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Endangered, essential and exploited: How extant laws are not enough to protect marine megafauna in Madagascar

Frances Humber [a,b,*,1], Mialy Andriamahefazafy [a,1], Brendan John Godley [b], Annette Cameron Broderick [b]

[a] Blue Ventures Conservation, Omnibus Business Centre, 39-41 North Road, London N7 9DP, UK
[b] Centre for Ecology and Conservation, College of Life and Environmental Sciences, University of Exeter, Cornwall Campus, Penryn TR10 9FE, UK

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ABSTRACT

The decline of many marine megafauna species is of global concern; but many of these species, in particular marine mammals, have been afforded international and national protection and are the focus of conservation programmes. The existing national and international legislation are reviewed through which marine megavertebrates are afforded protection in Malagasy waters. The decline and protection of marine megafauna has followed a familiar pattern in Madagascar, with two main exceptions: marine turtles and elasmobranchs remain heavily exploited by national and international fishing fleets. The status of legislation governing both taxa is unclear and unknown by many working within the fisheries and marine sector. In Madagascar, marine turtles are fully protected from exploitation by national regulations in conjunction with a number of multilateral agreements. The numerous pieces of legislation that protect marine turtles are not coherent, regularly misunderstood and rarely enforced. Madagascar is taking steps to improve protection of marine turtles through the development of a national strategy, but it is recommended that the opportunity is also taken to improve understanding of current legislation and work more closely with local communities that consider turtle fishing a customary practice. Elasmobranchs however, receive minimal legal protection and only those listed under multilateral agreements are bound by any potential future management. Where legislation does exist to help manage elasmobranchs (eg. bycatch stipulations for foreign fishing vessels) it is incomplete and difficult to enforce. It is also recommended that Madagascar puts in place national elasmobranch legislation to help prevent their continued overfishing, especially in the face of increasing numbers of elasmobranch species on CITES and CMS. As such, both groups of species are rendered effectively unprotected and are in danger of overexploitation. With the growth and proliferation of locally managed marine areas (LMMAs) in Madagascar the potential for local communities to increase protection and management of these species should be considered, especially with the limited capacity available to monitor and enforce legislation along such a vast coastline.

1. Introduction

Fisheries exploitation is not limited to finfish and invertebrate species but in many countries also includes megafauna [1–3]. Populations of large marine animals are estimated to have declined by 89% from their historical baseline, with rapid declines related to overexploitation [4]. The hunting of cetaceans, dugongs and marine turtles was historically much higher, although exploitation still continues today at reduced levels, due in part to an increase in protective legislation [5–7]. In contrast, the take of elasmobranchs has increased rapidly over the last half of the 20th century as the demand for shark fins from Asia became a major driver for the expansion of these fisheries [8,9], and are targeted by numerous small-scale and industrial fisheries [10–12].

Whales, dolphins, dugongs, elasmobranchs (including sawfish), and marine turtles are found in Madagascar's waters, and include many species of global conservation concern [13]. Humpback whales (*Megaptera novaeangliae*), for example, are known to migrate along the east and west coasts of Madagascar, but they have not been historically targeted by fishers and currently receive full legal protection from exploitation by Decree 93-022, as do all marine mammals (Supplementary material Appendix S1). Dolphins appear to only be targeted opportunistically in a few isolated locations,

* Corresponding author at: Blue Ventures Conservation, Omnibus Business Centre, 39-41 North Road, London, N7 9DP, UK. Tel.: +44 20 7697 8598.
E-mail addresses: fran@blueventures.org (F. Humber), mialy@blueventures.org (M. Andriamahefazafy), B.J.Godley@exeter.ac.uk (B.J. Godley), A.C.Broderick@exeter.ac.uk (A.C. Broderick).
[1] These authors made equal contributions to the manuscript.

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primarily by *Vezo* fishers in southwest Madagascar [14,15]. Dugongs (*Dugong dugon*) and sawfish (family Pristidae) were historically targeted by fishers but are now thought to exist at such a low level in Madagascar that any exploitation is likely to be negligible [15]. Dugongs have been also protected since 1961 (Decree 61-096).

However, elasmobranchs (excluding sawfish) and marine turtles continue to be heavily exploited directly, through targeted fisheries and as bycatch in Madagascar's fisheries [16–18]. Both groups of species are of growing international concern and therefore included within a number of multilateral agreements (Convention on International Trade in Endangered Species of Wild Flora and Fauna, CITES; Convention of Migratory Species, CMS; Inter-American Convention for the Protection and Conservation Sea Turtles, IAC).The need, in particular, for better protection and management measures for elasmobranch species within multilateral agreements has been recognised [19]. Both groups of animals are considered keystone species, playing an important role in healthy ecosystem function, with declines in elasmobranch population numbers linked to decreases in overall health of coral reefs [20,21], and marine turtle populations important in the maintenance of seagrass beds and coral reefs [22].

Turtles receive significant protection nationally and internationally, with all seven species on the IUCN Red List [13] and the conservation of turtles and their habitats addressed in numerous multilateral agreements [23]. Only 42 countries permit any take of turtles as of 2013 [7]; but illegal take continues in many countries, often against a backdrop of a strong cultural fishery, or legislation that is not appropriate or implemented properly [24,25].

Elasmobranch fisheries, in particular shark, have historically had very few management measures globally, and despite anti-finning legislation in a number of regions, there has been no apparent decline in the shark catches or the fin trade [26], although a recent decrease in demand for shark fin has been reported in China [27]. Growing concern on the status of elasmobranch populations has led to a recent increase in legislation and protection for elasmobranch species and populations. Five new shark species (of which *Sphyrna lewini*, *S. mokarran*, and *Carcharhinus longimanus* are extant in Madagascar's waters) and all *Manta* spp. (currently 2 species) entered CITES Appendix II in 2014 [28]. They joined three shark species (two of which are found in Madagascar's waters: *Rhincodon typus* and *Carcharodon carcharias*, added in 2003 and 2005 respectively) and the sawfish family (family Pristidae added in 2007) already listed. Further management and protection have also gained traction in recent years with new protected areas put in place for elasmobranchs and changes in government policies [29,30].

Both groups of species are exploited by the same groups of traditional and artisanal fishers along the majority of Madagascar's coastline [16–18,31], and are important fisheries within Madagascar. The marine turtle fishery is also culturally important, with traditions linked to ancestor worship [32,33] whilst the elasmobranch (primarily sharks) fishery has been fuelled by the high prices for shark fins in comparison to other marine resources [34]. Exploitation of sharks has increased as fishing pressure has increased with population growth and ecosystem degradation [34,35]; whilst traditions associated with marine turtle fishing have been eroded, reducing traditional resource management [36]. Despite this, marine turtle landings appear to have remained at constant levels since the 1970s [16,32,33,37]. The level of shark fishing in Madagascar is unclear; national export figures for shark fin show a steady increase since the early 1980s, with peaks in the mid-1990s and mid-2000s [15,34,38]. However, these figures are only for national fishing and do not include any sharks taken by foreign fishing vessels, and discrepancies with import data are known (G. Cripps pers. comm.). Indeed, a recent World Bank study highlighted the 'incoherent and ambiguous' legal framework that currently governs Madagascar's fisheries sector [39].

This paper aims to review past and current legislation in Madagascar relating to the protection and management of marine turtles and elasmobranch populations in face of current levels of exploitation and reports of declines, and presents recommendations for future management.

2. National legislation

2.1. How legislation is implemented in Madagascar

Legislation in Madagascar follows the French hierarchy of texts (Table 1). The constitution in Madagascar is the highest text and sets the principles governing the country (including the protection of the environment). The constitution can only be revised in cases declared urgent by the President of the Republic or by the Parliament (Articles 161-163) [40]. Revisions of the constitution have occurred eight times since 1960, often marked by a change in regime, with the last one in 2010 [41]. Any treaties or international conventions (e.g. Ramsar, The United Nations Framework Convention on Climate Change, CITES) have an authority superior to the national law once ratified (Article 137) [40]. Laws and ordinances, that can only relate to national issues, are created by the parliament and government (e.g. national fisheries or forestry); and decrees are then adopted by Ministries to provide details in order to implement the above laws (e.g. setting up a list of protected species, penalties). If further details are required to govern specific aspects or topics at the national or regional level (e.g. fishery closure dates), the adoption of orders by administrative authorities is required. In addition, within Madagascar, *Dina* (a community level agreement that rules behavior among those that have agreed to it, permitting and prohibiting activities including those related to natural resource management), can be legally recognised through validation via the courts, or as part of defined contractual management transfers and co-management of renewable natural resources [42] (see Section 2.5 for further information).

Table 1
The hierarchy of legislation within Madagascar (with 1 being the highest).

Text (Official title in Madagascar)	Set up by	Adopted by	Enforced by
1. Constitution	Government	The Malagasy population	High Constitutional Court
2. Ratified international conventions	Member states of the conventions	The President of the Republic after validation at the High Constitutional Court	Relevant governmental departments and national police (often outlined in implementing texts)
3. Laws and ordinances (Loi et Ordonnance)	Government departments	Parliament/the President of the Republic if authorised by the parliament	National judicial authorities/concerned government departments
4. Implementing decrees (Décret)	Government departments	Government	National judicial authorities/concerned government departments
5. National and regional orders (Arrêté)	Government departments/ regional authorities	Governmental departments/regional authorities	National and regional judicial authorities
6. *Dina*	Community	Community and validated by a judicial court	Community

2.2. Earliest texts

The first national legislation on either group of species was in 1923 (Table 2; Supplementary material Appendix S1). Two pieces of legislation were passed to protect a number of known marine turtle nesting sites and to forbid the capture of nesting females (Table 2). These were one of the first legal tools that specifically addressed the protection of any marine animal or resource in Madagascar, but no records exist of penalties being awarded for offences to either order. The material within these texts is now outdated, yet has not been officially overruled by more recent legislation, nor has the content been renewed. All marine turtles species were officially classified as a protected species in 1988 (Decree 88-243) [43] and granted full protection, although misclassification of a freshwater species was also included (Supplementary material Appendix S1). However, no penalties were associated with Decree 88-243 and, in 2006, it was superseded by Decree 2006-400 [44] (Table 2; Section 2.3.1). There are no historical texts that relate to the legislation of elasmobranch fishing or protection despite being part of industrial and artisanal fisheries since the 1950s [34,45].

2.3. Current national texts

2.3.1. Protection

All five species of marine turtle found in Madagascar's waters receive complete protection through a number of pieces of national legislation, whilst elasmobranchs receive no explicit protection within domestic legislation (Table 2). After Madagascar gained independence, on June 26th, 1960, the first text to regulate the use of fauna in hunting and fishing was adopted (Ordinance 60-126) [46]. This text states that it is forbidden to catch or hunt any “protected species” and details fines and imprisonment terms for any offences (Table 2). However, the protected species were not detailed until 1988 (Decree 88-243) [43], and updated with Decree 2006-400 [44]. Decree 2006-400 had a number of purposes, one of which was to implement Ordinance 60-126 and renew the classification of protected species in Decree 88-243. In Decree 2006-400 it is clearly started that it is prohibited to hunt, catch or possess a species under category I, class I (Table 2; Supplementary material Appendix S1). All five species of marine turtle found in the Indian Ocean/Madagascar fall under category I “protected species” which are based on CITES lists and Ordinance 60-126. No elasmobranch species are listed within Decree 2006-400 (Supplementary material Appendix S1).

2.3.2. Fishing regulations

2.3.2.1. National regulations. Marine turtles should receive additional protection within fisheries regulations by Ordinance 93-022 of May 4th, 1993 [47], and elaborated further by Decree 94-112 [48], which provides the general guiding principles for fisheries and aquaculture activities in Madagascar (Table 2). The ordinance states that it is forbidden to kill, injure or catch marine mammals and endangered species (Supplementary material Appendix S1), which would have been defined within implementing texts, yet these texts were not drawn up. However, marine turtles were protected in the decree of 1988 and later confirmed in category 1, class 1 of Decree 2006-400. As elasmobranchs are not mentioned in any implementing texts (decrees), they cannot currently claim protection under Ordinance 93-022 nor Decree 2006-400.

A draft Fishery Code, remodelling Ordinance 93-022, is in discussion at present. Within this new regulation, marine turtles are granted continued complete protection from capture. Elasmobranchs are still not mentioned and only those protected within other national legislation or international conventions would be covered. As of May 2015, no further updates were available on the timeline of the implementation of this new fishery code.

2.3.2.2. Export. As a fisheries product, elasmobranchs and their related products (such as fins and meat) can be exported, and are therefore governed by commercial export requirements (Table 3). Any elasmobranchs species listed under CITES must be exported in line with CITES regulations for Appendix II species. Export of turtle products is prohibited unless a CITES permit is given in line with regulations for Appendix I species. Further information on CITES and export regulations are provided in Section 2.4.1.

2.3.2.3. Bycatch. Elasmobranch bycatch is not addressed by any specific national legislation, despite the fact that Decree 94-112 (put in place to complete Ordinance 93-022) specifies that the state can manage and limit bycatch. However, fishing access agreements[2] with national or foreign fleets can mention sharks as a prohibited species, and if sharks must be landed with fins attached. This clause is subject to negotiation and is not always present in every agreement (M. Andriamahefazafy unpublished data). Among fishing operators under these agreements, the European Union (EU) has the largest fleet in Malagasy waters with its majority composed of longliners and secondly, purse seiners [49,50]. Although longliners have a higher percentage of bycatch than purse seiners, purse seiners can land higher volumes of fish and therefore may catch more individual sharks [51]. In December 2012, Madagascar signed an agreement with the EU, which set a catch limit of 200 t of whole sharks year^{-1} as bycatch within the EU fleet that target tuna and associated species [52]. Under the agreement, it is forbidden for EU boats to land two families and five species of shark (Table 4). However, the agreement does not provide any details on the further consequences of any sharks landed as bycatch within, or exceeding, this allowance. It is only detailed that >200 t will be considered an infraction, as well as fishing prohibited species; and only notes that regarding bycatch, the EU will comply with the Indian Ocean Tuna Commission (IOTC) recommendations, of which Madagascar is a contracting party [52,53]. In the most recent IOTC compliance report Madagascar was only found to fully comply with one (and partly comply to two) of the three resolutions related to shark bycatch [54]. Shark bycatch was also reported to have declined from 2010 to 2012 in Madagascar's most recent national report to the IOCT, accounting for $\sim$12% of sampled national landings [55].

A new four year agreement was signed between Madagascar and the EU in June 2014, and ratified by the European Council and Parliament on 15th December 2014, replacing the one that expired on 31 December 2014 [56,57]. The new agreement allows for an increase in shark bycatch to 250 t yr^{-1} allocated to the European fleet [56].

The threat of marine turtle bycatch within the national fishing fleet has been addressed through Decree 2003-1101 [58] which required the use of Turtle Excluder Devices (TEDs) and Bycatch Reducing Devices (BRDs) within industrial and small-scale shrimp trawlers (Table 2). The management of sea turtle bycatch is also addressed by Resolution 12/04 by the IOTC [59], and is regulated by Decree 12.666/2014 (Table 2). One accidental capture was reported in 2012, but there have been no specific studies [55].

2.3.3. Wider coastal management

As part of Madagascar's coastal management efforts and with the support of the Indian Ocean Commission (IOC), the country has adopted plans and strategies for integrated management of coastal and marine areas since 1997 [60]. These initiatives were endorsed with the adoption of Decree 2010-137 [61] (Integrated Management of Coastal Zones), which directs the preservation of

[2] Fishing access agreements determine the conditions and modalities of fishing in national waters, agreed between the MRHP of Madagascar and fishing operators (Article 13 of Ordinance 93-022).

Table 2
Past and current regulations that protect marine turtles in Madagascar. Relevant text from each piece of legislation is provided in Supplementary material Appendix S1.

Legislation	Area covered (Article)	Obligation	Status
Order of May 23, 1923	Nesting sites (Art. 1)	To set Nosy Anambo Nosy Iranja, Chesterfield, Trozona Nosy, Nosy Ve and Europa as protected nesting sites.	Outdated
	Penalties (Art. 2)	1 to 15 francs and imprisonment from 1 to 5 days.	
Order of October 23, 1923	Nesting turtles (Art. 1) Minimum size (Art. 2)	Prohibition of the capture of nesting turtles. Prohibition of the capture of turtles whose carapace is less than 0m50 in diameter.	Outdated
	Penalties (Art. 3)	1 to 15 francs and imprisonment from 1 to 5 days	
Ordinance no. 60–126 on 3rd October 1960 establishing the regime of hunting, fishing and wildlife	Prohibited activities (Art. 2) Penalties (Art. 45)	Prohibited activities: hunting and catching. 10,000 to 200,000 (no currency given) and/or imprisonment from 1 month to 2 years and if necessary revocation of licenses permits and rights.	In application
Decree no. 88-243 on 15th June 1988 amending Decree 62–096 on the list of protected animal species	Full protection (Art. 1)	All species of sea turtle species except *Erymnochelys madagascariensis*.	Overruled
Ordinance no. 93-022 on 4th May 1993 setting up the regulations for fishing and aquaculture	Prohibited activities (referring to an implementing text that was not adopted) (Art 9)	Prohibited activities: killing, injuring and catching of any endangered species.	In application (under remodelling)
Decree no. 94-112 on 18th February 1994 governing the general organisation of marine fishing activities	Regulation of bycatch in fishing licenses (Art 16.3.c and Art 27.c) Recording of bycatch (Art 28)	The Ministry of Fisheries determines the quantity of species allowed within fishing licenses including restrictions on bycatch allowed. Boat captains are required to record in a logbook the quantity of species, including bycatch species.	In application (under remodelling)
Decree no. 2003-1101 on 25th November 2003 regulating the practice of trawling the Malagasy territorial sea	Turtle Excluder Device (Art. 12)	Shrimp trawlers on the west and east coast are required to have Turtle Excluder Devices.	In application
Law no. 2005-018 on 17th October 2005 on International Trade in Endangered Species of Wild Fauna and Flora	Trade (Art.29)	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.	In application
	Penalties (Art.30, 32, 33)	Six months to ten years imprisonment and a fine of 10 million Ariary to 200 million Ariary, or one of these penalties. The amount of the fine and the size of the penalty is doubled if the species are in Appendix I.	
Decree no. 2006-097 on 31st January 2006 detailing the rules for the implementation of the law on International Trade in Endangered Species of Wild Fauna and Flora	International trade permits (Art. 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.	In application
Decree no. 2006-400 on 13th June 2006 on the classification of wildlife species	Absolute protection (Art. 2)	Prohibited activities: hunting, capture and detention.	In application
Decree no. 2010-137 on 23rd March 2010 regulating the integrated management of coastal and marine areas of Madagascar	Caution duty (Art. 6e)	Each actor needs to avoid causing irreparable damage to the natural resources and risk to themselves and for future generations.	In application
	Sustainable management (Art.26)	Actors and local authorities to commit to rationally and sustainably manage coastal and marine resources.	
Order no. 12.666/2014 on 28th March 2014 concerning the regulation of the conservation of marine turtles caught by fisheries (applicable to national longliners)	Care of injured marine turtles (Art. 2)	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.	In application
	Bycatch equipment (Art. 3)	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 IOTC.	
	Recording of incidents (Art. 4)	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[a]	Harvest restriction (Art. 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
2010 Constitution of Madagascar	Place of international treaties within national laws (Art, 137-4)	Treaties or agreements duly ratified, upon publication, have an authority superior to that of laws,	In application

[a] Draft text that is remodelling Ordinance 93-022 and is under adoption within the Ministère des Ressources Halieutiques et de la Pêche (MRHP) since 2011. At the time of writing of, this draft was not yet adopted.

Table 3
Documents required and controlled by national authorities for commercial export of all items (1–6) and marine resources (7).

Items	Requirement
1	A commercial invoice established by the exporting company
2	List of weight and packing of each package by the exporter
3	Value note given by the exporter
4	A certificate of origin according to different templates depending on the country of import – the templates are available at the chamber of commerce in Antananarivo
5	A transport letter from Transport Companies: "Lettre de Transport Aerien" for air shipments and "Bill of Lading" for maritime shipments
6	The customs declaration of export: Single Administrative Document (SAD)
7	The accreditation number and health certificate delivered by the sanitary authority (*Autorité sanitaire halieutique*) of the Ministère des Ressources Halieutiques et de la Pêche
8	A certificate or validation of export delivered by the Ministère des Ressources Halieutiques et de la Pêche

Table 4
Shark families and species forbidden as bycatch within the EU Fisheries Partnership Agreement [53]. IUCN Red List category: NT=Near Threatened, VU=Vulnerable, EN=Endangered.

Listed in agreement	Species found in Madagascar	Common name (IUCN Red Listing)
Family:		
Alopiidae	*Alopias pelagicus*	Pelagic thresher (VU)
	Alopias superciliosus	Bigeye Thresher Shark (VU)
	Alopias vulpinus	Common Thresher Shark (VU)
Sphyrnidae	*Sphyrna lewini*	Scalloped hammerhead (EN)
	Sphyrna mokarran	Great hammerhead (EN)
	Sphyrna zygaena	Smooth hammerhead (VU)
Species:	**Found in Madagascar**	
Cetorhinus maximus	No	Basking shark (VU)
Rhincodon typus	Yes	Whale shark (VU)
Carcharodon carcharias	Yes	Great white shark (VU)
Carcharhinus falciformis	Yes	Silky shark (NT)
Carcharhinus longimanus	Yes	Oceanic whitetip (VU)

coastal areas and marine resources (Table 2). Even though marine turtles and elasmobranchs are not specifically mentioned in the decree it does put an emphasis on the importance of the sustainable management and protection of marine resources.

2.4. International regulations

Madagascar has adopted several international and regional multilateral, environmental agreements (MEAs) that give protection to marine turtles and some elasmobranch species. Under the 2010 Malagasy Constitution, any treaties or conventions duly ratified, upon official publication, have an authority superior to the national law.

2.4.1. CITES

CITES was ratified in 1975 by Madagascar. Although CITES is legally binding for states that have ratified CITES it does not automatically become part, or take the place, of national laws. Parties must adopt their own domestic legislation to ensure that CITES is implemented at the national level [23]. Although CITES must be adopted through national legislation, it has no national remit and its requirements do not impact the domestic use of turtles [62].

CITES has been enacted into national legislation through two texts that transpose the requirements of CITES to domestic law: Law 2005-018 [63], 30 years after ratification, and Decree 2006-097 [64] that detailed the rules for the implementation of Law 2005-018, including establishing the management body and scientific authorities as required by CITES (Table 2, Supplementary material Appendix S1). Currently five sea turtle species and one elasmobranch family (pristidae: sawfish) found in Madagascar are listed in Appendix I of CITES and as such international trade in their products is banned, and only authorised in exceptional circumstances [65] (Table 5). Six elasmobranch species and one genus found in Madagascar are listed in Appendix II, which is for species that may be threatened with extinction unless trade is regulated more strictly [65] (Table 5).

2.4.2. CMS

In 1979, Madagascar ratified the Convention on Migratory Species (CMS), which aims to conserve migratory species throughout their range. Under the Convention, each state party is required to protect endangered species. CMS places all marine turtle species under Appendix I which lists endangered migratory species, as well as under Appendix II which includes migratory species that would benefit from international agreements under CMS (Table 5) [66]. Two elasmobranch species found in Madagascar are currently listed in Appendix I and five are listed in Appendix II (Table 5) [66]. A further 21 species will be added following the 2014 Conference of Parties [67], including hammerhead, ray and manta species found in Madagascar.

Although CMS does not need to be enacted into national legislation, countries may need to ensure legislation is in place in order to meet certain requirements of particular articles within the convention. For example, Article III states "parties that are range states of migratory species listed in Appendix I shall prohibit the taking of animals belonging to such species" (Table 5).

However, Article III of CMS also accommodates "the needs of traditional subsistence users" but the term has not been defined within the CMS text [62]. Therefore whilst this would seemingly allow subsistence use of species to occur at some level, there is confusion in other countries where legal harvest of marine turtles occur; and whether these parties are satisfying their obligations in relation to this convention, as commercial trade of turtles can form part of traditional use of turtles [23].

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Table 5
CITES and CMS restrictions and objectives by appendices; and marine turtle and elasmobranch species listings for those found in Madagascar waters [65,66]. Species are only placed in one Appendix for CITES dependent on their conservation status whilst can be placed within Appendix I and/or II for CMS.

Convention	Appendix I		Appendix II	Appendix III
CITES CITES is an international agreement that aims to regulate international trade in endangered species or those species that may become endangered if trade is not regulated and controlled.	**Restrictions**	Export permit: 1. a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species; 2. a Management Authority of the State of export is satisfied that: – the specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora; – any living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health or cruel treatment; – an import permit has been granted for the specimen.	Export permit: 1. a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species; 2. a Management Authority of the State of export is satisfied that: – the specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora; and – any living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health or cruel treatment.	Export permit: A Management Authority of the State of export is satisfied that: – the specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora; and – any living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health or cruel treatment. The import of any specimen shall require the prior presentation of a certificate of origin and, where the import is from a State which has included that species in Appendix III, an export permit.
	Species listed (Year)	Elasmobranchs: Pristidae (2007) All marine turtle species in Madagascar: *Chelonia mydas* (1981) *Eretmochelys imbricata* (1981) *Caretta caretta* (1981) *Lepidochelys olivacea* (1981) *Dermochelys coriacea* (1977)	Elasmobranchs: *Carcharodon carcharias* (2005) *Rhincodon typus* (2003) *Carcharhinus longimanus* (2014) *Sphyrna mokarran* (2014) *Sphyrna zygaena* (2014) *Sphyrna lewini* (2014) *Manta* spp. (2014)	None
CMS CMS aims to conserve migratory species throughout their range and parties should work unilaterally and cooperatively to provide strict protection for endangered migratory species (listed in Appendix I of the convention); concluding multilateral agreements (such as MoUs)(listed in Appendix II); and by undertaking co-operative research activities.	**Restrictions**	Parties that are Range States of a migratory species listed in Appendix I shall prohibit the taking of animals belonging to such species. Exceptions may be made to this prohibition only if: a) the taking is for scientific purposes; b) the taking is for the purpose of enhancing the propagation or survival of the affected species; c) the taking is to accommodate the needs of traditional subsistence users of such species; or d) extraordinary circumstances so require; provided that such exceptions are precise as to content and limited in space and time. Such taking should not operate to the disadvantage of the species.	Parties that are Range States of migratory species listed in Appendix II shall endeavour to conclude AGREEMENTS where these should benefit the species and should give priority to those species in an unfavourable conservation status.	NA – CMS only has two appendices.
	Species listed (Year)	Elasmobranchs: *Carcharodon carcharias* (2002) *Manta birostris* (2012) All marine turtle species in Madagascar: *Chelonia mydas* (1986) *Eretmochelys imbricata* (1986) *Caretta caretta* (1986) *Lepidochelys olivacea* (1986) *Dermochelys coriacea* (1983)	Elasmobranchs: *Carcharodon carcharias* (2002) *Isurus oxyrinchus* (2009) *Isurus paucus* (2009) *Manta birostris* (2012) *Rhincodon typus* (2000) All marine turtle species in Madagascar: *Chelonia mydas* (1983) *Eretmochelys imbricata* (1983) *Caretta caretta* (1983) *Lepidochelys olivacea* (1983) *Dermochelys coriacea* (1983)	NA - CMS only has two appendices.

Table 5 (*continued*)

Convention	Appendix I	Appendix II	Appendix III
Nairobi Convention Protocol concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region.	**Annex II**	**Annex III**	**Annex IV**
	Article 4: Species of wild fauna requiring special protection "The contracting parties shall take all appropriate measure to ensure the strictest protection of the endangered wild fauna species listed in Annex II. To this end, each Contracting Party **shall strictly regulate and where required, prohibit activities having adverse effects on the habitats** of such species. In particular, the following activities shall, where required, be prohibited with regard to such species: (a) All forms of capture, keeping or killing; (b) Damage to, or destruction of, critical habitats; (c) Disturbance of wild fauna, particularly during the period of breeding, rearing and hibernation; (d) Destruction or taking of eggs from the wild or keeping these eggs even if empty; (e) Possession of and internal trade in these animals, alive or dead, including stuffed animals and any readily recognizable part or derivative thereof." Article 5: Harvestable species of wild fauna "The contracting parties shall take all appropriate measures to ensure the protection of the depleted or threatened wild fauna species listed in annex III **Any exploitation** of such wild fauna species **shall be regulated in order to restore and maintain the populations at optimum levels**. Each contracting party **shall develop, adopt and implement management plans for the exploitation** of such species which may include: (a) The prohibition of the use of all indiscriminate means of capture and killing and of the use of all means capable of causing local disappearance of, or serious disturbance to, population of a species; (b) Closed seasons and other procedures regulating exploitation; (c) The temporary or local prohibition of exploitation, as appropriate, in order to restore viable population levels; (d) The regulation, as appropriate, of sale, keeping for sale, transport for sale or offering for sale of live and dead wild animals; (e) These safeguards of breeding stocks of such species and their critical habitats in protected areas designated in accordance with article 8 of this Protocol; (f) Exploitation in captivity." Article 6: Migratory species "The Contracting Parties shall, in addition to the measures specified in articles 3, 4, and 5, co-ordinate their efforts for the protection of migratory species listed in annex IV whose range extends into their territories. To this end, each Contracting Party shall ensure that, where appropriate, the closed seasons and other measures referred to in paragraph 2 of article 5 are also applied with regard to such migratory species.		
	Species listed (Year) *Lepidochelys olivacea* (1985) *Caretta caretta* (1985) *Dermochelys coriacea* (1985)	*Chelonia mydas* (1985) *Eretmochelys imbricata* (1985)	*Chelonia mydas* (1985) *Eretmochelys imbricata* (1985) *Lepidochelys olivacea* (1985) *Caretta caretta* (1985) *Dermochelys coriacea* (1985)

Understanding (IOSEA MoU) was drawn up under the auspices of CMS, and signed by Madagascar in April 2003 [68]. This is a non-binding framework, initiated under CMS, 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 marine turtles and their habitats. Improvements in Madagascar's implementation and reporting under this MoU were noted in the 2014 meeting of signatory states, although only partial implementation was noted for the majority of programme activities [69]. As of May 2015, Madagascar was not a signatory to the CMS Memorandum on the Conservation of Migratory Sharks (effective since March 2010).

2.4.3. Nairobi Convention

Madagascar ratified the Nairobi Convention in 1998 [70], which was updated in 2010 to the Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Western Indian Ocean. The convention offers a regional legal framework and coordinates the efforts of the member states to plan and develop programmes that strengthen their capacity to protect, manage and develop their coastal and marine environment sustainability [71], and Article 11 concerns specially protected areas and promotes protection of fragile ecosystems. Madagascar has not yet ratified the 2010 convention [72, Jacquis Rasoanaina pers. comm.].

The convention also includes the *Protocol concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region*, which 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) (Table 5) [71]. No elasmobranch species are currently listed. Articles 4, 5 and 6 set out the guidelines for protection and management of species found in each Annex (Table 5). Article 12 also highlights that "protective measures take into account the traditional activities of their local populations in the areas to be protected". Therefore under the Nairobi Convention, harvest of species in Annex III is permitted as long as it meets certain criteria (eg. the species are not in danger of extinction).

The Nairobi Convention provides clear guidelines on the obligations required by each member state. However the use of the phrase "where required" within the texts provides countries with the discretion that action need only be taken if considered proven [73].

2.5. Management at the local level

The *Dina* is a social code that is a community law within Madagascar, generally communicated through oral tradition but is also written down in some cases [74]. The *Dina* coexisted alongside modern law during colonisation but there was a recovery of traditional values after independence in 1960. At its simplest, the *Dina* are a set of customary rules based on a consensus within the community, and therefore the local population are bound to respect their content [75], but are legally defined as a "*collective agreement, freely adopted by the majority of the Community called 'Fokonolona' aged from eighteen*

years old, or as applicable, its designated representatives (…)" [76]. In the late 1990s the Malagasy Government enacted legislation that integrated these customary legal practices with the governmental laws. In addition, Madagascar's "*Programme Environnemental 2 (PE 2)*", one of the three phases implementing the National Environmental Action Plan (NEAP), was underway and being used to promote community-based natural resource management. In 1996, the Malagasy Government, through the then Ministry of Environment and Forests, introduced the "Gestion Locale Sécurisée" (GELOSE), or secured local management, with Law 96-025 of 30th September 1996 [77], to transfer authority to communities for management of natural resources (for example forests, lakes and pastures). Under this transfer, local communities can set up *Dina* to regulate and govern the use of natural resources (Articles 49-52) (Supplementary material Appendix S1). Although used extensively for terrestrial and mangrove management (as mangroves are considered to be part of forests), it cannot be currently applied to the marine environment because there are no specific texts as yet that put in place the management transfer of marine resources. In addition, *Dina* themselves can be legally recognised outside of the GELOSE framework, and used to govern natural resources on the basis of the socio-economic need of the community under Law 2001-004 of 25th October 2001 [76]. For *Dina* to be recognised under Law 2001-004, they must be validated by a Malagasy court (Section 2, Articles 7-9) (Supplementary material Appendix S1) [78,79].

Over the decades *Dina* have been developed to manage terrestrial resources and have spread to local coastal and marine resource management [80,81]. Their success has been varied but has been greatest where aligned with community aspirations and developed through full participatory approaches, such as in the Velondriake Locally Managed Marine Area (LMMA) where they govern marine resource use [81]. *Dina* have facilitated the proliferation of "bottom-up" management of marine resources in Madagascar in recent years [82–84]; and there are now >64 LMMAs covering over 11,000 km^2 (Mihari LMMA network pers. comm.), greater than 2.6 times the area covered by Marine Protected Areas (MPAs) [85].

The content of the *Dina* cannot contradict national legislation, only enhance it or validate local customs [75,86]. Several *Dina* exist that mention protection of marine turtles, some of which act as a means to communicate national law, whilst others appear to contravene it (Table 6). Due to the high cultural value of the turtle fishery in Madagascar, the success of the application of these *Dina* has had mixed results [16,36,80]. Whilst some may have increased awareness of national legislation, the likelihood of community enforcement of *Dina* articles related to turtles is likely to be extremely low.

Table 6
Details of articles with *Dina* for marine turtle protection in Madagascar.

Location	Management body	Mechanism	Date	Article in *Dina*	Still in force	Comments	Ref
Nosy Ve, SW Madagascar	FIMIMANO (*Fikambanana Miarosy Mampandroso an'I Nosy Ve*, translated as the Association for the Protection and Development of Nosy Ve)	*Dina* under Law 96-025	1999	You are not allowed to hunt sea turtles during the months of October and November.	Unknown	Article in *Dina* actually contravenes national law (unknowingly as authors do not recognize this either) and although this follows the 1923 law, it suggests that you can hunt turtles outside of these months. Issues with *Dina* in general as fishers perceived regulations as a violation of their personal freedoms. *Dina* not necessarily valid under mechanism of Law 96-025, although validation methods not clear in text.	[80]
Velondriake LMMA, SW Madagascar	Velondriake Association	*Dina* validated by court	2006	It is forbidden to catch marine species under legal protection including marine turtles. The penalty for any infringement is MGA 20 000 plus confiscation of the catch.	Yes	The articles in the *Dina* are generally ignored, although there has been some movement to reduce turtle take for markets rather than subsistence use.	R. Samba pers. comm.
Nosy Sakatia, NW Madagascar	Unknown	Unknown	Unknown	Prohibits the killing of sea turtles; egg raiding prohibited.	Unknown	Punishments were given to those that killed a turtle successfully. Other beaches with high mortality not protected at time of report.	[87]
Bay of Ranobe, SW Madagascar	FI.MPA.MI.FA (Fikambanana MPaniriky Miaro ny Fano: The association of fishers for the protection of marine turtles based in the Bay of Ranobe)	Unknown	Unknown (2013 likely)	Juvenile marine turtles under 70 cm curved carapace length (CCL) are protected. Closed season, encompassing a four-month ban on turtle fishing from 1st December (not validated).	Yes	Closed season *Dina*: articles contradict national legislation. It was submitted to Malagasy court of law for validation but advised that it was in conflict with national decrees. Recent research suggests protection of larger individuals is better for population recovery.	[88,89]
Villages near Tolagnaro, SE Madagascar	Villages themselves (Etapera, Elodrato, Antsotso, Ankaramany)	Unknown	2001–2002	Turtle harvest forbidden, including eggs.	Unknown	Level of adherence varied between villages from only one known transgression to multiple in other villages.	[31]

3. Resulting cross-cutting issues

3.1. Continued overexploitation

Populations of both elasmobranchs and turtles continue to be heavily exploited in Madagascar [16,90]. The lack of national legislation is one of the drivers that has led to the decrease in coastal shark populations to the point where shark fishing is becoming increasingly unprofitable (G. Cripps pers. comm.). Foreign fishing vessels that have access to Madagascar's waters have licenses with variable bycatch stipulations that often have loose or no requirements to monitor bycatch, details of bycatch species nor limits (M. Andriamahefazafy unpublished data). Furthermore, reported landings demonstrate some foreign vessels are clearly targeting sharks in Madagascar's waters, with Spanish longliner vessels landing 152 MT of sharks compared to 13.98 MT of tuna in 2011 [91]. In 2011, a six month agreement was also granted to a Korean fishing company for experimental targeted shark fishing (M. Andriamahefazafy unpublished data). Illegal fishing in Madagascar's waters is also known [48], and there are reports of a substantial Asian long-line fleet of which 7.5% of bycatch are estimated to be shark species [92].

The continued illegal take of marine turtles has been of national attention [93]. Although traditional fishing for turtles for local consumption has continued at similar levels since the 1970s [16,32,33,37], there were reports in 2012 of targeted turtle fishing by collector-exporters in Mahajanga seemingly destined for international export [94]. There were also reports of plastron (ventral surface of the shell) trafficking in southwest Madagascar for export (WWF Madagascar, pers. comm.). To help reinforce current legislation and protection, a regional order for the Atsimo Andrefana region (southwest Madagascar) was issued on 16th October 2013 that highlighted crimes within current legislation and infractions related to products destined for export [95].

3.2. Lack of adherence to legislation

Where legislation is in place to protect these species it has often been difficult to implement. At the community level, *Dina* that include bans on marine turtle hunting often do so to stay in line with national legislation, but often with the knowledge they will not be enforced [81]; other *Dina* have been known to contradict or mention only part of national regulations which could cause further confusion [80,88].

Reports analysing Madagascar's application of CITES from 2004 to 2007 highlight that the use of regulations has been partial or non-existent due to a lack of knowledge, corruption, lack of will and limited capacity [96–98]; and both national and international large-scale infractions have been reported [99,100]. Exports of protected species increased dramatically during the recent coup (2009–2014), in particular illegal logging and export of rosewood, and demonstrated a general decline in governance and respect for the rule of law [101–103]. Low national governance scores and corruption have been linked with reduced conservation success and population declines of protected species [104,105], although there are criticisms of such simplistic models [106,107]. Madagascar is taking steps to tackle illegal trade [108] but there are likely to be challenges in tracking the new Appendix II elasmobranch species and adhering to CITES requirements, and the new species added to CMS. Scalloped hammerheads (*S. lewini*), one of the

Table 7
Gaps and conflicts in current legislation relating to the protection of elasmobranchs and marine turtles.

Item	Issue	Elasmobranchs	Turtle
Drafting of texts	Insufficient legislation to protect populations/Lack of legislation.	✓	Legislation in place
	The majority of stakeholders that texts concern are not involved in the process of text development.	Lack of legislation	✓
	Existing national laws do not provide sufficient details of penalties if laws are broken.	✓	✓
	CITES is the only international convention that has a national implementation law to adapt the convention to the national context. The CMS and Nairobi Conventions do not have any texts to confer national implementation despite their importance.	✓	✓
Enforcement	Legislation is not well known across the different actors/stakeholders, leading to the legal framework being discarded.	Lack of legislation	✓
	Legislation is difficult to enforce (eg. shark bycatch laws for industrial vessels)	✓	✓
	Legislation is not communicated at the community level, the regional authorities, and the police. As a result, these laws are not enforced, or not enforced properly, at the national and local level.	NA	✓
	CITES procedures, from enforcement to permits, are not well known throughout Madagascar, and are difficult to enforce at the national/local level that could fuel international trade.	✓	✓
	There is no published or known history of penalization related to infractions that could provide tangible precedents for use by authorities. Various anecdotes of corruption regarding natural resource transactions in Madagascar have shown that corruption can represent a problem for the enforcement of texts.	Lack of legislation	✓
Implementation	Stipulations in international conventions are not always taken into account in national texts. For example, traditional allowance for marine turtles is permitted in CMS but prohibited at national level. Similarly, elasmobranch species in Appendix I of CMS should be protected but as yet are not under the Malagasy legislation.	NA	✓
	Due to the cultural value of marine turtles, legislation is currently incompatible with some local cultures in Madagascar.	NA	✓
	Greater migrations of fishermen are occurring along the coastal regions of Madagascar as a result of decreasing and degraded marine resources. Migrant communities are often in conflict with resident coastal communities where *Dina* are established.	✓	✓

species recently listed on Appendix II of CITES and Appendix II of CMS, are regularly landed within Madagascar's shark fisheries and are likely to be a significant part of current fin exports [18, F. Humber unpublished data].

4. Gaps and conflicts within legislation

There are numerous gaps and conflicts in current legislation in Madagascar that result in inadequate protection for marine turtles and elasmobranchs (Table 7).

4.1. Drafting of texts

There is often insufficient stakeholder input and consultation into drafting of texts which has led to a disconnect between those that have developed the legislation and those that are most affected by them or responsible for their implementation [109,110].

This disconnect has been highlighted in the lack of consultation and community engagement in the establishment of protected areas in Madagascar as part of the countries commitment in 2003 to triple its protected areas [111]. Furthermore, incongruities between texts and the feasibility of their implementation have been highlighted; within the application of GELOSE, Sarrasin (2009) emphasizes that communities are burdened with the majority of administrative requirements yet are the least well-placed to do so [112]. Effective consultation has been highlighted in the creation of a *Dina* to manage Madagascar's first LMMA, *Velondriake*, where participatory development has been key to engender local ownership [81]. Consultations with stakeholders have also been held at the national level in relation to the new national fishery strategy [113].

This is especially relevant to marine turtles where the fishery is considered part of local traditions, in particular in southwest Madagascar, and the national ban on turtle take is often unknown and/or ignored (Table 7) [16,80].

4.2. Implementation

The implementation of many legislative actions is compounded by issues of clarity, consistency between texts, and responsible bodies.

Despite the fact that many international conventions were ratified many years ago, their implementation at a national level has been insufficient. In particular authorities are unclear how to implement CITES at the national level for species thought to be targeted for international trade (Table 7) [114].

Inconsistencies currently lie between protected species listed in Decree 2006-400 and those that should be protected under CITES and CMS. For example, Decree 2006-400 only mentions one species of elasmobranch and is now out of date. Monitoring protected elasmobranch species is further complicated by the fact that sharks are currently classified and exported as a fishery product. In the past, there was no established link between the national CITES authorities (*Ministre de l'Environnement, de l'Ecologie, de la Mer et des Forêts*) and the Ministry of Fisheries (*Ministre des Ressources Halieutiques et de la Pêche*) but preliminary meetings have now been held after new species listings in 2013 (E. Robsomanitrandrasana, pers. comm.).

The proliferation of LMMAs in Madagascar has effectively initiated the first recognition of local management of marine resources, as management of coastal areas is designated to communities [81,85]. However, traditional migrations of fishers along the coast, and migration towards the coast from inland, has increased the potential for conflict to arise where established *Dina* are broken by migrant fishers [115,116].

4.3. Enforcement

Effective management of these species via current legislation is thwarted through a lack of enforcement, knowledge, communication and penalties across all levels of governance [36,80,90,114]. The 2009–2014 political crisis demonstrated the complex links between the impacts of political instability, poor governance in natural resource management and increased poverty [117].

A key recommendation from the 2011 IOSEA meeting in Madagascar was the need for a clear summary of existing legislation, as discussions highlighted there was a clear gap in knowledge [114]. Anecdotal reports indicate that confusion still exists and communities still receive mixed messages from authorities concerning the legality of turtle meat consumption (114, F. Pichon pers. comm.). Irregular enforcement of legislation for marine turtles, due to a lack of capacity, willingness and/or priority, has undermined the status of the legislation itself and the authorities that enforce it. Whilst the continuation of turtle exploitation is generally ignored, incidences of erratic heavy-handed punishments (e.g. arrests) of fishers, whilst others with more social status go unpunished, has led to growing distrust between authorities and communities in some regions (F. Pichon pers. comm.).

Enforcement of the bycatch allowance within EU fishing access agreements is weak due to insufficient capacity for monitoring and surveillance of Madagascar's EEZ [39,92] with only a small number of foreign vessels inspected in 2012 [55]. Within the EU public access agreements bycatch was only stipulated for the first time in 2013, and there were no details regarding enforcement or penalties for exceeding the 200 t shark bycatch limits or if prohibited species were taken [52,53].

5. Recommendations

Table 8 summarises recommendations across the drafting, implementation and enforcement of legislation. Whilst legislation is currently in place to protect marine turtles from overexploitation, it is often ignored due to a lack of knowledge, will, resources for enforcement and the fact that it is incompatible with local customs. Elasmobranch species are poorly protected by current legislation and national level legislation should be put in place to help manage Madagascar's elasmobranch fisheries, and promote recommended management measures [118,119]. However, Madagascar's first shark sanctuary was created in north-east Madagascar in Antongil Bay, as part of a network of LMMAs aimed to grant coastal communities management rights for local fishery areas [120]. The no-take zone was officially implemented in December 2014 and shark fishing is prohibited through the bay's management plan adopted by the MRHP [121] (Supplementary material Appendix S1). It is the first community level shark fisheries management measure established within a legal text in Madagascar.

The management and protection of elasmobranch fisheries has grown in recent years with many countries enacting unprecedented, large-scale protection [30,122]. Country-wide and large-scale shark sanctuaries are now in place in many countries including the Cook Islands, Federated States of Micronesia, French Polynesia, Honduras, Maldives, Marshall Islands, Palau and Tokelau, and commercial shark fishing is banned in the Bahamas and British Virgin Islands (UK) [123,124]; and loopholes closed within the EU so that sharks must now be landed with their fins "naturally attached" [125]. Marine turtle legislation has also been reviewed and updated in countries where it failed to protect the most vulnerable parts of life history to overexploitation, whilst ensuring that traditional customs can continue [126,127].

A national management plan for the conservation of marine turtles is currently being updated and has been validated at local

Table 8
Recommendations for the improvement in legislation for elasmobranchs and marine turtles in Madagascar.

Item	Issue
Development of texts	
Marine turtle	1. Scientific, socioeconomic and anthropological needs should be taken into account in upcoming texts, as well as considering local conventions "*Dina*" and regulations adopted in the Western Indian Ocean. 2. New implementation texts should be adopted based on the current management plan for marine turtles (as of February 2013).The management plan should include all recommendations and obligations from the CMS and the Nairobi Convention. 3. International vessels should also be required to comply with national legislation and use TEDs.
Elasmobranchs	1. Implement a national programme for conservation and management of shark stocks in relation to The International Plan of Action for Conservation and Management of Sharks (IPOA-SHARKS). 2. The protection and/or management of elasmobranchs should be mentioned in current fishery laws or implementing texts. 3. All species under CITES and CMS are added to the list of protected species in Madagascar. 4. As seven species are now under CITES protection, Malagasy authorities should consider export quotas for certain elasmobranch species.
Both	1. A national consultation of all concerned stakeholders should be undertaken before the adoption of new or updated texts. 2. Fines and sentences for offences should be included that directly relate to the legal obligations/prohibitions that are outlined in any existing or new text. 3. National implementing texts for the CMS and the Nairobi Convention should be set up and adopted to provide further protection to the species. 4. Bycatch stipulations within Fishing Access Agreements should be clarified with species and allowances detailed.
Enforcement	
Both	1. Legislation should be clearly understood by all stakeholders and needs to be published and shared to all national, regional and local authorities. Local communities should also be aware of all existing legislation to facilitate its implementation. A specific action should aim to clarify CITES procedures. 2. An analysis of the drivers of the international market could help to identify weaknesses in enforcement. 3. All stakeholders should be made aware of the main biological and ecological characteristics of marine turtles and elasmobranchs in order for appropriate legislation to not only be put in place but to be understood by all. 4. Awareness-raising should occur with stakeholders at local and national levels on the importance of marine turtles and elasmobranchs to promote the need for protection. 5. Texts currently in application that have penalties that can be easily applied by authorities to reprimand those caught with prohibited species should be promoted.
Implementation	
Marine turtle	1. To reduce the sale of marine turtles, the network of mayors/commune leaders could publish a local or regional text to prohibit their sale in accordance with national legislation.
Elasmobranchs	1. Increase in capacity for monitoring and surveillance of fishing vessels to observe elasmobranch landings and bycatch.
Both	1. The development and use of "*Dina*" should be encouraged and supported. 2. Information and educational awareness campaigns should be developed and/or strengthened. 3. Existing community management networks should be utilised for protection of marine turtles and elasmobranchs.

workshops (M. Andriamahefazafy pers. obvs.). It could provide an opportunity for stakeholder consultations to improve knowledge and enforcement of current legislation, or to engage communities in how to manage subsistence use if it is assumed that capacity or will to curb this is minimal.

A current major loophole for potential large-scale overexploitation of elasmobranchs is through limited protection within distant water fleets fishing in Madagascar's waters (M. Andriamahefazafy unpublished data) and it is important that fishing access agreements promote minimising bycatch. Bycatch species should be clarified with limits given, and to minimise confusion, targeted species should also be clearly defined [128,129]. Some agreements refer to "migratory species" as those that can be targeted, leaving sharks as a potential target species, whist contradicting the recommendations of the IOTC which Madagascar must uphold [130].

There is a growing network of local management associations and their supporting NGOs that are powerless to work with communities to reduce turtle and elasmobranch take within the current legal framework. Furthermore, engaging the private sector in conservation and resource management should be considered, as it has been successful where authorities may lack capacity or face challengers in terms of governance [104,131, T. Oliver unpublished results]. Financial restrictions also limit the ability for authorities to enforce legislation and the role of donors should be investigated.

6. Conclusion

Marine turtles and elasmobranchs remain Madagascar's most valuable marine megafauna both economically, culturally, and in terms of food security [17,132,133]; and are threatened by overfishing as direct take and as bycatch. The decline of both populations is fuelled in part by a lack of adequate legislation and poor enforcement in the face of increasing demand for marine resources from the international market, and continues to threaten their long term status. The almost complete lack of legislation for elasmobranch fisheries management, and the fact that legislation offering complete protection for marine turtles is ignored by fishers and traders, is difficult to enforce by authorities, and at odds with local customs, renders both groups of species "unprotected" in reality.

It is of national interest to protect both groups of species, not only in terms of their value as keystone species in maintaining healthy ecosystems, but also for cultural role that marine turtles

play within *Vezo* culture, and as shark fins still provide an important source of income for many fishers [36, G. Cripps unpublished data]. The proliferation of LMMAs in Madagascar, and the existence of a framework for decentralised management, could be utilised to increase management across a country with such a vast coastline and limited monitoring and surveillance capacity. However, with no allowance for customary take of turtles, and with no national legislation for shark fisheries management, and the high value of shark fins, management by communities is likely to be limited. Incentives for local management are also reduced when high demand from illegal traffickers of marine turtles continues and industrial vessels take large numbers of sharks directly and as bycatch [92,93].

Globally, the status of elasmobranchs are becoming of greater concern as overfishing and large populations declines are reported [134–137]. Increases and recovery in turtle populations have been reported since widescale protection has been in place [138–141], and may result in the green turtle moving out of the threatened categories on the IUCN Red List. Madagascar's marine resources are vital to the livelihoods of millions of people and a strong legislative framework with appropriate means of enforcement could help to significantly contribute to their protection.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.marpol.2015.05.006.

References

[1] Van Waerebeek K, Van Bressem M-F, Félix F, Alfaro-Shigueto J, García-Godos A, Chávez-Lisambart L, et al. Mortality of dolphins and porpoises in coastal fisheries off Peru and southern Ecuador. Biol Conserv 1997;81:43–9.
[2] Kasuya T. Japanese whaling and other cetacean fisheries. Environ Sci Pollut Res 2007;14:39–48.
[3] Daley B, Griggs P, Marsh H. Exploiting marine wildlife in Queensland: the commerical Dugong and marine turtle fisheries, 1847–1969. Aust Econ Hist Rev 2008;48:227–65.
[4] Lotze HK, Worm B. Historical baselines for large marine animals. Trends Ecol Evolut 2009;24:254–62.
[5] Marsh H, Gardner BR, Heinsohn GE. Present-day hunting and distribution of dugongs in the Wellesley Islands (Queensland): implications for conservation. Biol Conserv 1981;19:255–67.
[6] Stevick PT, Allen J, Clapham PJ, Friday N, Katona SK, Larsen F, et al. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Mar Ecol Progr Ser 2003;258:263–73.
[7] Humber F, Godley B, Broderick A. So excellent a fishe: a global overview of legal marine turtle fisheries. Divers Distrib 2014;20:579–90.
[8] FAO. FishStatJ – software for fishery statistical time series. Food and Agriculture Organization of the United Nations; 2011.
[9] Field IC, Meekan MG, Buckworth RC, Bradshaw CJA. Susceptibility of sharks, rays and chimaeras to global extinction. Adv Mar Biol 2009;56:275–363.
[10] Pierce SJ, Trerup M, Williams C, Tilley A, Marshall AD, Raba N. Shark fishing in Mozambique: a preliminary assessment of artisanal and semi-industrial fisheries. Maputo: Eyes on the Horizon, Maputo; 2008. p. 30.
[11] Blaber SJM, Dichmont CM, White W, Buckworth R, Sadiyah L, Iskandar B, et al. Elasmobranchs in southern Indonesian fisheries: the fisheries, the status of the stocks and management options. Rev Fish Biol Fish 2009;19:367–91.
[12] Cartamil D, Santana-Morales D, Escobedo-Olvera M, Kacev D, Castillo-Geniz L, Graham JB, et al. The artisanal elasmobranch fishery of the Pacific coast of Baja California, Mexico. Fish Res 2011;108:393–403.
[13] IUCN. IUCN red list of threatened animals. Gland and Cambridge: IUCN; 2014.
[14] Salvatore C, Andrianarivelo N, Razafindrakoto Y, Mendez M, Rosenbaum HC. Coastal dolphin hunting in the southwest of Madagascar: status of populations, human impacts and conservation actions. Fairfax, Virginia: International Marine Conservation Congress, George Madison University; 2009.
[15] Cooke A, Lutjeharms J, Vasseur P. Marine and coastal ecosystems. In: Goodman S, Benstead J, editors. The natural history of Madagascar. Chicago: Chicago University Press; 2003. p. 179–209.
[16] Humber F, Godley BJ, Ramahery V, Broderick AC. Using community members to assess artisanal fisheries: the marine turtle fishery in Madagascar. Anim Conserv 2011;14:175–85.
[17] Whitty TS, Davis P, Poonian CNS, Leandre I. Rapid assessment of marine megafauna capture, fishing effort, and socioeconomic and cultural drivers of artisanal fisheries in northern Madagascar. In: Proceedings of the world small scale fisheries congress, Bangkok, Thailand, 18 – 22 October; 2010. p. 7.
[18] Robinson L, Sauer WHH. A first description of the artisanal shark fishery in northern Madagascar: implications for management. Afr J Mar Sci 2013;35:9–15.
[19] CITES getting ready for sharks and rays. Convention on International Trade in Endangered Species of Wild Fauna and Flora; 2013.
[20] Myers RA, Worm B. Extinction, survival or recovery of large predatory fishes. Philos Trans R Soc B: Biol Sci 2005;360:13–20.
[21] Ruppert JLW, Travers MJ, Smith LL, Fortin M-J, Meekan MG. Caught in the middle: combined impacts of shark removal and coral loss on the fish communities of Coral Reefs. PLoS ONE 2013;8:e74648.
[22] Wilson EG, Miller KL, Allison D, Magliocca M. Why healthy oceans need sea turtles: the importance of sea turtles to marine ecosystems. Washington: Oceana; 2010. p. 20.
[23] TUKOT. Marine turtles and international law. An introduction to how the Environment Charter and selected Multilateral Environmental Agreements apply to marine turtles in the UK Overseas Territories. Available at ⟨http://www.seaturtle.org/mtrg/projects/tukot/MEA_Guide.pdf⟩; 2005.
[24] Peckham SH, Maldonado-Diaz D, Koch V, Mancini A, Gaos A, Tinker MT, et al. High mortality of loggerhead turtles due to bycatch, human consumption and strandings at Baja California Sur, Mexico, 2003 to 2007. Endanger Species Res, 5; 2008. p. 171–83.
[25] Hitipeuw C, Windia Adnyana IB, Suprapti D, Andar R. Sea turtle trade in Indonesia: Current magnitude and new mode of operation. In: Tucker T, Belskis L, Panagopoulou A, Rees A, Frick M, Williams K, et al., editors. Proceedings of the thirty-third annual symposium on sea turtle biology and conservation NOAA technical memorandum NOAA NMFS-SEFSC-645. Miami: National Marine Fisheries Service; 2013. p. 103–4.
[26] Worm B, Davis B, Kettemer L, Ward-Paige CA, Chapman D, Heithaus MR, et al. Global catches, exploitation rates, and rebuilding options for sharks. Mar Policy 2013;40:194–204.
[27] Whitcraft S, Hofford A, Hilton P, O'Malley M, Jaiteh V, Knights P. Evidence of declines in shark fin demand, China. San Francisco: WildAid; 2014. p. 21.
[28] Mundy-Taylor V, Crook V. Into the deep: implementing CITES measures for commercially-valuable sharks and manta rays. Report prepared for the European Commission. Cambridge: Traffic; 2013.
[29] Pew Charitable Trusts. Chinese business executives lead the way on shark conservation. Pew Charitable Trusts; 2014.
[30] Pew Charitable Trusts. Chuuk state enacts bill to protect sharks. Pew Charitable Trusts; 2014.
[31] Gladstone N, Andriantahina F, Soafiavy B. Azafady project fanomena – marine turtle conservation and research in southeast Madagascar. Report on activities and findings in the 2001 – 2002 nesting season. London: Azafady; 2003. p. 75.
[32] Frazier J. Exploitation of marine turtles in the Indian Ocean. Human Ecol 1980;8:329–70.
[33] Hughes GR. The status of sea turtles in South East Africa. I. Status, morphology and distributions. Durban: Oceanagraphic Reseach Institute; 1974. p. 1–144.
[34] Cooke A. Survey of Elasmobranch fisheries and trade in Madagascar. In: Marshall NT, Barnett R, editors. The trade in shark and shark products in the Western Indian and Southeast Atlantic Oceans. Nairobi: Traffic East/Southern Africa; 1997. p. 101–30.
[35] McVean A, Walker R, Fanning E. The traditional shark fisheries of southwest Madagascar: a study in the Toliara region. Fish Res 2006;82:280–9.
[36] Lilette V. Mixed results: conservation of the marine turtle and the red-tailed tropicbird by Vezo semi-nomadic fishers. Conserv Soc 2006;4:262–86.
[37] Rakotonirina B, Cooke A. Sea turtles of Madagascar – their status, exploitation and conservation. Oryx 1994;28:51–61.
[38] Ministère de la Pêche et des Ressources Halieutiques (MPRH). Captures de la pêche maritime par catégories administratives de pêcheries; 2011.
[39] Le Manach F. Valuation of fisheries resources in Madagascar. Draft report of the fisheries technical study prepared for The World Bank. Wealth Accounting and Ecosystem Services Valuation (WAVES) Global Partnership; 2012.
[40] Repoblikan'i Madagasikara. Constitution de la Quatrieme Republique [Consitution of the 4th Republic]; 2010. p. 28.
[41] Maury JP. République de Madagascar. Digithèque de matériaux juridiques et politiques. Université de Perpignan; 2006.

[42] Bérard M-H. Légitimité des normes environnementales dans la gestion locale de la forêt à Madagascar. Can J Law Soc 2011;26:89–111.
[43] Repoblikan'i Madagasikara. Décret no. 88-243 modifiant les articles 1 et 2 du décret no. 62 096 du 16 février 1961 sur la liste d'espèces animaux protégées [Decree no. 88-243 amending Articles 1 and 2 of Decree 62 096 of 16th February 1961 on the list of protected animal species]. Ministere de l'Environnement. Antananarivo, Madagascar; 15th June 1988.
[44] Repoblikan'i Madagasikara. Decret no. 2006-400 portant classement des espèces de faune sauvage [Decree no. 2006-400 on the classification of wildlife species]. Ministere de l'Environnement, des Eaux et Forêts. Antananarivo, Madagascar; 13th June, 2006.
[45] Fourmanoir P. Requins de la côte ouest de Madagascar. Mémoires de l'Institut Scientifique de Madagascar, Série F Océanographie; 1961. Tome IV:3-81.
[46] Repoblikan'i Madagasikara. Ordonnance no. 60-126 fixant le régime de la chasse, de la pêche et de la protection de la faune [Ordinance no. 60-126 establishing the regime of hunting, fishing and wildlife]. Ministere du Developpement Rural. Antananarivo, Madagascar; 3rd October 1960.
[47] Repoblikan'i Madagasikara. Ordonnance no. 93-022 portant réglementation de la pêche et de l'aquaculture [Ordinance no. 93-022 regulating fisheries and aquaculture]. Ministere de l'Elevage et des Ressources Halieutiques and Ministere d'Etat à l'Agriculture et au Développement Rural. Antananarivo, Madagascar; 4th May 1993.
[48] Repoblikan'i Madagasikara. Décret no. 94-112 Portant organisation générale des activités de pêche maritime [Decree no. 94-112 relating to the general organization of marine fishing activities]. Ministère d'Etat à l'Agriculture et au Développement Rural. Antananarivo, Madagascar; 18th February. 1994.
[49] Centre de Surveillances des Pêches (CSP). Rapport annuel d'activités année 2011. Antananarivo: Ministère de la Pêche et des Ressources Halieutiques; 2011. p. 76.
[50] Centre de Surveillances des Pêches (CSP). Rapport annuel d'activités année 2012. Antananarivo: Ministère de la Pêche et des Ressources Halieutiques; 2012. p. 75.
[51] Cofrepeche M, NFDS et POSEIDON. Évaluation rétrospective et prospective du protocole de l'accord de partenariat dans le secteur de la pêche entre l'Union européenne et la République de Madagascar. Contrat cadre MARE/2011/01 - Lot 3, contrat spécifique no. 10. Bruxelles; 2014. p. 175.
[52] European Union. Communiqué de presse, Partenariat Madagascar – Union Européenne. Available at ⟨www.ambafrance-mada.org/IMG/pdf/Commission_mixte_accord_peche__27-09-12.pdf⟩; 2012 [accessed 21.09.14].
[53] European Union. Fisheries partnership agreement between the European Union and the Republic of Madagascar, Council Decision 2012/826/EU (OJ EU L361 of 31.12.2012). Available at ⟨http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2012.361.01.0011.01.ENG⟩; 2012. [accessed 21.09.14].
[54] IOTC Secretariat. Compliance report (Madagascar). ⟨http://www.iotc.org/documents/compliance-report-madagascar⟩. Victoria Mahé: Indian Ocean Tuna Commission (IOTC); 2014. p. 5.
[55] Rahombanjanahary DM, Rasolonjatovo H, Fanazava R, Ratsimanarisoa N. Rapport National de Madagascar destiné au Comité scientifique d la Commission des thons de l'océan Indien. Antananarivo: Ministere de la Peche et des Ressources Halieutiques; 2013. p. 30.
[56] European Union. Communiqué de presse conjoint, Partenariat dans le secteur de la pêche entre Madagascar et l'Union européenne. Available at: ⟨http://eeas.europa.eu/delegations/madagascar/documents/press_corner/20140620_peche_fr.pdf⟩; 2014. [accessed 21.09.14].
[57] European Union. Fisheries partnership agreement between the European Union and the Republic of Madagascar, Council Decision 2014/929/EU. Available at: ⟨http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014D0929⟩; 2015. [accessed 18.01.15].
[58] Repoblikan'i Madagasikara. Décret no. 2003-1101 Modifiant certaines dispositions du décret no. 71-238 du 12 mai 1971, réglementant l'exercice de la pêche par chalutage, dans la mer territoriale malgache [Decree no. 2003-1101 Amending certain provisions of Decree no. 71-238 of 12 May 1971, regulating the practice of fishing trawling in Malagasy territorial sea]. Ministere de l'Agriculture, de l'Elevage et de la Pèche. Antananarivo, Madagascar; 25th November 2003.
[59] IOTC Secretariat. Resolution 12/04 on the conservation of marine turtles. ⟨www.iotc.org/cmm/resolution-1204-conservation-marine-turtles⟩. Victoria Mahé: Indian Ocean Tuna Commission (IOTC); 2012. [accessed 12.10.14].
[60] Billé R, Mermet L. Integrated coastal management at the regional level: lessons from Toliary, Madagascar. Ocean Coast Manag 2002;45:41–58.
[61] Repoblikan'i Madagasikara. Décret no. 2010-137 Portant réglementation de la gestion intégrée des zones côtières et marines de Madagascar [Decree no. 2010-137 Regulating the integrated management of coastal and marine areas of Madagascar]. Antananarivo, Madagascar; 23rd March 2010.
[62] Richardson P, Broderick A, Campbell L, Godley B, Ranger S. Marine turtle fisheries in the UK overseas territories of the Caribbean: domestic legislation and the requirements of multilateral agreements. J Int Wildl Law Policy 2006;9:223–46.
[63] Repoblikan'i Madagasikara. Loi no. 2005-018 Sur le commerce international des espèces de faune et de flore sauvages [Law no. 2005-018 on International Trade of in Endangered Species of Wild Fauna and Flora]. Antananarivo, Madagascar; 17th October 2005.
[64] Repoblikan'i Madagasikara. Décret no. 2006-097 Fixant les modalités d'application de la loisur le commerce international des espèces de faune et de flore sauvages [Decree no. 2006-097 Fixing the procedures for implementing the Law on International Trade in Endangered Species of Wild Fauna and Flora]. Ministere de l'Environnement, des Eaux et Forêts. Antananarivo, Madagascar; 17th October. 2006.
[65] CITES. Convention on international trade in endangered species of wild fauna and flora. ⟨www.cites.org⟩; 2014. [accessed 12.10.14].
[66] CMS. Convention on the conservation of migratory species of wild animals. ⟨http://www.cms.int/⟩; 2014. [accessed 04.12.14].
[67] Wildlife conservation society. New listing to protect 21 species of sharks and rays. ⟨http://www.sciencedaily.com/releases/2014/11/141110110209.htm⟩. Science Daily; 2014. [accessed 12.11.14].
[68] Ministère de l'Environnement et des Forêts. Fifth national report to the convention on biological diversity. Madagascar. Antananarivo: Ministry of Environment and Forests & UNEP; 2014. p. 221.
[69] IOSEA. Overview of IOSEA MoU Implementation. Synthesis of national reports as at 21 July 2014. MT-IOSEA/SS.7/Doc. 6 Agenda item 7a. Seventh meeting of the signatory states. Bonn: Memorandum of understanding on the conservation and management of marine turtles and their habitats of the Indian Ocean and South-East Asia (IOSEA); 2014. p. 33.
[70] Repoblikan'i Madagasikara. Loi no. 98-004. Autorisant la ratification de la convention pour la protection, la gestion et la mise en valeur du milieu marin et des zones côtières de la région de l'Afrique orientale et protocoles y relatifs (convection de Nairobi). [Law no. 98-004 Authorizing the ratification of the convention for the protection, management and development of the marine and coastal environment of the eastern african region and related protocols (Nairobi Convention)]; 19th February 1998.
[71] United Nations Environment Program (UNEP). UNEP. Nairobi Convention. ⟨http://www.unep.org/NairobiConvention/The_Convention/index.asp⟩; 2014. [accessed 13.08.14].
[72] Ministre de l'Environnement de l'Ecologie et des Forêts (MEEF). Convention de Nairobi. ⟨http://www.ecologie.gov.mg/les-conventions-rattifiees-par-madagascar/convention-de-nairobi/⟩. Ministre de l'Environnement de l'Ecologie et des Forêts. [accessed 16.10.14].
[73] UNEP. Negotiating language: important terms to recognise & understand. Guide for negotiators of multilateral environmental agreements. Nairobi: UNEP Division of Environmental Law and Conventions; 2006.
[74] Rasamoelina H. Le vol de boeufs en pays Betsileo. Polit Afr 1991;52:22–30.
[75] Henkels D. A close up of Malagasy environmental law. Vermont J Environ Law 2002:3.
[76] Repoblikan'i Madagasikara. Loi no. 2001-004 portant réglementation générale des Dina en matière de sécurité publique [Law no. 2001-004 on the general regulation of Dinas in terms of public security]. Antananarivo, Madagascar. 25th October; 2001.
[77] Repoblikan'i Madagasikara. Loi no. 96-025 relative à la gestion locale des ressources naturelles renouvelables [Law no. 96-025 on the local management of renewable natural resources]. Antananarivo, Madagascar; 30th September 1996.
[78] Ignace R. L'insécurité rurale liée au vol de bœufs: quelques propositions de solution. Taloha 2010:19.
[79] Alliance Voahary Gasy (AVG). Ny Dina: Fitaoavana mahomby tena malagasy entin'ny fokonolona hanatsara ny fifampitondrana ary hitantanana maharitra ny harena voajanahary (Dina: an efficient Malagasy tool for communities to sustainable manage natural resources). Antananarivo: Alliance Voahary Gasy; 2011.
[80] Rakotoson L, Tanner K. Community-based governance of coastal zone and marine resources in Madagascar. Ocean Coast Manag 2006;49:855–72.
[81] Andriamalala G, Gardner CJ. L'utilisation du dina comme outil de gouvernance des ressources naturelles: leçons tirés de Velondriake, sud-ouest de Madagascar. Trop Conserv Sci 2010;3:447–72.
[82] Harris A. Out of sight but no longer out of mind: a climate of change for marine conservation in Madagascar. Madag Conserv Dev 2011;6:7–14.
[83] Ramandraiarivony T, Rakotonandrasana J. Gestion rationnelle des ressources naturelles renouvelables, pilier du développement durable. Rôle et place des transferts de gestion des ressources naturelles renouvelables dans les politiques forestières actuelles à Madagascar. Antananarivo: CIRAD; 2013.
[84] Ratsimbazafy R. L'océan au coeur de la Grande Île: Les aires marines protégées, un outil de développement durable pour Madagascar. Madag Conserv Dev 2011;6:5–6.
[85] Rocliffe S, Peabody S, Samoilys M, Hawkins JP, Towards A. Network of locally managed marine areas (LMMAs) in the Western Indian Ocean. PLoS ONE 2014;9:1–14.
[86] Randrianarison M. Le vonodina. In: Randrianarison M, editor. La protection de la biodiversité à Madagascar: Les paiements pour services environnementaux (PSE): L'Harmattan; 2010. p. 59–61.
[87] Sagar J. The ecology and conservation of sea turtles in the Nosy Be Islands, Madagascar. Unpublished field mission report; 2001.
[88] Gibbons E. The Rufford small grants foundation final report. FANO project. Available at: ⟨http://www.rufford.org/projects/emma_gibbons⟩. 2013. [accessed 23.08.14].
[89] IOSEA. Indigenous communities of South-west Madagascar protect marine turtles. Available at: ⟨http://www.ioseaturtles.org/feature_detail.php?id=403⟩. IOSEA; 2013. [accessed 23.09.14].
[90] Le Manach F, Gough C, Harris A, Humber F, Harper S, Zeller D. Unreported fishing, hungry people and political turmoil: the recipe for a food security crisis in Madagascar? Mar Policy 2012;36:218–25.
[91] European Commission. Request for information on long-line catches in West Indian Ocean by Transparaentsea. Brussels; 2013.

[92] Le Manach F, Gough C, Humber F, Harper S, Zeller D. Reconstruction of total marine fisheries catches for Madagascar (1950 – 2008). In: Harper S, Zeller D, editors. Fisheries catch reconstructions: Islands, Part II. Fisheries Centre Research Reports, 19. Fisheries Centre, University of British Columbia; 2011. p. 21–37 ISSN1198-6727.
[93] Repoblikan'i Madagasikara. Réunion technique sur «les prises de mesures face au trafic de tortue marine à Madagascar». Note de presse. Mercredi 04 Décembre 2013. Antananarivo: Comite National de Gestion Integree de la Zone Cotiere et marine (CN-GIZC); 2013.
[94] Rakotondrazafy AMNA, Andrianasolo RM. Evaluation préliminaire de la filière tortue marine dans la baie de Moramba, les zones de Marovasa Be et d'Anjajavy. Antananarivo: Cetamada; 2012.
[95] Repoblikan'i Madagasikara. Arrêté régional no. 2013-009/REG/ATSIMO ANDREFANA portant préservation des tortues menacées d'extinction dans la Région [Regional Decree no. 2013-009/REG/ATSIMO ANDREFANA relating to the preservation of endangered turtles in the region.] Ministere de la Decentralisation. Atsimo Andrefana, Madagascar. 16th October 2013.
[96] Reeve R. The CITES treaty and compliance: progress or jeopardy? Sustainable Development Programme BP 04/01 London: Chatham House; 2004. p. 14.
[97] Reeve R. Wildlife trade, sanctions and compliance: lessons from the CITES regime. Int Aff 2006;82:881–97.
[98] Anon. Evaluation de la politique nationale du commerce des espèces sauvages. Madagascar. Available at: ⟨http://www.cites.org/sites/default/files/common/prog/policy/madagascar_fr.pdf⟩. CITES; 2007.
[99] Wildlifeextra. Lemurs slaughtered for bushmeat. Available at: ⟨http://www.wildlifeextra.com/go/news/madagascar-lemurs536.html#cr⟩; 2009. [accessed 27.10.14].
[100] Durrell Wildlife Conservation Trust. Largest seizure of Critically Endangered ploughshare tortoises ever made. Available at: ⟨http://www.durrell.org/latest/news/largest-seizure-of-critically-endangered-ploughshare-tortoises-ever-made/⟩; 2013. [accessed 27.10.14].
[101] Global Witness, The Environmental Investigation Agency. Investigation into the illegal felling, transport and export of precious wood in Sava region, Madagascar. Global Witness &The Environmental Investigation Agency; 2009.
[102] Madonline. Exportation de bois précieux: Voahary Gasy porte plainte contre l'Etat. Available at: ⟨http://www.madonline.com/article.php?article_id=03654&date=2014-10-26&lang=fr⟩; 2009. [accessed 26.10.14].
[103] Innes JL. Madagascar rosewood, illegal logging and the tropical timber trade. Madag Conserv Dev 2010;5:6–10.
[104] Smith RJ, Muir RDJ, Walpole MJ, Balmford A, Leader-Williams N. Governance and the loss of biodiversity. Nature 2003;426:67–70.
[105] Smith RJ, Walpole MJ. Should conservationists pay more attention to corruption? Oryx 2005;39:251–6.
[106] Katzner T. Corruption – a double-edged sword for conservation? A response to Smith & Walpole Oryx 2005;39:1–3.
[107] Barrett CB, Gibson CC, Hoffman B, McCubbins MD. The complex links between governance and biodiversity. Conserv Biol 2006;20:1358–66.
[108] CITES. Malagasy president and CITES secretary-general discuss actions to stem illegal timber trade in the margins of 69th UN general assembly. Available at: ⟨http://www.cites.org/eng/news/pr/2013/20130914_shark_ray.php⟩; 2014. [accessed 07.10.14].
[109] Norten M. The militarisation of marine resource conservation and law enforcement in the Western Cape, South Africa. Mar Policy 2015 http://dx.doi.org/10.1016/j.marpol.2014.09.007, in press.
[110] Kashwan P. The politics of rights-based approaches in conservation. Land Use Policy 2013:31.
[111] Corson C. From rhetoric to practice: how high-profile politics impeded community consultation in Madagascar's new protected areas. Soc Nat Resour 2012;25:336–51.
[112] Sarrasin B. La Gestion Locale Sécurisée (GELOSE): L'expérience malgache de gestion décentralisée des ressources naturelles. Études Caribéennes 2009:12.
[113] Madagate. Madagascar Pêche: validation du document de Stratégie nationale de bonne gouvernance des pêches maritimes. Available at: ⟨http://www.madagate.com/editorial/communique/2437-madagascar-peche-validation-du-document-de-strategie-nationale-de-bonne-gouvernance-des-peches-maritimes.html⟩; 2012. [accessed 03.05.15].
[114] Humber F, Hykle D. Report on the workshop for the adoption of a management and conservation plan for marine turtles in Madagascar. London: Blue Ventures Conservation and IOSEA; 2011. p. 56.
[115] Andriamalala G, Peabody S, Gardner CJ, Westerman K. Using social marketing to foster sustainable behaviour in traditional fishing communities of south-west Madagascar. Conserv Evid 2013;10:37–41.
[116] Pitt H. To live with the sea: community-based management of marine resources in Southwest Madagascar; 2007.
[117] The World Bank. Madagascar: measuring the impact of the political crisis. [accessed 28.04.15]. The World Bank; 2013. ⟨http://www.worldbank.org/en/news/feature/2013/06/05/madagascar-measuring-the-impact-of-the-political-crisis⟩ Available at.
[118] FAO marine resources service. Fisheries management. 1. Conservation and management of sharks. FAO Technical Guidelines for Responsible Fisheries No 4, Suppl 1 Rome, FAO 37p; 2000.
[119] Walker TI. Management measures. In: Musick JA, Bonfil R, editors. Management techniques for elasmobranch fisheries FAO fisheries technical paper no. 474. Rome: FAO; 2005. p. 216–42.
[120] Wildlife conservation society. Government of Madagascar creates country's first shark sanctuary. Available at: ⟨http://press.wcs.org/NewsReleases/tabid/13614/articleType/ArticleView/articleId/6563/Government-of-Madagascar-Creates-Countrys-First-Shark-Sanctuary.aspx⟩; 2015. [accessed 17.02.15].
[121] Repoblikan'i Madagasikara. Arrêté Ministeriel no. 37.069/2014 portant définition du plan d'aménagement concerté des pêcheries de la baie d'Antongil [Ministerial Order no. 37.069/2014 relating to the definition of a collaborative fisheries management plan for Antongil Bay] Antananarivo, Madagascar; 18th December. 2014.
[122] Vince G. Maldives moves to protect its sharks. Available at: ⟨http://news.bbc.co.uk/1/hi/sci/tech/7933662.stm⟩. BBC News; 2009. [accessed 27.08.14].
[123] CMS sharks MoU. Shark sanctuaries. Available at: ⟨http://sharksmou.org/shark-sanctuaries⟩. Memorandum of understanding on the conservation of migratory sharks; 2014. [accessed 06.11.14].
[124] Humane Society International. National laws, multi-lateral agreements, regional and global regulations on shark protection and shark finning as of October 2014. Humane Society International; 2014.
[125] European parliament. Available at: ⟨http://www.europarl.europa.eu/news/en/news-room/content/20121122IPR56237/html/Parliament-closes-loopholes-in-shark-finning-ban⟩. Parliament closes loopholes in shark finning ban; 2012. [accessed 06.11.14].
[126] Campbell LM, Haalboom BJ, Trow J. Sustainability of community-based conservation: sea turtle egg harvesting in Ostional (Costa Rica) ten years later. Environ Conserv 2007;34:122–31.
[127] Stringell T, Calosso MC, Claydon JA, Clerveaux W, Godley B, Lockhart KJ, et al. Marine turtle harvest in a mixed small-scale fishery: evidence for revised management measures. Ocean Coast Manag 2013;82:34–42.
[128] Lewison RL, Crowder LB, Read AJ, Freeman SA. Understanding impacts of fisheries bycatch on marine megafauna. Trends Ecol Evolution 2004;19:598–604.
[129] Kiszka J, Muir C, Poonian C, Cox TM, Amir OA, Bourjea J, et al. Marine mammal bycatch in the southwest Indian Ocean: review and need for a comprehensive status assessment. West Indian Ocean J Mar Sci 2009;7:119–36.
[130] European union. Fisheries partnership agreement between the European Union and the Republic of Madagascar. Available at: ⟨http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1421777222293&uri=CELEX:22007A1217(02)⟩; 2007. [accessed 21.09.14].
[131] Walpole MJ, Leader-Williams N. Masai Mara tourism reveals partnership benefits. Nature 2001;413:771.
[132] Barnes-Mauthe M, Oleson KLL, Zafindrasilivonona B. The total economic value of small-scale fisheries with a characterization of post-landing trends: an application in Madagascar with global relevance. Fish Res 2013;147:175–85.
[133] Tucker B, Tsimitamby, Humber F, Benbow S, Iida T. Foraging for development: a comparison of food insecurity, production, and risk among farmers, forest foragers, and marine foragers in Southwestern Madagascar. Human Org 2010;69:375–86.
[134] Baum JK, Myers RA, Kehler DG, Worm B, Harley SJ, Doherty PA. Collapse and conservation of shark populations in the Northwest Atlantic. Science 2003;299:389–92.
[135] Cortés E, Brooks E, Apostolaki P, Brown CA. Stock assessment of dusky shark in the U.S. Atlantic and Gulf of Mexico. Panama City, Florida: National Marine Fisheries Service, Southeast Fisheries Science Center; 2006.
[136] Ferretti F, Myers RA, Serena F, Lotze HK. Loss of large predatory sharks from the Mediterranean Sea. Conserv Biol 2008;22:952–64.
[137] Hayes C, Jiao Y, Cortés E. Stock assessment of scalloped hammerheads in the Western North Atlantic Ocean and Gulf of Mexico. N Am J Fish Manag 2009;29:1406–17.
[138] Broderick AC, Frauenstein R, Glen F, Hays GC, Jackson AL, Pelembe T, et al. Are green turtles globally endangered? Global Ecol Biogeogr 2006;15:21–6.
[139] Chaloupka M, Bjorndal K, Balazs GH, Bolten AB, Ehrhart LM, Limpus CJ, et al. Encouraging outlook for recovery of a once severely exploited marine megaherbivore. Global Ecol Biogeogr 2008;17:297–304.
[140] Kittinger JN, Van Houtan KS, McClenachan L, Lawrence AL. Using historical data to assess the biogeography of population recovery. Ecography 2013;36:868–72.
[141] Stokes KL, Fuller WJ, Glen F, Godley B, Hodgson DJ, Rhodes KA, et al. Detecting green shoots of recovery: the importance of long-term individual-based monitoring of marine turtles. Animal Conserv 2014.