

# CONSERVING MANTA & DEVIL RAYS

---

A Global Strategy & Action Plan

---



# CONSERVING MOBULID RAYS

A Global Strategy & Action Plan



ISABEL ENDER | GUY STEVENS  
REBECCA CARTER | REBECCA ATKINS | DANNY COPELAND



**Shark  
Conservation  
Fund**



**save our seas  
foundation**

---

*The Manta Trust would like to thank the Shark Conservation Fund and the Save Our Seas Foundation for their years of continued funding and support for mobulid conservation.*

*The Manta Trust would also like to thank Jessica Berliner and Marc Dando for creating the infographics and illustrations in this report.*

*Finally, the Manta Trust would like to thank Katie Lee-Brooks and Sarah Fowler for their expert comments and invaluable advise on the various draft versions of this document.*

---

# CONSERVING MOBULID RAYS

<b>INTRODUCTION</b>	<b>4</b>
A Sea of Change	5
The Manta Trust	6
Species Descriptions	7
Protective Legislation	13
Threats to Mobulid Rays	15
<b>CONSERVATION STRATEGY &amp; ACTION PLAN</b>	<b>16</b>
Strategies to eliminate targeted mobulid fishing	18
Strategies to reduce mobulid bycatch	22
Strategies to support responsible tourism	27
Strategies to maintain healthy mobulid habitats	30
<b>PRIORITIES FOR ACTION</b>	<b>33</b>
<b>Priority one:</b> Focus areas to address the threats from targeted & bycatch fisheries	33
<b>Priority two:</b> Focus areas to address the threat from tourism	34
<b>CONCLUSIONS</b>	<b>36</b>
<b>APPENDICES</b>	<b>37</b>
<b>Appendix I:</b> Theory of change to achieve conservation goals	37
<b>Appendix II:</b> Research priorities to support effective manta & devil ray conservation	41
<b>REFERENCES</b>	<b>42</b>



# INTRODUCTION

Manta and devil rays, known collectively as mobulids, are some of the most fascinating and enigmatic creatures in our oceans. Close relatives of all sharks and rays, these cartilaginous, filter feeding fish range throughout the tropical and sub-tropical oceans of the world<sup>1,2</sup>. Born into a life of perpetual motion, they can never stop moving as they must keep water flowing over their gills to respire. Their daily and seasonal movements are tuned to the ebb and flow of the ocean currents that breathe life into their world, bearing the planktonic food upon which they depend<sup>3</sup>.

Manta rays are giants of their kind, with the largest individuals reaching seven metres in width and weighing up to two tonnes. Despite their colossal size, mantas are gentle creatures. They have the largest brain of all fish, and their intelligence and curiosity make encounters with manta rays a truly magical experience<sup>4,5</sup>. Their obvious intellect and complex social interactions set manta rays apart from most other fish, but as they have only been intensively studied in detail for around a decade, much of their life history remains a mystery<sup>6</sup>.

Devil rays are the manta's smaller relatives, but what they lack in size they make up for in acrobatic enthusiasm. During courting events, several of the

pygmy devil ray species are known to aggregate in vast shoals that number in the thousands - delivering one of the ocean's greatest spectacles<sup>2</sup>. Even less is known about devil rays than mantas; they are generally very shy towards divers, making it hard to observe and study their behaviour in the wild<sup>6</sup>.

Mobulids first appear in the fossil record around 28 million years ago; evolving from bottom dwelling rays, they adapted to life in the water column<sup>7</sup>. They are defined by their specially modified gill plates, which they use to filter zooplankton and small fishes from the water column<sup>8</sup>. Mobulid rays have a conservative life history strategy; they take a long time to reach sexual maturity, are slow to reproduce, and tend to give birth to a single pup every two to five years following a nine to twelve- month pregnancy<sup>6,9,10</sup>. This strategy may have served them well for millions of years, but unfortunately these traits, paired with their highly migratory nature, now leave mobulids extremely vulnerable to overexploitation by humans<sup>1,9</sup>.

## A SEA OF CHANGE

The greatest threat to mobulids is excessive targeted and incidental catch in fisheries<sup>1,9,11</sup>, increasingly driven by an international trade in gill plates that are used in an Asian health tonic<sup>12</sup>. As a result, some mobulid populations exhibit declines of over 90%<sup>13-15</sup>. Of particular concern is the exploitation of this species from within critical habitats, where numerous individuals can be targeted with relatively high catch-per-unit-effort. For such intrinsically vulnerable species, even small negative pressures exerted upon a population are likely to have severe consequences for the population's survival<sup>9</sup>.

Due to their vulnerable life history traits, and in response to the growing threat of the gill plate trade, several significant steps have been taken in recent years to improve the conservation status of mobulids. In 2011 oceanic manta rays (*Mobula birostris*) were successfully listed on the Convention for the Conservation of Migratory Species (CMS) Appendices I and II. Concurrently, both manta species were reclassified on the IUCN Red List

of Threatened Species as *Vulnerable*. In 2013, collaborative efforts between the world's nations, researchers and NGOs saw manta rays listed on Appendix II of the Convention for International Trade of Endangered Species (CITES), and in 2014 reef manta rays (*Mobula alfredi*) and all species of devil ray were listed on the CMS Appendices I and II. More recently, 2016 saw all devil ray species join manta rays on the CITES Appendix II, driven by an impressive number of co-proponent governments, conservationists and NGOs.

Despite these growing protective measures, manta and devil rays remain extremely vulnerable to exploitation. A comprehensive approach and strategic plan is therefore needed to ensure the long-term conservation and sustainable use of mobulid rays. Crucially, this plan needs to address the levels of bycatch and targeted fisheries that threaten these rays. Other threats, such as the impacts of tourism<sup>16-18</sup> and pollution<sup>6,19</sup>, also need to be considered and mitigated.



Photo by Shawn Heinrichs



Photo by Guy Stevens

## THE MANTA TRUST

Founded in 2011, the Manta Trust is a UK registered charity that co-ordinates global mobulid research and conservation efforts. Our team is comprised of a diverse group of researchers, scientists, conservationists, educators and media experts; working together to share and promote knowledge and expertise. The Manta Trust takes a multifaceted approach to mobulid conservation. By conducting long-term, robust scientific studies, we aim to build the solid foundations upon which governments, NGO's and conservationists can make informed and effective marine management decisions. With a network of over twenty projects worldwide, we specialise in collaborating with

multiple parties to drive conservation as a collective; from businesses and governments, to individuals and local communities. Finally, we place considerable effort into raising awareness of the threats facing mobulids. As charismatic megafauna, manta rays act as a flagship species, helping to motivate and engage people with the wider message of marine ecosystem conservation. Through this multifaceted approach, the manta ray becomes the catalyst for change, educating people about the solutions needed to ensure the long-term survival of these animals and the underwater world we all rely upon.

### VISION

To see all species of manta rays and their relatives protected or effectively managed for sustainable or non-consumptive use, by the people closest to them, in a means that promotes wider ocean conservation.

We measure our success in achieving this vision through metrics related to global mobulid ray landings, the amount of mobulids caught as bycatch, and the number of protective policies that are in place. We also take into consideration the number

of communities involved in mobulid conservation efforts, the level of engagement of communities and the general public, and ultimately evaluate our success through an increase or stability in mobulid ray population numbers globally.

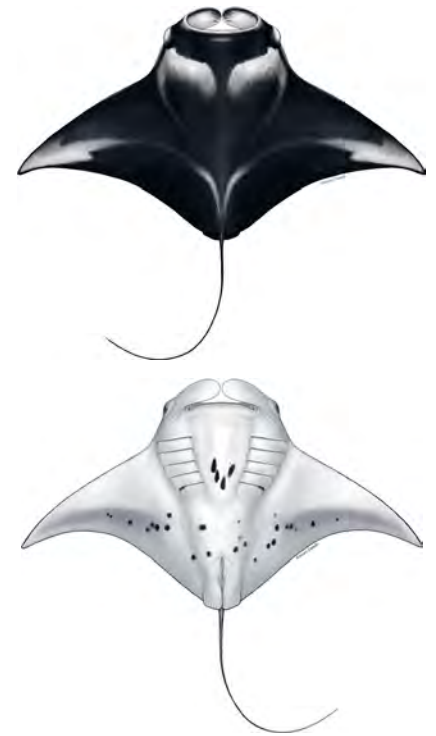
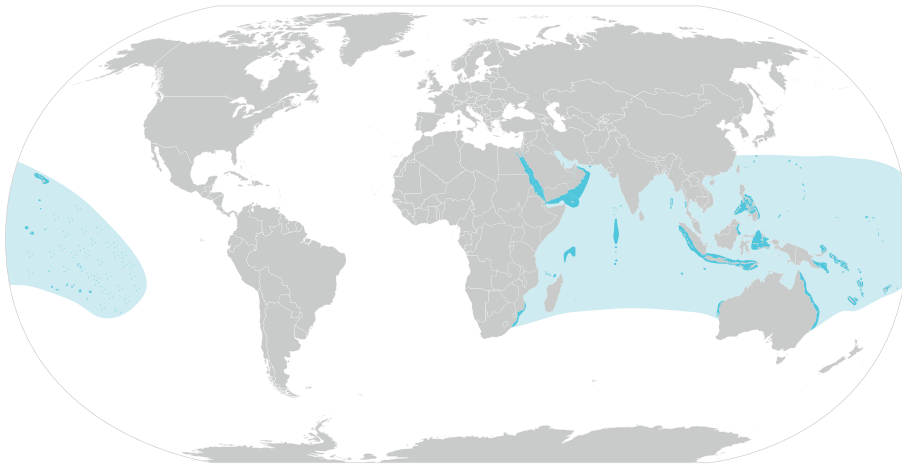
## SPECIES DESCRIPTIONS

Manta and devil rays (mobulids) belong to a group of rays called the Myliobatiformes, which contains 12 families and about 370 species. Taxonomically, within the Mobulidae family there is just one genus: *Mobula*, which contains **ten species** – two (possibly three) manta species<sup>20,21</sup> and eight devil ray species<sup>2,6,22</sup>.

### REEF MANTA RAY - *Mobula alfredi*

**Disc width:** average 300-350cm (10-11.5ft)

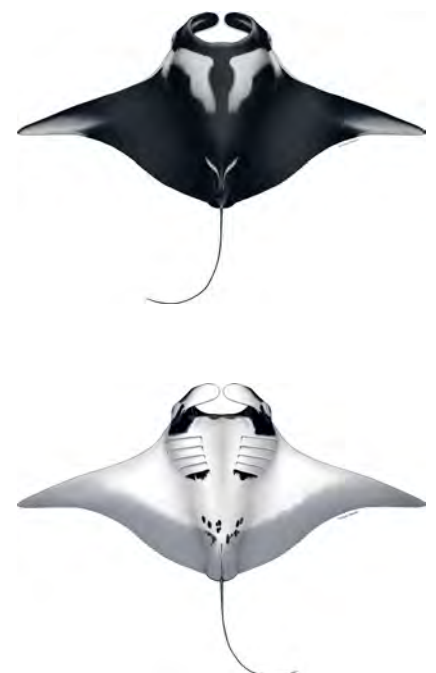
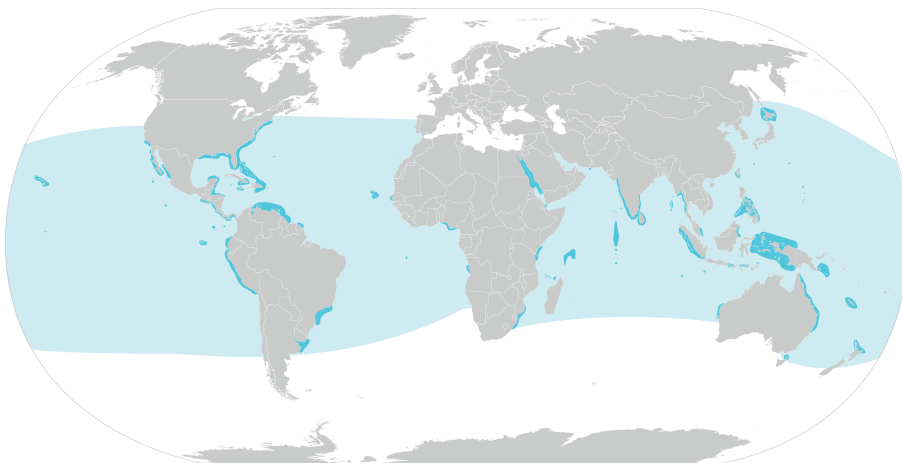
**IUCN Red List:** Vulnerable



### OCEANIC MANTA RAY - *Mobula birostris*

**Disc width:** average 400-500cm (13-16.5ft)

**IUCN Red List:** Vulnerable





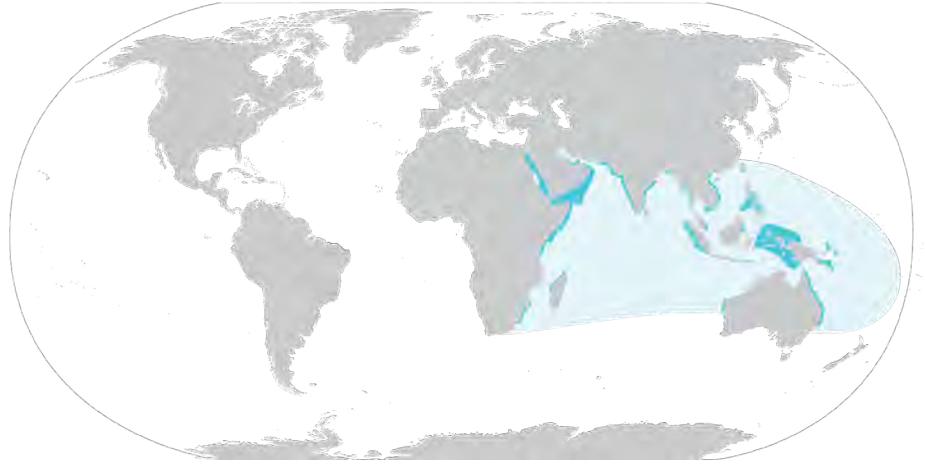


## LONGHORNED PYGMY DEVIL RAY

*Mobula eregoodootenkee*

**Disc width:** average 110cm (3.6ft)

**IUCN Red List:** Near Threatened

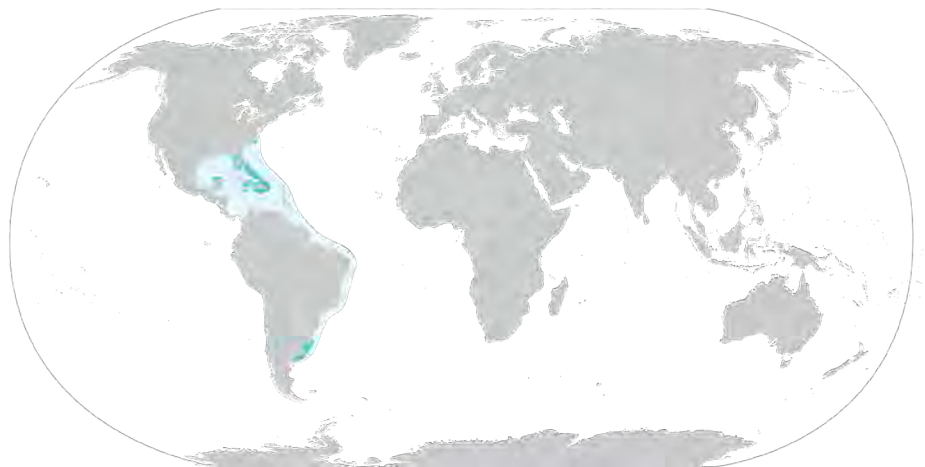


## WEST ATLANTIC PYGMY DEVIL RAY

*Mobula hypostoma*

**Disc width:** average 110cm (3.6ft)

**IUCN Red List:** Data Deficient

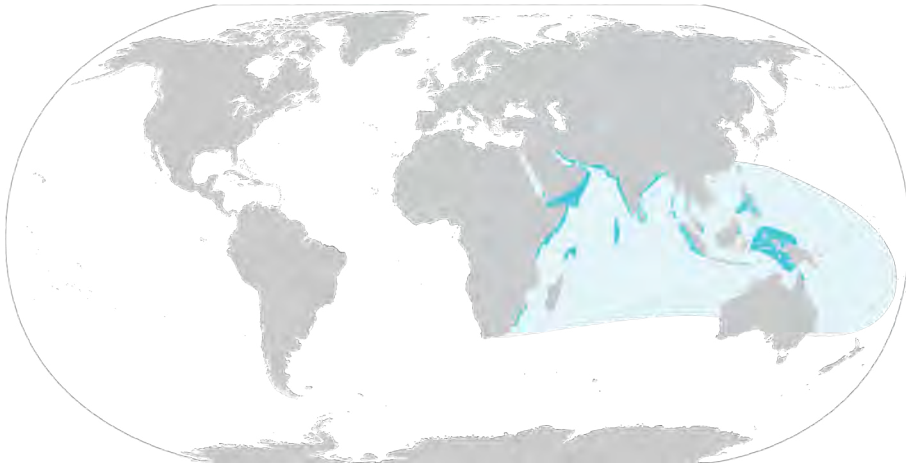


## SHORTHORNED PYGMY DEVIL RAY

*Mobula kuhlii*

**Disc width:** average 100cm (3.3ft)

**IUCN Red List:** Data Deficient



## SPINETAIL DEVIL RAY

*Mobula mobular*

**Disc width:** average 180-280cm (5.9-9.2ft)

**IUCN Red List:** Near Threatened



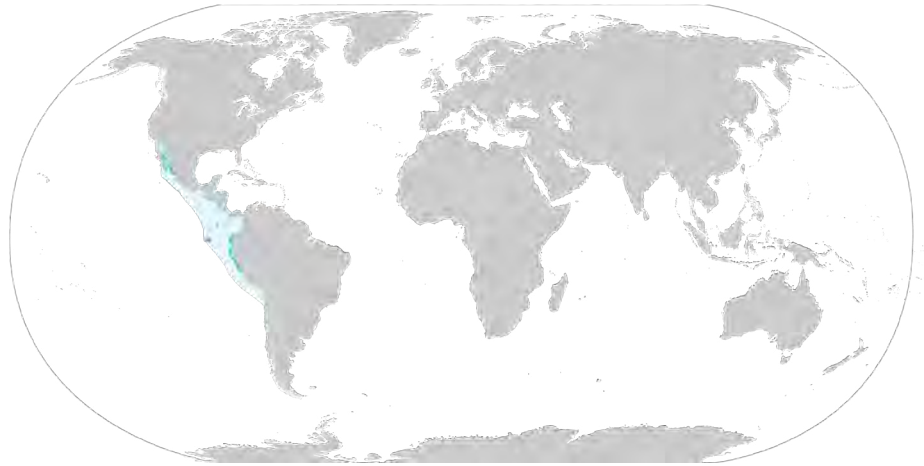


## MUNK'S PYGMY DEVIL RAY

*Mobula munkiana*

**Disc width:** average 89-100cm (2.9-3.3ft)

**IUCN Red List:** Near Threatened



## EAST ATLANTIC PYGMY DEVIL RAY

*Mobula rochebrunei*

**Disc width:** average 113cm (3.7ft)

**IUCN Red List:** Vulnerable

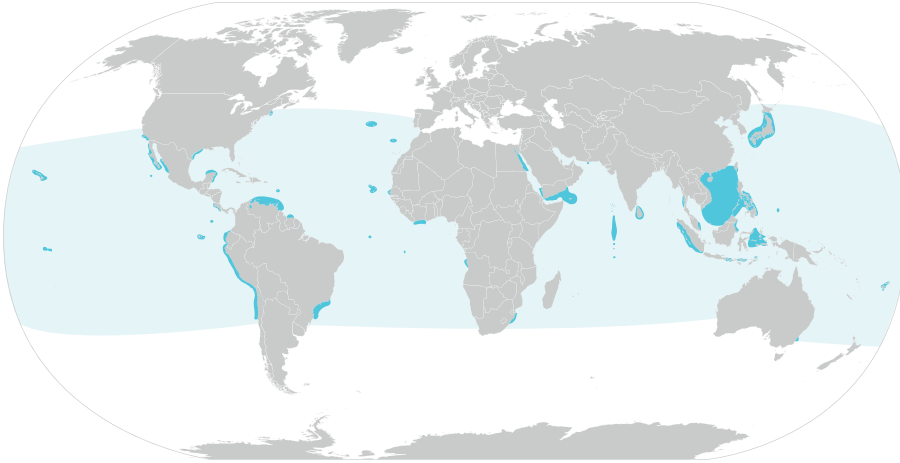


## SICKLEFIN DEVIL RAY

*Mobula tarapacana*

**Disc width:** average 200-270cm (6.6-8.8ft)

**IUCN Red List:** Vulnerable



## BENTFIN DEVIL RAY

*Mobula thurstoni*

**Disc width:** average 135cm (4.5ft)

**IUCN Red List:** Near Threatened



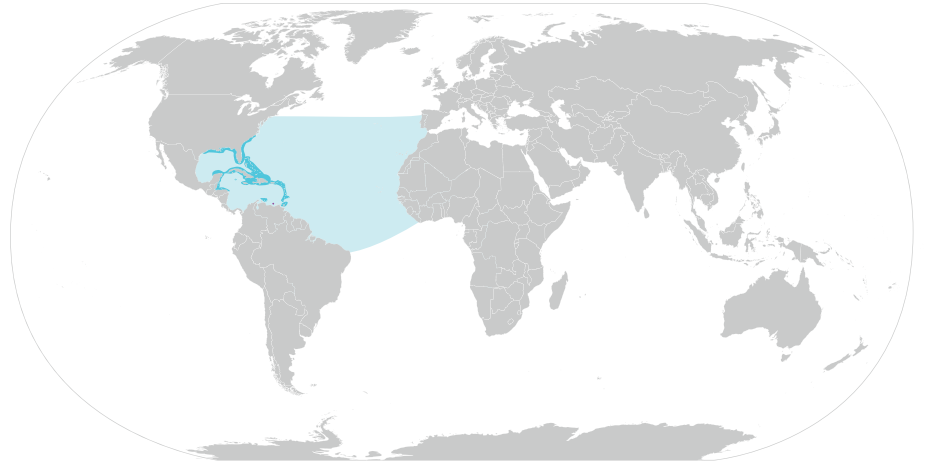


## CARIBBEAN MANTA RAY

*Mobula cf. birostris*

**Disc width:** average 300-400cm (10-13ft)

**IUCN Red List:** Vulnerable



# PROTECTIVE LEGISLATION

While international, regional, and national protective legislation has improved in recent years, there is still a need for greater protection throughout the range of all manta and devil ray species globally.

LOCATION	SPECIES	LEGAL PROTECTION MEASURE
INTERNATIONAL		
CITES Appendix II	All mobulid species	Listing of the genus <i>Manta</i> (2013) and <i>Mobula</i> (2016) on Appendix II of the Convention on International Trade in Endangered Species (CITES).
CMS Signatories	All mobulid species	Convention on the Conservation of Migratory Species of Wild Animals (CMS), Appendix I and II; <i>M. birostris</i> (2011), all other mobulid species (2014).
Inter-American Tropical Tuna Commission (IATTC)	All mobulid species	Resolution C-15-04 on the Conservation of Mobulid Rays Caught in Association with Fisheries in the IATTC Convention Area.
REGIONAL		
Barcelona & Bern Conventions	<i>M. mobular</i>	Added to the Annex II 'list of strictly protected fauna species' of the Bern Convention and the Annex II 'List of endangered or threatened species' to the Protocol concerning Special Protected Areas and Biological Diversity in the Mediterranean of the Barcelona Convention, which came into force in 2001.
European Union member countries	All mobulid species	Council Regulation (EU) 2015/2014 amending Regulation (EU) No 43/2014 and repealing Regulation (EU) No 779/2014.
NATIONAL		
Australia	All mobulid species	Environment Protection and Biodiversity Conservation Act (added as protected species 2012).
Brazil	All mobulid species	Inter-ministerial Normative Instruction No. 2 of 14/3/2013.
Croatia	<i>M. mobular</i>	Law of the Wild Taxa 2006 Strictly prohibited.
Ecuador	<i>M. birostris</i> , <i>M. mobular</i> , <i>M. thurstoni</i> , <i>M. munkiana</i> & <i>M. tarapacana</i>	Ecuador Official Policy 093, 2010.
Indonesia	<i>M. birostris</i> & <i>M. alfredi</i>	KepMen National Protective Legislation, 2014.
Israel	All ray species	All sharks and all fully protected in Israel since 2005. They may not be captured, harmed, traded or kept, without a specific permit from the Israel Nature and Parks Authority (INPA).

LOCATION	SPECIES	LEGAL PROTECTION MEASURE
NATIONAL		
Maldives	All ray species	Exports of all ray products banned 1995. Environment Protection Agency rule - illegal to capture, keep or harm any type of ray; Batoidea Maldives Protection Gazette No. (IUL) 438-ECAS/438/2014/81.
Malta	<i>M. mobular</i>	Sch. VI Absolute protection.
Mexico	<i>M. birostris</i> , <i>M. mobular</i> , <i>M. thurstoni</i> , <i>M. munkiana</i> , <i>M. hypostoma</i> & <i>M. tarapacana</i>	NOM-029-PESC-2006 Prohibits harvest and sale.
New Zealand	<i>M. birostris</i> & <i>M. mobular</i>	Wildlife Act 1953 Schedule 7A (absolute protection).
Peru	<i>M. birostris</i>	Article 2 of Resolution 441-2015-PRODUCE, Jan 2016.
Philippines	<i>M. birostris</i> & <i>M. alfredi</i>	FAO 193 1998 Whale Shark and Manta Ray Ban.
United Arab Emirates (UAE)	<i>M. birostris</i> & <i>M. alfredi</i>	Fully protected in UAE waters (2014).
STATE		
Christmas Island and Cocos (Keeling) Islands, Australian Indian Ocean Territories	All ray species	Protected species. Dept. of Fisheries Western Australia 2010.
Commonwealth of the Northern Mariana Islands, USA Territory	All ray species	Public Law No. 15-124.
Florida, USA	<i>Manta</i> spp.	FL Admin Code 68B-44.008 - no harvest.
Guam, USA Territory	All ray species	Bill 44-31 prohibiting possession/sale/trade in ray parts 2011.
Hawaii, USA	<i>Manta</i> spp.	H.B. 366 2009 - no harvest or trade.
West Manggarai/Komodo	<i>Manta</i> spp.	Shark and Manta Ray Sanctuary Bupati Decree 2013.
Raja Ampat Regency, Indonesia	All ray species	PERDA (Provincial Law) Hiu No. 9 Raja Ampat 2012.
Yap (Federated States of Micronesia)	<i>Manta</i> spp.	Manta Ray Sanctuary and Protection Act 2008.

# THREATS TO MOBULID RAYS

The greatest threats to mobulid rays are fisheries (both targeted and bycatch) and tourism<sup>1,6,9,11,17,18</sup>. These threats can be categorised as “*biological resource use*” and “*human intrusion and disturbance*”, using the IUCN classification scheme of threats, and are considered direct threats caused by anthropogenic impacts.

Mobulids are also threatened by environmental changes, such as food availability, reef degradation, and pollution<sup>6,19</sup>. These factors fall within the IUCN categories of “*pollution*” and “*climate change*”, and are considered indirect threats ([www.iucnredlist.org/technicaldocuments/classification-schemes/threats-classification-scheme](http://www.iucnredlist.org/technicaldocuments/classification-schemes/threats-classification-scheme)).

Table 1 lists the key threats to mobulid rays in order of priority (1=highest; 6=lowest), with desired

goals for the threat, and metrics to measure success. In the remaining sections of this strategic document we describe how to address each of these threats so that their impact on mobulid rays is either reduced or eliminated. An overview of this approach is illustrated graphically (Mobulid Conservation Strategy & Action Plan), and a detailed plan of action for each threat is presented through the following text, infographics, and via a theory of change flowchart (see Appendix I). To address these threats and prioritise future research on these species, a complimentary publication to identify the most pressing questions in mobulid conservation research was also undertaken (see Appendix II).

**Table 1:** Key threats to mobulid rays, desired goals and metrics for measuring progress.

	PRIORITY	THREAT	GOAL	METRICS
DIRECT THREATS	1	Targeted fishing	No demand for mobulid products	Volume of landings; gill plates (in markets); other body parts (in markets).
	2	Bycatch	Limited bycatch	Levels of catch & release; mitigation measures in gear (gear, spatial, temporal); policies.
	3	Tourism	Well-managed tourism	Boat strikes; in-water interactions; code of conduct.
INDIRECT THREATS	4	Food availability	High productivity	Fecundity; plankton levels (amount & type); oceanographic variables.
	5	Reef degradation	Healthy reefs	Coral diversity; coral cover; resilience; bleaching; associated species.
	6	Pollution	Limited pollution	Water quality; pollution types.



---

MOBULID CONSERVATION

# STRATEGY & ACTION PLAN

---



Photo by Guy Stevens

# Mobulid Conservation Strategy & Action Plan

## THE MANTA TRUST VISION:

All species of manta ray and their relatives are protected or effectively managed for sustainable or non-consumptive use, by the people closest to them, in a means that promotes wider ocean conservation

### 1 KEY THREAT: TARGETED FISHERY

#### THE GOAL: NO DEMAND FOR MOBULID PRODUCTS

Targeted fishing of mobulid rays has greatly increased driven by the demand for gill plates, which are used as a Traditional Asian Medicine

### 3 KEY THREAT: TOURISM

#### THE GOAL: TO SEE WELL-MANAGED MOBULID TOURISM

Unregulated or badly managed tourism can negatively affect the animals and in turn the tourism industry

### 2 KEY THREAT: BYCATCH

#### THE GOAL: LIMIT MOBULID BYCATCH WORLDWIDE

Mobulid rays are incidentally caught in at least 30 fisheries in 23 countries

### 4 KEY THREATS: ENVIRONMENTAL CHANGES

#### THE GOAL: TO ENSURE HEALTHY ECOSYSTEMS FOR MOBULIDS

Reef degradation, pollution and lower plankton productivity limit their food supply and suitable habitat

## Mobulid species IUCN Red List status

### DATA DEFICIENT



Shorthorned Pygmy Devil Ray  
*Mobula kuhlii*



West Atlantic Pygmy Devil Ray  
*Mobula hypostoma*

### NEAR THREATENED



Munk's Pygmy Devil Ray  
*Mobula munkiana*



Bentfin Devil Ray  
*Mobula thurstoni*



Longhorned Pygmy Devil Ray  
*Mobula eregoodootenkee*



Spinetail Devil Ray  
*Mobula mobular*

### VULNERABLE



East Atlantic Pygmy Devil Ray  
*Mobula rochebrunei*



Caribbean Manta Ray  
*Mobula cf. birostris*



Sicklefin Devil Ray  
*Mobula tarapacana*



Oceanic Manta Ray  
*Mobula birostris*



Reef Manta Ray  
*Mobula alfredi*

Thanks and credit to Marc Dando (Wild Nature Press) for the mobulid illustrations



## STRATEGIES TO ELIMINATE TARGETED MOBULID FISHING

### Goal 1 No demand for mobulid products.

Over the last decade, targeted fishing of mobulid rays has increased dramatically. This is primarily due to the rising demand for mobulid products, in particular gill plates, which are used in traditional Asian medicinal health tonics<sup>12</sup>. Mobulids are targeted for their gill plates in six continental and ocean regions, 13 countries, and 21 locations, making it a truly global threat to the species<sup>12</sup>. As a result of increasing demand, many former bycatch fisheries have become directed commercial export fisheries<sup>13,23</sup>.

To eliminate this threat, the demand for mobulid products needs to be reduced. Demand for mobulid products is complex and driven by a number of factors, which can differ depending on location. In order for demand to be reduced the following preconditions need to be met:

- 1. Mobulid fisheries need to become commercially unviable; a high risk and low reward activity.**
- 2. Alternative sources of protein need to be available where mobulids are used for food.**
- 3. There needs to be no marketing of gill plates and other mobulid products, and there are culturally acceptable alternatives to using gill plates as medicine.**

In order to achieve these preconditions, the following actions have been identified:

- Change the balance between risk and reward for mobulid fisheries to make mobulid fishing commercially unviable through;
  - a. Influencing the development of policies (national and regional) and management plans to ensure that legislation exists that supports mobulid conservation.

- b. Building capacities for the enforcement of policies and management plans.
- c. Monitoring and evaluating the effectiveness of enforcement. The commercial viability of mobulid fishing is also affected by access to mobulid rays, access to markets, and the cultural and livelihood compatibility for mobulid fisheries. However, we cannot directly influence these factors.

- Develop and coordinate livelihoods programmes in communities that are dependent on mobulid fisheries, so that sufficient income alternatives exist.
- Implement development projects, such as aquaculture and farming, to generate alternative sources of protein for the communities, and reduce their dependency on mobulids.
- Develop marketing campaigns that encourage consumers to choose alternatives to traditional Asian medicine, and raise awareness for reducing gill plate consumption.

The responsible party, relative priority, scale of operation, cost, and time required to carry out these actions is described in Table 2. See Appendix I for a detailed theory of change diagram.



Photo by Thomas P. Peschak

**Table 2:** Action plan to address the threat from targeted fishery.

GOAL 1: No demand for mobulid products.		PRIORITY	SCALE	COST	TIMELINE
<b>Objective 1.1</b>	<b>Mobulid fishing is high risk / low reward, therefore mobulid fishing is commercially unviable.</b>				
<b>Sub-objective 1.1.1</b>	<b>Policies exist to support mobulid conservation.</b>				
Action	Develop or influence the development of policies and management plans.	High	Nat/ Intl	\$\$	Med
<b>Sub-objective 1.1.2</b>	<b>There is good enforcement of policy and regulations.</b>				
Action	Monitor and evaluate the enforcement of policies and management plans and report to decision makers.	High	Nat/ Intl	\$\$	Med
Action	Build capacities for enforcement of protective policies and management plans.	High	Nat/ Intl	\$\$	Med
<b>Sub-objective 1.1.3</b>	<b>Sufficient alternatives exist so that mobulid fisheries are not a priority.</b>				
Action	Support the development of livelihood programs (including surveys, developing alternatives and socializing alternatives).	Med	Local	\$\$\$	Long
<b>Objective 1.2</b>	<b>Alternative sources of protein.</b>				
Action	Introduce development projects (farming, aquaculture).	Med	Local	\$\$\$	Long
<b>Objective 1.3</b>	<b>Accepted alternatives to traditional medicines &amp; no marketing of gill plates.</b>				
Action	Marketing campaigns to educate consumers in choosing alternatives to traditional medicines.	High	Nat	\$\$	Med
Action	Raise awareness to reduce consumer demand for gill plates.	High	Nat	\$\$	Med

Purple: Actions that Manta Trust are currently undertaking, or have an interest in undertaking.

Green: Actions currently led by other NGOs, IGOs, governments, and industry.

Orange: Actions undertaken by a combination of both of the above.

# Strategies to eliminate targeted mobulid fishing

**THE GOAL: NO DEMAND FOR MOBULID PRODUCTS**



## 1 MOBULID FISHING IS COMMERCIALY UNVAILABLE



Mobulid fishing is a high risk and low reward activity -



Policies exist to support mobulid conservation



There is good enforcement of policy & regulations



Sufficient alternatives exist that mobulid fisheries are not a priority



Mobulid fishing is not profitable\*



There is limited access to fishing for mobulids\*



There is limited access to markets\*



Mobulid fishing is not compatible with local culture and livelihoods\*

\*Factors that the Manta Trust has no control over

## 2 THERE ARE ALTERNATIVE SOURCES OF PROTEIN



## 3 THERE IS NO MARKETING OF MOBULID PRODUCTS



THERE ARE CULTURALLY ACCEPTED **ALTERNATIVES** TO TRADITIONAL ASIAN MEDICINE

## Manta Trust's actions



- Influence the development of national and regional policies and management plans



- Develop and coordinate alternative livelihood programmes



- Build capacities for enforcement of policies and management plans



- Monitor and evaluate the effectiveness of enforcement



POLICY



COMMUNITY



RESEARCH

### EXTERNAL ACTIONS

- Development projects such as farming and aquaculture
- Marketing campaigns to encourage choosing alternatives to Traditional Asian Medicine
- Raising awareness to reduce consumer demand for gill plates

THE MANTA TRUST VISION: To see all species of manta rays and their relatives protected or effectively managed for sustainable or non-consumptive use





## STRATEGIES TO REDUCE MOBULID BYCATCH

### Goal 2 Limit mobulid bycatch worldwide.

Important milestones were achieved upon the successful listing of mobulids under the CMS and the CITES Appendices in 2014 and 2016 respectively, which has put a tighter regulation on the international trade of these species. The CMS signatories have declared their commitment to better protect mobulid rays, and several countries announced a national ban on the targeted fishery of manta and devil rays. Nevertheless, mobulid rays continue to be fished at an unsustainable level as bycatch.

A study on the vulnerabilities and fisheries impacts on manta and devil rays<sup>11</sup> showed that mobulids are incidentally caught in at least 30 fisheries in 23 countries, and that the annual non-discarded bycatch of mobulids in the tuna fishery was 14,000 individuals in 2015<sup>11</sup>. Post release mortality of mobulid rays is also likely to be high<sup>6</sup>, demonstrated by Francis & Jones' study<sup>24</sup>, where four out of seven spintail devil rays (*Mobula mobular*) died shortly after being released from a purse-seine net. High levels of mobulid bycatch are caused by the use of unselective gear in both commercial and artisanal fisheries, usually because there are insufficient spatial or temporal fisheries restrictions in place, and because there is too much fishing globally.

To address this threat, the level of mobulid bycatch globally needs to be reduced. To achieve this, the following preconditions need to be met:

1. There is selective gear use, or better gear use, in commercial and artisanal fisheries.
2. Effective temporal and spatial restrictions on mobulid fishing are in place.
3. The activity of ghost fishing is limited.
4. Mobulid fisheries are commercially unviable (see previous strategy), and the amount of fishing globally is reduced. We have limited influence on the latter.

In order to achieve these preconditions, the following actions have been identified:

- Develop and implement national and regional policies, such as via Regional Fisheries Management Organisations, to support better gear use and its enforcement in artisanal and commercial fisheries.
- Monitor the effectiveness of enforcement, and provide this data to governments to ensure destructive gear use becomes high risk and low reward.
- Conduct research on post release mortality and mobulid bycatch mitigation, and education on safe release methods. This will support an improved understanding of bycatch mitigation via alternative gear use.
- Implement gear swap programmes, trade, or market incentives, to switch gear and provide subsidies to fishers to ensure they have access to affordable alternative gears. Traditional /cultural practices will influence the success of this factor.
- Encourage collaborations among governments and scientists to jointly develop fisheries management regulations. This will help to ensure informed decision making, and ensure that skills, money and people are available to enable the restriction of mobulid fishing.
- Educate governments and the general public about mobulid conservation and management, to ensure there is a political will to restrict fisheries.
- Conduct research on mobulid movement, ecology, and habitat use, to ensure spatial and temporal restrictions are developed based on scientific knowledge.
- Liaise with governments to develop protected areas, and ensure mobulids have a higher profile in management priorities.
- Conduct research on sub-lethal impacts on mobulid rays to better understand which practices are harmful, and improve management of practices that lead to ghost fishing.
- Investigate hotspots for ghost fishing and mortality to define appropriate mitigation methods that ultimately limit ghost fishing.

The responsible party, relative priority, scale of operation, cost, and time required to carry out these actions is described in Table 3. See Appendix I for a detailed theory of change diagram.



**Table 3:** Action plan to address the threat from of bycatch.

GOAL 2: Limit mobulid bycatch worldwide.		PRIORITY	SCALE	COST	TIMELINE
Objective 2.1	Selective gear is used in commercial and artisanal fisheries.				
Sub-objective 2.1.1	Alternative gears are affordable.				
Action:	Provide subsidies to fishers.	Med	Local/ Nat	\$\$	Med
Action:	Trade and market incentives to switch gear.	Med	Local/ Nat	\$\$	Med
Sub-objective 2.1.2	Artisanal fisheries have access to alternative gears and/or appropriate mitigation.				
Action	Gear swap programs funded by government or industry.	Med	Local/ Nat	\$\$	Med
Sub-objective 2.1.3	Artisanal fishers have the knowledge and understanding of alternative gear mitigation practices.				
Action	Develop and communicate safe release methods for mobulids accidentally caught in fisheries.	High	Nat	\$	Short
Action	Conduct research on post-release mortality and reduction of bycatch in mobulid rays.	High	Nat	\$	Short
Sub-objective 2.1.4	There is a high risk and low reward to using destructive gears in both artisanal and commercial fisheries.				
2.1.4.1	Regulations exist to support better gear use.				
Action	National and regional policy (RFMOs and government led).	High	Nat/ Intl	\$	Med
2.1.4.2	Effective enforcement of gear-use regulations exists.				
Action	Provide data on enforcement levels.	High	Nat/ Intl	\$\$	Med
Action	Monitor and enforce via governments.	High	Nat/ Intl	\$\$	Med

Purple: Actions that Manta Trust are currently undertaking, or have an interest in undertaking.

Green: Actions currently led by other NGOs, IGOs, governments, and industry.

Orange: Actions undertaken by a combination of both of the above.

**Table 3 (continued):** Action plan to address the threat from of bycatch.

GOAL 2: Limit mobulid bycatch worldwide.		PRIORITY	SCALE	COST	TIMELINE
Objective 2.2	Effective temporal and spatial restrictions on fishing exist.				
Sub-objective 2.2.1	The skills, money and people needed to enable restriction of fisheries are available.				
Action	Fisheries departments, researchers and governments working together to implement fisheries restrictions.	Med	Nat	\$\$	Long
Sub-objective 2.2.2	There is the political will to restrict fisheries.				
Action	Educate governments and the general public about the need to protect mobulids and manage fisheries.	High	Nat	\$\$	Short
Sub-objective 2.2.3	Good knowledge of mobulid movement and habitat use exists.				
Action	Conduct research on mobulid movement ecology and habitat use.	High	Loc/ Nat/ Intl	\$\$	Long
Sub-objective 2.2.4	Mobulids have a higher profile in management priorities.				
Action	Liaise with governments to develop protected areas for mobulid rays.	Med	Nat	\$	Long
Objective 2.3	Limited ghost fishing.				
Sub-objective 2.3.1	Improved management practices that limit ghost fishing.				
2.3.1.1	Understanding of practices that might be harmful.				
Action	Conduct research on sub-lethal impacts on mobulids.	Low	Intl	\$	Short
2.3.1.2	Understanding of appropriate mitigation methods.				
Action	Understand hotspots for ghost fishing and mortality.	Low	Intl	\$	Short

Purple: Actions that Manta Trust are currently undertaking, or have an interest in undertaking.

Green: Actions currently led by other NGOs, IGOs, governments, and industry.

Orange: Actions undertaken by a combination of both of the above.

# Strategies to reduce mobulid bycatch

## THE GOAL: LIMIT MOBULID BYCATCH WORLDWIDE

### 1 FISHERIES USE SELECTIVE GEAR



Artisanal fisheries have access to alternative gear and appropriate mitigation



Artisanal fisheries have an understanding of alternative gear mitigation and use



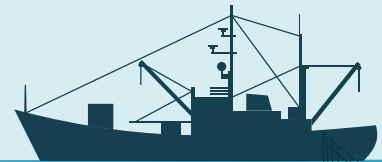
Alternative gears for fisheries are affordable



There is high risk and low reward in using destructive fishing gears



Artisanal fishery traditional and cultural practices align with use of selective gear\*



### 2 THERE ARE EFFECTIVE TEMPORAL & SPATIAL RESTRICTIONS ON FISHING



The skill, money and people are available to enable restriction of fisheries



Good knowledge about mobulid movement and habitat use exists



There is a political will to restrict fisheries



Mobulids have a higher profile in management priorities



The scale of global fishing is reduced\*



### 3 GHOST FISHING IS LIMITED



Improved management practices are in place that lead to reduced ghost fishing

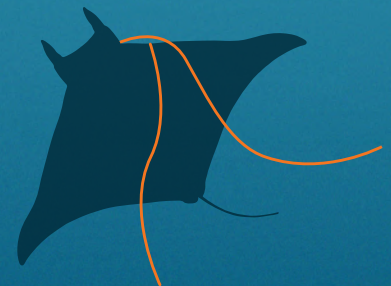


There is an understanding of practices that might be harmful



There is an understanding of appropriate mitigation methods

*\*Factors that the Manta Trust has no control over*



## Manta Trust's actions



- Develop and implement national and regional policies e.g. via RFMOs



- Conduct research on mobulid movement ecology and habitat use



- Encourage collaboration among governments and scientists to develop fisheries restrictions



- Conduct research on post-release mortality and mobulid bycatch mitigation



- Develop protected areas by liaising with governments



- Monitor the effectiveness of enforcement and provide data to governments



- Educate fishers about safe release methods for mobulid rays



- Conduct research on sub-lethal impacts on mobulid rays



- Educate governments and the general public about mobulid conservation and management



- Investigate hotspots for ghost fishing and mortality

### EXTERNAL ACTIONS

Trade or market incentives to switch gear exist, gear swap programmes are introduced and there are subsidies to fishers for switching gear funded by government or industry



POLICY



COMMUNITY



RESEARCH

THE MANTA TRUST VISION: To see all species of manta rays and their relatives protected or effectively managed for sustainable or non-consumptive use



## STRATEGIES TO SUPPORT RESPONSIBLE TOURISM

**Goal 3** To see well-managed mobulid tourism worldwide.

Tourism focused on charismatic marine megafauna, such as whales, sharks and rays, has become increasingly popular over the last two decades<sup>16,25</sup>. Wildlife watching tourism offers a variety of benefits. For tourists, these include recreational and educational values<sup>26,27</sup>. For local communities, wildlife tourism supports the economy by providing jobs and income<sup>28</sup>. The global manta-watching tourism is estimated to be worth US\$ 73 million per annum<sup>16</sup>, thus contributes substantially to the economy. However, unregulated or badly managed tourism may negatively affect the animals, and in turn the tourism industry, by disturbing the species' natural behaviour, degrading their habitat, and potentially reducing their fitness<sup>17,18,29</sup>. Increased human presence may induce animal stress<sup>30</sup>, and higher boat traffic may increase the rate of injuries<sup>31</sup>.

To see well-managed mobulid tourism, the following preconditions need to be met:

- 1. Tourists and operators are aware of, and comply with, responsible practices.**
- 2. There is management at key mobulid tourism sites.**
- 3. Mobulid rays have a higher profile in management priorities.**

To achieve these preconditions, the following actions have been identified:

- Identify key sites for mobulid tourism through conducting research.
- Support the creation of management plans for key tourism sites; for instance, by providing data on tourism interactions and sightings to governments.
- Monitor enforcement and compliance with regulations.

- Create educational materials for operators and tourists that clearly communicate how to sustainably interact with the species.
- Educate operators, governments, and tourists about mobulid rays and their conservation needs.

The responsible party, relative priority, scale of operation, cost, and time required to carry out these actions is described in Table 4. See Appendix I for a detailed theory of change diagram.

**Table 4:** Action plan to address the threat from tourism.

GOAL 3: To see well-managed mobulid tourism worldwide.		PRIORITY	SCALE	COST	TIMELINE
<b>Objective 3.1</b>	<b>Tourists and operators are aware of, and comply with, responsible practices.</b>				
Action	Create educational materials for operators and tourists.	Med	Intl	\$	Short
Action	Monitor enforcement and compliance.	Med	Nat	\$\$	Short
Action	Effective enforcement by government and industries, and compliance by tourists (through education).	Med	Local/ Nat	\$\$	Short
<b>Objective 3.2</b>	<b>Key mobulid-tourism sites are managed.</b>				
<b>Sub-objective 3.2.1</b>	<b>Regulations for/of mobulids in tourism exist.</b>				
Action	Identify key sites for mobulid tourism.	High	Local/ Nat	\$	Short
Action	Create management plans for tourism.	High	Local/ Nat	\$	Short
<b>Sub-objective 3.2.2</b>	<b>Enforcement of regulations related to mobulid tourism.</b>				
Action	Monitoring of enforcement to ensure it exists and persists.	High	Local/ Nat	\$\$	Short
<b>Objective 3.3</b>	<b>Mobulids have a higher profile in management priorities.</b>				
Action	Educate operators, governments and industry about mobulids and the need for their conservation.	Med	Local	\$	Med

Purple: Actions that Manta Trust are currently undertaking, or have an interest in undertaking.

Green: Actions currently led by other NGOs, IGOs, governments, and industry.

Orange: Actions undertaken by a combination of both of the above.

# Strategies to support responsible tourism

**THE GOAL: TO SEE WELL-MANAGED MOBULID TOURISM**

**1 TOURISTS AND OPERATORS ARE AWARE OF AND COMPLY WITH RESPONSIBLE PRACTICES**



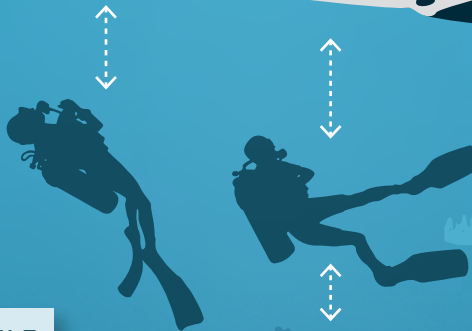
**2 THERE IS MANAGEMENT OF KEY TOURISM SITES:**



Mobulid tourism is regulated



Regulations related to mobulid tourism are enforced



**3 MOBULIDS HAVE A HIGHER PROFILE IN MANAGEMENT PRIORITIES**

## Manta Trust's actions



- Support the creation of management plans for key tourism sites



- Educate operators, government and tourists about mobulid rays and their conservation need



- Create educational materials for tourists and operators



- Monitor enforcement and compliance with regulations



- Identify key sites for mobulid tourism

### EXTERNAL ACTIONS

- Enforce regulations via government and industry commitment

- Educated tourists comply with regulations



POLICY



COMMUNITY



RESEARCH

THE MANTA TRUST VISION: To see all species of manta rays and their relatives protected or effectively managed for sustainable or non-consumptive use





## STRATEGIES TO MAINTAIN HEALTHY MOBULID HABITATS

**Goal 4** To ensure healthy ecosystems exist for mobulid rays.

The health of marine environments is dependent on a suite of diverse factors, which also vary with location. Mobulid rays need healthy oceans to thrive as the ocean provides habitat and food for these animals. A key goal thus is to ensure there is a high amount of prey in the water. Food availability for mobulids is affected by plankton productivity and plankton type. Plankton productivity may be impacted by changes in global climate; the productivity and type are likely to become more variable and potentially limited as climate change progresses<sup>32-34</sup>. While there are limited actions that can be taken to address the linkages between plankton productivity and climate change, activities to better understand this relationship should be undertaken and are described below.

To ensure healthy ecosystems, it is also essential to maintain or rebuild coral reefs. Reefs provide, for example, cleaning stations for mobulid rays that are essential for mobulid health and socializing among the population<sup>35</sup>. The principal factors that lead to coral reef degradation are sedimentation, reef destruction, unmanaged fisheries, destructive fishing, as well as climate change, invasive species, and pollution<sup>36,37</sup>. These activities destroy and pollute the oceans, thus making it more difficult for mobulid rays to thrive.

To ensure healthy ecosystems for mobulid rays, the following preconditions need to be met:

- 1. There is high plankton productivity in the oceans.**
- 2. There are healthy coral reef ecosystems worldwide.**
- 3. There is limited pollution in the oceans.**

Recognizing that we have limited influence on the myriad of factors that affect ecosystem health, there are fewer actions that can be undertaken:

- Provide data on mobulid rays to ensure informed decision-making of planning and management of coastal developments.
- Conduct research on the effect of climate change and plankton productivity on mobulid fitness and population health.
- Conduct research into the potential effects of pollutants on mobulid rays.

The responsible party, relative priority, scale of operation, cost, and time required to carry out these actions is described in Table 5. See Appendix I for a detailed theory of change diagram.

**Table 5:** Action plan to address the threat from reef degradation, pollution, and food availability.

GOAL 4: To ensure healthy ecosystems exist for mobulid rays.		PRIORITY	SCALE	COST	TIMELINE
<b>Objective 4.1</b>	<b>There is high plankton productivity.</b>				
Action	The effects of climate change on plankton productivity are better understood.	High	Intl	\$\$\$	Long
<b>Objective 4.2</b>	<b>Coral reefs are healthy.</b>				
Action	Provide data for better planning & management.	Med	Local	\$\$	Short
Action	Agricultural activities and coastal development are well-managed.	Med	Local	\$\$	Short
Action	Reef destruction is minimal, and there is limited sedimentation.	Med	Local	\$\$	Short
Action	Fisheries are well managed and there is reduced destructive fishing.	High	Local/ Nat	\$\$	Med
<b>Objective 4.3</b>	<b>There is limited pollution.</b>				
Action	Conduct research into the potential effects of pollutants on mobulids.	Med	Intl	\$\$	Med

Purple: Actions that Manta Trust are currently undertaking, or have an interest in undertaking.

Green: Actions currently led by other NGOs, IGOs, governments, and industry.

Orange: Actions undertaken by a combination of both of the above.



# Strategies to build healthy mobulid habitats

**THE GOAL:** TO ENSURE HEALTHY ECOSYSTEMS FOR MOBULIDS

## 1 THERE IS HIGH PLANKTON PRODUCTIVITY



The effects of climate change on plankton productivity are better understood

## 2 THE CORAL REEFS ARE HEALTHY



There is limited sedimentation



Agricultural activities and coastal development are well-managed



Reef destruction is minimal



Fisheries are well-managed and there is reduced destructive fishing



There are minimal invasive species\*



The effect of climate change is mitigated\*

## 3 THERE IS LIMITED POLLUTION



Waste products, including use of plastics are reduced

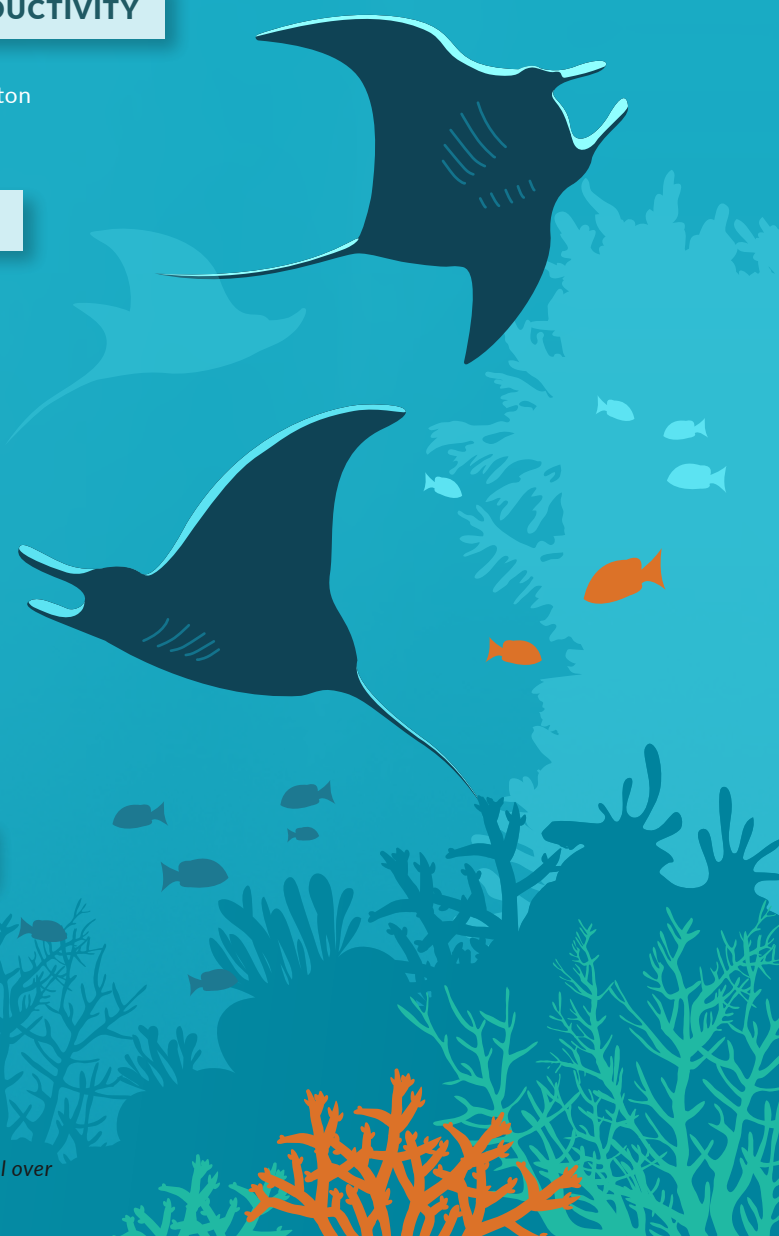


There is limited run-off\*



Agricultural practices are well-managed\*

\*Factors that the Manta Trust has no control over



## Manta Trust's actions



- Provide data for informed decision-making of planning and managing coastal developments



- Conduct research on effect of climate change on plankton productivity, and anatomical changes related to these

### EXTERNAL ACTIONS

- Conduct research into the potential effects of pollutants on mobulid rays



POLICY



RESEARCH

THE MANTA TRUST VISION: To see all species of manta rays and their relatives protected or effectively managed for sustainable or non-consumptive use



# PRIORITIES FOR ACTION

A comprehensive approach to conserving mobulid rays with distinct goals, based on a theory of change, has been defined here. Whilst all goals and actions are relevant and important, some should be addressed with more urgency than others.

As identified above, the threats to mobulids in order of priority are as follows:

1. Targeted fishery
2. Bycatch
3. Tourism
4. Food availability
5. Reef degradation
6. Pollution

The scale of each of these threats differs geographically. The section below details locations which need action most urgently, in addition to high priority actions described in the tables. It is hoped the following section will serve as a guide for allocating resources and capacities most effectively.

## PRIORITY ONE

### Focus Areas to Address the Threats from Targeted & Bycatch Fisheries.

A study on the vulnerabilities and fisheries impacts on manta and devil rays<sup>11</sup> identified 13 fisheries in 12 countries targeting mobulids, and 30 fisheries in 23 countries recording mobulid bycatch. Individuals are reported as targeted or bycatch in both recreational and commercial harpoon, gill net, longline, trawl, purse seine, and trap fisheries throughout their range<sup>11</sup>. This information can be overlaid with recorded decline data for mobulid rays, as well as information on source countries for the gill plate trade. By combining these data, priority areas emerge; 1.) where mobulid fisheries occurs, 2.) which are sources for the gill plate trade, and 3.) where serious declines have occurred, and consequently action is immediately required (see map on page 35).

The **Indo-West Pacific Ocean** region ranks highest in terms of catch decline and gill plate source countries:

- **77-99%** declines in mobulid ray landings have been reported in **Indonesia**, despite increased fishing efforts<sup>13</sup>. Whilst manta rays are now nationally protected in Indonesia, there are currently no restrictions on fishing or trade in devil rays, which constitute a large proportion of the mobulid landings.
- A study characterising the trade in mobulid gill plates ranked countries in terms of the volume of gill plates supplied to this trade<sup>12</sup>:

- » **Indonesia** ranked as the second highest source country after **China**.
- » **Sri Lanka** and **India** rank as the fourth and fifth highest source countries, with recorded declines in mobulid landings and no national protection or fisheries management in place.
- » **Malaysia** and the **Philippines** also each provide significant proportions of the total traded gill plates.
- » Whilst not an identified source for the trade, **>90%** declines in sightings of both manta and devil rays have been documented in **Mozambique**<sup>15</sup> and **Pakistan**<sup>38</sup>, also making these priority locations for action.

The **Eastern-Pacific Ocean** emerges as a second priority region:

- **89%** declines in landings of devil rays have been recorded in the north of **Peru**<sup>39,40</sup>.
- A **78%** decline in sightings of devil rays have been reported from Cocos Island, **Costa Rica**<sup>14</sup>.
- More than **50%** declines in the Inter-American-Tropical-Tuna-Commission catch data for devil rays have been recorded from purse seine fisheries in the **Eastern Pacific** region<sup>41</sup>.

Within the **Atlantic Ocean** fisheries data is sparse:

- In **Guinea**, West Africa a **61%** decrease in landings of devil rays has been recorded<sup>42</sup>.

## PRIORITY TWO

### Focus Areas to Address the Threat from Tourism Worldwide.

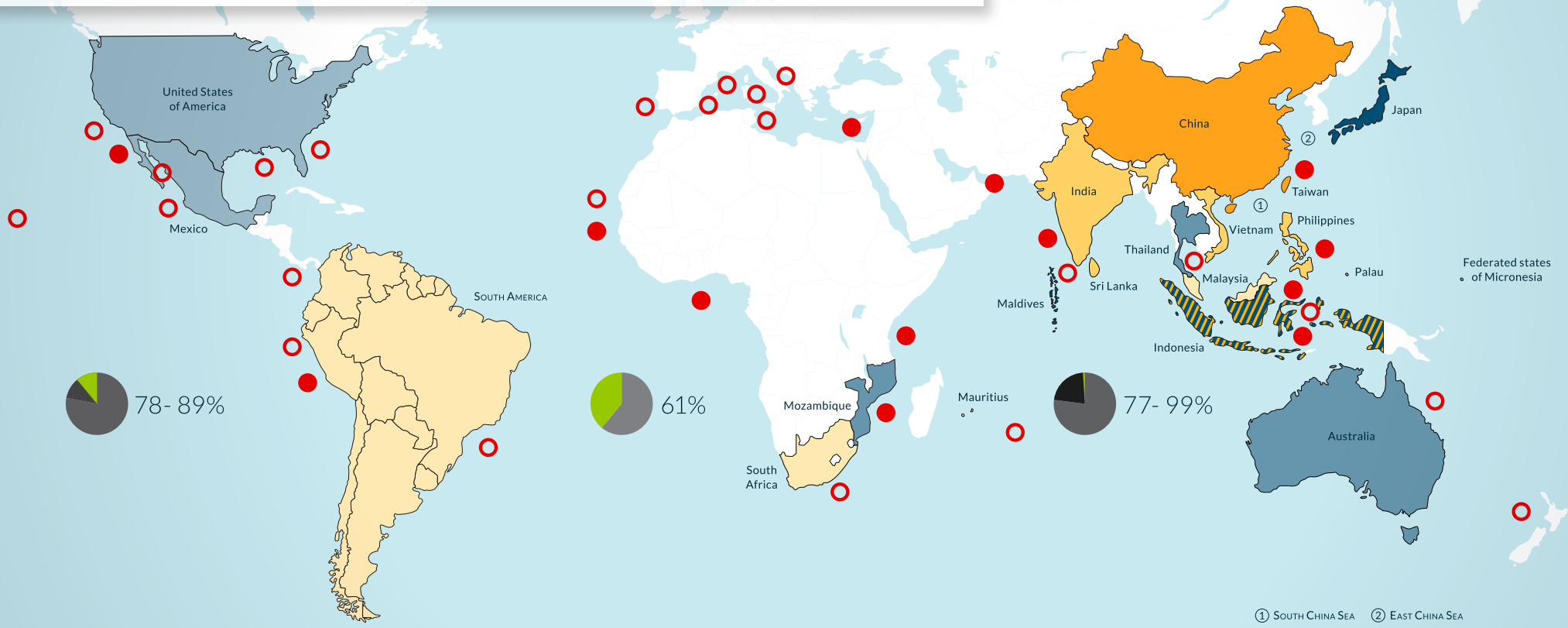
It is crucial to ensure that mobulid tourism is managed sustainably. Shark and ray watching tourism can provide a sustainable alternative to fishing, with economic returns to the country and an incentive to their conservation<sup>25,43</sup>. This is based on the principle that an animal is worth much more alive than dead<sup>17</sup>. Willingness to pay and tourist satisfaction is also linked to the extent that healthy populations are encountered, and conservation activities are in place<sup>44</sup>.

A study on the global impact of manta ray tourism identified the key locations of manta tourism and the associated economic returns<sup>16</sup>. The **Indo-West Pacific Ocean** region ranked highest in terms of revenue generated. In **Japan**, manta watching tourism contributes 11.4m USD per annum to the local economy, followed closely by **Indonesia** (10.7m USD/year), and the **Maldives** (8.1m USD/year). In **Mozambique**, manta tourism is worth 7.6m USD/year, similar to the amount recorded for **Thailand** (7.4m USD/year). Manta tourism also creates significant revenue in **Australia** (6.5m USD/year), **Mexico** (5.1m USD/year), the **USA** (4.7m USD/year), within the **Micronesian** region (4.1m USD/year), and in **Palau** (2.5m USD/year).

Whilst limited information is available on the revenue generated from devil ray tourism, a study on the occurrence of mobulids in the **Azores** highlights this region as a key location for tourism dedicated towards these species<sup>45</sup> (see map on page 35).

# Mobulid conservation – priority areas for action

Infographic design by Jessica Berner



## TOP 10 REPORTED GILL PLATE SOURCES FROM VENDOR INTERVIEWS <sup>12</sup>

% of vendors reporting this location as a source of gill plates

40% - 15%	China	40.3%
13% - 15%	China Seas	14.4%
	Indonesia	13.8%
5% - 8%	Vietnam	7.2%
	Sri Lanka	5.5%
	India	5.0%
	South America	4.4%
	Malaysia	4.4%
3% - 5%	South Africa	3.3%
	Hong Kong	3.3%

## TOP 10 COUNTRIES FOR MANTA RAY TOURISM INTERACTIONS <sup>16</sup>

Estimated expenditure, in US\$

\$8m - \$12m	Japan	\$11.4m
	Indonesia	\$10.7m
	Maldives	\$8.1m
\$5m - \$8m	Mozambique	\$7.6m
	Thailand	\$7.4m
	Australia	\$6.5m
	Mexico	\$5.1m
\$2m - \$5m	USA	\$4.7m
	Micronesia	\$4.1m
	Palau	\$2.5m

## ESTIMATED DECLINE OF MOBULID POPULATIONS

### INDO-WEST PACIFIC OCEAN

Cilacap, Indonesia	77% <sup>13</sup>
Tanjung Luar, Indonesia	99% <sup>13</sup>
Pakistan	>90% <sup>38</sup>
Mozambique	>90% <sup>15</sup>

### EASTERN PACIFIC OCEAN

Cocos Islands, Costa Rica	78% <sup>14</sup>
Tumbes, Peru	89% <sup>40, 39</sup>

### ATLANTIC OCEAN

Guinea	61% <sup>42</sup>
--------	-------------------

## KEY

- Targeted mobulid fishing locations
- Mobulid bycatch locations
- Estimated population declines
- Countries reported to sell mobulid gill plates
- Countries that benefit from manta tourism
- Countries reported to sell mobulid gill plates and also benefit from manta tourism

## REFERENCES

- |                                   |                                 |                                 |
|-----------------------------------|---------------------------------|---------------------------------|
| 11. Croll <i>et al.</i> , 2016    | 13. Lewis <i>et al.</i> , 2015  | 38. Moazzam, 2018               |
| 12. O'Malley <i>et al.</i> , 2016 | 14. White <i>et al.</i> , 2015  | 39. IMARPE, 2014                |
| 16. O'Malley <i>et al.</i> , 2013 | 15. Rohner <i>et al.</i> , 2017 | 40. Llanos <i>et al.</i> , 2010 |
|                                   |                                 | 42. Doumbouya, 2009             |

THE MANTA TRUST VISION: To see all species of manta rays and their relatives protected or effectively managed for sustainable or non-consumptive use



# CONCLUSIONS

A comprehensive approach and strategic plan is needed to ensure the long-term conservation and sustainable use of mobulid rays. Crucially, this plan needs to define the pathways and actions that will lead to the desired end-state: to see all species of manta rays and their relatives protected or effectively managed for sustainable or non-consumptive use, by the people closest to them, in a means that promotes wider ocean conservation.

In this document we define a strategic, comprehensive approach towards tackling the direct threats which these species face, from fisheries (target and bycatch) to tourism. The document also tackles the indirect threats which mobulids are exposed to as a result of environmental changes, such as reef degradation and pollution. A theory of change diagram has been created for each threat, showing the range of factors that contribute to

each, what it would look like if these threats were eliminated, and consequently what actions need to occur to achieve this change.

For each action that can be influenced by parties (such as the Manta Trust, other NGOs, governments, or researchers), we have defined the time-frame, level of investment, priority, and responsible party. To more effectively use the limited resources available, we have identified priorities for actions for practitioners, donors and policy makers. We trust that the recommendations will guide future actions to ensure these incredible species have the best chance of surviving in our oceans for future generations.

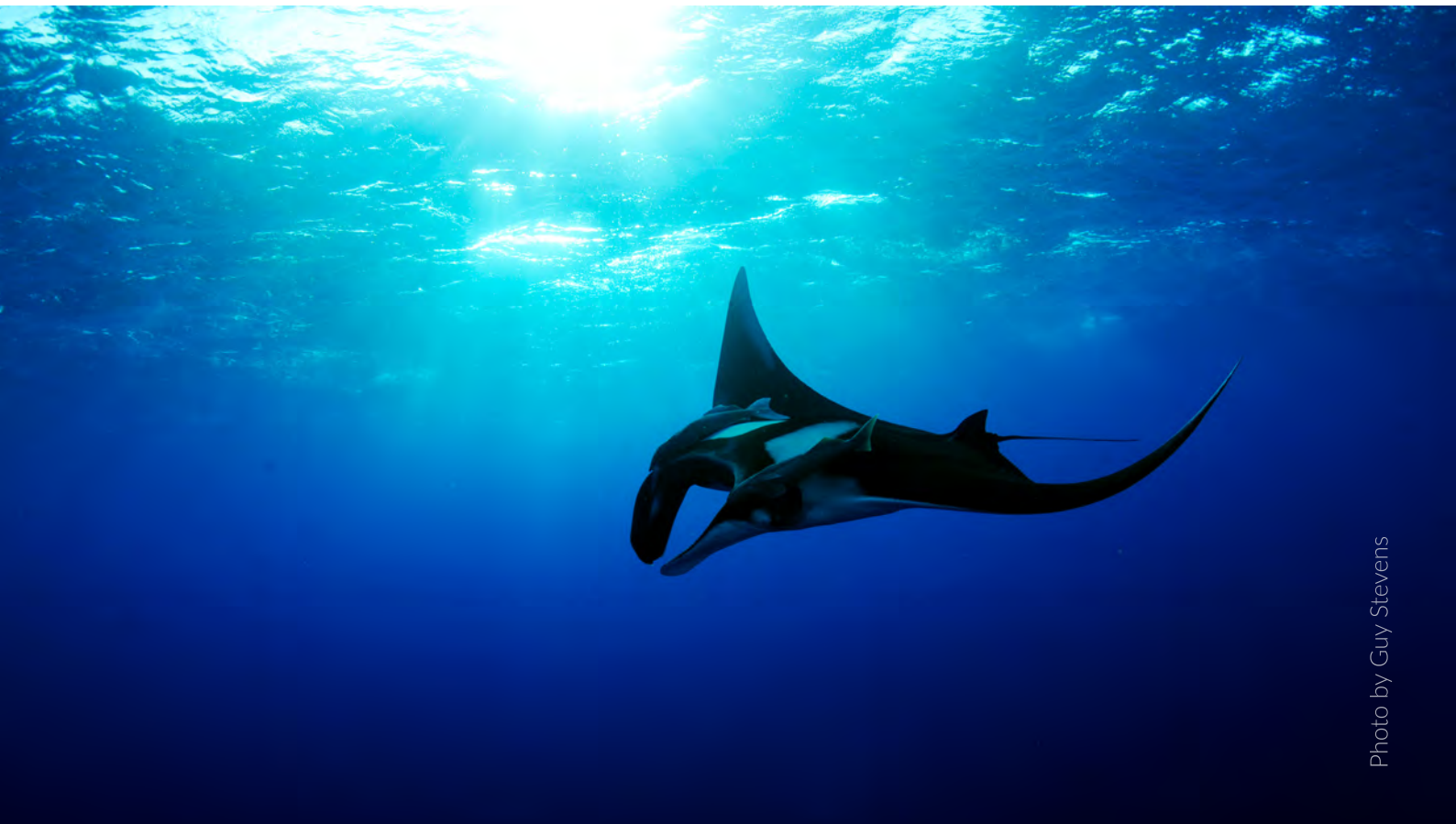
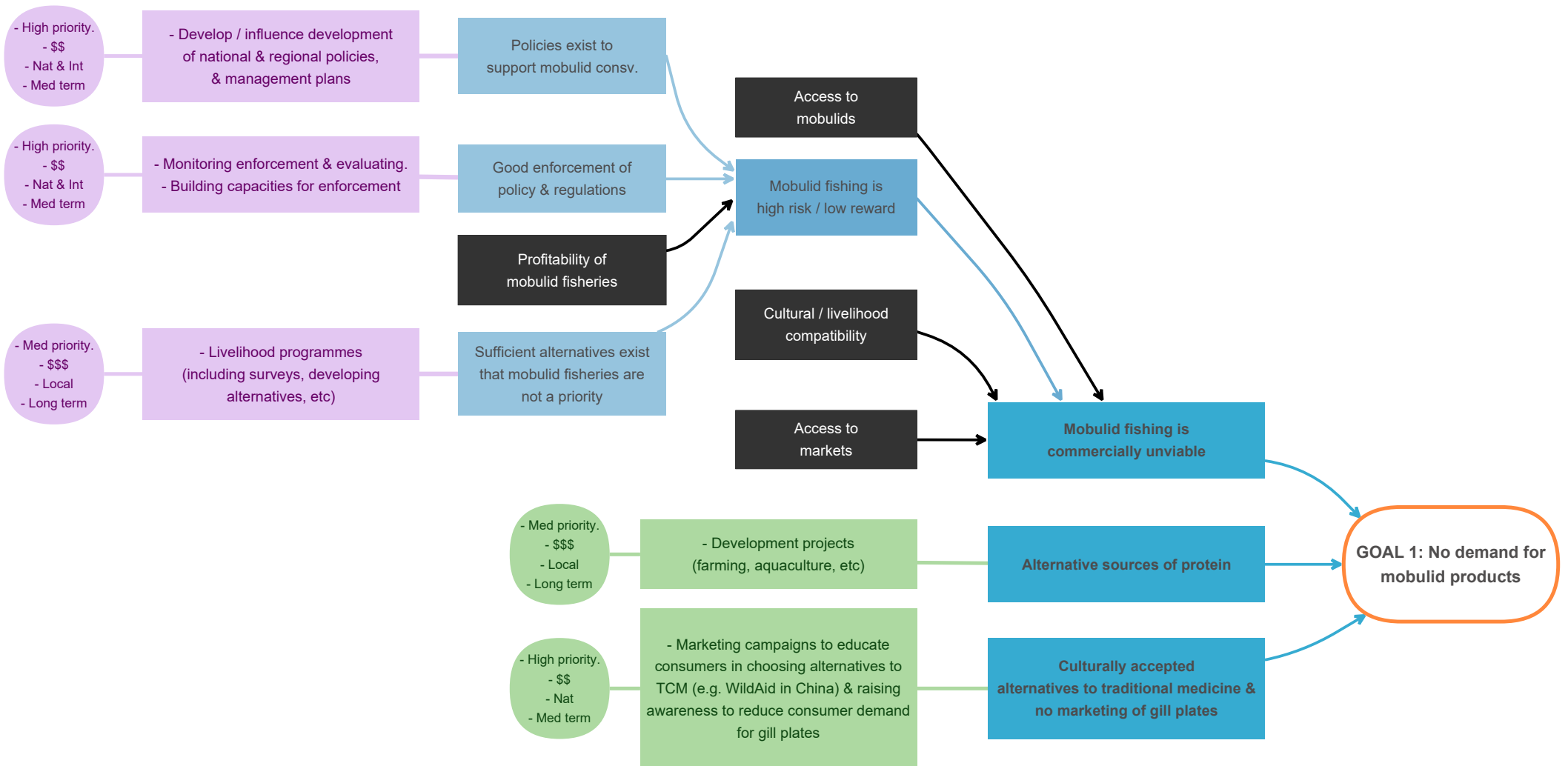


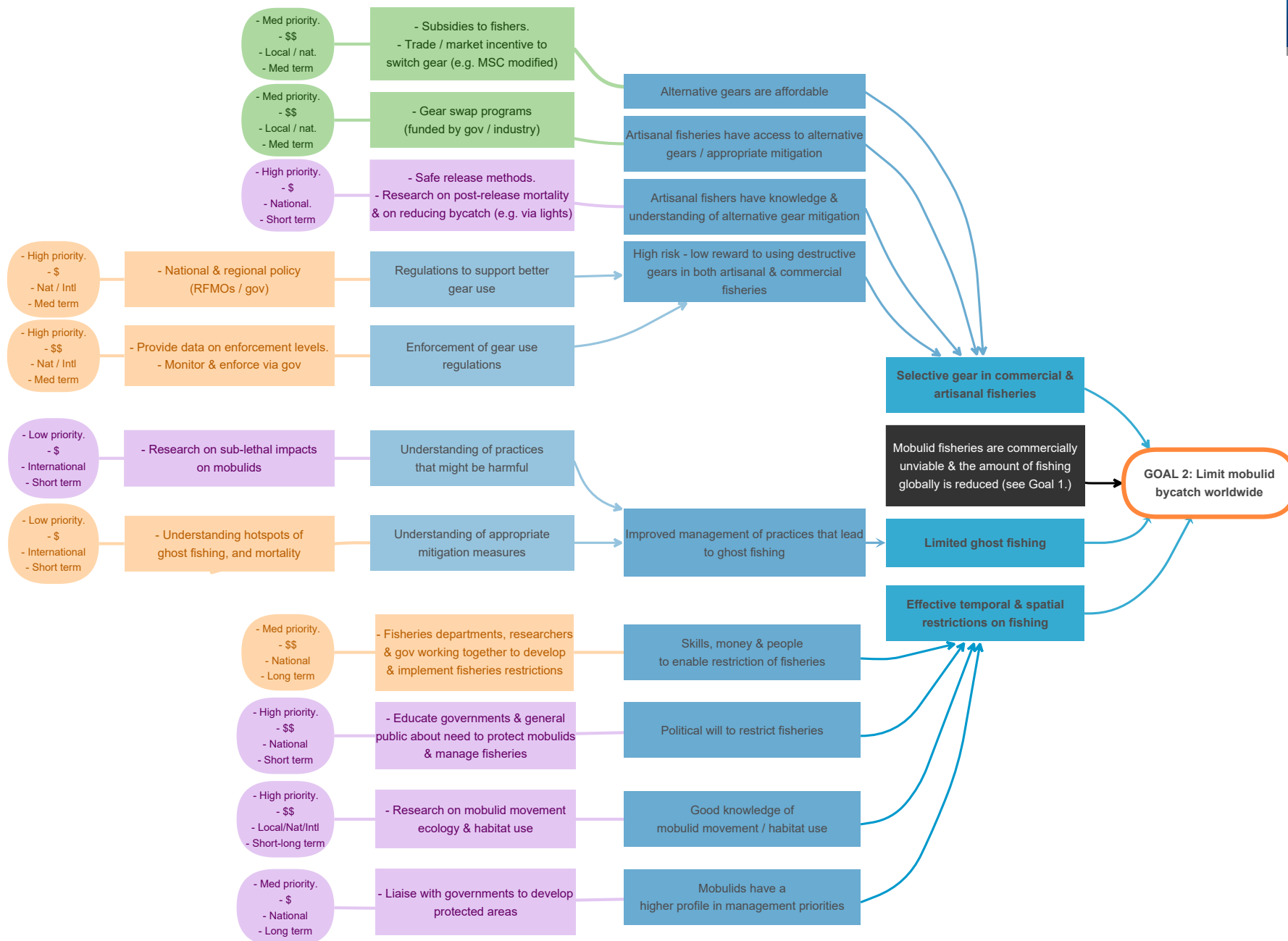
Photo by Guy Stevens

# APPENDICES

Theory of change to eliminate threat from targeted fisheries.



Theory of change to address threat from mobulid bycatch fisheries.

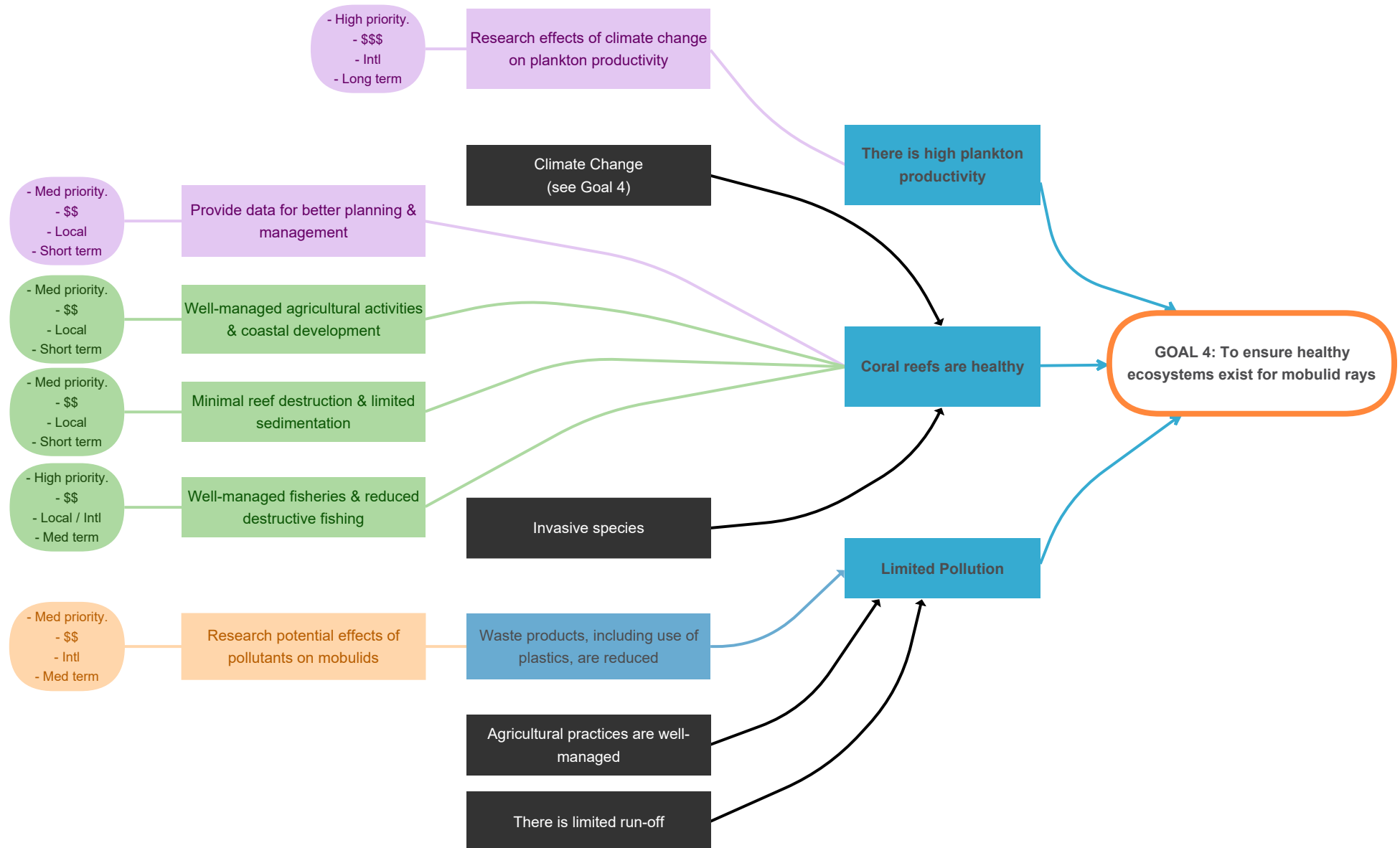


Theory of change to address threat from tourism.





Theory of change to address threat from environmental changes.



## Appendix II: Research Priorities to Support Effective Manta & Devil Ray Conservation

**Stewart JD, et al (2018)** Research Priorities to Support Effective Manta and Devil Ray Conservation. *Front. Mar. Sci.* 5:314. doi: 10.3389/fmars.2018.00314

In the last ten years, a huge amount of progress has been made in manta and devil ray research. However, threats remain to these vulnerable species and there are many knowledge gaps that continue to hinder effective conservation and management. To prioritise future research on these species and support conservation action, 30 experts from 27 organisations put their heads together to identify the most pressing questions in mobulid conservation research.

Led by the Manta Trust, this open access paper gives a detailed overview of previous research on mobulid rays, and which knowledge gaps most urgently need to be filled to support conservation action.

Available via: <http://bit.ly/2D3h8Se>.

### ABSTRACT

Manta and devil rays are filter-feeding elasmobranchs that are found circumglobally in tropical and subtropical waters. Although relatively understudied for most of the Twentieth century, public awareness and scientific research on these species has increased dramatically in recent years. Much of this attention has been in response to targeted fisheries, international trade in mobulid products, and a growing concern over the fate of exploited populations. Despite progress in mobulid research, major knowledge gaps still exist, hindering the development of effective management and conservation strategies. We assembled 30 leaders and emerging experts in the fields of mobulid biology, ecology, and conservation to identify pressing knowledge gaps that must be filled to facilitate improved science-based management of these vulnerable species. We highlight focal research topics in the subject areas of taxonomy and diversity, life history, reproduction and nursery areas, population trends, bycatch and fisheries, spatial dynamics and movements, foraging and diving, pollution and contaminants, and sub-lethal impacts. Mobulid rays remain a poorly studied group, and therefore our list of important knowledge gaps is extensive. However, we hope that this identification of high priority knowledge gaps will stimulate and focus future mobulid research.

# REFERENCES

1. Lawson, J. M. et al. (2017) Sympathy for the devil: A conservation strategy for devil and manta rays. *PeerJ* 5:e3027
2. Stevens, G. M. W., Fernando, D., Dando, M. & Notarbartolo di Sciara, G. (2018) *Guide to the Manta and Devil Rays of the World*. Wild Nature Press, UK
3. Anderson, R. C., Adam, M. S. & Goes, J. I. (2011) From monsoons to mantas: seasonal distribution of *Manta alfredi* in the Maldives. *Fish. Oceanogr.* 20, 104–113
4. Stevens, G. M. W. & Peschak, T. (2016) *MANTA: Secret Life of Devil Rays*. Save Our Seas Foundation
5. Ari, C. (2011) Encephalization and Brain Organization of Mobulid Rays (Myliobatiformes, Elasmobranchii) with Ecological Perspectives. *Open Anat. J.* 3, 1–13
6. Stewart, J. D. et al. (2018) Research Priorities to Support Effective Manta and Devil Ray Conservation. *Front. Mar. Sci.* 5, 1–27
7. Poortvliet, M. et al. (2015) A dated molecular phylogeny of manta and devil rays (Mobulidae) based on mitogenome and nuclear sequences. *Mol. Phylogenet. Evol.* 83
8. Paig-Tran, E. W. M., Kleinteich, T. & Summers, A. P. (2013) The filter pads and filtration mechanisms of the devil rays: Variation at macro and microscopic scales. *J. Morphol.* 274, 1026–43
9. Dulvy, N. K., Pardo, S. A., Simpfendorfer, C. A. & Carlson, J. K. (2014) Diagnosing the dangerous demography of manta rays using life history theory. *PeerJ* 2, e400
10. Stevens, G. M. W. (2016) *Conservation and Population Ecology of Manta Rays in the Maldives*. Doctoral thesis, University of York
11. Croll, D. A. et al. (2016) Vulnerabilities and fisheries impacts: the uncertain future of manta and devil rays. *Aquat. Conserv. Mar. Freshw. Ecosyst.* 26
12. O'Malley, M. P., Townsend, K. A., Hilton, P. & Heinrichs, S. (2016) Characterization of the Trade in Manta and Devil Ray Gill Plates in China and Southeast Asia Through Trader Surveys. *Aquat. Conserv. Mar. Freshw. Ecosyst.* 1–41
13. Lewis, S. A. et al. (2015) Assessing Indonesian manta and devil ray populations through historical landings and fishing community interviews. *PeerJ Prepr.* 6:e1334v
14. White, E. R., Myers, M. C., Flemming, J. M. & Baum, J. K. (2015) Shifting elasmobranch community assemblage at Cocos Island—an isolated marine protected area. *Conserv. Biol.* 29, 1186–1197
15. Rohner, C. A., Flam, A. L., Pierce, S. J. & Marshall, A. D. (2017) Steep declines of manta rays a devilrays (Mobulidae) in southern Mozambique. *PeerJ Preprints* 5:e3051v1

16. O'Malley, M. P., Lee-Brooks, K. & Medd, H. B. (2013) The Global Economic Impact of Manta Ray Watching Tourism. *PLoS One* 8, 1–14
17. Murray, A. P., Garrud, E., Ender, I., Lee-Brooks, K., Atkins, R., Lynam, R., Arnold, K., Roberts, C., Hawkins, J. P. & Stevens, G. M. W. (2018) Protecting the million-dollar mantas; creating an evidence- based code of conduct for manta ray tourism interactions. *J. Ecotourism* In review
18. Venables, S. (2013) Short-term behavioural responses of manta rays, *Manta alfredi*, to tourism interactions in Coral Bay, Western Australia. Honours thesis, Murdoch University
19. Germanov, E. S., Marshall, A. D., Bejder, L., Fossi, M. C. & Loneragan, N. R. (2018) Microplastics: No Small Problem for Filter- Feeding Megafauna. *Trends Ecol. Evol.* 33, 227–232
20. Marshall, A. D., Compagno, L. J. V. & Bennett, M. B. (2009) Redescription of the genus *Manta* with resurrection of *Manta alfredi* (Krefft, 1868) (Chondrichthyes; Myliobatoidei; Mobulidae). *Zootaxa* 2301, 1–28
21. Hinojosa-Alvarez, S., Walter, R. P., Diaz-Jaimes, P., Galván-Magaña, F. & Paig-Tran, E. M. (2016) A potential third Manta Ray species near the Yucatán Peninsula? Evidence for a recently diverged and novel genetic Manta group from the Gulf of Mexico. *PeerJ* e2586, 1–20
22. White, W. T. et al. (2017) Phylogeny of the manta and devilrays (Chondrichthyes: Mobulidae), with an updated taxonomic arrangement for the family. *Zool. J. Linn. Soc.* XX, 1–26
23. White, W. T., Giles, J., Potter, I. C., Dharmadi & Potter, I. C. (2006) Data on the bycatch fishery and reproductive biology of mobulid rays (Myliobatiformes) in Indonesia. *Fish. Res.* 82, 65–73
24. Francis, M. P. (2014) Survival and depth distribution of spinetail devilrays (*Mobula japanica*) released from purse-seine catches. *NIWA* 24 p.
25. Gallagher, A. J. & Hammerschlag, N. (2011) Global shark currency: the distribution, frequency, and economic value of shark ecotourism. *Current Issues in Tourism* 37–41
26. Ballantyne, R., Packer, J. & Falk, J. (2011) Visitors' learning for environmental sustainability: Testing short- and long-term impacts of wildlife tourism experiences using structural equation modelling. *Tour. Manag.* 32, 1243–1252
27. Curtin, S. (2009) Wildlife tourism: the intangible, psychological benefits of human-wildlife encounters. *Curr. Issues Tour.* 12, 451–474
28. Wilson, C. & Tisdell, C. (2003) Conservation and economic benefits of wildlife-based marine tourism: sea turtles and whales as case studies. *Hum. Dimens. Wildl.* 8, 49–58
29. Anderson, R. C., Adam, M. S., Kitchen-Wheeler, A.-M. & Stevens, G. M. W. (2011) Extent and Economic Value of Manta Ray Watching in Maldives. *Tour. Mar. Environ.* 7, 15–27
30. Müllner, A. (2004) Breeding ecology and related life-history traits of the Hoatzin, *Opisthocomus hoazin*, in a primary rainforest habitat. *Biological Conservation*
31. Stevens, G. M. W. & Froman, N. (2018) The Maldives Archipelago. In *World Seas: An Environmental Evaluation. Volume II, The Indian Ocean to the Pacific* (ed. Sheppard, C.) 32

32. Hays, G. C., Richardson, A. J. & Robinson, C. (2005) Climate change and marine plankton. *Trends Ecol. Evol.* 20, 337–344
33. Hoegh-Guldberg, O. & Bruno, J. F. (2010) The Impact of Climate Change on the World's Marine Ecosystems. *Science* (80) 328, 1523–1528
34. Behrenfeld, M. J. et al. (2006) Climate-driven trends in contemporary ocean productivity. *Nature* 444, 752–755
35. Stevens, G. M. W., Hawkins, J. P. & Roberts, C. M. (2018) Courtship and mating behaviour of manta rays *Mobula alfredi* and *M. birostris* in the Maldives. *J. Fish Biol.* 93, 344–359
36. De'ath, G., Fabricius, K. E., Sweatman, H. & Puotinen, M. (2012) The 27-year decline of coral cover on the Great Barrier Reef and its causes. *Proc. Natl. Acad. Sci.* 109, 17995–17999
37. Hughes, T. P., Graham, N. A. J., Jackson, J. B. C., Mumby, P. J. & Steneck, R. S. (2010) Rising to the challenge of sustaining coral reef resilience. *Trends Ecol. Evol.* 25, 633–642
38. Moazzam, M. (2018) Unprecedented decline in the catches of mobulids: an important component of tuna gillnet fisheries of the Northern Arabian Sea. Technical Report
39. IMARPE (2014) Boletín Informativo Pesquero Abril 2014 No. 9, Instituto del Mar del Peru Laboratorio Costero de Tumbes
40. Llanos, J., Inga, C., Ordinola, E. Y. & Rujel, J. (2010) Investigaciones Biológico Pesqueras en la Región Tumbes, Perú. 1996 – 2005. Informe IMARPE 37 (3-4)
41. Hall, M. & Roman, M. (2013) Bycatch and Non-Tuna Catch in the Tropical Tuna Purse Seine Fisheries of the World. FAO Fisheries and Aquaculture Technical Paper No. 56
42. Doumbouya, F. (2009) Rapport sur l'actualisation des études sur les raies mantas en Guinée. Cent. Natl. des Sci. Halieutiques Boussoua. Ministère la Pêche l'Aquaculture. Repub. Guinée
43. Vianna, G. M. S., Meekan, M. G., Pannell, D. J., Marsh, S. P. & Meeuwig, J. J. (2012) Socio-economic value and community benefits from shark-diving tourism in Palau: A sustainable use of reef shark populations. *Biol. Conserv.* 145, 267–277
44. Zimmerhackel, J. S. et al. (2018) How shark conservation in the Maldives affects demand for dive tourism. *Tour. Manag.* 69, 263–271
45. Sobral, a. F. & Afonso, P. (2014) Occurrence of mobulids in the Azores, central North Atlantic. *J. Mar. Biol. Assoc. UK* 94, 1–5



For more general information on the Manta Trust, please visit our website at:

**[www.mantatrust.org](http://www.mantatrust.org)**

---

**Strategy Authors:** Isabel Ender, Dr. Guy Stevens, Rebecca Carter, Rebecca Atkins, Danny Copeland

**Document created by:** Danny Copeland

CONSERVING

# MANTA & DEVIL RAYS

An Education & Diversity Strategy



**BEX CARTER | JEN SPACAGNA**

---

*The Manta Trust would like to thank Onceayear Global Ocean (Restricted fund-Prism 1099682), the Ernest Kleinwort Charitable Trust, and the Paul M. Angell Family Foundation for their funding and support of our education and diversity work.*

*The Manta Trust would also like to thank Flossy Barraud, Maesha Mohamed, Yaniu Mohamed and Katie-Lee Brooks for their expert comments and invaluable advice on the various drafts of this document.*

---



**Ernest Kleinwort  
Charitable Trust**

**PAUL M. ANGELL**  
FAMILY FOUNDATION



# CONSERVING MANTA & DEVIL RAYS

## An Education & Diversity Strategy

<b>INTRODUCTION</b>	<b>5</b>
<b>STRATEGY</b>	<b>7</b>
Goal 1: Diversify The Marine Conservation Sector	7
<i>Theory of Change: Action Plan</i>	9
Goal 2: Gain Manta & Devil Ray Conservation Support	10
<i>Theory of Change: Action Plan</i>	12
Goal 3: Drive Conservation Locally	13
<i>Theory of Change: Action Plan</i>	15
Goal 4: Inspire Manta & Devil Ray Conservation Champions	16
<i>Theory of Change: Action Plan</i>	17
<b>APPENDIX</b>	<b>18</b>

*"In the end, we will conserve only what we love; we will love only what we understand, and we will understand only what we are taught."*

*Baba Dioum*



# INTRODUCTION

Education is one of the key pillars of the Manta Trust's strategic approach to its conservation activities. Inspirational education, delivered by passionate individuals, is a powerful tool in solving the complex threats that manta & devil rays face. Over the years, our educational outreach has connected hundreds of Maldivian schoolchildren with environmental issues for the first time, aided the enforcement and monitoring of the gill plate trade, brought manta rays into the mainstream media through TV shows like Blue Planet II, inspired delegates to vote in favour of international protective legislation for manta & devil rays, and much more!

Our core objective is to see all species of manta rays and their relatives protected or effectively managed for sustainable or non-consumptive use, by the people closest to them in a means that promotes wider ocean conservation.

To achieve this, we need to engage and inspire people around the world with the marine environment, facilitate more people to access, enjoy, and connect to nature through experiential learning, educate people about blue issues and their impact on wildlife, and empower them to take action for the oceans. So, our educational aspirations keep on growing.

We also strongly believe that conservation can only be truly effective when everyone has a seat at the table. Unfortunately, this is not yet the case as the conservation sector does not currently reflect the diversity of people needed to implement positive local and global change. Often, people from the communities who bear the largest burden for implementing conservation action, and are most severely affected by the impacts of the climate and biodiversity crises, are underrepresented in local conservation initiatives.

---

*Our vision is to see a diverse and inclusive global network of ocean guardians taking positive action for manta & devil rays and their habitats.*

---

An industry predominantly made up of people from privileged backgrounds who can afford a university education, diving qualifications and international travel drives disparity, is unethical, and it hinders our success.

Tackling this lack of diversity is a crucial and growing focus for the Manta Trust team as we acknowledge the vital role that we must play in helping to make a positive difference. We have conducted extensive research into the barriers to inclusion in our sector and sought external expert advice on what changes we can make to break down these barriers. We are proud to say that this journey has culminated in the creation of the Manta Trust's first Education & Diversity Strategy for Manta & Devil Ray Conservation.

This document will be used in tandem with our Global Strategy & Action Plan for Manta & Devil Ray Conservation, guiding the development of new and ongoing Manta Trust projects in a way that champions a diversity of backgrounds, perspectives and experiences of the world. It will also be used to help direct the efforts of our global network of Affiliate Projects.

We recognise that designing this Strategy is merely the first step of many, that we may make mistakes along the way, and that we still have a lot more to learn about these issues. However, we hope that its creation and implementation clearly demonstrate our ongoing commitment to driving inclusion in our sector and making room at the marine conservation table for everyone.





**STRATEGIES TO DIVERSIFY THE MARINE CONSERVATION SECTOR**

**GOAL 1:** A greater diversity of people seek careers in the marine conservation sector.

Many factors influence which people seek careers in marine conservation, including social hurdles such as race, ethnicity, social status, and gender. We need to ensure that a greater diversity of people are inspired to pursue careers in this sector, and help them overcome barriers to inclusion through access to vital education, training, financial support and opportunities for networking.

Objective 1.1	A greater number and diversity of people are able to access training in skills needed to pursue a career in marine research, education and/or conservation.
Action	Provide training, mentorship, and experiential learning prioritising access for children / university students / early career conservationists/ and others who would not have the means to access these opportunities.
Action	Provide the funding and/or placements for children / university students / early career conservationists/ and others who would otherwise not have the means to access placements.
Action	Create and/or join regional and global networks of educators to allow for coproduction of education expertise and resources.

<b>Objective 1.2</b>	<b>A greater number and diversity of people understand marine conservation is a viable career option.</b>
Action	Highlight diversity in marine conservation; using media and events to enhance the visibility and amplify the work of a diverse range of role models.
Action	Provide career focused outreach in educational establishments, prioritising children and young people who do not normally have access to this.
Action	Provide free, accessible resources for career advisors on careers in the marine conservation sector, in a variety of languages.
Action	Provide free marine conservation career advice via online platforms (website and social media).
Action	Actively advertise jobs and volunteer roles in the best stream of local advertisement.

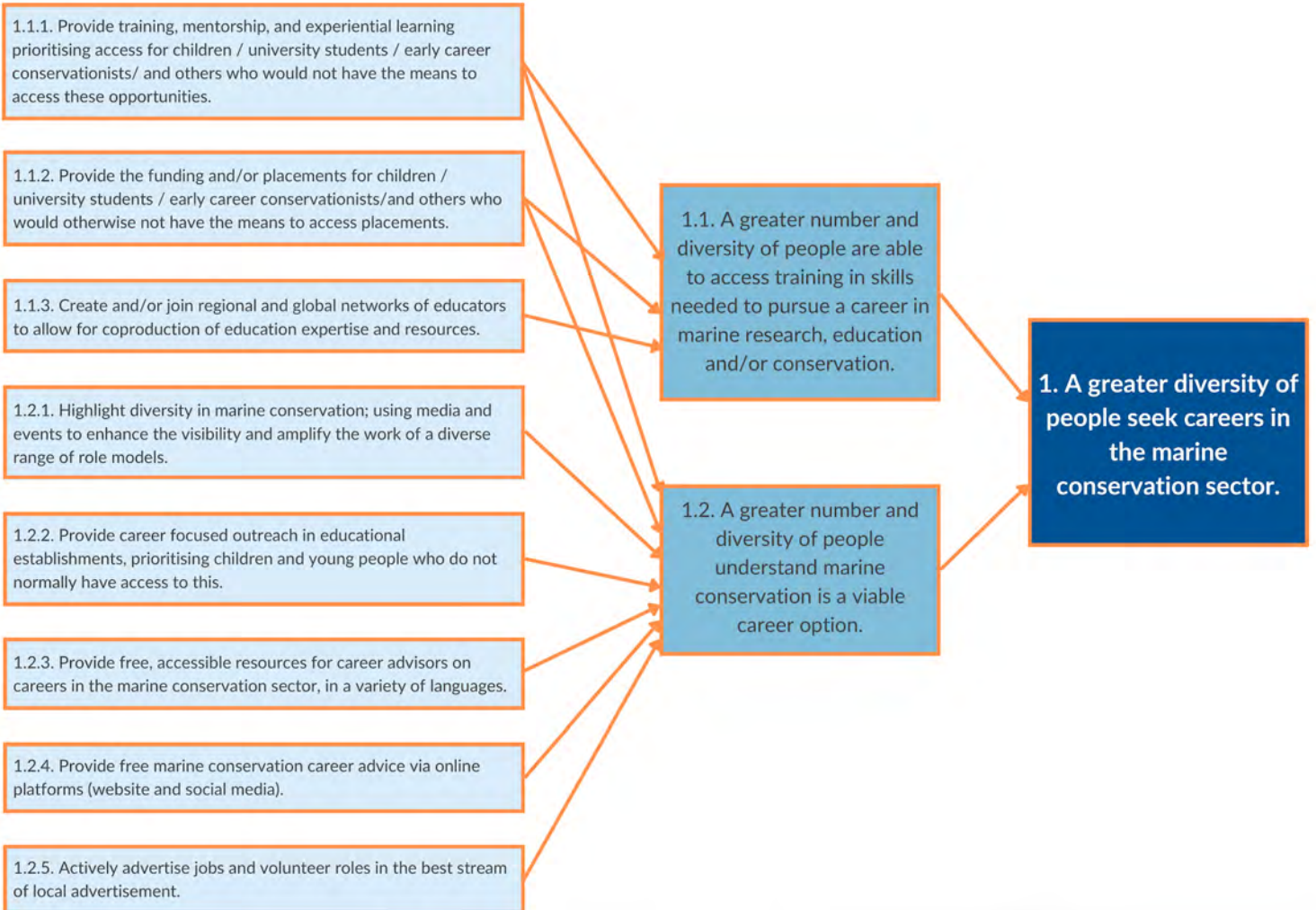


# Theory of Change: Action Plan to Diversify the Marine Conservation Sector

## ACTIONS

## OBJECTIVES

## GOAL





**STRATEGIES TO GAIN MANTA & DEVIL RAY CONSERVATION SUPPORT**

**GOAL 2:** People working in other sectors (not marine conservation) and those not in employment (including youth) are supportive of the conservation of manta & devil rays and their habitats.

The actions of millions of people have serious repercussions for manta & devil rays and the marine habitats on which they depend, even those of individuals who have no direct interaction with these vulnerable species. We need more people to consider their impact on manta & devil rays and the marine environment when, for example, making everyday consumer choices, implementing business practices, donating to charity, and deciding how to vote.

<b>Objective 2.1</b>	<b>A greater number and diversity of people have an in-depth knowledge of marine environmental issues and impacts. (Also contributes to GOAL 1)</b>
Action	Create and promote free educational resources on marine environmental issues to educators worldwide, in a variety of languages.
Action	Provide marine focused outreach, including experiential learning where possible, in educational establishments, prioritising those least likely to have access to this knowledge.
Action	Provide training for educators on teaching marine environmental issues.
Action	Run online educational campaigns on marine environmental issues that promote pro-environmental behaviour change.
Action	Assist journalists and production companies in creating educational media and where possible amplify the work of a diverse range of people involved in manta & devil ray conservation.



Objective 2.2	People who have very limited or no access to moblulids and their habitats still feel responsible for them.
Action	Provide marine focused outreach that promotes pro-environmental behaviour change for the general public.
Action	Provide marine focused outreach for staff in organisations that partner with the Manta Trust and our Affiliate Projects.
Action	Encourage more sustainable business practices in organisations that partner with the Manta Trust and our Affiliate Projects.
Action	Use innovative and accessible media tools and educational resources to help people remotely experience marine species and ecosystems.



# Theory of Change: Action Plan to Gain Manta & Devil Ray Conservation Support

## ACTIONS

## OBJECTIVES

## GOAL

2.1.1. Create and promote free educational resources on marine environmental issues to educators worldwide, in a variety of languages.

2.1.2. Provide marine focused outreach, including experiential learning where possible, in educational establishments, prioritising those least likely to have access to this knowledge.

2.1.3. Provide training for educators on teaching marine environmental issues.

2.1.4. Run online educational campaigns on marine environmental issues that promote pro-environmental behaviour change.

2.1.5. Assist journalists and production companies in creating educational media and where possible amplify the work of a diverse range of people involved in manta & devil ray conservation.

2.2.1. Provide marine focused outreach that promotes pro-environmental behaviour change for the general public.

2.2.2. Provide marine focused outreach for staff in organisations that partner with the Manta Trust and our Affiliate Projects.

2.2.3. Encourage more sustainable business practices in organisations that partner with the Manta Trust and our Affiliate Projects.

2.2.4. Use innovative and accessible media tools and educational resources to help people remotely experience marine species and ecosystems.

2.1. A greater number and diversity of people have an in depth knowledge of marine environmental issues and impacts.

2.2. People who have very limited or no access to manta & devil rays and their habitats still feel responsible for them.

2. People working in other sectors (not marine conservation) and those not in employment (including youth) are supportive of the conservation of manta & devil rays and their habitats.





## STRATEGIES TO DRIVE CONSERVATION LOCALLY

**GOAL 3:** A diverse range of individuals local to manta & devil ray conservation initiatives play an active role in the design and implementation of these initiatives.

To find sustainable solutions to marine conservation challenges, our efforts must be locally driven. In key manta & devil ray regions we therefore need to harness the knowledge and enthusiasm of potential manta & devil ray-conservationists on the ground through the provision of resources, training, funding and employment opportunities.

Objective 3.1	Manta & devil ray conservation initiatives are designed to benefit local communities and benefit from vital local knowledge and gain social, political and legal legitimacy to proceed.
Action	Support grass roots conservation initiatives, started by / involving a diverse range of individuals local to manta & devil ray conservation initiatives.
Action	Ensure that conservation and research development is responding to local priorities.
Action	Ensure we have a legitimate (social, political and legal) right to carry out work in all locations.

<b>Objective 3.2</b>	<b>More people (a diverse range of individuals) local to manta &amp; devil ray conservation initiatives are recruited to work on these initiatives.</b>
Action	Use participatory design to find the right people during the recruitment process for new and ongoing manta & devil ray conservation initiatives.
Action	Create roles (paid and voluntary where appropriate) within new and ongoing manta & devil ray conservation initiatives for a diverse range of people local to these projects.
<b>Objective 3.3</b>	<b>A diverse range of individuals local to manta &amp; devil ray conservation initiatives have the capacity to take part in local marine conservation and research initiatives.</b>
Action	Build technical capacity in project locations via provision of training and opportunities to connect to marine ecosystems in real life.
Action	Provide the resources needed for local people to take part in local conservation initiatives.
Action	Seek opportunities to collaborate with organisations addressing intersectional issues (e.g., social or economic development) when planning new manta & devil ray conservation initiatives.



## Theory of Change: Action Plan to Drive Conservation Locally

### ACTIONS

3.1.1. Support grass roots conservation initiatives, started by / involving a diverse range of individuals local to manta & devil ray conservation initiatives.

3.1.2. Ensure that conservation and research development is responding to local priorities.

3.1.3. Ensure we have a legitimate (social, political and legal) right to carry out work in all locations.

3.2.1. Use participatory design to find the right people during the recruitment process for new and ongoing manta & devil ray conservation initiatives.

3.2.2. Create roles (paid and voluntary where appropriate) within new and ongoing manta & devil ray conservation initiatives for a diverse range of people local to these projects.

3.3.1. Build technical capacity in project locations via provision of training and opportunities to connect to marine ecosystems in real life.

3.3.2. Provide the resources needed for local people to take part in local conservation initiatives.

3.3.3. Seek opportunities to collaborate with organisations addressing intersectional issues (e.g., social or economic development) when planning new manta & devil ray conservation initiatives.

### OBJECTIVES

3.1. Manta & devil ray conservation initiatives are designed to benefit local communities and benefit from vital local knowledge and gain social, political and legal legitimacy to proceed.

3.2. More people (a diverse range of individuals) local to manta & devil ray conservation initiatives are recruited to work on these initiatives.

3.3. A diverse range of individuals local to manta & devil ray conservation initiatives have the capacity to take part in local marine conservation and research initiatives.

### GOAL

**3. A diverse range of individuals local to manta & devil ray conservation initiatives play an active role in the design and implementation of these initiatives.**





**STRATEGIES TO INSPIRE MANTA & DEVIL RAY CONSERVATION CHAMPIONS**

**GOAL 4:** People who interact with manta & devil rays and their habitats are supportive of their conservation.

By equipping those who are fortunate enough to interact with manta & devil rays and their ocean habitats with vital knowledge, we can minimise disturbance of these vulnerable animals whilst creating a global network of manta & devil ray conservation champions, who help us to raise awareness and drive citizen science initiatives.

Objective 4.1	Tourism boat, diver and snorkeler conduct minimises disturbance on manta & devil rays as much as possible.
Action	Raise the social and economic value of responsible tourism when in discussions with Government officials and other relevant parties.
Objective 4.2	Tourists learn about threats to manta & devil rays and their habitats, and the work of the Manta Trust and/or our Affiliate Projects.
Action	Encourage dive operators/resorts to sign up to the swim with mantas code of conduct, emphasising how they will positively benefit as a result.
Action	Seek opportunities for Manta Trust staff to engage people who interact with manta & devil rays and their habitats through educational presentations and citizen science workshops.

# Theory of Change: Action Plan to Inspire Manta & Devil Ray Conservation Champions

## ACTIONS

- 4.1.1. Raise the social and economic value of responsible tourism when in discussions with Government officials and other relevant parties.
- 4.2.1. Encourage dive operators/resorts to sign up to the swim with mantas code of conduct, emphasising how they will positively benefit as a result.
- 4.2.2. Seek opportunities for Manta Trust staff to engage people who interact with manta & devil rays and their habitats through educational presentations and citizen science workshops.

## OBJECTIVES

- 4.1. Tourism boat, diver and snorkeler conduct minimises disturbance on manta & devil rays as much as possible.
- 4.2. Tourists learn about threats to manta & devil rays and their habitats, and the work of the Manta Trust and/or our Affiliate Projects.

## GOAL

4. People who interact with manta & devil rays and their habitats are supportive of their conservation.

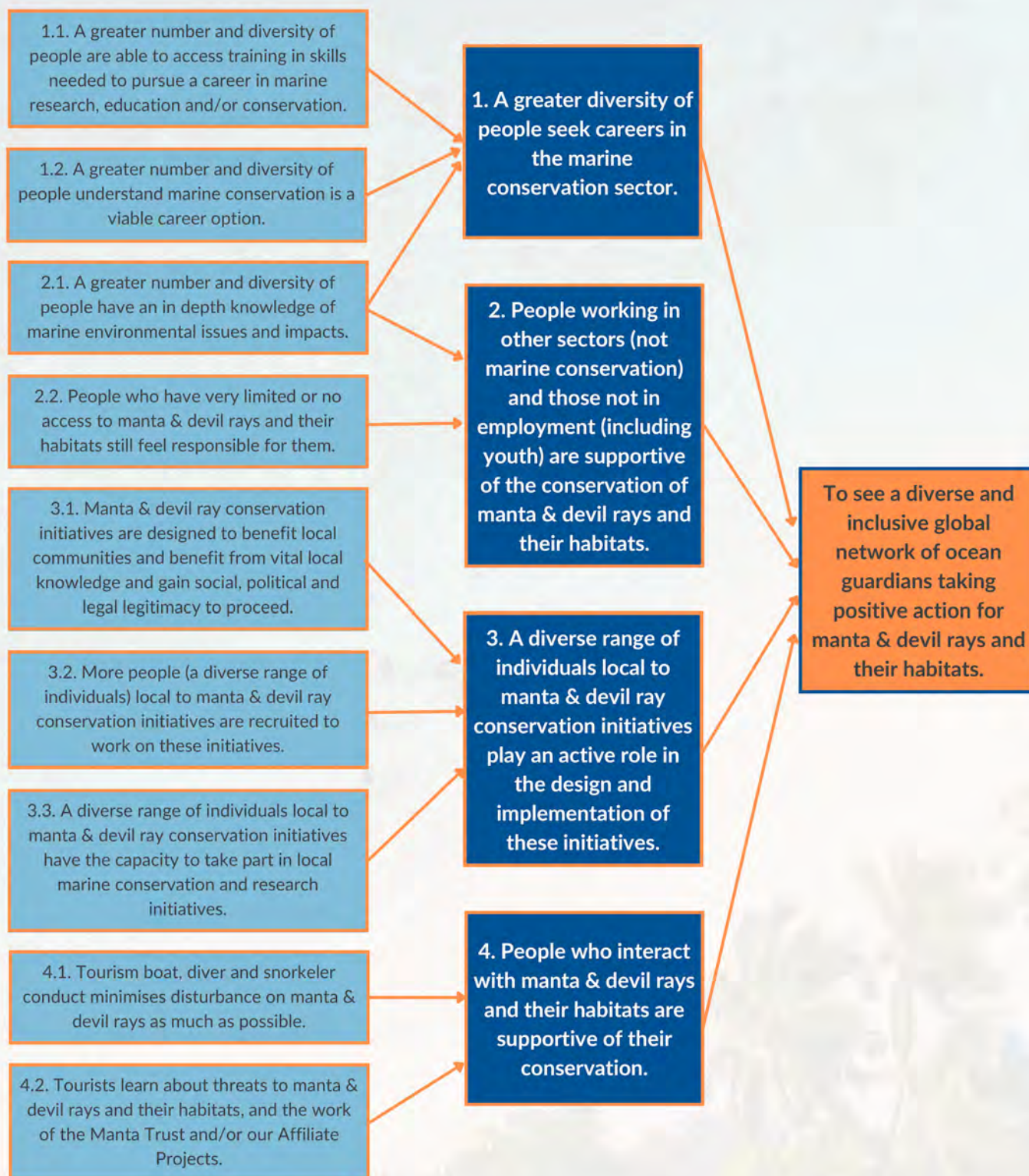


## Appendix: Theory of Change Action Plan Objectives, Goals, and Vision

### OBJECTIVES

### GOALS

### VISION



#### Image Credits:

Flossy Barraud: Front cover, 14, 15. Jasmine Corbett: 4, 7, 10, 16. Valentina Cucchiara: 6. Simon Hilbourne: 8, 11, back cover. Isabel Ender: 9. Jessica Haines: 12. Joao Rodrigues: 13. Carlos Roca: 17.





---

For more general information on the Manta Trust, please visit our website at:



[www.mantatrust.org](http://www.mantatrust.org)

---

*Strategy authors: Bex Carter, Jen Spacagna*

*Document created by: Jasmine Corbett*