further defined within the CMS text.	Ratified in 1979. The five species of marine turtles found in Madagascar and its waters are listed on Appendix I and II of CMS. Appendix I listing obliges Parties to prohibit taking of animals, allowing take only in exceptional circumstances.
Memorandum of Understanding on the Conservation and Management of the Marine turtles and its Habitats in the Indian Ocean and Southeast Asia (IOSEA-MoU)	A non- binding framework through which States of the Indian Ocean and South-East Asia, as well as other concerned States and partners, collaborate to protect, conserve, replenish and recover sea turtles and their habitats. MoU's conservation and management plan (programme 1.4) prescribes the Signatory States to: Prohibit the direct harvest (capture or killing) of, and domestic trade in, marine turtles, their eggs, parts or products, whilst allowing exceptions for traditional harvest by communities within each jurisdiction provided that: such harvest does not undermine efforts to protect, conserve and recover marine turtle populations and their habitats; and the marine turtle populations in question are able to sustain the harvest	MoU signatory in April 2003
Nairobi Convention	Includes programmes that strengthen the capacity to protect, manage and develop coastal and marine environments sustainability. Lists olive ridley, loggerhead and leatherback turtles in Annex II (species of wild fauna requiring special protection); green and hawksbill turtles in Annex III (harvestable species of wild fauna requiring protection); and all five in Annex IV (protected migratory species).	Ratified in 1998 but the 2010 convention on the "*Protocol for the Protection of the Marine and Coastal Environment of the Western Indian Ocean from Land-Based Sources and Activities*" is yet to be ratified. However, for the intents of this report, this lack of ratification is not of major relevance
Indirect incidence		
African Convention for Nature and Natural Resources Conservation	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. It does not explicitly mention marine turtles.	Signed off on the 2003 revisions in February 2004.
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 1997

1.2.5 Illegal, Unreported and Unregulated (IUU) Fishing

Whilst the extent of IUU fisheries is not known, Le Manach et al. (2013) estimated the landings of IUU at 50,000 tons per year. IUU fisheries for shark finning and sea cucumber are also thought to be extensive (Le Manach et al. 2013).

With continued declines in artisanal fish landings and more evidence of probable fisheries collapses for both invertebrates and finfish, artisanal fishers are increasingly migrating further in search of new stocks or adopting new gears and techniques. Illegal fishing for sea cucumbers in deep waters (20 – 50m) using compressed air has become widespread along the west (and north) coasts (Raberinarya & Benbowa 2012). Sea cucumber official export rates are likely to be significantly lower than actual harvest rates, as the majority of sea cucumbers are exported illegally (Raberinarya & Benbowa 2012).

It's not yet clear how targeted marine turtle hunting, or trafficking of turtle products connects to IUU activities in Madagascar. However, it is important to note IUU fishing is prolific and extensive trade networks already exist. New concerns (September 2018) are mounting regarding the increased opportunity for IUU to take place in Madagascar's Excusive Economic Zone (EEZ) up to IUU after a recent approval of a between the government and China to allow the operation of an additional 330 commercial fishing vessels (EJA 2018).

1.2.6 Fisheries enforcement

Enforcement and patrol of Madagascar's fisheries resources is severely limited given the approximately 5000km coastline. Enforcement and patrols can only be covered by three monitoring vessels, eight speedboats, 18 inspectors and 22 observers (R. Fanazava pers. comm., reported in Razafindrainibe 2010). This duty falls on behalf of the Centre de Surveillance des Pêches (CSP) whose mandate is to enforce regulations on fisheries and aquaculture, as well as fishing agreements. Commercial vessels are inspected by CSP at the beginning of each season to ensure their equipment complies with regulations, however throughout the fishing season, enforcement and inspections are severely restricted due to both limitations in the financial and human resources of the centre (R. Fanazava pers. comm., reported in Razafindrainibe 2010).

1.2.7 Community-based management and 'Dina'

Dina refers to a community level agreement that dictates / suggests behaviour among those that have agreed to it, permitting and prohibiting activities including those related to natural resource management. Dina is a pre-colonial concept based on the notion of a social contract (McClanahan et al. 2014). Dina can be legally recognised through validation via the courts, or as part of defined contractual management transfers and co-management of renewable natural resources (Humber et al. 2015), and has been integrated into the country's legal framework and used to develop local and customary regulations of natural resources. Dina can be used as a way to communicate national legislation, enhance it or validate local customs but cannot contradict existing national legislation (although this often happens; see below). Punishment for breaking Dina is variable and is set by each implementing community, but can include monetary fines or material fines (e.g. 1 zebu, 5kg of rice, 5kg of salt etc.).

Typically, Dina relating to the marine turtle fishery impose a size limit, for instance no take of animals under 70cm in Curved Carapace Length (CCL), closed seasons for targeted hunting (i.e. during the nesting season), or prohibiting egg harvesting. Of note, the two first examples contradict national legislation. A summary table of the Dina's in place relating to marine turtles are presented in Humber et al. (2015). Goulding et al. (2017) also describes the Dina used by 13 communities in the Bay of Ranobe, southwest Madagascar to prohibit the catch of turtles smaller than 70cm in CCL.

Marine turtle Dina have had mixed results, and some directly contradict national legislation. The difficultly of multiple management systems has been noted as challenging to natural resource management, as it requires merging modern legislation with traditional and emerging customs such as Dina (Rakotoson & Tanner 2006). Humber et al. (2015) suggested that the success of Dina relating to turtles was due to the strong cultural value placed upon turtles, especially by the Vezo ethnic group, which are based in Toliara, southwest Madagascar.

1.3 Intentional and accidental take of marine turtles in Madagascar

Illegal take comprises directed fisheries for marine turtles and also the retention of accidentally caught turtles. Two studies comprehensively review the intentional (illegal) marine turtle captures in Madagascar (see Humber et al. 2011, Golding et al. 2017). In the former, surveys of the marine turtle fishery in 12 major villages in southwest Madagascar documented 699 marine turtle landings representing four species in 2007, with the majority being green turtles *Chelonia mydas* (93.6%; Humber et al. 2011). In Toliara Province they reported an illegal take rate of 817 turtles per 60km. Using data from community surveys, they extrapolated these data and estimated the marine turtle fishery from just one southwestern Province to range between 10,000 and 16,000 turtles per year (Humber et al. 2011; Figs. 3 & 4).

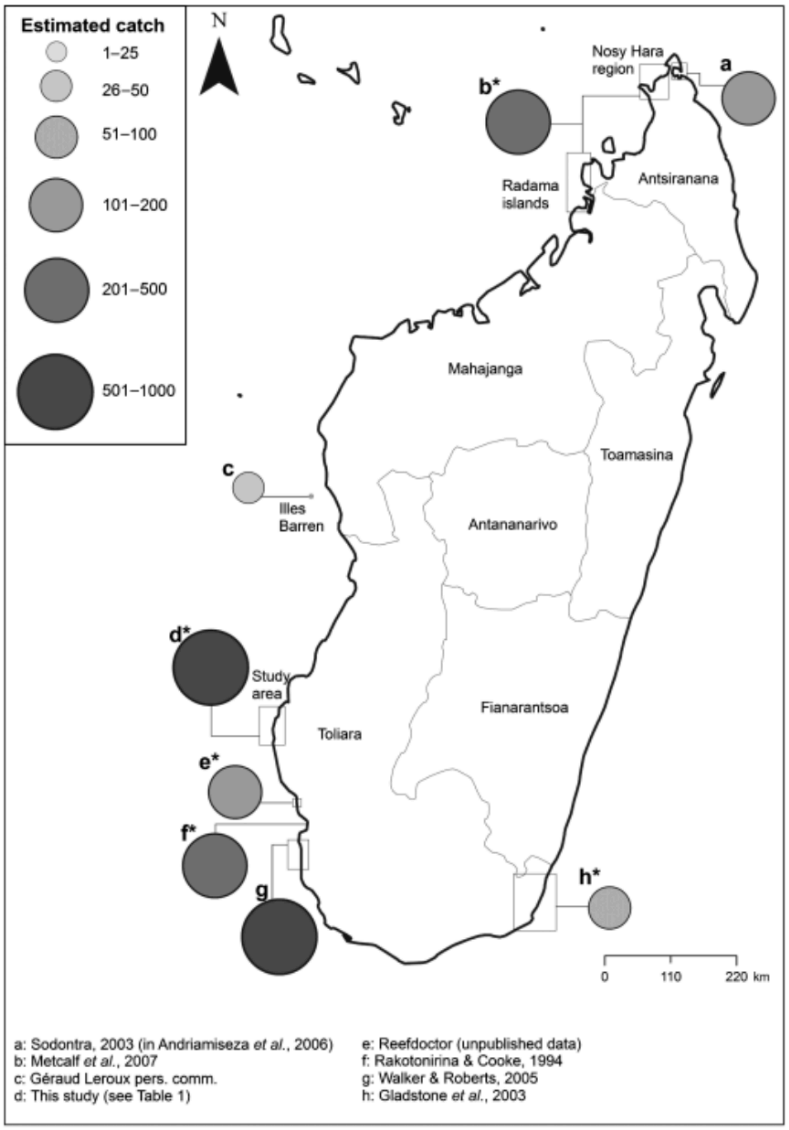


Figure 3: Locations of artisanal marine turtle fisheries in Madagascar and relative estimates of landings

(Source: Humber et al. 2011).

Golding et al. (2017) presents a detailed case study of the marine turtle fishery in the Bay of Ranobe, in southwest Madagascar. The marine turtle fishery in the Bay of Ranobe reportedly landed a total of 1,521 turtles, of which 867 were killed or sold and 654 (43%) were released in 2016. This turtle fishery generated an income of 71.4 million MGA (approximately 20,000 USD) in 2016 for an estimated 80 fishermen in four communities (Ambolomailaky, Andrevo, Fitsitikie and Ifaty; Golding et al. 2017).

Isolated case studies also suggest high levels of bycatch, with 3,656 turtles per year with an average capture of 20-25 turtles per fisher reported in the artisanal fisheries between Soalara and Ambola (Frontier-Madagascar 2003). In addition, illegal take of 180-300 turtles was reported in the North between July and November 2012 (Cétamada 2012). These findings highlight that the impact a small human population can have on marine turtles over one year can be substantial (Humber et al. 2011).

Considering these studies, it is likely the artisanal turtle fishery in Madagascar is the largest in the Southwest Indian Ocean Region (SWIO) region, with the southwest Madagascar region hosting the most significant marine turtle fishery in the country (Humber et al. 2011). Marine turtle landings from intentional take appear to have (on average) remained at constant levels since the 1970s (Frazier 1970, Hughes 1974, Rakotonirina & Cooke 1994, Humber et al. 2011) despite temporal variances across the year, although claims suggest that poaching activity may be intensifying in other areas of the country (IOSEA 2014). Despite the sustained illegal take of marine turtles receiving national attention (Repoblikan'i Madagasikara 2013a, 2013b), effective management measures, direct assessments of fisheries impact and illegal export have yet to be implemented.

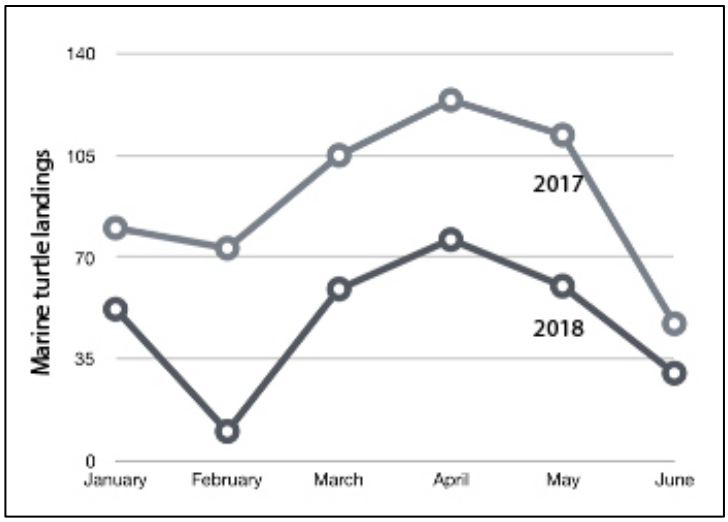


Figure 4: 2017 and 2018 trends in the monitored landings of the marine turtle fishery at Ifaty, Madagascar. Unpublished data and graph courtesy of Reef Doctor and the Institut Halieutique et des Sciences Marines (IHSM), Université de Toliara (Madagascar).

1.4 Domestic trade in marine turtles

Marine turtles are heavily exploited directly through illegal targeted fisheries and as bycatch along the majority of Madagascar's coastline (Humber et al. 2015). In 1971 Hughes (1974) estimated annual catches among all five species of marine turtles to be in the thousands in southwest Madagascar. Reports suggest that in historical times (ca. 1970-1980), turtle fishing was regulated by traditional resource management systems (Jones 2012, Humber et al. 2015). Historical (prior to

2000) captures were on a 1 to 2 turtles / week basis rather than the greater 8 to 20 / day trends reported more recently (pers. comm. Emma Gibbons; in Jones 2012).

Despite the erosion of older marine turtle fishing traditions in favour of more commercial-style hunting, local consumption is thought to have continued at similar levels since the 1970s (Frazier 1970, Hughes 1974, Rakotonirina & Cooke 1994, Humber et al. 2011), and today *Kinanga fano* (turtle sales) have become an established business (Lilette 2006). The hunting of turtles to sell for profit now drives the fishery, especially for villages close to the larger markets of Toliara and Morombe (Pascal 2003, Lilette 2007), where turtles fetch a high price in comparison with other marine resources. This has led to the development of merchants that specialise in buying and selling turtle meat (Lilette 2006, 2007, Pascal 2003, 2008).

Whilst the southwest is known as the hub for turtle fishing, due to the high density of artisanal fishers, of which most are Vezo with strong cultural and identity ties to turtle hunting, scattered reports from the north and northwest of Madagascar suggest turtle that fishing and consumption are widespread. Between 2007 and 2010 it was estimated that more than 40% of the green and hawksbill turtles captured at sea by local fishermen off northern Madagascar villages had been locally consumed or sold (Poonian & Whitty, unpublished). Metcalf et al. (2007) reports mortality events across a collective of 115km of beach from field surveys completed in three regions in 2000; Nosy Hara (261 green, 119 hawksbill, 2 olive ridley and 3 loggerhead), Nosy Iranja (30 green, 33 hawksbill) and the Radama Islands (295 green, 157 hawksbill and 3 olive ridley). Whilst the local ethnic group Sakalava have a fady (traditional ban) against consumption of turtle, adherence to tradition has declined. Also, a large number of migrant fishers (from other parts of Madagascar) operate in the region to exploit lucrative fisheries (Metcalf et al. 2007). Intentional capture of turtles was recently reported in the far north, in six communities in the Bay of Rigny (Rahantanirina 2018).

In the southwest, across eight communities spanning a 60km stretch from Anakao to Ambola, the village of Maromena had the highest monthly capture of turtles, with a reported 300 turtles/month during peak fishing seasons (Walker & Roberts 2005). Anakao village is also well known in southwestern Madagascar for its exploitation of turtles and is the most populous and the most dependent on that trade (Lilette 2006). In Ifaty, also in southwest Madagascar, more than 87 % of the respondents in a study on taste preference, market demand, and annual catch in an indigenous marine turtle fishery in south west Madagascar indicated they consumed marine turtles “very often”; the majority reporting they consumed turtle every day (Jones 2012).

Across these eight villages, it was agreed that the catches of turtles had declined over the past ten years (Walker & Roberts 2005). Diminishing catch levels reportedly made it impossible for fishers to exist solely based on turtle landings (Walker & Roberts 2005) with many targeted turtle hunters focusing their effort on consistent and profitable catches such as sea cucumber, shark fin, lobster and octopus, while remaining only opportunistic turtle hunters.

Lilette (2006) reported that turtle meat portions were sold in shops in Toliara, southwest Madagascar, and moved through a transport network of bush taxis, with turtles suffering several days in transport before slaughter. It has been suggested that shipping routes used by octopus and squid collectors also sustain the turtle trade, as collectors for these legal products also request turtle products. The Androka region (in southwest Madagascar) is thought to be one of the major providers of the domestic supply of marine turtles, whereby turtles are sent by motorbike, sail boat (pirogue) or by truck on to Toliara. Turtles are reported to have decreased in numbers in the Toliara lagoon and from reef fringes of Anakao due to the high levels of domestic take and use (Lilette 2006).

1.5 Export of marine turtles

Despite the marine turtle fishery being clearly reported throughout the literature, robust data documenting export numbers remains scarce (Jones 2012, Golding et al. 2017). Whilst most bycatch and illegal take supply domestic demand for turtle meat (Humber et al. 2011, Jones 2012, Golding et al. 2017), scattered reports of trade incidents indicate illegal export does occur (Humber et al. 2015). Table V documents all records in the literature that point to the export of marine turtle products in Madagascar.

Table V: Documented marine turtle trafficking incidents reported in the published literature since 2010.

Year	Details	Location	Source
?	Unofficial reports of turtle plastron trafficking	Southwest Madagascar	Humber et al. 2015
2012	Targeted turtle fishing by collector-exporters destined for international export	Mahajanga	Humber et al. 2015
Jan 2012	Traffic of plastron shell was identified. Discovery of a stockpile led to five people arrested	Androka	IOSEA 2014 p148
Jul 2012	Estimated 40kg of plastron shell was being shipped every week to Toliara, involving up to 50% of the fishermen of certain municipalities	Itampolo	IOSEA 2014 p149
Jul-Nov 2012	Illegal take of an estimated 180-300 turtles. Turtle smuggling network was also uncovered in northwest Madagascar in Marokibay whereby isolated fishing villages were supplying traders established in Mahajanga, shipping 10-38 live turtles by speedboat every two weeks. The final destination and end buyer of products was not identified but was presumed to be for illegal export.	Fishers from Marokibay, who fish in the Maramba Bay vicinity and then ship live turtles to Mahajanga, NW Madagascar	Rakotondrazafy & Adrianasolo 2012
Nov 2012	Fisheries and gendarmerie officials raided Marokibay village. Five people arrested and taken to Antsohihy. 20 turtles released alive.	Marokibay	Rakotondrazafy & Adrianasolo 2012
Dec 2012	Illegal turtle collection reported. Three people arrested and taken to Mahajanga.	South of Anjajavy	Rakotondrazafy & Adrianasolo 2012
Aug 2016	13 “large gillnets (jarifa)” and three live turtles found on site. Authorities discovered hundreds of green turtle remains.	Radama Islands	WCS 2016
Apr 2016	Remains of poached turtles discovered in Ankivonjy Marine Protected Area, a co-managed MPA between local communities and WCS.	Ankivonjy Marine Protected Area (50km southwest of Nosy Be)	WCS 2016
Pre 2012	Demand for turtle carapace by the kilo by Arab, Indo-Pakistani, and European merchants.	Anakao	Lilette 2006
2004	Trade network in the south of Madagascar, where fishers sell live turtles to dealers, and dealers then sell slaughtered whole or portions of turtle to traders who sell to the general public. 28 marine turtles (21 green, 4 hawksbill, 2 loggerhead and 1 olive ridley) passed through the four dealers of Anakao during the study period.	Anakao, Andriangy, Maramena, Befasy, Beheloka, Ampasimahaoro, Besambay and Ambola	Walker & Roberts 2005
2017	A joint patrol organized by WCS with local authorities identified a camp of illegal marine turtle traders in the north part of Antsohihy next to the MPA border. There was nobody at the camp, but there were a lot of marine turtle carapaces, and dry meat that the authorities collected and burnt. No more information on the offenders involved in the trafficking; the issue is quite sensitive. In Analalava and Antsohihy, the WCS team saw fishers using specific nets to catch marine turtle.	Analalava and Antsohihy (next to the MPA border).	pers. comm., WCS via email

1.4 Culture and traditions

1.4.1 Traditional beliefs and taboos ('fady' or 'faly')

Traditionally the sale of marine turtles and their products was historically considered a taboo known locally as 'fady' (Lilette 2006). Selling turtle meat was taboo, but gifting turtle meat was socially acceptable and consumption of turtle meat was regarded as a gift. Numerous justifications for fady exist with reasons relating to accidental death of family ancestors from consumption of turtle meat in some groups, and other groups describing a custom not to eat any type of seafood because it can be lethal (Jones 2012). Growing interest in acquiring purchasing power and symbols of wealth for celebrations, weddings and funerals, for building houses, and for buying better fishing nets has recently eroded respect for fady (Lilette 2006). Particularly among the younger generations and those in close proximity to cities, traditional beliefs regarding marine turtles are today largely ignored (Rakotonirina & Cooke 1994, Jones 2012).

1.4.2 Vezo culture

The marine turtle fishery is culturally important in Madagascar, particularly to the Vezo people, with turtle traditions linked to ancestor worship (Humber et al. 2011). Vezo culture is strongly tied to the ocean and Vezo people are known for their rituals linked to the hunting and consumption of marine turtles or 'fano' (Lilette 2006, Pascal 2003). Vezo fishers often refer to marine turtles as "cows," where marine turtles are considered to be an animal of sacrifice comparable to the size, spiritual, and monetary value of a zebu (Jones 2012). Green turtles in particular are often referred to as 'fano aomby' or 'zebu turtle' as they are considered comparable to the zebu as a sacrificial animal (Lilette 2006).

Vezo are also noted for being skilled watermen and are considered semi-nomadic. They pride themselves on their innovative fishing techniques and adoption of new fishing methods, for example jarifa nets (wide mesh benthic nets). Jarifa nets were introduced in the 1990's (Langley 2006) to target sharks, and have since been used to target turtles (Humber et al. 2011). Using jarifas to target turtles, whilst not traditional, makes turtle fishing significantly more effective (Astuti 1995, Pascal 2003, Walker & Roberts 2005, Lilette, 2007). Turtle fishing with jarifa nets requires less skill and physical effort compared to the traditional method of free diving with a teza harpoon (Humber et al. 2011).

The sale of marine turtle meat is a valued economic resource, providing economic stability and buying power in Vezu fishing communities (Golding et al. 2017, Lilette 2002). The capture and sale of turtles brings in large sums of money where there are no perceived viable alternatives to supplement income. Growth in the turtle trade has expanded due to the availability of effective gear to target turtles (i.e. jarifa) and increases in the price of turtle meat and products (Lilette 2006). Calls for a system that could regulate (and legalise) local use but which prohibits the sale of turtles has been suggested as a solution to the expansion of trade (Golding et al. 2017, Lilette 2006).

Interestingly, when comparing conservation case studies involving community support from Vezo villages, attitudes are highly variable. Lilette (2006) presented a detailed comparison on this matter, demonstrating that exogenous environmental policies can range from being completely ignored (prohibition against the exploitation of marine turtles) to being enthusiastically embraced (protection of the Nosy Ve Island red-tailed tropicbird). Additional social insight into motives, drivers and willingness to embrace alternative livelihoods and management regimes is needed (Lilette 2006).

1.4.3 Consumption and illness

Consumption occurs widely throughout the country with frequent reports in the media relating to intoxication, sickness and death among those who eat turtle meat. In May 2014, the deaths of six children and the sickening of about 50 people were reported from the rural community in Belobaka, Mahajanga II District. Sickness from turtle consumption occurred as recently as January 2018, where eight people lost their lives and an additional 14 people from Ambavarano rural community of Mahavanona in Diego Suarez were reported to be the victims of marine turtle meat poisoning (Midi Madagasikara 2018). It has been proposed that consumption is widespread (high number of people involved) with turtle meat distributed through numerous local trade / bartering networks (IOSEA 2014), and that the incidence of illness may be higher than currently reported.

2.0 Methodology

2.1 Literature review

A literature review was conducted to identify published and unpublished reports of illegal take of marine turtles within Madagascar which could be attributed to artisanal fishing, targeted hunting, reported bycatch from commercial fishing fleets (artisanal or commercial), records of illegal take that may suggest illegal export, and records of illness or mortality from consumption of turtle meat. Both published peer review and grey literature including the Indian Ocean Turtle Newsletter, African Marine turtle Newsletter, Marine turtle Newsletter, funding/donor reports and Malagasy academic works were reviewed for pertinent information. Madagascar does not compile an annual national status report for marine turtles, precluding direct access to nesting and trade statistics.

2.2 Fieldwork

Interviews were undertaken with artisanal fishers and conservation management practitioners across five coastal regions of Madagascar and the capital city of Antananarivo (Fig. 5) in September 2018. Two teams were mobilised to cover this period comprising of 32 days in the field. A detailed movement record is provided in Annex I. In addition to this, opportunistic surveys of markets and curio stalls were conducted to document the availability of turtle shell products (often referred to as tortoise shell products, but listed here as turtle shell to distinguish these from land tortoise species).

2.3 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 across these impacts are a major challenge to the effective conservation and management of threatened species such as marine turtles.

Interview surveys are considered to be one of the most inexpensive and practical techniques to derive fishery data (Aragones et al. 1997, Ortega-Argueta 2012), and many researchers now use interviews to quantify fishery effort and gather information on both targeted and incidental catch (Moore et al. 2010, Ortega-Argueta 2012). The use of local and traditional knowledge derived via these interview processes is 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 marine turtles by artisanal fishers in Mozambique, and Riskas (2018) also developed a series of fisher interviews to improve the understanding of IUU fishing and wildlife crime in Malaysia. The survey questionnaires used for this study incorporate aspects of all of these tools, tailored to meet the requirements of the Terms of Reference for the project.

Two questionnaires were developed to solicit information on illegal take and export or marine 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 Annexes II and III for copies of the questionnaires.

2.3.1. Key Informants

In addition to the artisanal fishing and conservation and management practitioner interviews, some interviews were conducted with anonymous key informants. These informants were identified through a snowball sampling approach (Goodman 1961, Biernacki & Waldorf 1981), whereby potential knowledgeable respondents were suggested by experts with extensive experience in Madagascar. Due to the sensitivity of the information provided, they requested anonymity as a condition of participation. In total four anonymous informants were interviewed.

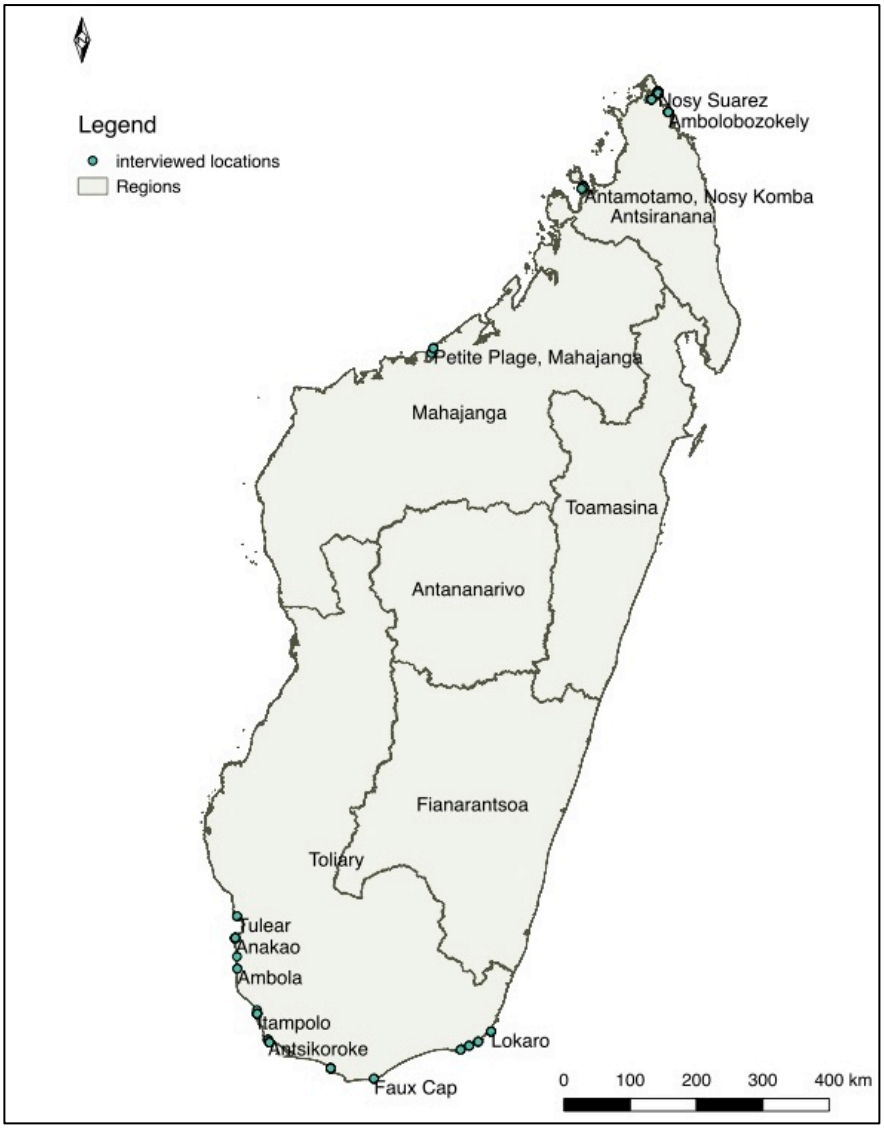


Figure 5: Locations surveyed in Madagascar during this study.

2.4 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 engine (Google) and content browsers (Firefox, Chrome). We used key words and combinations of key words such as 'turtle', 'sea turtle', 'Madagascar', '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.

2.5 Sampling sites

Field surveys were conducted in southern Madagascar (Atsimo Andrefana, Androy & Anosy regions) from September to 1st to 23rd 2018, in northwest Madagascar (Boeny, Diana) from 24th to 30th September, and in the north (Antsiranana, Sofia) from the 1st to 30th of September 2018 by a second survey team. A total of 153 artisanal fishers were interviewed and 4 interviews were completed with conservation management practitioners (Table VI).

Table VI: Locations surveyed in six coastal provinces of Madagascar during September 2018.

Date	Region	Location	n
03/09/2018	Atsimo Andrefana	Tulear	2
04/09/2018	Atsimo Andrefana	Mahavati	2
05/09/2018 – 06/09/2018	Atsimo Andrefana	Anakao	9
07/09/2018	Atsimo Andrefana	Beheloky	1
07/09/2018	Atsimo Andrefana	Ambola	2
07/09/2018 – 09/09/2018	Atsimo Andrefana	Itampolo	7
10/09/2018	Atsimo Andrefana	Antsikoroke	5
10/09/2018 – 11/09/2018	Atsimo Andrefana	Ambohibola	7
13/09/2018 – 14/09/2018	Androy	Lavanono	10
15/09/2018	Androy	Faux Cap	3
18/09/2018	Anosy	Ambinany Be	4
19/09/2018	Anosy	Analapasy II	2
19/09/2018	Anosy	Arabaraba	3
20/09/2018	Anosy	Lokaro	5
25/09/2018	Boeny	Antsa Bigo, Mahajanga	2
25/09/2018	Boeny	Mahajanga Port	1
26/09/2018	Boeny	Petite Plage, Mahajanga	3
28/09/2018	Diana	Antitoro, Nosy Komba	2
28/09/2018	Diana	Antamotamo, Nosy Komba	4
29/09/2018	Diana	Andria Be, Nosy Komba	4
08/09/2018	Sofia/ Antsiranana	Nosy Suarez	10
09/09/2018	Sofia Antsiranana	Androvohonko	10
15/9/2018 – 16/9/2018	Sofia Antsiranana	Ambodivahibe	30
22/9/2018 – 23/09/2018	Sofia Antsiranana	Ambolobozokely	20
27/09/2018	Sofia Antsiranana	Bay of Diego Suarez	7
Sep / Oct 2018	Online	Via Google forms	4

3.0 Results

3.2 Fishery description

Given that the majority of respondents were artisanal fishers (as this group interacts with turtles on a regular basis), we briefly describe herein the artisanal fisheries that we interacted with during the

survey. However, responses were also gathered from respondents who also had a range of other occupations; Fig. 6). While there are slight differences among locations, we believe the following data generally describe the artisanal fishery sectors in the areas where the survey was conducted. Fishers were generally young, with very few senior fishers putting to sea (Fig. 7). This is in keeping with a generally lower life expectancy recorded for Madagascar (approximately 65 years; WHO 2018). Average age amongst fisher respondents was approximately 20 years, and approximately 75% of all fishers were aged 10 to 40 years. The artisanal fishery is mostly small scale, with primary vessel types comprising wooden boats (Fig. 8), dhows, and pirogues (local canoes; Fig. 9). A small proportion of vessels are motorised or carry sails, with sails being preferred, as they do not incur fuel costs. Vessels are mostly small, with lengths rarely exceeding 5m.

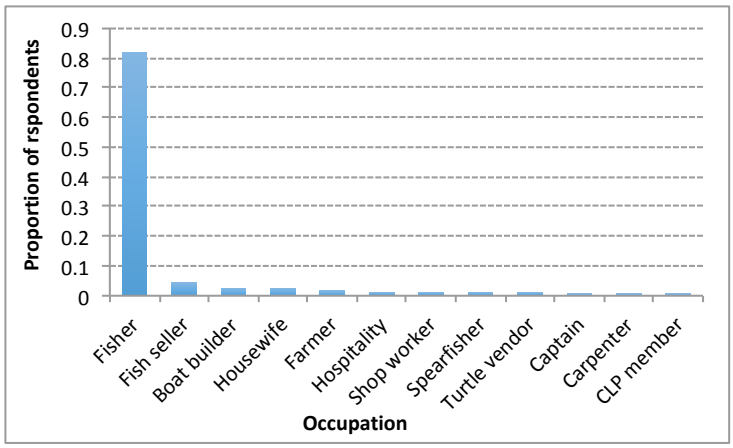


Figure 6: Primary occupations of respondents during the field surveys (n=151). CLP denotes local fisheries council, or Comité Locaux de Peche).

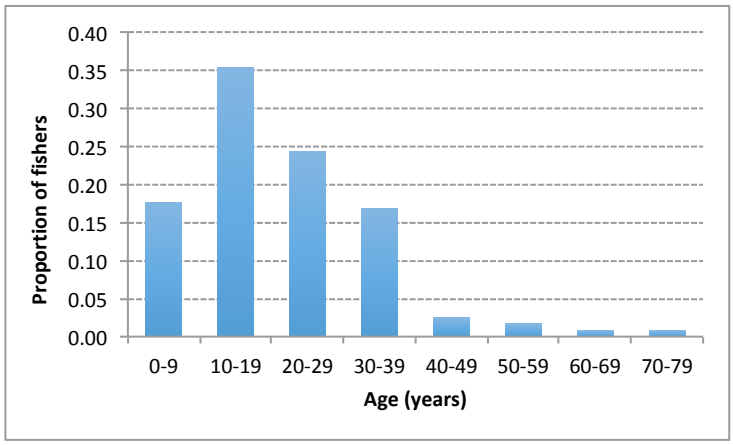


Figure 7: Age distribution of interview respondents (n=119).

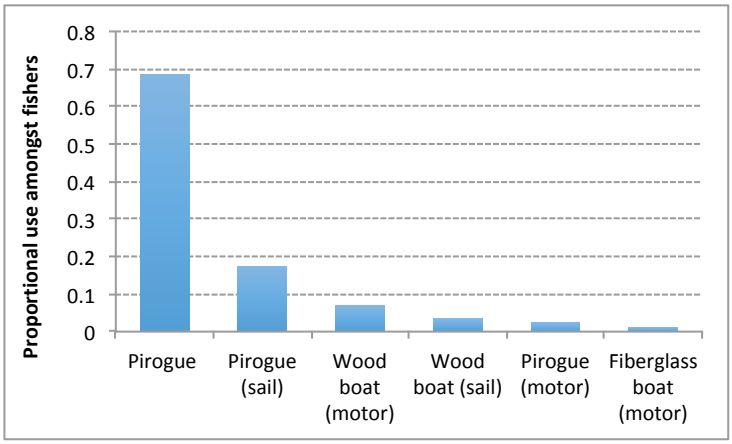


Figure 8: Vessel types used in the artisanal fishery in Madagascar (n=86).

Fig. 9: Typical fishing pirogue used in the Madagascar artisanal fisheries (photo courtesy of Michel Strongoff, Chris Scarffe Film & Photography).

Target catches in Madagascar's artisanal fisheries comprised a wide range of species, reflecting the wide range of gear types being used in the varied fisheries. Many respondents indicated they targeted certain species, but acknowledged they kept nearly all catches, irrespective of species. Marine turtles are a targeted species in Madagascar, and not retained solely from bycatch instances (e.g. Lilette 2006, Humber et al. 2011, Jones 2012, present study). Our surveys revealed that the artisanal fishery in Madagascar is mostly non-selective, and (generally) all catch is retained, irrespective if it was targeted or not. Fishers generally use more than one type of gear, and target different species with each of the different gears. As a rough guide, freediving and spears are used for lobster and octopus, longline and hook & line are used for large pelagic fish and sharks, and gillnets are generally used for reef and lagoon fish. Jarifa nets (also encountered in Mozambique) are large mesh gillnets (up to 45cm stretched mesh) and are usually used to catch marine turtles (e.g. Humber & Hykle 2011). The main target species groups are shown in Figure 10.

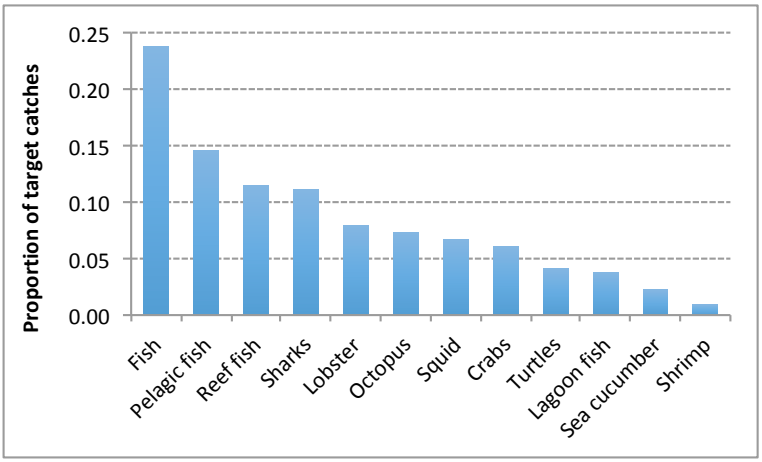


Figure 10: Predominance of main target species groups reported in Madagascar's artisanal fisheries, sorted by most-targeted catch. There were 315 responses among 153 respondents due to fishers often targeting multiple species.

Many respondents indicated they used multiple gear types, with the differences in gear use generally being due to differing seasons and target species. Figure 11 describes the main fishing gear types, sorted by most common to least common. The reported number of gears exceeds the number of respondents due to multiple gears used.

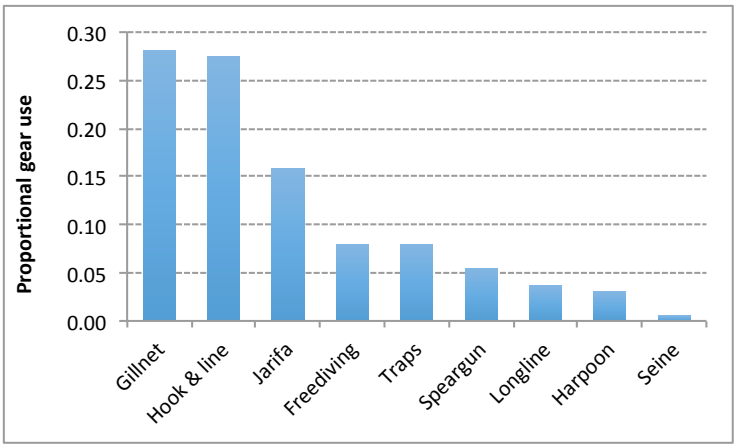


Figure 11: Predominance of main fishing gears used in Madagascar's artisanal fisheries, comprising 164 responses among 78 respondents.

3.3 Turtle interactions

The vast majority of respondents (89%) indicated they had seen turtles in the areas in which they fished, with the balance of respondents indicating turtles did not occur in their area (or at least had not been seen). The location of turtle sightings was generally aligned with the key fishing habitats frequented by fishers, who target lagoon and reef fish, but also larger pelagic species further offshore Fig. 12).

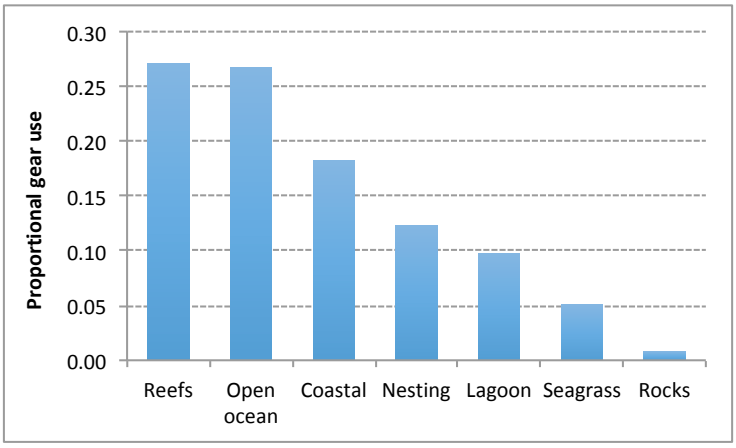


Figure 12: Locations of turtle sightings reported by interview respondents (n=236 responses among 133 respondents; respondents often indicated seeing turtles in more than one location).

Roughly half of all respondents believed marine turtle stocks were declining, with only ~10% of interviewees believing that numbers were increasing (Fig. 13). Our surveys asked respondents to think across time spans of one and five years, and also within their lifetimes, but we believe these responses reflect trends over the last decade based on anecdotal feedback, roughly since 1995-2000. A similar small number of respondents believed the population had remained unchanged. However, during a subsequent follow-up question on the local trade in turtles and their products, all respondents believed numbers of turtles were decreasing due to the trade, and nobody suggested that overall numbers were on the rise (including the 10% who responded positively to the earlier question).

Many respondents indicated that they were catching more small turtles in recent years than they did in past years, suggesting many of the larger adults have been removed from the population. The most frequent responses for the cause of turtle population declines were the increased use of jarifa nets, increased fishery pressure overall, changes in seagrass coverage (presumably decreases in coverage), and increased demand for turtle meat and products. Those suggesting populations were increased attributed this to the legal protection status of marine turtles and a decrease in the number of hunters. Given the widespread and blatant trade in marine turtles we observed during this survey, it is unlikely that either of these two responses are realistic, and similarly it is likely that the stock is not increasing.

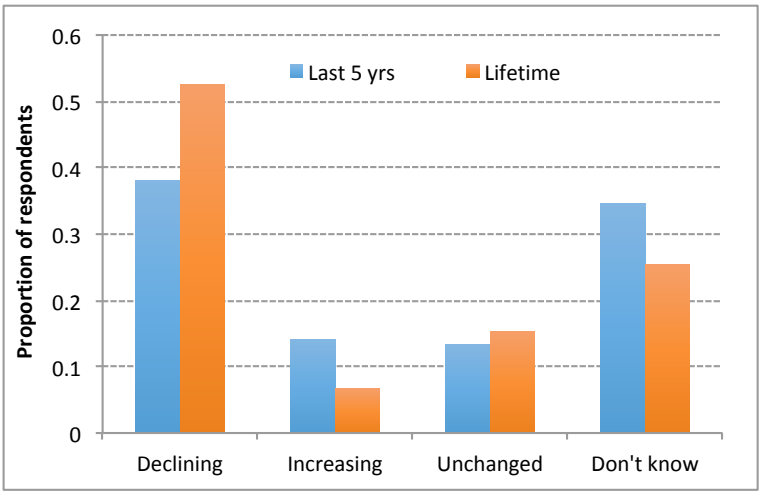


Figure 13: Perceived population trend in marine turtles described by interview respondents ($n_{5\text{-years}}$=137, $n_{lifetime}$=142).

More than half of all 153 respondents indicated they had caught turtles accidentally in their nets (many also targeted the turtles directly: 77 respondents indicated this, or roughly 49%) and indicated they were aware that the majority of fishers caught marine turtles as bycatch (Fig. 14). A few respondents (n=9) indicated that turtles were caught as frequently as daily, and a substantial proportion (~26%) of respondents indicated they caught four to six turtles each month. It is problematic to distinguish between directed take and accidental take, because turtles that were caught accidentally were retained, and respondent often struggled to understand the difference between accidental and directed take. In many cases they stated that they set their nets, and anything that was caught was retained. Overall, we estimate that *only the respondents of this survey* (153 respondents) caught approximately 3,500 marine turtles in total over the last 12 months, either as bycatch or as directed take.

The majority of these turtles were identified as green turtles, and classified as either juvenile (18%) or sub-adult (53%) based on the sizes reported by respondents, with only 30% of landing comprising adult turtles (Figs. 15 & 16). Several of the adults were reportedly collected on nesting beaches rather than at sea. These findings support the above notion that the stocks may be declining, with fishers taking smaller and smaller animals each year. Indeed, many of the respondents indicated that they used to catch much larger turtles in earlier years.

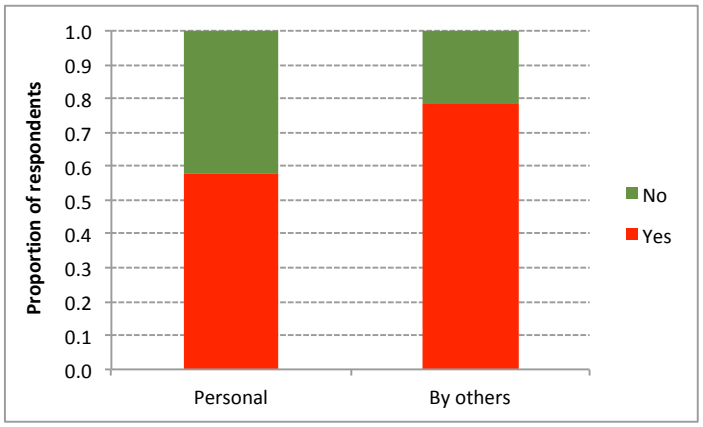


Figure 14: Reported incidences of marine turtle bycatch in artisanal fisheries in Madagascar (n=145). *Personal* reflects instances where respondents indicated *they themselves* had caught turtles. *By others* refers to instances where respondents indicated they knew of *other* fishers catching sea turtles.

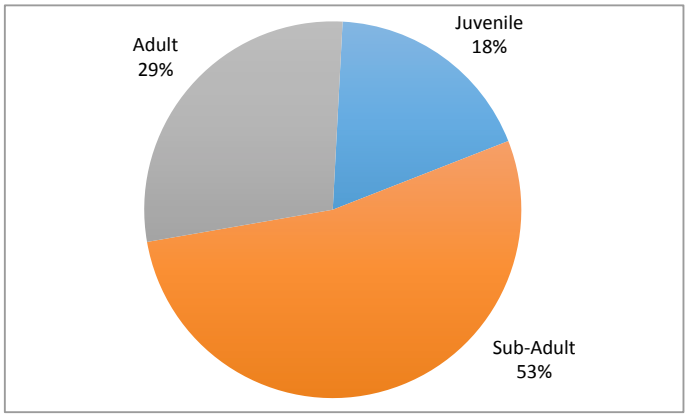


Figure 15: Size classes of marine turtle bycatch in artisanal fisheries in Madagascar (n=203 from 131 respondents who could catch multiple turtles of various sizes).

Figure 16: A small juvenile green turtle caught in the artisanal fishery in Madagascar (photo courtesy of Michel Strongoff, Chris Scarffe Film & Photography).

Turtles were either kept for domestic use (as food, primarily) or sold to middlemen and buyers who also sold them (primarily) for food (Fig. 17). Very few respondents indicated turtles might be shipped overseas (only 2% of 148 respondents) or used for traditional purposes (medicinal, handicrafts). Only 13% of 148 respondents indicated they released bycaught turtles, and in virtually every instance they indicated this was because turtles were protected via fady.

The heavy dependence on marine turtles as a food resource many explain the lack (or perceived lack) of international trade. Our surveys found that 70% of all respondents ate both turtle meat and turtle eggs, and we found no suggestion during our interviews / no respondents indicated that overseas buyers would pay higher prices for turtle meat and products compared to local villagers to fuel the international trade. Of note, while we only encountered green turtles during our surveys, a substantial number of respondents indicated a preference for hawksbills over greens despite records of illness from consuming hawksbill turtle meat.

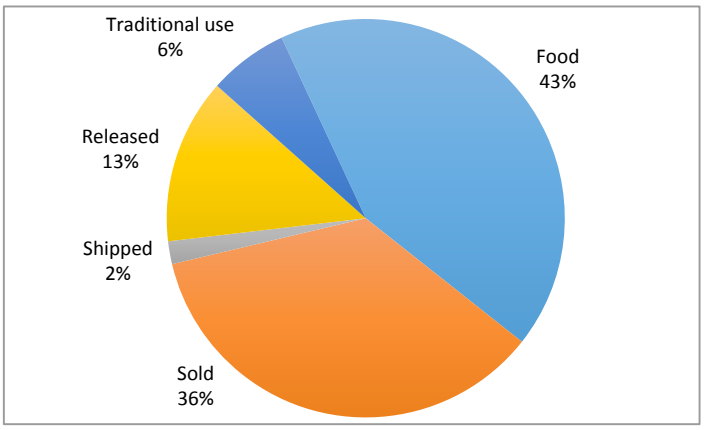


Figure 16: Reported fate of marine turtles in artisanal fisheries (n=216 responses among 148 respondents).

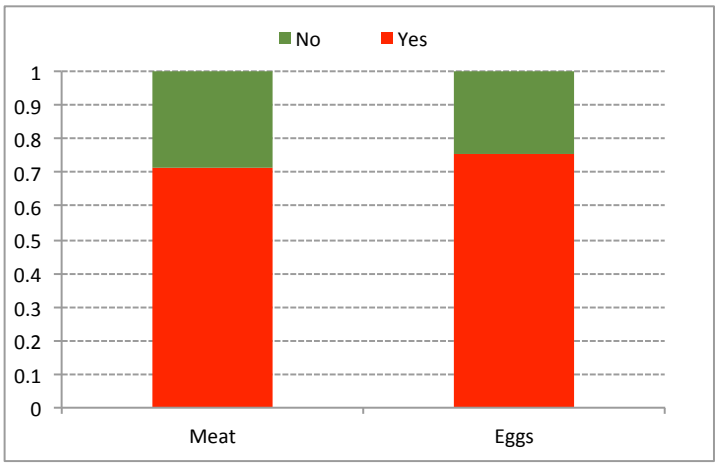


Figure 17: Proportion of respondents who indicated they consumed marine turtles or marine turtle eggs (n=152).

3.4 Domestic marine turtle trade

Live marine turtles, turtle meat, eggs and plastron / ligaments are all part of the domestic trade in Madagascar (Fig. 18). Marine turtle take appears to be primarily for food and for trade in local markets, but these markets can be many hundreds of kilometers away. Based on responses to our interviews, there appear to be active transport networks that move marine turtles and their products around the country, with turtles moving north and south along the west coast, but also moving to the capital city of Antananarivo. 45% of 153 respondents indicated that they were aware of / participated in trade in marine turtles and / or their products. In addition to whole turtles, we also documented several instances in which non meat-related products were being traded (Table VII).

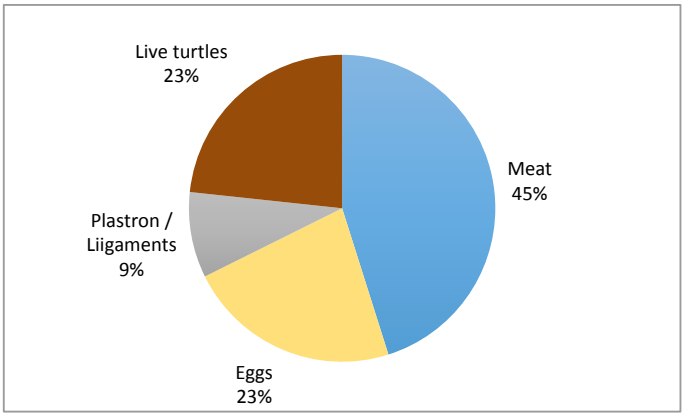


Figure 18: Proportional use of marine turtles and marine turtle products in the domestic trade (n=133).

Table VII: Locations where trade in turtle scutes or plastron ligament was documented during the survey.

Scutes - primarily hawksbill turtles	Plastron ligament (dry or wet)
Locations buyers sourced or requested products from	
Antsikoroke	Anakao
Ambohibola	Ambohibola
Lavanono	Lavanono
Faux Cap	Faux Cap
Arabaraba	Ambinany Be
Antitoro, Nosy Komba	Ampasimariny
Antsa Bigo, Mahajanga	

The turtle carapaces are also used, often to make jewellery (Table VIII) but were often repurposed locally for uses around the village, such as animal shelters (for ducks, geese, puppies) and as containers to store animal feed or scraps. Marine turtle shell products were detected in three locations spread across three different regions: in the village of Ambohibola (Antisimo Andrefana), Nosy Be (Diana) and Mahajanga (Boeny). On two occasions the carapace had been converted into craft products, the third incident involved the resale of juvenile carapaces.

Fresh evidence of illegal take (live turtles or freshly slaughtered) was witnessed on six occasions during the survey (Table IX), all in southwest Madagascar. Two juvenile green turtles were being held in a village awaiting slaughter, and two separate portions of freshly killed turtle were also found. An additional two occurrences of cooked turtle meat were detected whilst conducting interviews in Anakao village.

Table VIII: Turtle shell products documented opportunistically across three regions of Madagascar.

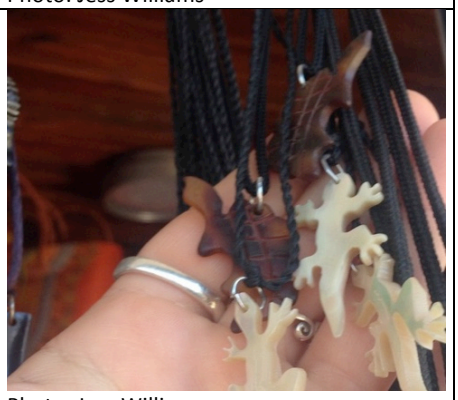
Site	Items	Location	Details	Date	Photographic evidence
Atsimo Andrefana Ambohibola	Earrings	In home of fisher woman.	A fisher women invited us in to show us her earing which she found in Antananarivo and brought back to her home in Ambohibola. It is unclear if this was to be used as a model/ prototype to replicate locally.	11/9/18	 Photo: Jess Williams
Diana, Nosy Be	Necklace pendants	Fascene Airport curio store	Pendants available for sale in airport curio shop, Nosy Be.	3/10/18	 Photo: Jess Williams
Boeny, Mahajanga	Carapace (green and hawksbill turtles)	Bazaar Be tourist market	Turtle carapaces available for sale along with numerous other animals (sea horse, crocodile, corals, stingray tails, star fish)	25/9/18	 Photo: Jess Williams

Table IX: Illegal turtle take incidents witnessed during the study period.

Location	Date	Incident details	Photographic evidence
Atsimo Andrefana, Mahavati village, Tulear City	4/9/18	Live juvenile green turtle was found by our village guide at the landing area of Mahavati, in Tulear. The fisher disappeared into the busy unloading area so we were unable to interview him. The turtle was likely to be kept for personal consumption given the small size or resold to one of two main buyers in Mahavati.	 Photo: J. Williams
Atsimo Andrefana, Anakao	6/9/18	Caught with spear gun. Kept alive for a day before slaughtered. Approximately 50 cm Curved Carapace Length (CCL).	 Photo: J. Williams
Atsimo Andrefana, Anakao	6/9/18	Capture method unknown. Killed and portioned before we detected it.	 Photo: M. Strongoff, Chris Scarffe Filmmaker

Atsimo Andrefana, Anakao	6/9/18	A very small juvenile green turtle (approximately 30 cm CCL), with parts of carapace and front shoulder joint. An interview was completed with this fisher.	 Photo: J. Williams
Atsimo Andrefana, Anakao	5/9/18	Green turtle meat, freshly cooked, being cut up into smaller portions.	 Photo: J. Williams
Atsimo Andrefana, Anakao	5/9/18	Green turtle meat, freshly cooked, being cut up into smaller portions.	 Photo: M. Strongoff, Chris Scarffe Filmmaker

3.5 Case studies

A number of case studies help illustrate the complexity and extent of the domestic trade in marine turtles in Madagascar:

3.4.1 Case Study 1: Trafficking across 180km from Analalava to Mahajanga

A source who requested anonymity provided a case study of an investigation conducted in 2013 in Analalava. The report highlighted the existence of a group that targeted marine turtles (mainly green turtles) on the northwest side of Madagascar between Mahajanga and the Radama Archipelago. This illegal take activity was conducted by a team involving more than 30 migrant fishers from Mahajanga and Ampasibe. The poachers reportedly set up temporary fishing camps, building fenced areas to hold the turtles alive until they had enough to transport back to Mahajanga by boat.

One of these camps was detected on 26th May 2013 near Komadzara, on a beach in a mangrove area at a place called Belalandana. More than 70 green turtles were found in holding pens (Fig. 19). The site was abandoned but had signs that the fishers had recently fled (warm rice in a pot over the fire).

Figure 19: Green turtles waiting to be transported from Belalandana, Komadzara, Analalava to Arantsa, Mahajanga.

3.4.2 Case Study 2: Trafficking from Analalava

A second investigation in June 2013 involved local authorities in Analalava, who released 20 marine turtles from fenced enclosures at Ambolobozo, in Narindra Bay. Authorities arrested some of the fishers, destroyed their camps and confiscated the nets used for turtle fishing (although these nets were reportedly later resold in Analalava).

Further inquiry in Komadzara village revealed that local villagers were not pleased by the presence of the migrant fishers, some of whom originated from southern Madagascar. Analalava police came to drive the migrant fishers away and during the course of the investigation, the President of Fokontany (village chief) was also found to be involved and was dismissed by Analalava district authorities.

Reports emerged from villagers that the migrant fisher group had been spotted further south and this area was thus inspected. On arrival the authorities found a fishing camp, with five carapaces and

three holding pens (one of the largest measured 6m x 4m). Local villagers informed the authorities that the offenders had been in the area for a few weeks before recently fleeing. They reportedly used several nets in nearby areas, and in waters extending offshore to Nosy Lava Island. They reportedly fished over 4-5 day campaigns, catching 20-25 turtles per day. At the end of the campaign they would sail to Mahajanga to sell the turtles. Villagers reported that during the last trip by the turtle fishers to Mahajanga their canoe sank with more than 40 turtles aboard.

Further details from a shrimp / fish collector confirmed that the group had been operating in the area for over a year, based out of Nosy Lava but using several temporary camps in the area. They sent the turtles to Mahajanga and unloaded in the fishing district of Arantsa. Some of the turtle meat was consumed in Mahajanga and part of it was sent to Antananarivo. The fishermen arrested by the Analalava police were subsequently released and it is unlikely they were prosecuted.

Two key informants during our current surveys suggested that these activities still continued up to 2018. The isolation of these areas, with thick mangroves that make it easy to hide clandestine activities, coupled with the remoteness of the areas and incipient corruption are likely to facilitate the ongoing exploitation of turtles in this area and other locations with similar conditions.

3.4.3 Case Study 3: Moramba Bay, Marovasa Be and Anjajavy

In Moramba Bay, Marovasa Be and Anjajavy areas (Fig. 20), local newspapers reported arrests related to targeted hunting and widespread illegal marine turtle exploitation. This area is remote and only accessible by boats / canoes. Respondents to our survey indicated that directed poaching has been increasing since 2012 in Moramba Bay and continues to this day, whereby fishers collect live turtles at the request of a dealer based in Mahajanga, which are held in pens until transported by speedboat back to the city. Fishers use a 500m long net in the bay area to catch 10-40 turtles per week. A middleman located in Mahajanga collects the turtles, but the final destination is unknown. The turtles are reportedly sold at 5000 MGA/kg once they arrive in Mahajanga.

Figure 20: Location of sites surveyed where turtle trafficking was reported by researches at Cétamada in 2012 (Cétamada 2012).

An investigation led by the NGO Cétamada reported that marine turtle hunting and collection has been increasing in scale over the last few years. Cétamada (2012) reported that fishers were active between Feb and Nov 2012 and estimated they caught 180-300 turtles (with an average catch of 20 turtles per net deployment), which were sent to Mahajanga every second week.

Another case of intensive turtle fishing destined for Mahajanga was recorded in a village further south of Anjajavy, where three people were arrested and taken to Mahajanga in December, 2012 according to local villagers. The owner of a hotel in Marovasa reported intensive turtle fishing to local authorities, and in November 2012, the gendarmerie and fishery officials caught fishers in the act of poaching during a raid on the village of Marokibay. Five people were arrested and taken to Antsohihy, and twenty live turtles were released.

3.4.4 Case Study 4: Turtle meat vendors of Mahavatse, Toliara

We interviewed the two main buyers and resellers of turtles in Toliara city - both female, between the ages of 51 and 60, each of whom had a small market stall at their homes in Mahavatse, Toliara. Generally they only purchase live turtles to ensure the meat is fresh, and they both estimate buying at least one turtle daily, averaging about 20 turtles per month (accounting for bad weather, when the fishers could not go to sea).

One buyer reported that fishers do not generally collect turtles during the nesting season (Nov - Dec) but estimated that one of every 20 turtles she purchased was a gravid female, and that the eggs are extracted and sold. She also reported that in the few instances when the fisher caught a turtle that released her eggs on board aboard the vessel, the fishers then collected and sold these on to her.

Both women indicated they sourced turtles from fishers outside of Toliara city (one sourcing northwards, the other southwards). To get an idea of the extent of the trade, one of the women was referred to by name as the buyer in two different interviews with fishers in Ambohibola, 200km distant. This highlights the vast coverage of the trade routes. Fishers told us the buyer pays a worker to keep a lookout for their pirogue coming from the south, and if it has turtles the worker uses the zebu cart to transport them from their boat to the buyer's house. The other buyer sourced turtles from fishers based in Salary, 100km away, and fishers called ahead to bring the turtles in during the night. Both buyers had multiple fishers (3-30) supplying them.

For the buyer sourcing from the south coast, the best season was reportedly March through August when more turtles are supplied. The other buyer suggested January to April was better due to cooler weather which prevented turtle meat going bad.

Both buyers purchased live green turtles larger than 50cm at approximately 50,000 MGA (approximately 14 USD) for a 0.5m CCL turtle up to approximately 200,000 MGA (approximately 57 USD) for a turtle > 1.2m CCL. Both buyers then chopped and cooked the turtles and sell them in portions. Portions sold from 100 to 2,000 MGA (0.02 - 0.57 USD). The meat was not prepared in any particular way, simply cooking the turtle meat in salty water. Carapaces were not used for artisanal products, but were broken down and fed to domestic pigs.

Both buyers had experienced encounters with local authorities but neither had been fined or issued an infringement. Both had offered turtle meat as a bribe. The second buyer suggested that the case of arrested fishers from Ambohibola had deterred fishers from supplying her and that recently she was only receiving three to four turtles per month. "*No one is scared to eat turtle meat if its available to buy, it is only the fishers that are scared to catch turtles*" she remarked. This suggests that widely publicised news of all matters relating to turtle fishing would likely benefit conservation

efforts. It also suggests that a campaign regarding the legality of turtle meat consumption in Toliara city is a necessary step towards stigmatising the bushmeat consumption.

3.5 Domestic marine turtle trade routes

Domestic trade routes cover vast distances supplying turtles to the larger inhabited areas from the remote wilderness areas.

For instance, coastal communities between St. Augustin, Anakao, Itampolo, Antsirkoroke, Ambohibola, Fanambosa to Lavanono contribute to the illegal take and support domestic trade routes (see Fig. 21). This area is a 300km expanse of coastline in the Atsimo Anrefana to Androy region, with fishers supplying Toliara city with marine turtles either as the result of opportunistic use of bycatch or intentional take.

Numerous parallels between the tortoise and marine turtle domestic trade routes are evident. The bushmeat trade network for radiated tortoise is thought to extend as far as the capital city, Antananarivo (Manjoazy et al. 2017). While we did not directly witness this, trade routes for marine turtles from the southwest to Antanarivo were confirmed by CSP Mahajanga; dried turtle meat is sent from Ambanja to Antanarivo, and fresh turtle meat is sent through Mahajanga to Antananarivo (Cétamada 2012; see Fig. 21).

Our interviews in the Atsimo Andrefana region revealed that marine turtles are sent by pirogue to pre-established buyers in Tulear (see Fig. 21). This is a similar finding to that reported in Manjoazy et al. (2017) who surveyed discarded carapaces of *Astrochelys radiata* in urban rubbish dumps to quantify the scale of the radiated tortoise used for bushmeat trade. Manjoazy et al. (2017) found that a single rubbish dump at Mahavatse, an area near the artisanal fishery landing beaches, accounted for 93% of the observed carapaces. They also documented that Mahavatse was the main arrival point for tortoise-laden pirogues at night. Our interviews with turtle meat vendors in Mahavaste suggest the same occurs for marine turtles that arrive into Mahavaste by pirogue at night.

The majority of turtles that are sent to Toliara are bought, cooked and resold by just two key vendors in Mahavatse. Both these buyers and dealers in Mahavatse, Toliara city use a pre-established network of fishers to supply them with turtles to cook and resell.

Interviews with one of the two turtle buyers / resellers in Toliara city suggested that turtles were sent to her from Salary, 100km further NW of Toliara, by more than 20 different spear-fishers. The buyer explained that trade was better from January to April as the cooler weather prevented the turtle meat from deteriorating during transit, as already reported above.

Regardless of the species (tortoise or turtle), it is imperative that enforcement activities in urban centres and along major transport routes are intensified and respond to any changes in the behaviour of the transporters, and butchers (Manjoazy et al. 2017). Particular concern should be focused to Anakao where we witnessed several illegal take and domestic consumption incidents in the span of a three-day site visit. Additional efforts should also be focused to the neighbouring communities of Ambohibola, Antsirkoroke and Fanambosa which had active turtle hunting groups that sailed with pirogues full of live turtles to sell to buyers in Toliara.

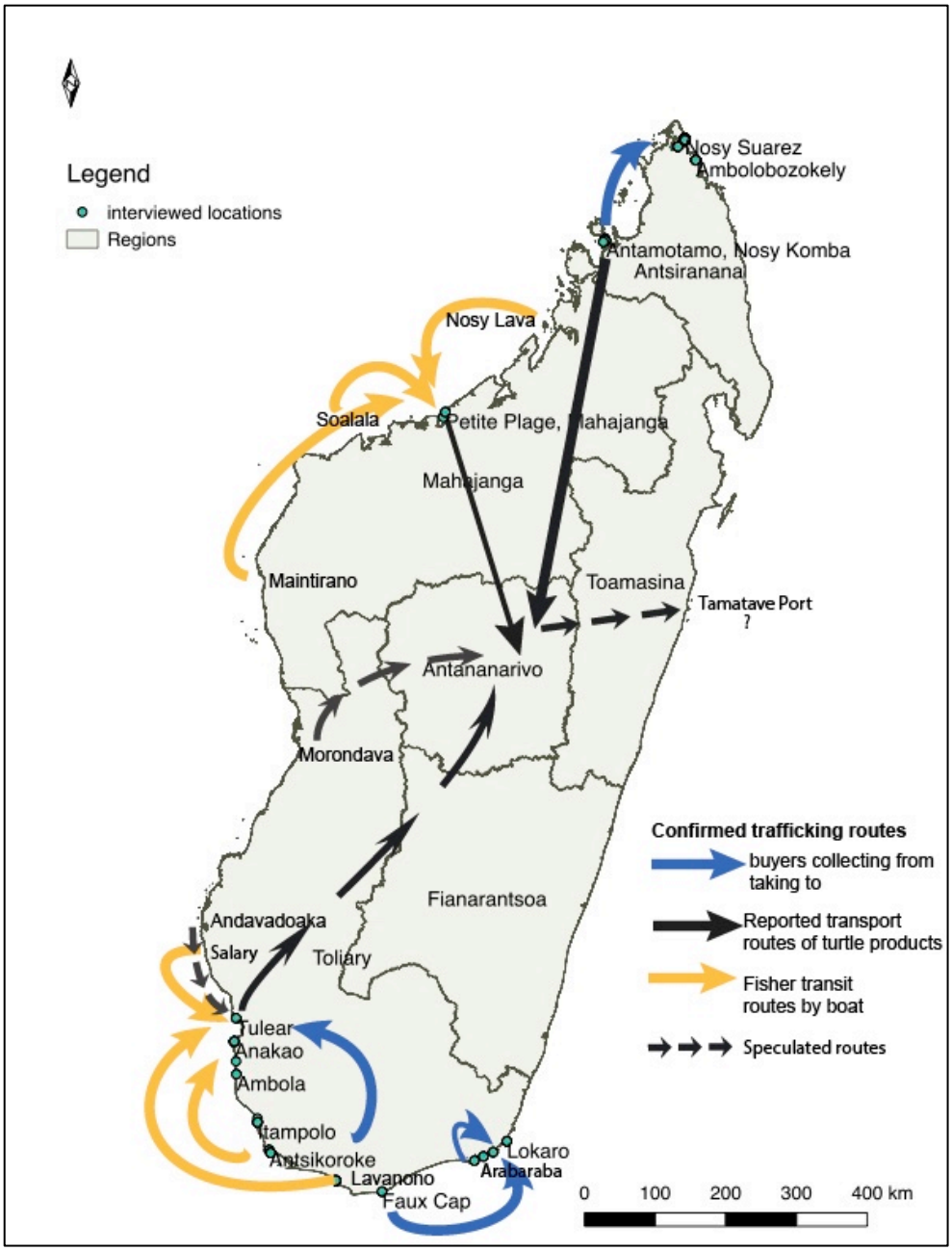


Figure 21: Trade routes of turtle products within Madagascar.

3.6 Magnitude of domestic trade from artisanal fishing

As in the case of Mozambique, extrapolating from a short rapid assessment to a National level trade magnitude is problematic on various fronts: Turtle trade and take likely occur along the entire coast, while our surveys covered only small extents of this. Similarly, published literature generally reflects small, localised studies rather than national assessments. Secondly, the turtle take reported to us during these surveys is unlikely to be of the same magnitude across all fishing areas and years. Also, some fishers provided estimates for turtle take over the last 12 months, while others provided this for multiple years. Finally, fishers do not indicate the total number of fishing days with clarity, so if they report catching turtles 'weekly' this might not mean that catch one every week of the year.

However, in the lead-up to our field research we selected sites that had been reported as hotspots of turtle take and use (as denoted in the literature and in conversations with NGOs that were active

in Madagascar (e.g. Blue Ventures, Community Centred Conservation [C3], Reef Doctor), and thus the estimates we have for directed and accidental take, while not national in scope, are informative and alarming.

Direct take of marine turtles is rampant along the coast, with over half of all respondents indicating they purposefully targeted marine turtles (Fig. 22). The number of targeted turtles in the last 12 months (roughly October 2017 to September 2018), only among survey respondents (n=148), was 2,500. This only covers targeted take. The estimated number of bycaught turtles over the preceding 12 months amongst survey respondents was 2,543 turtles, but given the challenge of distinguishing between direct take and bycatch, we consider 3,500 turtles to be a realistic figure overall.

These numbers are only estimates, because seasons and bad weather days are not reported. We have adjusted the figures to account for a 'season' based on the indications we received from turtle buyers during the interviews. In addition, some of the interviewees were part of organised 'groups' who hunted turtles destined for trade, while others simply caught one or two occasionally for domestic use. Extrapolating from this mix of respondents would not be prudent until an estimate can be made of the number of participants in each form of turtle extraction.

Regardless, the overall figures point towards some 3,500 turtles being extracted from local waters in just the last year among only the 153 respondents reached via this survey. Many respondents indicated that the turtle captures were historic and on-going, meaning that thousands of turtles have been extracted over the years.

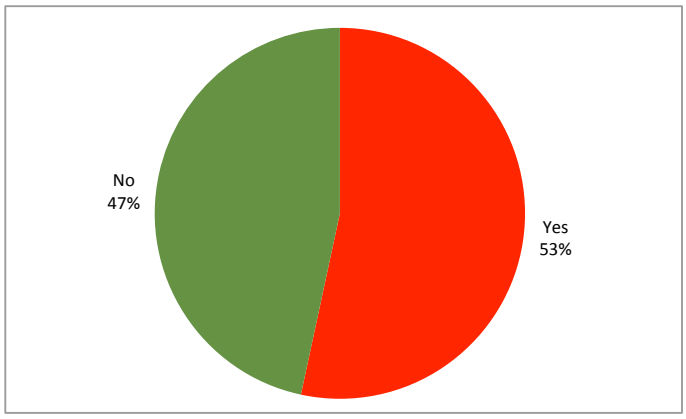


Figure 22: Proportion of survey respondents who indicated they purposefully targeted marine turtles (n=148).

Le Manach et al. (2012) suggested there were some 100,000 fishers engaged in artisanal fishing in 2008, the latest figure available estimating the size of the artisanal fishery. Statistics by the World Bank (presented in Le Manach et al. 2013) suggest that the two key provinces in which turtles are particularly targeted (Antsiranana and Toliara; with Mahajanga being more of a trading centre) are home to ~45,000 fishers. We do not suggest all of these are involved in directed or accidental take of marine turtles, as marine turtles are not spread evenly along the coast, nor are local customs the same. Therefore we suggest that the two regions we investigated (southwest and northwest Madagascar) are likely the *key* areas where turtles are taken, given the prevalence of reports on the trade in these regions in earlier publications (e.g. Humber et al. 2011, Jones 2012), and based on our preliminary research.

Humber et al. (2011) indicated that some 6% to 7% of fishers targeted turtles more frequently and with greater effort than other fishers in their study, and we use that figure here to estimate a total number of turtle fishers for these two provinces. Conservatively we suggest that some 3,068 fishers

could be involved in directed turtle take in both Antsiranana and Toliara provinces. We believe this figure is far higher however, because not 6% to 7% but 53% of respondents in the present study indicated that they targeted turtles in the six regions investigated. We suggest also that this is likely an underestimate of the total number of fishers involved, because this only considers directed take – noting the challenges in getting fishers to understand the difference between directed take and bycatch, but until more thorough and exhaustive studies can be carried out, we have no way of being more accurate.

The present survey found that, of the 118 fishers who indicated they targeted turtles, an average of 32 turtles/fisher were taken in a year. This was simply an average of the numbers each fisher reported in the interviews, extrapolated for a one year period; e.g. when a fisher said he caught one turtle per week, then this was extrapolated to 52 turtles in a year; or when a fisher indicated one turtle per month, this was extrapolated to 12 turtles per year. Our figure is somewhat higher but comparable to the average capture rate of 20 to 25 animals per fisher reported by Frontier-Madagascar (2003). Given this we feel the results of our interviews captured fairly accurately the individual activity of artisanal fishers with regards to marine turtle captures.

Extrapolated directly (notwithstanding caveats mentioned above), this means that the directed take of marine turtles in the artisanal fishery in Madagascar (restricted to Antsiranana and Toliara provinces as identified above) has the potential to take close to 100,000 turtles per year. While we have no way to ascertain the accuracy of this estimate based on the challenges of extrapolating across regions that were not surveyed, we wish to draw the attention of the reader to the magnitude of the take, rather than the exact number *per se*. Turtles are not being taken by a few hundred or a few thousand, but by an order of magnitude greater, and this warrants further attention.

3.7 International trade

Little is known of international trade in marine turtles from Madagascar, and our surveys were unable to unearth any fresh leads that might have documented international trade routes and magnitudes. Madagascar's notoriety for trade in reptiles is almost exclusively due to demand for two tortoise species endemic to the island: the ploughshare tortoise and the radiated tortoise (CADS 2018). Similarly, a recent report by the Global Initiative Against Transnational Organized Crime did not cite any records of online sale of marine turtles from Madagascar (Rumhovde 2018), while Sung & Fong (2018) did not record cases of marine turtles being transshipped via Hong Kong from Madagascar. WildAid's report on marine turtle trade similarly does not report on any international trade out of Madagascar (WildAid 2018). A recent note by the World Conservation Society on their website suggests that demand for oil and meat from Southeast Asia was fuelling the increased demand for turtles in Madagascar (WCS 2016), but we have found no evidence that points to this occurring. Indeed, their report simply reports on the turtles they found during surveys, not on any international trade. There have been cases documenting trade in tortoises from Madagascar to China (e.g. Kiester et al. 2013, Runhovde 2018), and we suggest it is possible these trade routes may enable the trade in a small number of marine turtles (although we have no evidence to support this). But there is no evidence that the numbers are substantial or that it is an organised, on-going activity.

We did not find any online sources for turtle products through searches on social media sites (Facebook, Instagram), and neither through the main website search engine (Google) and content browsers (Firefox, Chrome). 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). One informant who wished to remain anonymous reported on trade from the north of Madagascar, with marine turtles being shipped to Antananarivo, and possibly beyond as export. However this was not ever confirmed. We had another informant who reported on a cotton farm

near Ananalava that purchased and supposedly exported a wide range of exotic species from Madagascar to China, with local vessels sailing offshore to meet up with foreign vessels beyond the national boundary. Marine turtle hatchlings were reportedly involved in this trade, but there is no information if there were substantial numbers of larger turtles being exported.

Key informants at the management level suggested that international trade was unlikely to be substantial given the high local demand for turtle meat and products. In two questions related to trade, none of the informants believed export even occurred (Fig. 23). We recognise that the number of informants is low, but coupled with a better understanding of the domestic demand, trade routes and markets, we believe this finding is rather accurate. Given this, we feel international trade in marine turtles is of small consequence to marine turtles of Madagascar, and suggest a focus on domestic trade and consumption is far more of a priority.

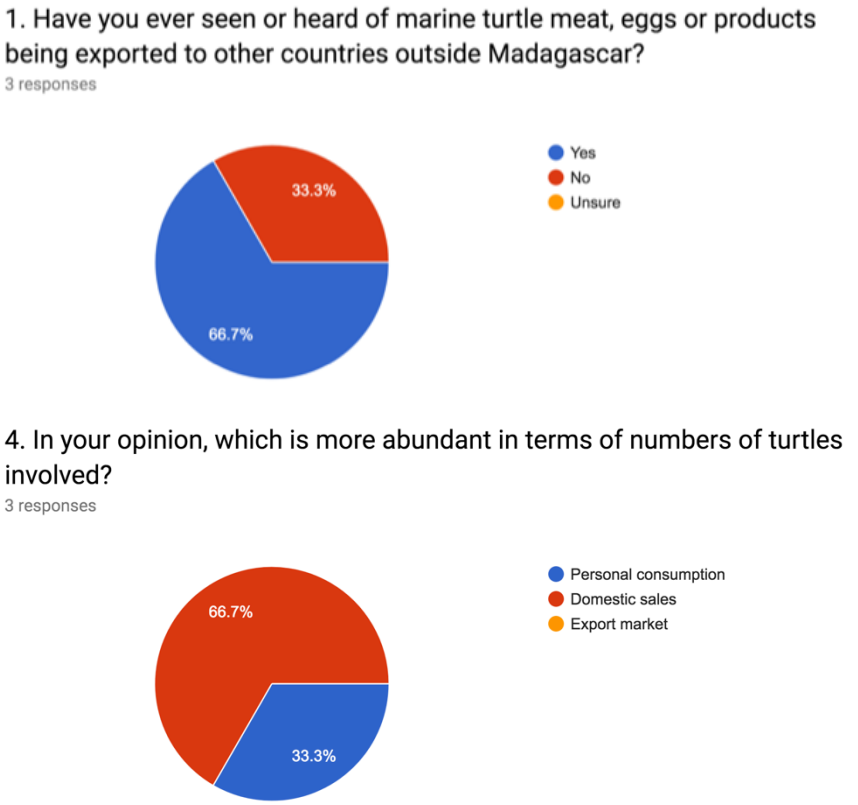


Figure 23: Responses from key informants related to use of marine turtles in Madagascar (n=3).

4.0 Discussion

Our surveys highlight the intense pressure from artisanal fisheries in Madagascar, and point to it supporting local trade and consumption rather than international trade in marine turtles and/or turtle products. Hawksbill turtles (usually used to craft jewellery from carapace scutes) were extremely rare in our market surveys, in keeping with the findings by Humber et al. (2011), and pointing to a lesser role of handicraft and curios in the turtle trade (only 19 of 153 or 12% of respondents indicated shell products were traded, and 14 of these indicated the trade was minimal or decreasing. During the present survey, only green turtles were encountered as meat for sale, but a small number of shell handicrafts were also recorded. Our surveys revealed that over 90% of turtles were either consumed at home, or traded to be consumed at other homes in Madagascar. We did not detect any noteworthy international trade. However, the magnitude of the turtle take is

staggering: some 3,500 turtles were taken by the 153 interviewees in our study, which could be extrapolated to some 100,000 turtles taken annually in the three provinces we investigated in this study.

We caution how these extrapolation values should be interpreted, as there are numerous uncertainties related to the distribution of effort, the number of fishers involved in turtle collection (accidental or targeted), the seasonality (and thus representativeness of our findings through this rapid assessment), and the marked differences between organised groups that target marine turtles (Fig. 24 left) and the occasional hunter who feeds his family (Fig. 24 right). Given this, we urge that the numbers be used as a wake-up call to the vast potential for turtle mortality in Madagascar, and to catalyse a suite of management and conservation initiatives.

Figure 24: Organised collection of marine turtles for commercial trade (left) and individual turtles caught for household consumption (right). Photos courtesy of Michel Strongoff and Jess Williams.

4.1 Artisanal fishing impacts

The number of artisanal fishers in Madagascar has steadily increased over the last two decades (Le Manach et al. 2013) and with it so has the pressure on marine turtles. The trajectory of fishing pressure on turtle populations in Malagasy waters, both in magnitude and method, is concerning (Humber et al. 2011).

Our findings suggest that there is little enforcement of national laws protecting marine turtles, and that often those entrusted with protection and management were involved in the trade. One of the case studies pointed out how a village chief was involved with the organised gangs which removed turtles by the hundreds, and our interviews with the two key turtle buyers in Mahavatse, Tulear suggested that law enforcement officers knew of their operations and were regular customers.

We have chosen not to separate bycatch and directed take because we found fishers rarely considered these different. If they caught a turtle, it was considered part of the day's catch, rather than some accidental take. This is also reflected in the low 'Release' response (18%) to the question of what fishers would do if they caught a turtle accidentally.

Our extrapolations differed somewhat from the Humber et al. (2011) approach (number of fishers vs. length of coastline) because in that instance the authors chose to extrapolate using linear distance of coastline, whereas there are likely fishers that use that coastline and be involved in the turtle trade. We believe that our approach makes a more realistic appraisal of turtle take by considering the number of fishers involved in turtle trade, and presents a more realistic view of the numbers of turtles potentially taken out by the fishery.

Overall therefore, take of marine turtles across the nation could be several orders of magnitude higher than has ever been reported in the past. This is because past reports have only ever focussed on small locations, and have not attempted to extrapolate to a national level. We acknowledge that the potential to take some 100,000 turtles per year may seem unrealistically high, but when put into context considering the sheer number of fishers involved in the artisanal trade across the vast expanse of coastline, we believe this is very likely the case.

4.2 Commercial fishing impacts

The two key commercial fishing industries in Madagascar are shrimp trawling and tuna fishing. The shrimp fishing fleet is small (50 vessels) and all vessels are required to use Turtle Excluder Devices. One study indicated that the change to using TEDs resulted in a drop from 120 to just two turtles across the entire fishery (Razafindrainibe 2010). It is believed that due to lack of enforcement and monitoring, many of the shrimp boats sew up the TEDs shortly after their singe annual inspection, with the possible exception of the 30% of vessels that carry on-board observers (pers comm., J. Vahoavy, CSP). Irrespective of this, the shrimp fishery impact on marine turtles, while of note, appears insignificant in comparison to the direct take and bycatch of turtles in the artisanal fishery.

There is no data available on the impact of the tuna industry on marine turtles, but as the fastest growing commercial fishery, known to impact marine turtles across other parts of the world, we suggest this is an area in need of investigation. Madagascar's tuna industry uses a mix of seine vessels and longline vessels, the latter of the two being known to catch turtles accidentally (e.g. Camiñas et al. 2006) to land some 52,000 tonnes of tuna each year.

There is rampant illegal, unreported and unregulated fishing in Malagasy waters by foreign vessels (Le Manach et al. 2012) and a lack of resources to address the problem. "Malagasy authorities do not possess the resources to patrol their own EEZ and therefore cannot address the problem of illegal fishing for such high-value species" cited as Jain (1995) & Cooke (1997) in Le Manach et al. (2012). This lack of capacity and resources to monitor and enforce national fishery laws are the same ones that hinder the monitoring of the impacts of these fisheries on marine turtles. We suggest that this is a priority area in need of further investigation.

4.3 International trade impacts

Madagascar is known as a hub for illegal wildlife trafficking (IWT). IWT in Madagascar covers a vast array of terrestrial and marine flora and fauna species such as lemurs (Reuter et al. 2016, Bailey & Tobiason 2017), tortoises (Manjoazy et al. 2017, Schwarz et al. 2017), chameleons (Robinson et al. 2018), and rosewood (Ke & Zhi 2017). Ploughshare and radiated tortoises are prized targets for IWT in Madagascar, and it is thought that over 21,000 tortoises were exported in Asia between 2009 and 2016 (WWF 2018). In April 2018 10,000 tortoises were detected in a raid on an abandoned building

in a coordinated busted by led by DREF (Actman 2018, pers comm. S. Randrianjafizanka, National Geographic 2018). Trafficking and illicit activities often aggregate, sharing routes and buyer networks (UNODC 2016).

A promising recent development to address IWT in Madagascar comes in the form of a new partnership between WWF, TRAFFIC, and the Ministry of Justice with support from the US Fish & Wildlife Service. The aim of the partnership is to oversee the training of fifty magistrates, police officers, gendarme, border police, custom officers, and environmental officers, to provide heightened capacity building and awareness to ensure that the systematic condemnation of traffickers at all levels, as soon as their guilt is proven (WWF 2018).

Detecting smuggling activities is challenging, as traders are well informed of the flight routes that enable them to avoid luggage checks (Schwarz et al. 2017). One flight route used to smuggle animals to Bangkok is from Mahajanga, because this airport lacks baggage scanners, to Mayotte in the Comoros Islands, then on to Reunion Island, and from there to Bangkok (Kiester et al. 2013). Further inquiry into the how turtle products leave Madagascar (if at all) should focus on determining if such known routes are used.

It is possible that illegal take and trade of marine turtles is connected, or uses the same trade network and routes as other IWT, but we have not found any evidence of this to date, and suggest that it is of far lesser concern at present than is the domestic trade.

4.4 Illustrative feedback from key informants

Two particular interviews resulted in a number of interesting findings which help put the results of our rapid assessment, and the difficulties in assessing overall impact of the varied fisheries, into context. These are presented below in support of some of the arguments made in this Discussion.

4.4.1 CSP Mahajanga Feedback

One of the key people we spoke to during the survey was the Director of the Fisheries Surveillabe Center (CSP) in Mahajanga, from which several key points are notweworthy:

Commercial fisheries and turtle bycatch: CSP report that there are currently 39 Malagasy registered shrimp trawlers and that all (supposedly) had TEDs installed, and that all boats are inspected at the opening of the season in Mahajanga port. However, the Director reported that these vessels were known to wire the TED doors shut following the season's single inspection. This suggests that turtle bycatch rates may be significantly higher than what is reported in the literature, such as "Virtually all mortality from trawlers has ceased" in Razafindrainibe (2010).

The Director reported that CSP have an onboard observer program for the shrimp fishery and currently 30% of the Malagasy fleet had observers onboard every day of the season. In addition to this, there are currently 140 other vessels in the foreign fleet of which only 10% have observers onboard.

Illegal turtle take: The Director estimated that about six incidents per year occur in the region, and that approximately 600 kg of turtle meat are confiscated from vendors in markets in Antsaha Bigo, Cotema and near the port. He reported that raw turtle meat is transported into and around Mahajanga city by boat. The biggest constraint to enforcement of illegal turtle take is catching fishers in the act of fishing turtles to ensure they can be prosecuted.

In 2016 CSP Mahajanga intercepted a shipment of dried turtle meat being sent from Ambanja to Antananarivo. They found six full baskets (large baskets approximately 1.5m tall x 0.75m wide with more than 50kg each basket) of dried, smoked / salted turtle meat. They intercepted the shipment on the road between Ambanja and Antsohihy, as the dried turtle meat was being moved by local taxi-bus. They believe that the transporters / middle men had shipped products like this many times before. The offenders were released and the products were seized. This is the only record of dried turtle meat, with the exception of plastron ligament products, that we detected during our field work. When asked about plastron / ligament products the CSP was not aware and had not detected this type of product.

Export activities: CSP were not aware of illegal turtle take for the purpose of export. However, it falls within the jurisdiction of the Fish Quality Agency (Agence Sanitaire Halieutique, ASH) to inspect sea containers with marine products for export. CSP suggested that it would be difficult to label turtle meat as seafood products being exported by sea container, as this is closely checked by ASH and customs agencies. However, other shipping containers containing non-seafood products might have anything inside due to corruption.

The role of Dina: CSP were positive of the impact and importance of having well designed Dina in local communities, especially those with Locally Managed Marine Areas (LMMAs). CSP assist local communities when they are drafting the Dina to make sure that the proposed Dina mirrors and aligns with national policies. They report that a reoccurring management challenge for local communities relates to enforcing their Dina and justifying the spatial area that the Dina applies to. They gave an example of fishers from Ambalamanga poaching turtles on boundary lines or in neighbouring villages to escape the penalties of breaking their own village Dina.

Generally, it is the duty of the community association to handle the issue of a fisher breaking a Dina. But if it cannot be resolved locally, then the police and other authorities need to be involved, in which case the Dina rules are surpassed and the matter escalates to what is applicable at the level of the national laws. In some circumstances, the local community may not report to local authorities when a Dina is broken, not because the matter was dealt with but because the whole community is disregarding the rules. "*It's highly likely the whole community pretends to implement Dina regarding Fano (turtle) but actually they are all fishing turtles openly just not reporting or dealing with Dina issues to CSP and Peche*", reported the Director.

The Director considered the single biggest move to improve compliance to Dina and turtle protection laws would be to educate communities to stop hunting and consuming turtle, but that CSP didn't have time or jurisdiction for sensitisation/ awareness building. The government relies on NGO's to do this work. Thus, in areas where NGOs are not active or not focused on marine turtles, there is likely to be a huge deficit in awareness programmes.

4.4.2 Feedback from an artisanal maritime transporter

Notes from an artisanal maritime transporter and ex-fisher revealed the following information: Marine transport routes travel southward from Soalala, Maintirano, Besalampy, and it takes 4-7 days to sail from Maintirano to Mahajanga. The vessels from Analalava, Nosy Be, and Antsohihy which typically require 6-7 days to return back to Mahajanga. The vessels typically transport building supplies to these villages on the outward journey, and on the return passage to Mahajanga the wooden ship is filled with dried fish, semi-precious stones such as jasper and agate, or domestic belongings. The vessels also often transport shark fin and sea cucumbers. The small villages along the coast usually give their supplies to the large shipping dhows to sell on to middlemen/buyers in Amborovy, Mahajanga. The villagers put turtle meat in iceboxes and sell to transporters who then

sell it in Mahajanga. Chinese buyers purchase tortoises, crabs, shrimps, sea cucumber and shark fin, and he thought it was plausible they would buy marine turtle, but this was speculative.

The vessels (see Fig. 25 for an example) sail close to the coast and they often pass Chinese trawlers with Malagasy crews along the way. Whilst sailing along the south-routes, the respondent indicated he had never seen a patrol boat between Mahajanga and Maintirano.

The respondent indicated that targeted hunting of turtles was abundant using jarifa nets in Soalala, but suggested this was for just for local consumption. He confirmed that in Mahajanga city turtle meat could be purchased at Bazaar Mahabibo. He also relayed a story from 2016 when fishers from Ambatomanompa were hunting nesting turtles and their eggs. They would take the turtles, slaughter and chop them into portions and put these in ice boxes and sail back to Mahajanga. He also heard rumours of a middleman that was buying turtle meat using car or boat to bring it back to the city.

The respondent indicated that on the 15th of each month there is a shipping container vessel that comes to Mahajanga and is loaded up and heads back to China, filled with just about anything. There are apparently two main shipping boats from Mahajanga; those that go to Comores and those that got to China. They reportedly offer 4X4 vehicles and tricycles, or tuk-tuks, as bribes in exchange for assistance in their export businesses.

Figure 25: Artisanal transport vessels.

4.5 Management challenges

4.5.1 Application and enforcement of the law

Overall, there seems to be a large absence of respect for national laws, and awareness and capacity work is needed with a focus on officials and community leaders so they can spearhead efforts and

lead by example. The law is often dismissed by some local authorities under the understanding /notion that marine turtles have always been part of Vezo food (Lilette 2002).

Publicising widely any arrests and busts of turtle trafficking, illegal take and illness from consumption of turtle meat would benefit community perception of the seriousness and attitude towards respecting national legislation. News of the recent arrests of the group of fishers in Ambohibola had spread across much of the south coast and fishers cited it as an example of how turtle fishing was not tolerated by the government. As noted by Gardner et al. (2018) the difficulties experienced in enforcing the law in Madagascar are further hindered as neither the Madagascar National Parks (MNP) nor the new Protected Area promoters have authority to apply the law. Instead, serious infractions require managers to organise and fund field missions by a 'mixed brigade', comprising members of the gendarmerie, Ministère de l'Environnement, de l'Ecologie et des Forêts (MEEF) agents, local and municipal authorities and members of the protected area management committee. (Gardner et al. 2018).

4.5.2 Trafficking turtle plastron

It is unclear from our current surveys where the end destination(s) for turtle plastron products are and whether these products are exported out of Madagascar. Further work would also be beneficial to document the use of such product, in order to understand the demand and motives of buyers and the trade. To the best of our knowledge, this plastron / ligament trade has not been widely documented and appears exclusive to Madagascar. As is required for any wildlife crime, multisector collaboration between environmental departments, import/export sector and judicial system will be critical to mitigating such activities. This is likely to be an ongoing challenge for Madagascar.

In order to address this developing trade of turtle plastron, an increased level of information sharing between all sectors involved is strongly suggested. Limited capacity for detection is expected if authorities, customs agents are not given specialist training and motivated to detect such products. All efforts to enhance the forensic capacity of customs agents and law enforcement are central to detecting wildlife crimes (UNODC 2016). We suggest that information and images of turtle plastron products and known transit routes be widely disseminated to facilitate authorities in monitoring this trade.

4.5.3 Corruption

It has been thoroughly documented that widespread corruption within Madagascar facilitates wildlife crime (Humber & Hykle 2011, Jones 2012, Le Manach et al. 2012, Runhovde 2018). Two examples of corruption were recorded during the study, with one involving a fisheries authority with transit permits for shipping marine products, and the other an anecdotal account implicating complacency / accepting bribes in large international NGOs to not conduct thorough or repeat inspections at facilities known to stockpile sea cucumber, turtle plastron and shark fin.

Both turtle meat vendors in Mahavatse, Toliara confirmed police and or other authorities had made site inspections but no actions towards issuing fines or stronger forms of enforcement had been issued. Both vendors confirmed that officials had accepted turtle meat as a bribe, with one vendor saying some officials were part of her regular clientele. Complacency of officials to act on inspections and enforcing the law with regard to turtle meat vendors in Mahavatse, Toliara is likely to permit somewhere between 400-700 turtles per year to be sold as bushmeat given that each of the two vendors questioned during this survey described selling up to one turtle per day.

As noted by Lilette (2006), the widespread trade of the green turtles is an outcome of a lax enforcement of regulations due to indifference, corruption, and the desire of the law enforcement

agents to eat the prohibited game (Lilette 2006). Efforts to address these attitudes/longstanding issues are scarce or have proven to be ineffective to date.

4.5.4 Cultural sensitivity / bushmeat demand

Balancing the disharmony between the cultural significance of turtle for Vezo / migrant fishers and the national laws which prohibits turtle fishing has been a long-cited ongoing problem (Walker & Roberts 2005, Jones 2012, Humber et al. 2015). Attempts to reconcile this issue have been limited and there is a significant need for increased marine turtle conservation efforts to sensitise fishing communities (Humber et al. 2015).

Our results demonstrate a high demand for turtle as marine bushmeat. Paralleling the terrestrial bushmeat case, Rueter et al. (2016) documented a trend towards smaller bushmeat species that reflect scarcity of larger animals, a finding which was mirrored by our results with marine turtles. One potential management solution postulated to reduce demand for bushmeat is by using taboos to increase community compliance (Westerman & Gardner 2013). This could be a compelling strategy for reducing trade in turtles, given the (occasionally effective) fady against turtle meat sales.

Emphasis must be placed on establishing consistent long term collaborative partnerships to guide community based management, particularly in remote areas. In south of Madagascar we witnessed harmful relationships (miscommunication, distrust, lack of capacity) between authorities / NGOs and local communities. It appears that problems stemmed with conservation practitioners pushing national legislation without providing ample support and sensitisation to the community. For example, the village chief of Antsikoroke said they no longer welcome collaboration from WWF or Madagascar National Parks (MNP), making effective follow-up actions extremely challenging and opening up an opportunity for wildlife trafficking to become an appealing economic alternative.

Specific attention should be focused to the drafting, and implementing of Dina regarding conservation matters, as many existing Dina seem to contradict or conflict with national legislation (Humber et al. 2015). The current ongoing case of the group of turtle fishers from Ambohibola is a good example of this issue. The Ambohibola villagers and fishing association expressed confusion and frustration as to why the convicted turtle fishers were not given the opportunity to pay the turtle fishing fine of 300,000 MGA as agreed upon in the Dina, although they intended to sell each turtle at up to 450,000 MGA. Effective management is not likely to occur without community approval (Humber et al. 2011) and thus significant effort will need to be made to build/ restore relationships between community and the conservation sector, as well as general environmental awareness programmes.

6.0 Conclusions

It is evident that there is much follow-up work required to expand on our results presented in this report. Of particular importance to future efforts will be the need to undertake ample undercover investigatory work in the larger cities that are likely to act as trade hubs and export points for marine turtle products. We suggest that Tulear, Mahajanga, Diego Suarez and Antananarivo require additional work to determine finer scope details on the resale and export of the turtle plastron products, including how such products pass through the ports.

Our surveys across 153 fishers or fishery related workers and four management practitioners have provided a wealth of information on the turtle fishery and the potential impacts of both the commercial and artisanal fisheries on turtles.

We estimate over 3,500 marine turtles were extracted by the interviewees in our survey during the past 12 months alone, and extrapolations suggests that national level extraction could be of a magnitude of hundreds of thousands.

We do not believe the commercial shrimp industry is having a major impact on marine turtles, but further work in this area is warranted given the impact of shrimp trawlers on marine turtles elsewhere, and the proximity to shore in which they fish in Madagascar.

Similarly we do not believe that international trade in marine turtles in Madagascar is of a large scale and organised. We believe it is likely more an opportunistic issue, with domestic trade taking precedence over international sales. This is made all the more so by the dearth of hawksbills in the catches, which would otherwise be favoured as high value handicraft, with scutes more easily transported than whole animals.

There are no beaches within Madagascar that would support the production of sufficient hatchlings to support the number of juveniles, subadults and adults 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 Mozambique, where similarly large numbers of turtles are extracted each year.

Notwithstanding the current legislative status of marine turtles, the low income levels in Madagascar and the requirement for protein for sustenance mean that marine turtles are (and likely will continue to be) a favoured and extremely common commodity. Indeed, it is likely that marine turtles have been sustaining local communities for many years

However, what is unknown is whether 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 also important to note there remains a lack of clarity on where Madagascar turtles coming from – what are the nesting beaches that form the source of all the turtles found in Malagasy waters? These two key biological questions are particularly relevant, as answers to these might inform management agencies and assist in the design of conservation options, addressed in the following section.

7.0 Recommendations

Recommendations made herein are broken down into management and conservation related actions and biology / sustainability related issues.

7.1 Conservation & Management

1. Strengthen local traditional management approaches such as Dina and fady, and provide an opportunity for local communities to assume responsibility for enforcing traditional bans that support national legislation;
2. Conduct wide-ranging awareness campaigns on the legal status and conservation / management needs of marine turtles in Madagascar among coastal communities;
3. Increase exposure of incidences of poacher captures and turtle releases amongst coastal communities to heighten awareness of the illegality of the activities;
4. Conduct training of port and Ministry officials who are involved in the permitting and inspection process of outgoing shipments (both fish and non-fish-related) to better assess and control the export of illegal marine turtle products;

5. 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;
6. Develop a comprehensive Fisheries Act / tailored legislation that addresses both commercial and artisanal fishing and is compliant with CITES and CMS (including IOSEA Turtle MOU Requirements);
7. Digitise permitting systems for transport of fisheries products to minimise duplication or fake papers, possibly through a barcoding system or QR code instead of carbon paper;
8. Invest more heavily in marine enforcement facilities and in staff and station key resources at key fishery areas where marine turtles, sharks and other protected species are targeted;
9. Intensify enforcement of current existing national legislation;
10. Support undercover investigations which may provide greater insight into any illegal marine turtle export activities;
11. Develop programmes to eliminate corruption amongst enforcement officials to enhance implementation and enforcement of current existing national legislation;
12. Conduct studies to understand impacts and scale of IUU in the Mozambique channel and Madagascar's EEZ. There is an urgent need to collect a baseline information on IUU before an increase in foreign fishing vessels Madagascar EEZ occurs;
13. Investigate the opportunities for regional collaboration amongst countries who share the marine turtle stocks on which Malagasy fishers depend, for example, utilizing the expertise and resources of the Western Indian Ocean Marine Turtle Task Force of the IOSEA Marine Turtles MOU;
14. Explore the potential for alternative livelihoods as a means to reduce pressures on marine turtle stocks, for example, community-based ecotourism;
15. 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 marine turtle consumption for sustenance;
16. Establish an emergency fund for government agencies to act on IWT related to marine turtles and other marine products;
17. Seek support from NGOs and donor agencies to strengthen current conservation approaches, expand awareness- and capacity-building activities, and to design Dina that are effective in protecting marine turtle stocks.

7.2 Biology & Sustainability

1. Determine the provenance of marine turtles being taken out of Madagascar's waters (through genetic studies) and determine the overall productivity of these source rookeries, and other regional impact areas (e.g. Mozambique).
2. Expand the current rapid survey to a greater geographical area in order to refine the estimates of total annual turtle take in Madagascar (see also Section 7.3, below).
3. Conduct a thorough and national-level assessment of nesting marine turtles in Madagascar to understand their contribution to marine turtle stocks in Madagascar's coastal foraging grounds.
4. Conduct studies in Madagascar turtle foraging grounds to understand population size and structure;

5. Compile (and publicise) records of illness / death related to consumption of marine turtle meat;
6. Conduct detailed studies on species preference and selection by local fishers to understand impacts at a species-specific level;
7. Develop a holistic regional survival probability model of marine 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 marine turtles are being produced each year), natural survival probabilities, and marine turtle biology to determine the sustainability of the current harvests;
8. Conduct studies on the bycatch and survival prospects of marine turtles in the shrimp fishing fleets, and on the effectiveness of the Turtle Excluder Device programme;
9. Conduct studies on the bycatch and survival prospects of marine turtles in the tuna longline fishing fleets;
10. Understanding fisher migrations in response to increasing climate pressure or dwindling fish stocks and the resultant (increased) pressures on marine turtles;
11. Conduct experimental trials on bycatch mitigation in the longline industry, such as via circle hooks or bait choices.

7.3 Additional priority survey areas

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

Table X: Areas in need of additional surveys and/or preliminary baseline data.

Area	Known situation / Data available	Effort required
Fanambosa, Atsimo Andrefana	Mentioned during interviews in the area as a base for targeted turtle fishers.	Baseline surveys
Maintirano, Melakey	Villagers reported fishing turtle and selling to transporter who sail in large sail boats to Mahajanga.	Baseline surveys. Undercover investigation about products transported to Mahajanga for exports
Mahajanga Port, Boeny	Known to be a hub of corruption for IWT export for other species, and resources.	Undercover investigation about products transported and trafficking routes
Monrondava Atsimo Andrefana	Illegal take of Leatherback in Nov 2016 for local consumption reported (Williams 2017). Many fishers likely to target turtle stocks around Barren Islands and Juan De Nova.	Baseline surveys
Andavadoaka, Atsimo Andrefana	Illegal take of Leatherback in Nov 2016 for local consumption reported (Williams 2017). Report of house storing turtle plastron ligaments detected in late 2016.	Baseline surveys with fishers
St. Marie Island	No data available	Baseline surveys
Tamatave, Toamasina	No data on turtles available. Largest port, known for corruption and other products being smuggled out through Tamatave, closest to China.	Baseline surveys Undercover investigation about port exports
Radama Islands, Sofia	2016 reports of turtle poaching from WCS.	Baseline surveys to detect turtle

region	Reports of temporary turtle fishing camps through Radama Islands.	fishing camps
Analalava, Sofia region	Intensive turtle fishing by group of 30 fishers.	Baseline surveys Undercover investigation to identify trafficking route and partners
Barren Islands	Popular turtle fishing area for migrant fishers.	Baseline surveys to detect turtle fishing camps
Androka- Lavanono, Atsimo Andrefana	This is a remote stretch of the coast that was suggested that migrant fishers from Ambohihola go to fish turtles.	Baseline surveys
St Augustin, Atsimo Andrefana	Transit stop on way to Tulear from villages along the south coast.	Baseline surveys
Soalala, Boeny	No survey data available but this site was mentioned as where turtle fishers sourced the turtles they sell to Cotema, Mahajanga.	Baseline surveys
Diego Suarez, Antsirasana, Diana region	Baseline data available- this study and thesis (Rahantanirina 2018). Ei scutes bought in Nosy Be / Nosy Komba by buyers who sell on in Diego.	Follow-up surveys to elucidate trafficking network
Mainland NW coast (Ambanja to Diego), Diana region	Remote heavily mangrove area referenced in interviews conducted in this study who use beach seine or jarifa to target turtles.	Baseline surveys
Ambanja, Diana region	Confiscation of six large baskets of dried and salted turtle meat by CSP in 2016 (pers. com. CSP Mahajanga).	
Atapera, Anosy	Baseline surveys needed. Jarifa fishing abundant. Referenced as site of targeted fishing and domestic use during surveys in the Anosy region interviews.	Baseline surveys

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Annex I: Fieldwork itinerary

Date	Region	Activity type	Itinerary	Team
1/9/18	Antananarivo	Transit/ Arrival	Project team arrive in Tana for kickoff meeting.	1
2/9/18	Atsimo Andrefana	Transit	Antananrivo to Tulear	1
3/9/18	Atsimo Andrefana	Interviews and local approvals, meeting with MRHP, DREF + Reef Doctor	Mahatavse, Tulear	1
4/9/18	Atsimo Andrefana	Transit + interviews +	Tulear to Anakao	1
5/9/18-6/9/18	Atsimo Andrefana	interviews	Anakao village	1
7/9/18	Atsimo Andrefana	Transit + interviews	Anakao to Itampolo, via Beheloky and Ambola	1
8/9/18-9/9/18	Atsimo Andrefana	Interviews + management meeting with MNP	Itampolo	1
10/9/18	Atsimo Andrefana	Transit + interviews	Itampolo to Androka, via Antsikoroke and Ambohibola	1
11/9/18	Atsimo Andrefana	Interviews	Ambohibola	1
12/9/18	Atsimo Andrefana	Transit	Ambohibola to Lavanono	1
13/9/18-14/9/18	Atsimo Andrefana - Androy	Interviews	Lavanono	1
15/9/18	Androy	Transit + interviews	Lavanono to Faux Cap	1
16/9/18	Androy to Anosy	Transit	Faux Cap to Fort Dauphin	1
17/9/18	Anosy	Interviews and local approvals with MRHP, MIHARI network	Fort Dauphin	1
18/9/18	Anosy	Transit + interviews	Ambinany Be, Fort Dauphin	1
19/9/18	Anosy	Transit + interviews	Analapsy II + Arabaraba	1
20/9/18	Anosy	Transit + interviews	Lokaro	1
21/9/18-22/9/18	Anosy	Data entry + Logistics	Fort Dauphin	1
23/9/18	Anosy - Antananarivo	Transit	Fort Dauphin - Antananarivo	1
24/9/18	Antananarivo to Boeny	Transit	Antananarivo - Mahajanga	1
25/9/18	Boeny	Interviews	Antsa Bigo, Mahajanga Port	1
26/9/18	Boeny	Interviews + Management interview with CSP	Petite Plage + CSP	1
27/9/18	Boeny to Diana	Transit	Mahajanga to Nosy Komba	1
28/9/18	Diana	Interviews	Antitoro + Antamotamo, Nosy Komba	1
29/9/18	Diana	Interviews	Andria Be, Nosy Komba	1
30/9/18	Diana	Anonymous informants	Nosy Be	1
1/10/18-2/10/18	Diana	Data Entry	Nosy Be	1
3/10/18-5/10/18	Madagascar to Mozambique	Transit	Return to Mozambique via South Africa.	1
8/9/18-	Sofia, Antsiranana	Interviews	Nosy Suarez + Androvohonko	2

9/9/18				
15/9/18-16/9/18	Sofia, Antsiranana	Interviews	Ambodivahibe	2
22/9/18-23/9/18	Sofia, Antsiranana	Interviews	Ambolobozokely	2
27/9/18 – 28/9/18	Sofia, Antsiranana	Interviews	Bay of Diego Suarez	2

*Field team 1: Jess Williams, Michel Strongoff
Field team 2: Amelie Landy Soambola, Moise Andriantsoly Amada Regis Nelson and Ahmed Moustoifa.

Annex II: Interview questions for fishing communities

CHARACTERISING THE LEGAL AND ILLEGAL TRADE OF MARINE TURTLES IN MADAGASCAR

Interviewer name: _____Translator_____
Location (village, town, region):_____
Date: _____Language_____
Survey number: _____
Latitude: Longitude:
Waypoint 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. Started in year:____

iv. Number of fishers in village

v. Village population size:

vi. Target catch:

vii. Where is the fish sold?

viii. Where is your usual fishing area?

B. MARINE TURTLES IN MADAGASCAR

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.a. Can you ID turtle species (Y/N) if Y;

b. Please indicate how frequently you have seen each species of marine turtle

	Every day	Every week	Every month	Every year	Not seen	Can't quantify
Green						
Loggerhead						
Hawksbill						

4. a)

Leatherback						
Olive Ridley						
Not differentiated						

Please indicate how your sightings of marine turtles have changed:

Trend	A) In past 5 years	B) Over fishing career/ life time
Increasing		
Decreasing		
Stayed the same		
Don't know		
Comments:		

5. Why do you believe this is so? _____

6a. Have you seen any stranded sick or dead carcasses? Y/N

6b. What happened to the carcasses/turtles:

6c. What state were they in: freshly dead/ decomposed/ bones or shell only

7. Have you heard of people in your village that have eaten turtles that they found washed up dead?

C. INCIDENTAL CAPTURE OF MARINE TURTLES IN SMALL SCALE FISHERIES

8a.Have you ever been fishing and when you pulled up the net/line/trap a turtle was there? (Y/N)

b. do you know if this has happened to others in your fishing area/ village? (Y/N)

b. in which gear type:

9a.how many times has this happened? _____

b. How often does this happen? (Daily, weekly, monthly, yearly. (*Specify number or range*):_____

c. How many turtles per occasion_____

d. what size are these turtles? (XS, S, M, L, XL)?_____

e. Is this continuous or sporadic? (circle one), is there season, or certain months of the year_____

10. What happens to the turtles caught *incidentally*?

Fate of turtle	**Personally**	**By others in community**
Released alive		
Kept and used for food		
Sold locally for food		
Sold to a buyer/ middle man/ foreigner		
Used traditionally for craft or medicine		
Shipped overseas: list countries		
Other:		

D. USE AND TRADE OF MARINE TURTLES <u>IN THE COMMUNITY</u>

11a. Have you ever eaten turtles or their eggs (Y/N)

b. or heard of others who do? (Y/N)

c. if yes, here in this village (Y/N) or another area:_____

12b. Have you ever seen (Y/N) or heard of (Y/N) marine turtle meat, eggs or products being sold or traded in your community and surrounding areas?

13. In your local waters, are turtles targeted *intentionally* by members of the community? (Y/N)

14a.how many times has this happened? _____

14b. How often does this happen? (Daily, weekly, monthly, yearly. (*Specify number or range*):_____

14c. How many turtles per occasion_____

14d. what size are these turtles? (XS, S, M, L, XL)?_____

14e. Is this continuous or sporadic? (*circle one*), is there season, or certain months of the year_____

15. 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): _____

16. Please indicate how frequently marine turtle meat, whole turtle, eggs or products are sold/traded for each of the following locations in your community: (*specify quantity or range*)

	Never	daily	weekly	monthly	yearly	In a season (specify months)
Aboard fishing boats						
At a port						
Fish markets						
Other market						
In homes in the community						
Other location:						

17. 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_____

18. Please indicate how the following marine turtle items are usually exchanged (select all that apply):

	Purchased/sold	**Price (per kg or item)**	**Exchanged/traded**	**Don't know**	**Supplier A/B/C/D/E/F**
Meat					
Eggs					
Carapaces/ turtle shell products					
Live turtles					
Other turtle prodcuts					

KEY FOR TABLE

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)

19. Do the marine turtle meat, eggs and products from your community get sent to other parts of Madagascar? (Y/N) please list destinations: _____

20. Please list the types of items sent to other parts of Madagascar (e.g. meat, eggs, carapaces, whole turtles, etc):_____

21. Why do you believe people would choose to trade locally in marine turtle meat, eggs and products?

22. Please indicate how the trade of marine turtle meat, eggs or products **in your community** and surrounding areas has changed in past 5 years (specify a reason so in each box)

	Increasing	Decreasing	Stayed the same	Don't know	Not found here
Meat					
Eggs					
Carapaces/ shell products					
Live turtles					
Other products:					
Same over life time? (Y/N)	Comments:				

23a. 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)

23b. Why do you believe that this is so? _____

D. USE AND TRADE BY FOREIGNERS

24a. Have you seen foreign fishers (Y/N)?

- Where:_____
- When:_____
- Fishing for:_____
- Using which fishing gear: _____

b. Have you seen foreign vessels((Y/N)?

- Where:_____
- When:_____
- Fishing for:_____
- Using which fishing gear: _____

25a. Are there foreign buyers (of fish or marine species) in your area? (Y/N)

b. How many (people or companies)?

c. What products do they buy (please list):

d. Do you know the price per kilo/ item:

e. Do they buy turtles or turtle products? (Y/N) describe:

f. what size turtles? (XS,S,M,L,XL)

OTHER DETAILS?

26a) In your local waters are there foreign fishers (Y/N), do they target turtles (Y/N)

b) Where do these people come from?

27a.how many times have foreign fishers caught turtles in your area? _____

27b. How often does this happen? (Daily, weekly, monthly, yearly - *Specify number or range*):_____

27c. How many turtles per occasion? _____or total (specify number over time-frame)_____

27d. what size are these turtles? (XS, S, M, L, XL)?_____

27e. Is this continuous or sporadic? (*circle one*), is there a season, or certain months of the year (Specify months)_____

28. What do you believe happens to the turtles caught *on purpose* 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): _____

29. In your local waters, are marine turtles caught *incidentally* by foreign fishers? (Y/N) and with which fishing gear?

30a.how many times have foreign fishers *incidentally* caught turtles in your area? _____

30b. How often does this happen? (Daily, weekly, monthly, yearly - *Specify number or range*):_____

30c. How many turtles per occasion? _____

Or total (specify number over timeframe)_____

30d. what size are these turtles? (XS, S, M, L, XL)?_____

30e. Is this continuous or sporadic? (*circle one*), is there season, or certain months of the year (Specify months)_____

31. What happens to the turtles caught *by mistake* by foreign fishers?
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): _____
32. What makes you think this?

E. MARINE TURTLE EXPORT

33. Does the marine turtle meat, eggs and products from your community get sent to other countries outside of Madagascar? (Y/N) please list destinations:

_____

34. Please list the types of items sent to other countries (e.g. meat, eggs, carapaces, whole turtles, etc):

_____

35. Please estimate how many turtles (or eggs) (or kgs or meat) are exported (e.g. daily, weekly monthly, etc):
_____
_____

36. How often does this happen? E.g. daily, weekly, monthly, etc: _____
37. How do people export the turtles/turtle parts?
38. Please indicate how the trade of marine turtle meat, eggs or products **for EXPORT** has changed in past 5 years (specify a reason so in each box)

	Increasing	Decreasing	Stayed the same	Don't know	Not found here
Meat					
Eggs					
Carapaces/ shell products					
Live turtles					
Other products:					
Same over life time? (Y/N)	Comments:				

39. Why do you believe people would choose to export marine turtle meat, eggs and products?

40. 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)

41. Why do you believe that this is so?_____

Annex III: Interview questions for management executives

Illegal take, trade and export of marine turtles in Madagascar.

Acting on CITES Decision 17.222 and 17.223 this work is being undertaken throughout August 2018 - October 2018. The specific objectives of the study are (a) to provide a global overview of the status, scope and trends of the international trade in the seven extant, CITES-listed species of marine turtles; (b) to achieve a better understanding of the current and potential conservation impacts associated to current trade levels; (c) to identify management options; (d) to identify areas where immediate mitigation efforts may be needed; and (e) to encourage communication among CITES and its key partners, optimizing resources and enhancing synergies.

The information you provide in this questionnaire will contribute towards the national country-level overview for Madagascar, and a parallel study is occurring in Mozambique. If you do not have an answer, please describe a brief response e.g. I don't know or not relevant in my area.

Email address: *

A. What is the name of your organisation? *
B. What is your current position here? *
C. How long have you been in your current position? (years) *.
D. Geographic scope of your work? Please specify regions or towns, MPAs or other.
E. E. Your expertise comes from which of the following sectors? *

- [ ] Academic research
- [ ] Government research
- [ ] Fisheries management
- [ ] Policy making
- [ ] NGO
- [ ] Consulting
- [ ] Other:

1. Have you ever seen or heard of marine turtle meat, eggs or products being exported to other countries outside Madagascar?

- ○ Yes
- ○ No
- ○ Unsure
- ○ Other:

2a. Have you ever seen or heard of OTHER marine products being exported to other countries outside Madagascar?

- ◯ Yes
- ◯ No
- ◯ Unsure
- ◯ Other:

2b. If Yes, please list types of marine products (i.e. shark n, sea horse....)

3. Is marine turtle meat or other turtle products sold within Madagascar? Is it transported internally?

4. In your opinion, which is more abundant in terms of numbers of turtles involved (tick all that apply)

- ◯ Personal consumption
- ◯ Domestic sales
- ◯ Export market
- ◯ Other:

5a. Do you believe or have evidence that suggests marine turtle trade of products, turtle parts or whole alive turtles is linked with other Illegal Wildlife Trafficking (IWT)?

- ◯ Yes
- ◯ No
- ◯ Unsure
- ◯ Other:

5b. If yes, what makes you think so?

6a. Please indicate how the following marine turtle items are usually exchanged or used (select all that apply)

	Bought / sold	Traded / exchanged for other goods?	Both exchanged and sold	Don't know	Personal consumption	Not applicable	Traditional medicine	Traditional beliefs
Turtle meat								
Turtle eggs								
Carapaces / turtle shell products								
Whole alive turtles								
Other products?								

6b. If you filled in a response above for 'other product' please describe what type of product you are referring to?

7. Do you know the price per item, or kilo that turtle products sell for? Please specify a price or price range for: turtle meat, eggs, carapace products, live turtles, other turtle products. Is price based on size classes i.e. small, medium or large? If yes, please specify:

8. Do you know who are the MAIN suppliers of marine turtle meat, eggs and products that are exported

- [ ] Local fishers from the community
- [ ] Local non fishers from the community
- [ ] Malagasy fishers from outside community
- [ ] Malagasy non-fishers from outside community
- [ ] Foreign fishers
- [ ] Others:

9. Where do live turtles, their meat, eggs or products get sent within Madagascar? Please describe domestic routes that you know or think could be involved in turtle trade. Or name specific locations/towns

10. Please tick the types of items sent to other countries

- [ ] meat
- [ ] eggs
- [ ] carapaces
- [ ] whole turtles
- [ ] Other...

11. To which countries do these products get sent to?

12. Do you know how the turtles or products are transported to these countries? Please describe all the means of transportation involved in this trade route.

13. How are such products packaged for transit or shipping? Please describe packaging materials, or processing techniques used to transport such products. e.g. meat is cut into portions, smoked and packaged into a sack to be shipped to a middle man, or eggs are disguised as duck eggs and are exported under a license for duck eggs.

14. Why do you believe people would choose to export marine turtle meat, eggs and products? Please consider the following factors in your response; Monetary value, delicacy, tradition, religion, foreign demand, lack of alternative livelihoods, opportunistic use of bycatch.

15a. Please indicate how the export of marine turtle products has changed in the last five years, if at all:

	Increasing	Decreasing	Stayed the same	I don't know
Turtle meat				
Turtle eggs				
Carapaces/ turtle				

shell products				
Whole alive turtles				
Other products?				

15b. If you answered the question above for 'OTHER TURTLE PRODUCTS' please describe the particular product you are referring to:

15c. For the item(s) where you believe export has INCREASED, please suggest a reason as to why this might be happening:

15d. For the item(s) where you believe export has STAYED THE SAME, please suggest a reason as to why this might be happening:

15e. For the item(s) where you believe export has DECREASED, please suggest a reason as to why this might be happening:

Enforcement and management priorities

16. Is it illegal to intentionally kill sea turtles in Madagascar?

- ○ Yes
- ○ No
- ○ Don't know
- ○ Other...

17. Is it illegal to accidentally kill a sea turtle? e.g. caught by mistake in a net but the animal is found dead.

- ○ Yes
- ○ No
- ○ Don't know
- ○ Other...

18. Are fishers required to report an accidental turtle mortality to the authorities?

- ○ Yes
- ○ No
- ○ Don't know
- ○ Other...

19a. Are any areas routinely / periodically patrolled?

- ○ Yes
- ○ No
- ○ Don't know
- ○ Other...

19b. If yes, are penalties ever imposed? (Frequently, Infrequently, Never, Don’t know)?

- ○ Frequently
- ○ Infrequently
- ○ Never
- ○ Don't know

20. Do you have any relevant comments about patrolling, enforcement or application of penalties?

21a. Does your agency have specific programs in place to deter, mitigate and/or manage sea turtle capture and trade?

- ○ Yes
- ○ No
- ○ Don't know
- ○ Other...

21b. 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:

- ☐ enforcement of license/permit system
- ☐ vessel monitoring system (VMS)
- ☐ catch monitoring programs for target and non-target species
- ☐ maintaining publicly available sea turtle capture and trade vessel blacklists
- ☐ port inspections
- ☐ awareness and education campaigns
- ☐ Other...

22a. In your opinion, how effective have these programs been in reducing the number of incidents of sea turtle captures and trade in Madagascar? Choose one only: a. Completely ineffective, b. Somewhat ineffective, c. Somewhat effective, d. Very effective, e. Don't know

	1	2	3	4	5	
Completely ineffective	○	○	○	○	○	Very effective

22b. Please provide an explanation as to why you think this is so:

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

24. 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:

25. Please estimate how many incidents of sea turtle capture and trade occur yearly in the AREAS YOU WORK within Madagascar.

	Never	1 per year	Less than 10	11 to 50	51 to 100	More than 101	I don't know
Capture of turtles (intentional/ targeted)							
Capture of turtles (accidental/ bycatch)							
Trade of turtle (domestic market/ local use)							
Trade of turtle (export for international market)							

26a. Please estimate how many incidents of sea turtle capture and trade occur yearly for Madagascar on a NATIONAL SCALE.

- ○ 1 turtle per case
- ○ 2 - 10 turtles per case
- ○ 11 - 20 turtles per case
- ○ 21-50 turtle per case
- ○ more than 50 turtles per case.
- ○ Other...

27. 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: 1. No threat to turtles, 2. Minimal threat to turtles, 3. Moderate threat to turtles, 4. High threat to turtles, 5. Very high threat to turtles

	1	2	3	4	5	
No threat	○	○	○	○	○	Very high threat to turtles

28. How important is it to your agency to address the sea turtle capture and trade problem? Choose ONE only: 1. Not a priority, 2. Low priority, 3. Moderate priority, 4. High priority, 5. Very high priority

	1	2	3	4	5	
No threat	○	○	○	○	○	Very high threat to turtles

29. To what extent do you believe that reducing sea turtle capture and trade is a government priority in Madagascar? 1. Not a priority, 2. Low priority, 3. Moderate priority, 4. High priority, 5. Very high priority

	1	2	3	4	5	
No threat	○	○	○	○	○	Very high threat to turtles

30. In your opinion, when people are caught doing sea turtle capture and trade, how often are they formally punished? Choose ONE only: 1. Never, 2. Rarely, 3. Sometimes, 4. Frequently, 5. Very frequently

	1	2	3	4	5	
No threat	○	○	○	○	○	Very high threat to turtles

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

Legislation effectiveness and application

31a. Are there laws related to DOMESTIC trade in sea turtles and/or their products?

- Yes
- No
- Don't know
- Other...

31b. If so, who is in charge of implementing / enforcing these laws?

32a. Are there any challenges to implementing these regulations?

- Yes
- No
- Don't know
- Other...

32b. If yes, what are these?

33a. Are there laws related to INTERNATIONAL trade in sea turtles and/or their products?

- Yes
- No
- Don't know
- Other...

33b. If so, who is in charge of implementing / enforcing these laws?

34. Are there any challenges to implementing these regulations?

- Yes
- No
- Don't know
- Other...

Final Comments

35. Is there anything related to illegal take or trade of sea turtles in Madagascar that you would like to share, that hasn't been covered in the questions above?

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.

Fishers could have omitted incriminating information in our 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 estimation on the topic. 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.

The limited timeframe and funding allocated to conduct this work significantly impeded our ability to conduct a rapid assessment over a larger geographic area, and many existing data gaps are evident. With regards to logistics, whilst in the field our survey efforts were limited by poor quality access roads and road conditions, and by it not being safe to travel at night. Our attempts to survey the jarifa fishing village of Atapera in Anosy region (where we believe turtle take and trade also occur) were unsuccessful due to the remote nature and bad access routes (no suitable bridge to cross a waterway).

Unfortunately, we were also limited in our opportunity to survey offshore islands, which are likely to be a hub for fishing activities whether clandestine or not. It is believed that Madagascar's offshore islands host the majority of nesting turtle activity (Humber et al. 2016), and future efforts should prioritise comprehensive surveys of offshore islands especially given the limited capacity of authorities to patrol or enforce in these areas. Many fishers are highly migratory and are at sea for weeks at a time. This added additional challenges to us in Nosy Komba and Mahajanga where all the fishermen of some villages were away and only women and children could be found.

Qualitative survey methodology does not always render well to producing quantitative estimates that can be extrapolated to regional and national scales, especially when interviewing participants with low literacy levels. For example, fishers struggled to quantify how often they saw turtles at sea. 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 Malagsy and change terms into the local dialects to facilitate comprehension of the question. We must also consider any issued to our interpretation of the data brought about through translation bias and errors. Whilst unavoidable, caution should be made when reinterpreting translated data. One particular issue of misinterpretation was identified halfway through surveying in Southern Madagascar. We became aware that fishers were having difficulty understanding the concept of targeted vs. non-targeted hunting. Fishers did not classify themselves as targeting turtles but when they described the way turtles were captured it suggested intentional target i.e. using a line with a large hook and lassoing turtles resting at the surface.

Given the limited time available we chose to focus our surveys to particular regions where turtle trade hotspots had already been identified (see Section 3.6). It was not possible to survey the eastern coast of Madagascar during this study. We were able to collect very limited data for the southeast coast from focal points, and thus limited our survey time in this region. Expansion of surveys in this region should be strongly considered in follow up work.

Unfortunately, our management surveys yielded limited responses. However, we believe there is the literature we have noted and cited above provide suitable insight into the hindrances towards effective conservation management in Madagascar.

Annex V: Acknowledgements

Name	Organization	Position	Location	Support Provided
Anthony Bracke	Opti'Pousse Haie	Director	Analalava	Information
Bemitera	Opti'Pousse Haie	Unknown	Analalava	Information
Gaetan Tovondrainy	WWF	SOUTHWEST coordinator	SOUTHWEST Madagascar	
Jaonerav	Madagascar National Parks	Unknown	Androka	Information
Taylor Veriza	Madagascar National Parks	Unknown	Androka	Information
Prof. Berthin Rakotonirina	Antananarivo University	Professor	Antananarivo	
Anjara Saloma	Cétamada	Scientific leader	Antananarivo	Information
Patricia Davis	Community Centered Conservation (C3)	Director	Antananarivo, Diego Suarez	Information
Lala' Lalarisoa Rakotoarimino	C3	Project coordinator	Antananarivo, Diego Suarez	Information
Amelie Landy Soambola	University of Antsirasana	Responsable du Parcours Sciences Marines/Faculté des Sciences.	Antsiranana	Field team coordinator-Antsiranana
Moise Andriantsoly Amada Regis Nelson	University of Antsirasana	Student	Antsiranana	Data collection
Ahmed Moustoifa	University of Antsirasana	Student	Antsiranana	Data collection
Gio Ramora	Ministry of Halieutic Resources and Fisheries (MRHP)	Regional Director - Anosy Region	Fort Dauphin	Local approvals
Justin Retenany Vahoavy	Centre de Surveillance des Peches Mahajanga (CSP)	Chef de service logistique et Armement	Mahajanga	Interviewed
Al Harris	Blue Ventures	Director	Maintirano, Toliara, Ambanja	Information
Chris Scarffe	Chris Scarffe Filmmaker	Founder	Nosy Komba	Information, logistics, photos
Michel Strongoff	Chris Scarffe Filmmaker	Assistant photography, filmmaking and fixer	Nosy Komba	Field support, logistics, information, photos
Anjara Salomavola	Cétamada		St. Marie	Information
Vatosoa Rakotondrazafy	MIHARI	President	SOUTHWEST coast	Information, community contacts
Pascal	MIHARI	Vice President	Tolagnaro / Fort Dauphin	Focal Point
Emma Gibbons	Reef Doctor	Director	Tulear	Information, community contacts
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Jamal Mahafina	Institute Halieutique et des Sciences Marines (IHSM)	Director	Tulear	information
Dr. Gildas	ISHM, University	Senior Lecturer	Tulear	Information, contacts

Todinanahary	of Toliara			
Dr. Mamy Rakotoarijaona	Madagascar National Parts		Atsimo Andrefana region	Contacts, site approvals
Jean Barnabe Ravelomanankavamd	Ministry of Halieutic Resources and Fisheries (MRHP)	Chief Tulear, Zones 1 + 2	Tulear Province	Interviewed, information
Fran Humber	Blue Ventures		UK / Madagascar	Information
Jeremy Kiszka	Marine Sciences Program, Florida International University		USA / Madagascar	Information
Fifou Mayer	Cétamada	Scientific administrator		Information
Prof. Maharavo Jean	CNRO - National Centre for Oceanography, SOUTHWEST Madagascar		Nosy Be	