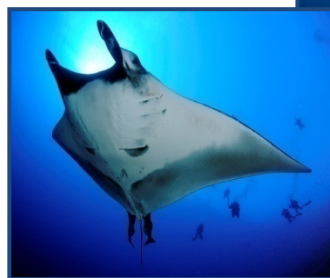
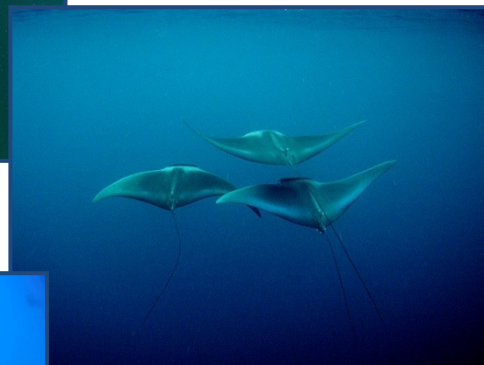


Field Guide to the Identification of Mobulid Rays (Mobulidae): Indo-West Pacific



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Overview

The guide is intended to be used as a resource for both scientists and members of the general public who have a keen interest in identifying and learning more about the Mobulidae family, which contains the manta and devil rays. At present the taxonomy of this family of batoid rays is poorly understood, with many questions remaining over the true distinction between, and validity of, the 11 described species currently recognized globally. Due to the scarcity of data available for the mobula species which are restricted to the Atlantic and Eastern Pacific, this guide focuses only on the 7 mobulid species which occur in the Indo-West Pacific. Close underwater encounters of the smaller and more elusive devil rays (mobula) are rare, making identification during these brief encounters difficult without prior knowledge of the key identifiable features of each of these species. Scientists working in the field examining dead specimens at fish markets often find the current literature unsatisfactory for accurate identification.

This guide brings together a comprehensive pool of images, knowledge and data pieced together by scientists working with the Manta Trust in the Indo-West Pacific to create the first field guide to the identification of all the species which occur in this region. It is hoped that the creation of this guide will aid future scientific research, while simultaneously increasing the general public's knowledge of these animals, which together, will lead to better conservation and protection measures for these fascinating animals.



A Scientist measuring a dead Oceanic Manta Ray (*Manta birostris*) at a fish market in Sri Lanka.

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Introduction to Mobulid Rays

Taxonomy & Family Characteristics

Manta and mobula rays belong to the Suborder Myliobatoidei, which contains all of the Eagle Rays (Myliobatidae), Cownose Rays (*Rhinopteridae*) and the Mobulid Rays. In total this suborder contains about 40 species which are characterized by diamond shaped bodies and wing-like pectoral fins which they use to propel themselves through open water. Eagle Rays and Cownose Rays all feed on the seabed, using their mouths to dig amongst the substrate in search of buried Molluscs and crustaceans, while the mobulid rays have truly reverted back to a completely pelagic way of life.

Scientifically the mobulid rays belong to one family called Mobulidae, which contains two Genera; the Mobula Rays (9 species) and the Manta Rays (2 species). All are filter feeders, using their mouths and modified gill rakers to strain plankton and small fishes from the water. In general, mobula rays are much smaller than the mantas and can be distinguished by morphological differences in their mouths and cephalic fins ('head fins'). Mobula rays have a bottom jaw which is undercut, so that when their mouths are closed the edge of the lower jaw rests much further back than the upper, whereas manta ray's jaws are aligned evenly. The other differentiating anatomical feature is the shape of the cephalic fins, which when rolled up look like horns projecting off their heads, hence the name "Devil Rays". The primary function of these fins is to help funnel planktonic food into the gaping mouths of the ray's when they are feeding. Unfurled, the mobula ray's cephalic fins are just a flap, but in the mantas these fins unravel to form much larger paddle-like structures which touch in the centre to form a complete funnel around the mantas mouth.



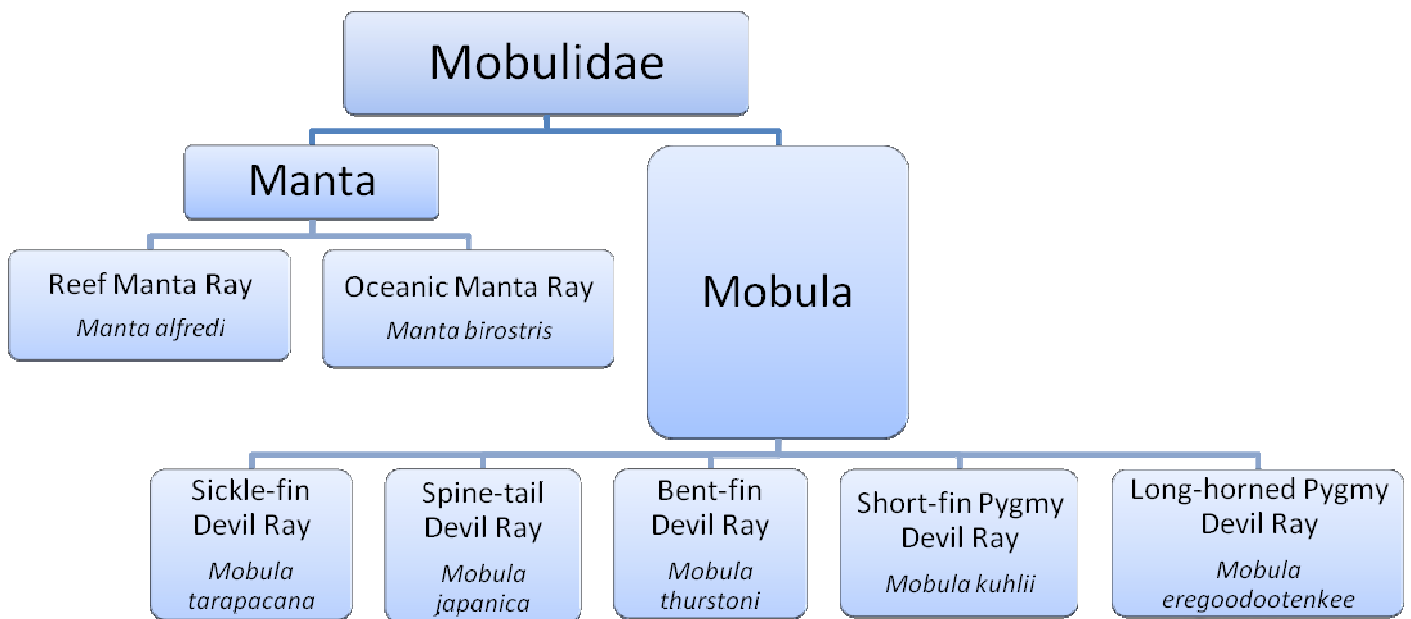
Large cephalic fins of a Reef Manta Ray (*Manta alfredi*), scoop up tiny planktonic prey into their forward facing, terminal mouths.



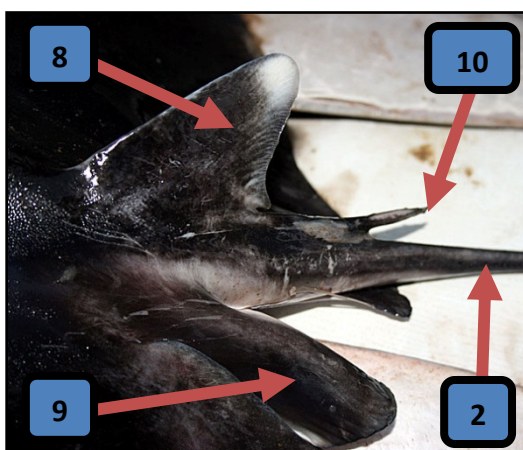
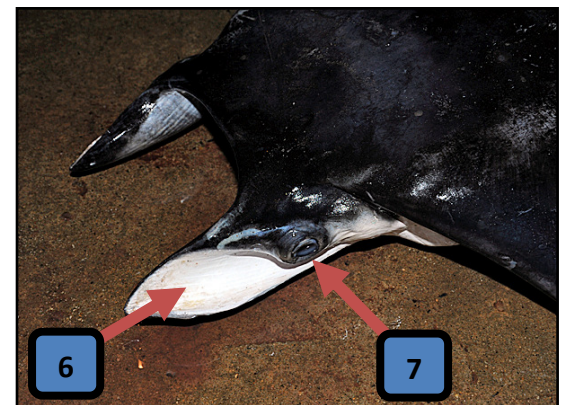
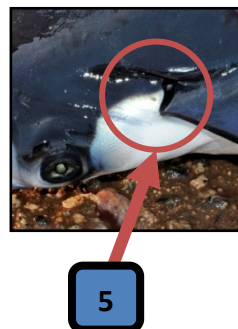
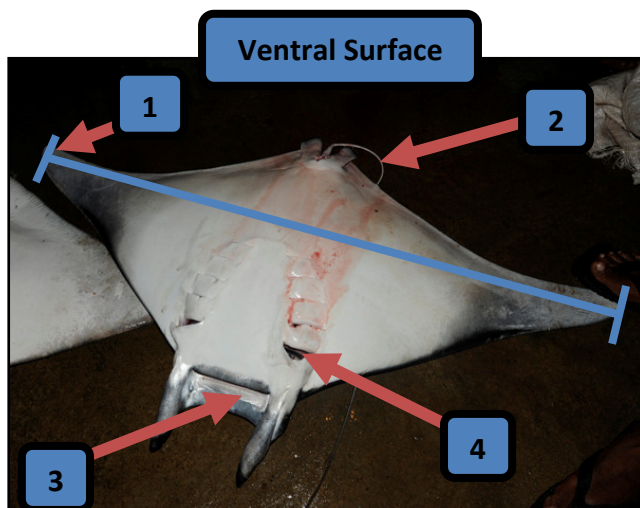
The mouths of all Devil Rays, like this Bent-fin Devil Ray (*Mobula thurstoni*), are all under slung, unlike the mantas, which face forward.

Very little is known about the mobula rays which, unlike the mantas, are generally very shy in the presence of divers making it hard for scientists to observe behaviour in the wild. Like the mantas they are found throughout tropical and sub-tropical oceans, sometimes aggregating in vast shoals of many hundreds which probably come together to seek safety in numbers. These aggregations may also occur more frequently at breeding times and it is not uncommon to encounter these large groups attracting attention from those at the surface as the rays leap several metres out of the water.

Mobulid Species of the Indo-West Pacific

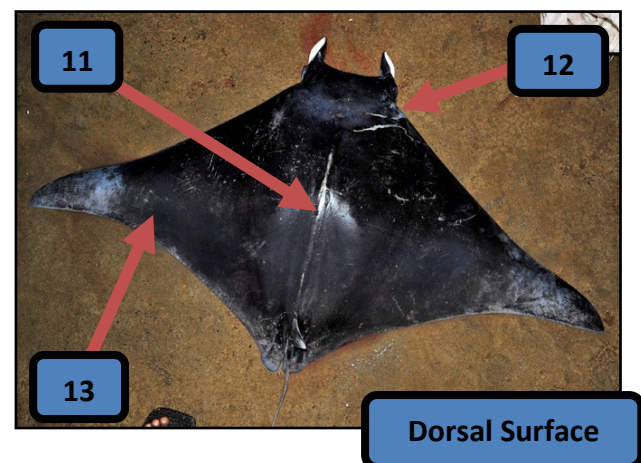


Basic Mobulid Anatomy

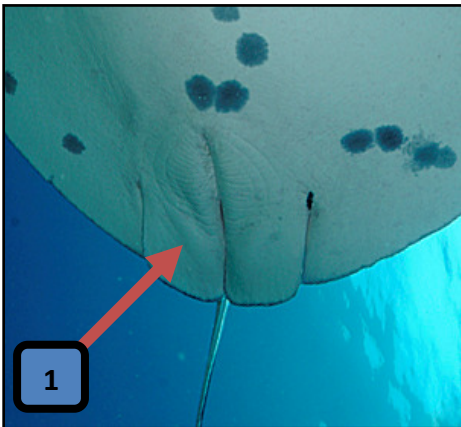


Mobulid Anatomy

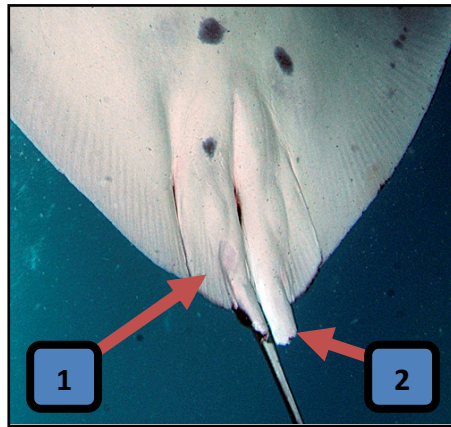
1. Disc Width (DW)
2. Tail
3. Mouth
4. 1st Gill Slit
5. Spiracle
6. Cephalic Fin
7. Eye
8. Dorsal Fin
9. Pelvic Fin
10. Tail Spine
11. Dorsal Ridge
12. Neck
13. Pectoral Fin



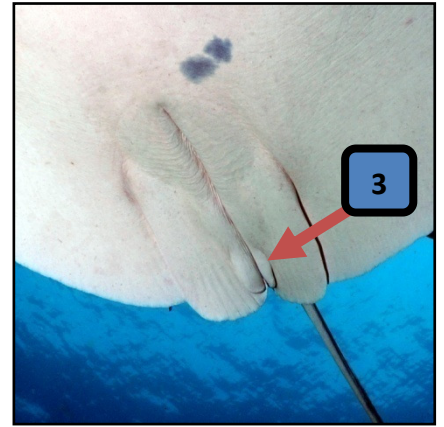
Sexual Dimorphism



Female



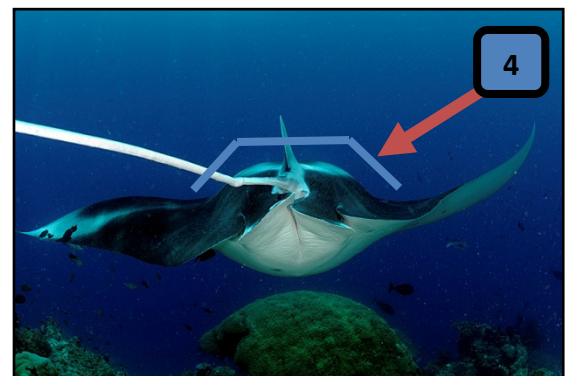
Mature Male



Immature Male

Sexual Dimorphism

1. Pelvic fin.
2. Enlarged claspers in mature male.
3. Undeveloped claspers in juvenile male.
4. Pregnancy bulge in mature female.



Closely Related Species

Spotted Eagle Ray – *Aetobatus narinari*



Javanese Cow-nose Ray – *Rhinoptera javanica*



Threats to Mobulid Rays

Global Mobulid Fisheries

One of the first country's to commercially fish their Mobulid populations was Mexico, when in the early 1980's, fishermen in the Sea of Cortez switched from subsistence and bycatch fishing of the locally abundant oceanic manta and mobula ray species to directed target fisheries. Using harpoons to impale the surface feeding animals, and gill nets to entangle and drown them, the rays were easy targets, and their numbers soon began to plummet. The giant carcasses were towed back to the beaches where only the choicest flesh was sold for consumption, while the remainder was often used as bait in lobster pots, or simply discarded.

Within just a decade populations of the large mobulid ray species within the Sea of Cortez were virtually wiped out, and the fishery collapsed. It was not until 2005 that the Mexican Government finally passed legislation protecting the oceanic manta rays in Mexican waters, but by then the damage had already been done. Even today, after nearly two decades of protection, very few mantas are recorded in this area and those that are still fall victim to illegal fishing or bycatch.

Many other countries have also targeted their mobulid populations with similar results, switching from local artisanal fisheries to commercial export fisheries wherever a market for their products can be found. The Philippines, Indonesia, Mozambique, Madagascar, India, Pakistan, Sri Lanka, Brazil and Tanzania have all chosen the same path as Mexico, with similar trends of population declines reported in many of these countries. Yet out of all these countries, only in the Philippines are there now official laws in place to protect these vulnerable species.



A pile of Spine-tail Devil Ray (*Mobula japanica*) in Sri Lanka, fished for their gill rakers which are sent to Asia to be used in Chinese Medicines.

Globally Threatened Status of Mobulid Species Found in the Indo-West Pacific

Common Name	Scientific Name	IUCN "Red List" Status
Oceanic Manta Ray	<i>Manta birostris</i>	Near Threatened (NT)
Reef Manta Ray	<i>Manta alfredi</i>	-
Spine-tail Devil Ray	<i>Mobula japanica</i>	Near Threatened (NT)
Sickle-fin Devil Ray	<i>Mobula tarapacana</i>	Data Deficient (DD)
Bent-fin Devil Ray	<i>Mobula thurstoni</i>	Near Threatened (NT)
Short-fin Pygmy Devil Ray	<i>Mobula kuhlii</i>	Data Deficient (DD)
Long-horned Pygmy Devil Ray	<i>Mobula eregoodootenkee</i>	Near Threatened (NT)

Why So Vulnerable?



Drying manta and devil ray gill rakers in Sri Lanka, destined for China.

The reason for these rapid declines is simple; Mobulid rays live for a long time and reproduce infrequently. They are large animals with few natural predators that have long gestation periods which result in the birth of just a single pup (most of the time), which themselves are likely to take over a decades to reach sexual maturity. As a result of these life history strategies, and like many other large marine animals, manta ray populations simply cannot survive or sustain any commercial fisheries for an extended period of time. Any target fishery which annually removes even a relatively small percentage of the breeding adults results

in a rapid decline in the overall population within just a few years, as the remaining mature individuals simply cannot breed fast enough to replace the losses. This is why, even with complete protection from anthropogenic threats, an overfished population of manta rays will take decades to recover to its natural state. A situation which, in the realities of today's global fisheries management and protective enforcement (or lack thereof), is never likely to happen to these populations which have already been overfished.

The Gill Raker Trade

While the meat from the fished rays is often consumed locally, the driving factor behind the dramatic increases in fishing pressure for mobulid rays seen throughout South-east Asia and Eastern Africa in recent decades is the growing demand for the mantas branchial filaments, or gill rakers, which are dried and exported for the Asian medicinal market. The dried rakers are crushed into a powder which is added to a soup or broth, along with crushed pipefishes, ginseng and other ingredients, to be used as a treatment for a variety of ailments. The gill rakers are marketed as being; anti-inflammatory, clearing away heat and toxic



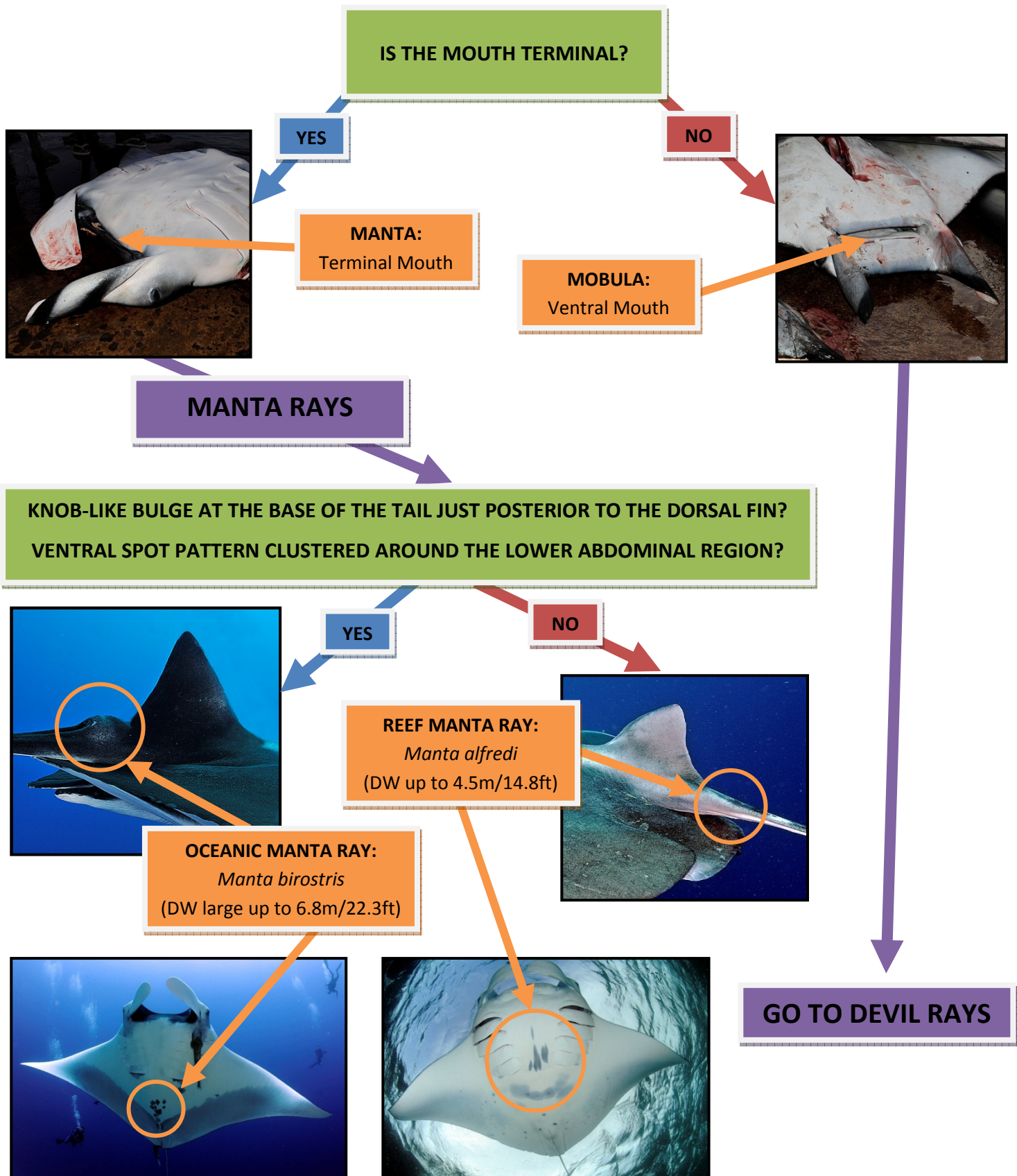
Gill rakers being chopped out of a large Oceanic Manta Ray (*Manta birostris*).



Gill Raker Soup – Peng Yu Sai.

material, and eliminating stasis to activate blood circulation. There is absolutely no scientific proof to back up these claims, and there are not even any records in the traditional Chinese medicinal texts which list manta or mobula rays gills as being used in this way. So it appears as though this is a fairly new product, clever marketing of a readily available and cheap bycatch source from the fisheries. Marketed as a “medicine” on the basis that because mobulid rays are capable of filtering the water to catch their food, their gill rakers when consumed can also filter and remove toxins from our human bodies.

Key to the Identification of Mobulid Rays (Mobulidae) in the Indo-West Pacific



DEVIL RAYS

IS THE TAIL LONGER THAN THE DISC WIDTH?
IS THERE A SPINE AT THE BASE OF THE TAIL?

YES



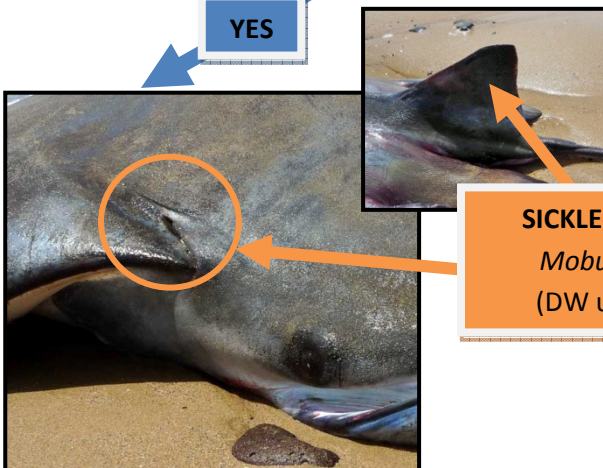
SPINE-TAIL DEVIL RAY:
Mobula japanica
(DW up to 3.1m/10.2ft)

NO

IS THE SPIRACLE ABOVE THE MARGIN OF THE PECTORAL FIN
SITUATED UNDER A DISTINCT RIDGE?
AND SITUATED POSTERIORLY TO THE INTERSECTION OF THE
PECTORAL FIN WITH THE HEAD?
IS THE DORSAL FIN PLAIN IN COLOUR?

NO

YES

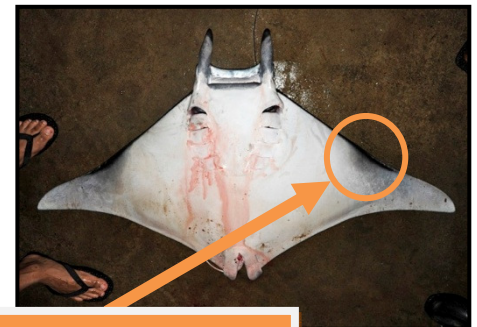


SICKLE-FIN DEVIL RAY:
Mobula tarapacana
(DW up to 3m/9.8ft)

NO

DOES THE PECTORAL FIN'S ANTERIOR MARGIN
HAVE A DISTINCTIVE DOUBLE CURVATURE?

YES



BENT-FIN DEVIL RAY:
Mobula thurstoni
(DW up to 2.2m/7.2ft)

DOES THE ANIMAL HAVE A LONG-NECKED APPEARANCE?
VERY LONG CEPHALIC FINS?
(Length, from the tip of each fin to the corner of the mouth, is **more**
than 16% of the total disc width)

NO

YES



SHORT-FIN PYGMY DEVIL RAY:
Mobula kuhlii
(DW up to 1m/3.3ft)

LONG-HORNED PYGMY DEVIL RAY:
Mobula eregoodootenkee
(DW up to 1m/3.3ft)



Mobulid Identification Guide

Manta Rays

- Oceanic Manta Ray – *Manta birostris* (Page 12)



- Reef Manta Ray – *Manta alfredi* (Page 13)



Mobula Rays

- Spine-tail Devil Ray – *Mobula japanica* (Page 14)



- Sickie-fin Devil Ray – *Mobula tarapacana* (Page 15)



- Bent-fin Devil Ray – *Mobula thurstoni* (Page 16)



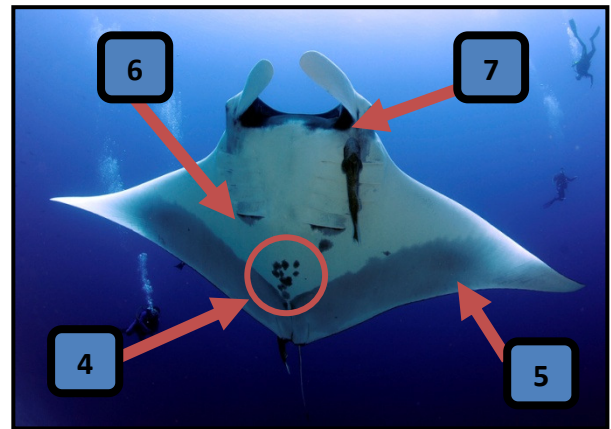
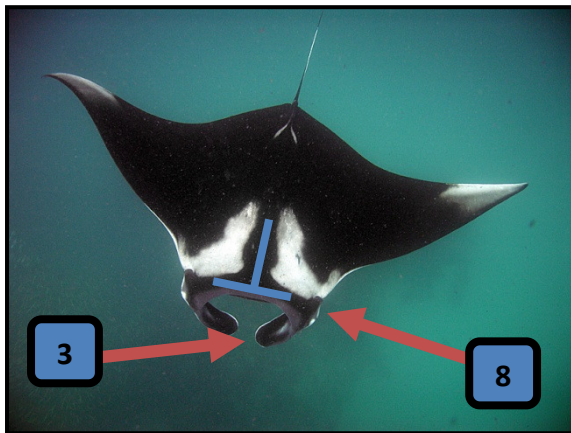
- Short-fin Pygmy Devil Ray – *Mobula kuhlii* (Page 17)



- Long-horned Pygmy Devil Ray – *Mobula eregoodootenkee* (Page 18)



Oceanic Manta Ray - *Manta birostris* (Walbaum, 1792)



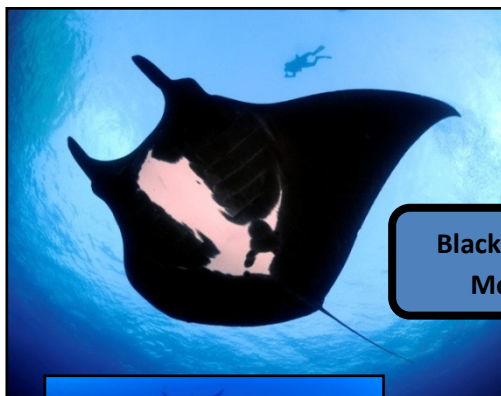
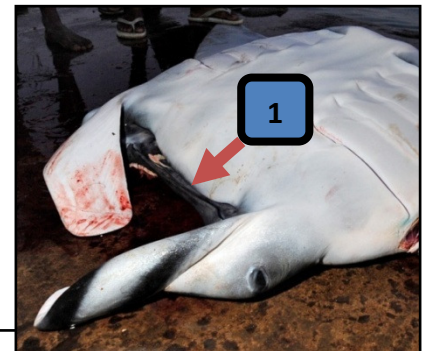
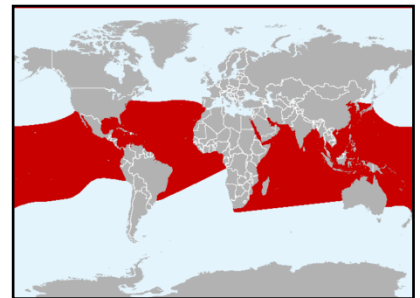
Species Characteristics

Size: Disc width large, up to 6.8m/22.3ft

Range: Circumtropical; Often in association with offshore oceanic islands

Distinctive Features:

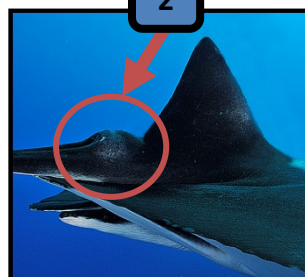
1. Terminal mouth.
2. Knob-like bulge at base of tail.
3. Cephalic fins large and unfurl to meet together in centre of the mouth.
4. Ventral spot pattern clustered around lower abdominal region.
5. Trailing underside edge of pectoral fins usually shaded black.
6. Gill covers often with black shading/flaring.
7. Inside of mouth and cephalic fins often coloured black.
8. White shoulder markings form two mirror image right angled triangles which create the letter 'T' in black across the top of the head.



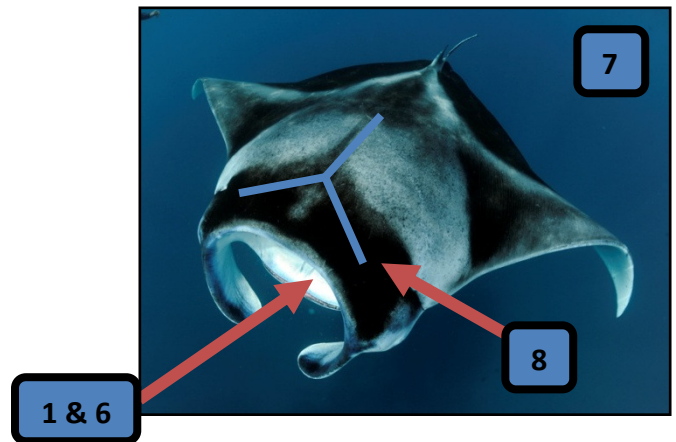
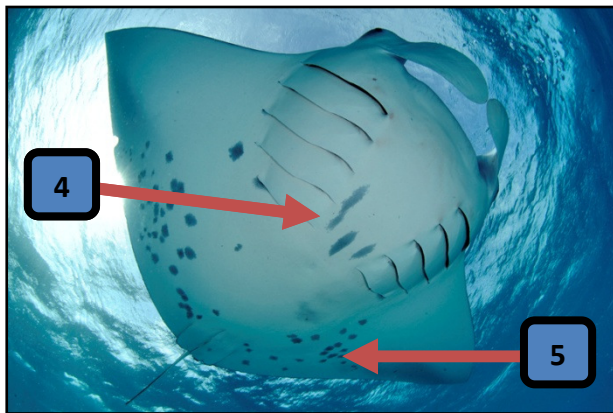
Black Colour Morph



Gill Rakers



Reef Manta Ray - *Manta alfredi* (Krefft, 1868)



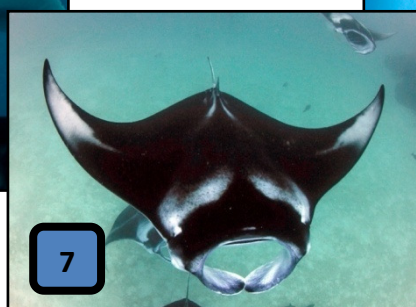
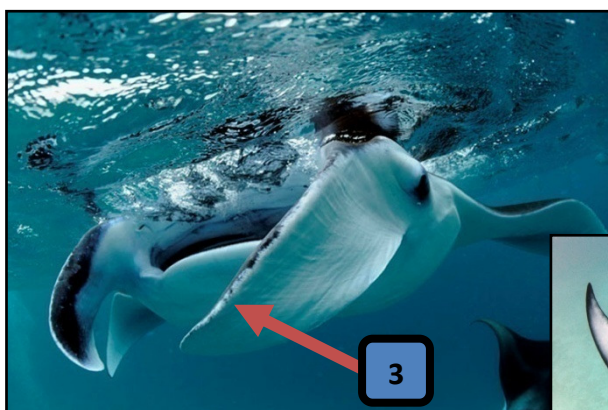
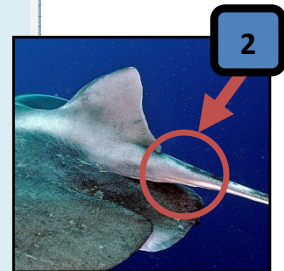
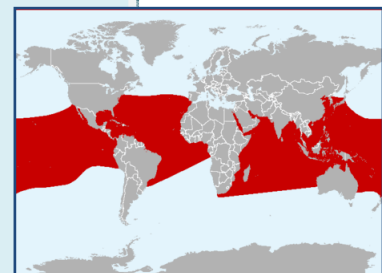
Species Characteristics

Size: Disc width up to 4.5m/14.8ft

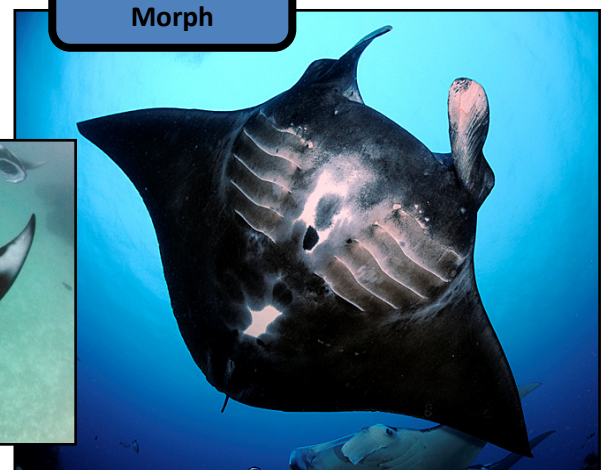
Range: Circumtropical; Often in association with warm water coral reefs

Distinctive Features:

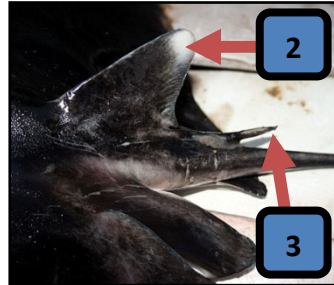
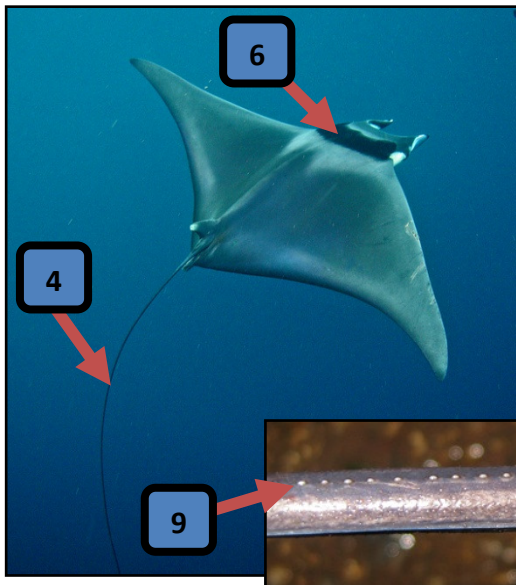
1. Terminal mouth.
2. Slight depression at base of tail; no bulge.
3. Cephalic fins large and unfurl to meet together in centre of the mouth.
4. Often ventral spots between the branchial gill slits.
5. Ventral spots spread across trailing edge of pectoral fins and abdominal region.
6. Inside of mouth and cephalic fins usually pale (excluding black morph).
7. Dorsal markings more varied than *M. birostris*, with some individuals almost completely white across the whole dorsal surface, while others are completely black.
8. Transition between the white and black markings on the dorsal surface is blurred along the colour boundary (unlike *M. birostris* which has a more defined boundary), forming more of a 'Y' shaped pattern across the animals head and down the centre of its back.



Black Colour Morph



Spine-tail Devil Ray - *Mobula japanica* (Müller & Henle, 1841)



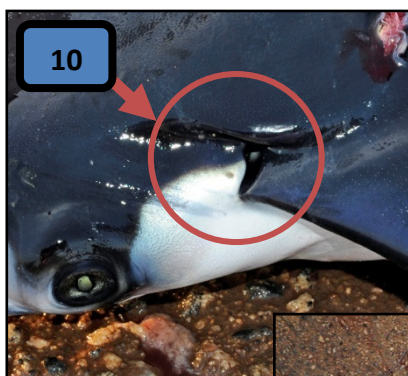
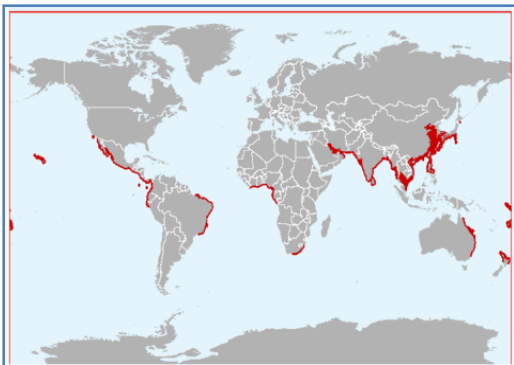
Species Characteristics

Size: Disc width up to 3.1m/10.2ft

Range: Probably circumglobal in temperate and tropical waters

Distinctive Features:

1. Ventral mouth.
2. White-tipped dorsal fin.
3. Spine at the base of the tail.
4. Very long tail, much longer than disc width (whip-like).
5. Coloration: general deep blue-mauve and purple on dorsal surface, bright white across entire ventral surface.
6. Top of the head has a thick dark black band which stretches from eye-eye (fades when animal is dead).
7. White ventral markings wrap up behind, and above, the eyes to meet the black dorsal head band.
8. Tail is ventrally flattened (ovoid) near the base of the dorsal fin.
9. Tail is covered in distinctive rows of tiny white bumps (tubercles) along either side.
10. The spiracle is **above** the margin of the pectoral fin near where the fin meets the body; and under a distinct ridge.



Gill Rakers



Sickle-fin Devil Ray - *Mobula tarapacana* (Philippi, 1892)

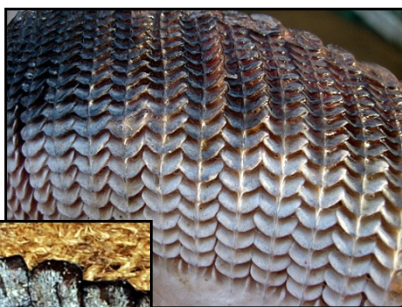
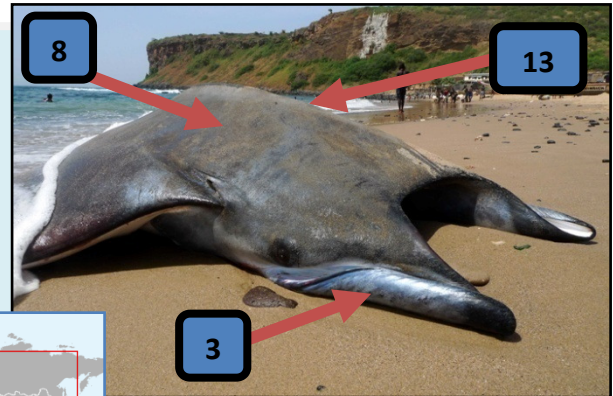
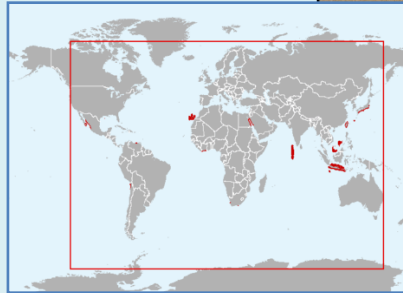
Species Characteristics

Size: Disc width up to 3m/9.8ft

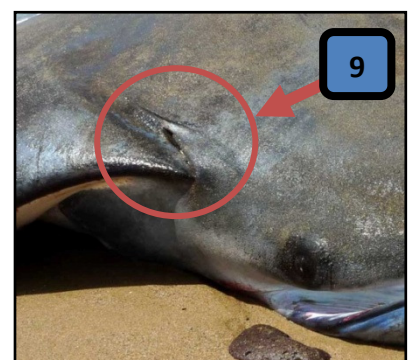
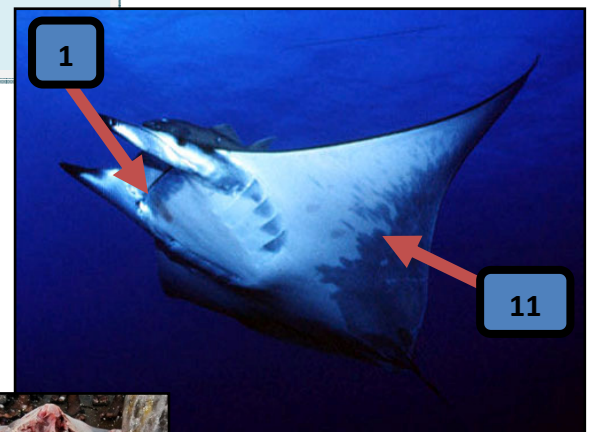
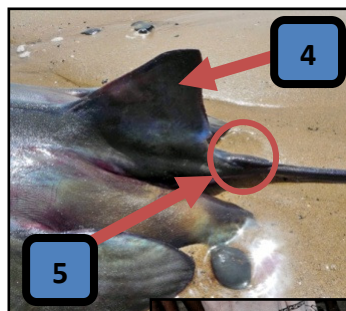
Range: Circumtropical; Oceanic

Distinctive Features:

1. Ventral mouth.
2. Long-necked appearance.
3. Long cephalic fins.
4. Plain colored dorsal fin.
5. No spine.
6. Tail is shorter than disc width.
7. Distinctive bicoloured gill rakers.
8. Dorsal surface entirely olive green-brown in colour.
9. Spiracle is **above** and **behind** the margin of the pectoral fin where it joins the body; and under a distinct ridge.
10. The trailing edge of the Pectoral fins are distinctly falcate, or crescent moon-shaped, hence the name 'Sickle-fin Mobula Ray'.
11. Trailing underside region of pectoral fins shaded grey, while anterior region is white; with a zigzagged messy margin between the two areas.
12. Gill covers often with grey shading/flaring.
13. Distinctive pronounced ridge along dorsal midline.



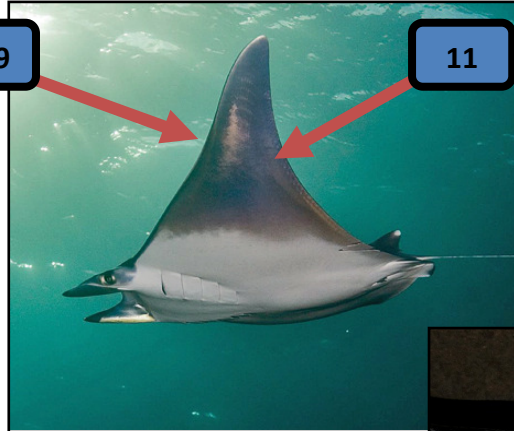
Gill Rakers



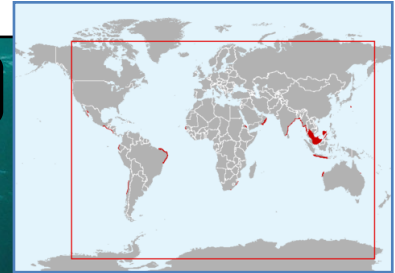
Bent-fin Devil Ray - *Mobula thurstoni* (Lloyd, 1908)



9



11



6

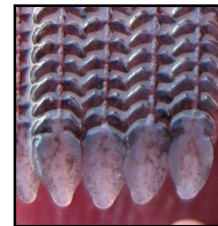
Species Characteristics

Size: Disc width up to 2.2m/7.2ft

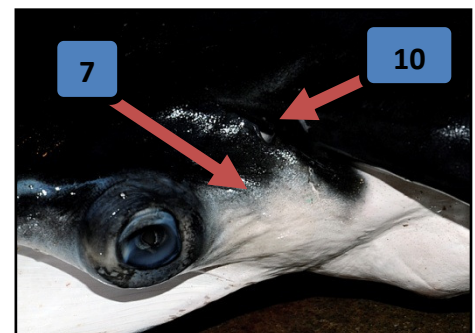
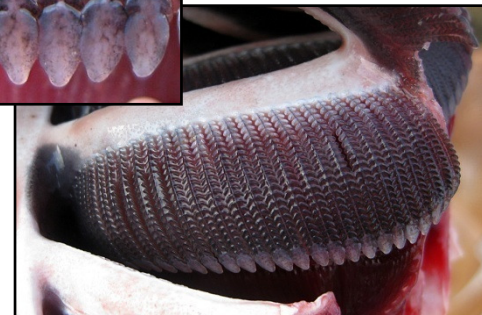
Range: Probably circumglobal in tropical and subtropical waters

Distinctive Features:

1. Ventral mouth.
2. White-tipped dorsal fin.
3. No spine at the base of the tail.
4. Tail long; equals disc width in length when fully intact.
5. Short necked appearance.
6. Short cephalic fins: length, from the tip of each fin to the corner of the mouth, is **less** than 16% of the total disc width.
7. White ventral markings do not extend above the eyes.
8. Tail base dorso-ventrally compressed close to the dorsal fin.
9. Pectoral fins anterior margin have a distinctive double curvature.
10. Spiracle small in size, sub-circular and **below** the margin of the pectoral fin where it meets the body.
11. Coloration: general deep blue-black on dorsal surface, white ventral surface anteriorly, while the distal half has a silver-brown sheen.
12. The top of the head has a dark band which stretches across the head behind the eyes (fades when animal is dead).

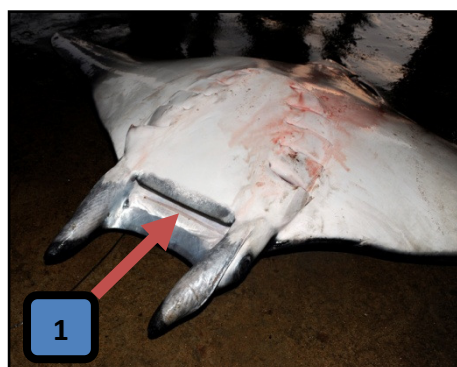


Gill Rakers

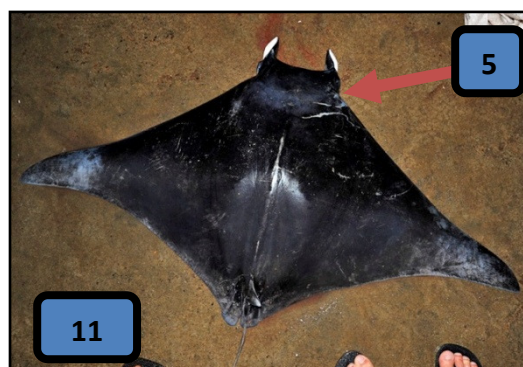


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10

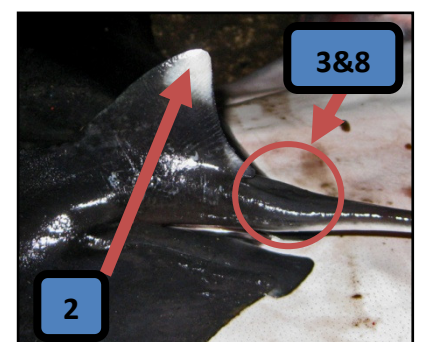


1



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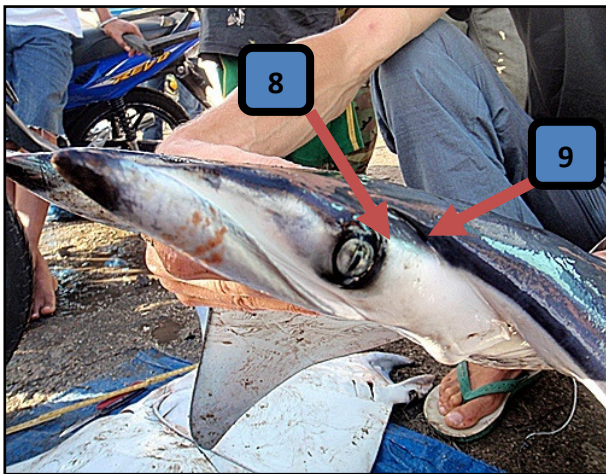
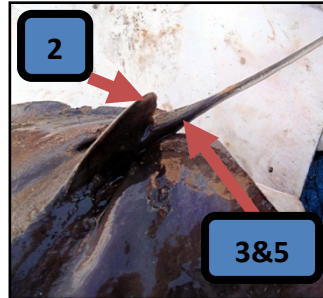
11



3&8

2

Short-fin Pygmy Devil Ray - *Mobula kuhlii* (Müller & Henle, 1841)



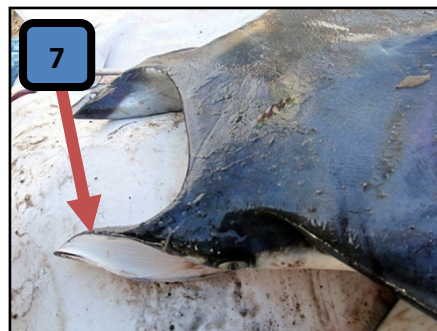
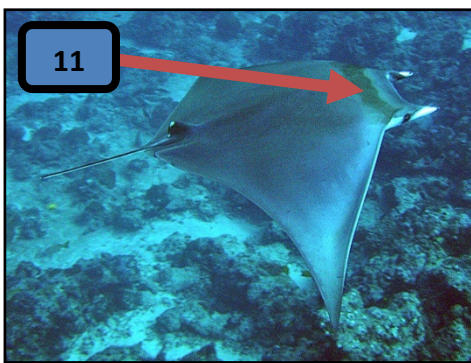
Species Characteristics

Size: Disc width up to 1.2m/3.9ft

Range: Distributed throughout the coastal continental waters of the tropical Indian Ocean and Western Central Pacific

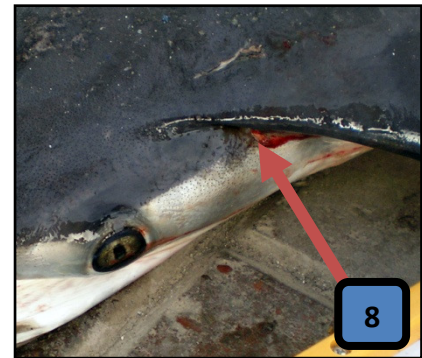
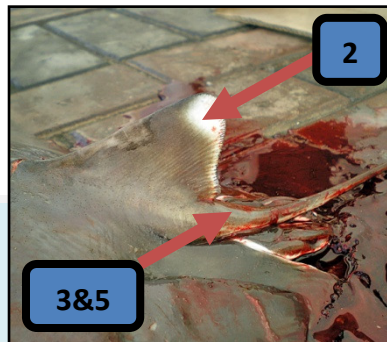
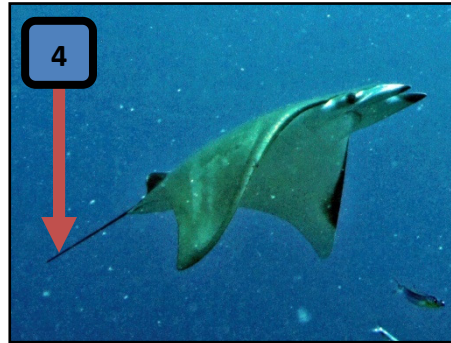
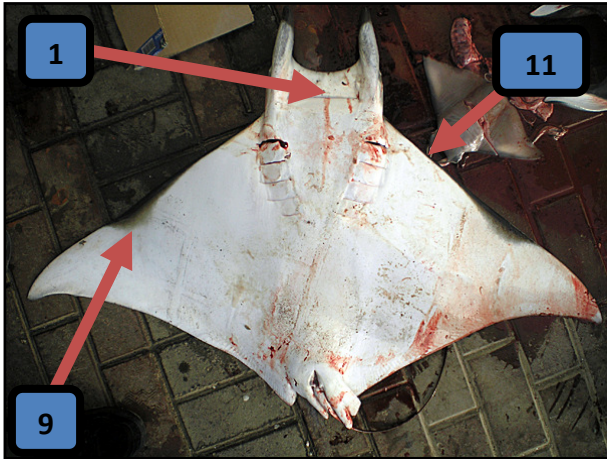
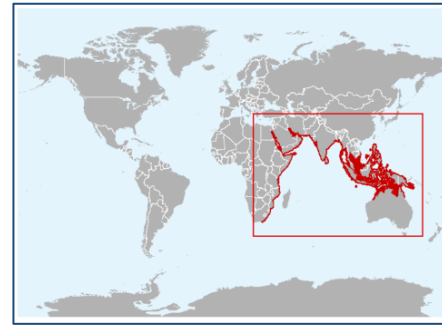
Distinctive Features:

1. Ventral mouth.
2. White-tipped dorsal fin (not all specimens, or regions).
3. No spine at the base of the tail.
4. Tail shorter than disc width and counter-shaded.
5. Base of tail quadrangular (square) in section.
6. Short necked appearance.
7. Short cephalic fins: length, from the tip of each fin to the corner of the mouth, is **less** than 16% of the total disc width.
8. White ventral markings do not extend above the eyes.
9. Spiracle very small in size, sub-circular and **below** the margin of the pectoral fin where it meets the body.
10. Coloration: mauve to chocolate brown and grey dorsally, ventral surface usually plain white, although distal halve of pectoral fins sometimes shaded dark brown-black.
11. Top of the head has a narrow brown-black band which stretches across the head behind the eyes (fades when animal is dead).



Long-horned Pygmy Devil Ray - *Mobula*

eregoodootenkee (Bleeker, 1859)



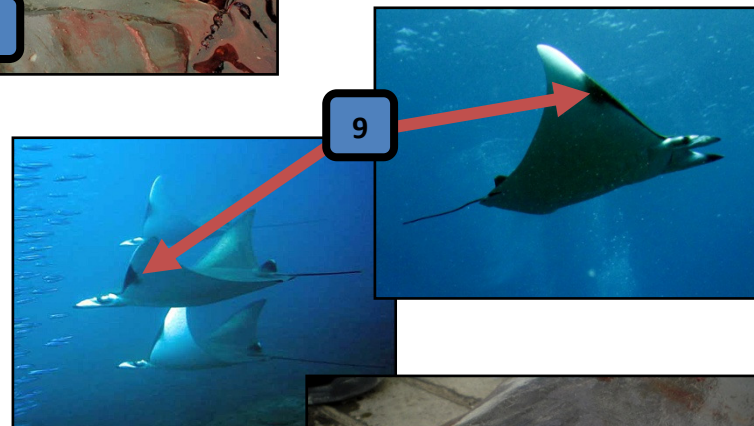
Species Characteristics

Size: Disc width up to 1m/3.3ft

Range: Widely distributed throughout the coastal continental waters of the tropical Indo-West Pacific

Distinctive Features:

1. Ventral mouth.
2. White-tip to dorsal fin in most specimens, with variations possibly occurring between regions.
3. No spine at the base of the tail.
4. Tail shorter than disc width.
5. Base of tail quadrangular (square) in section.
6. Long-necked appearance.
7. Long cephalic fins: length, from the tip of each fin to the corner of the mouth, is **more** than 16% of the total disc width.
8. Spiracle very small, sub-circular and **below** the margin of the pectoral fin where it meets the body.
9. Coloration: Chocolate brown dorsally, white ventrally, with a patch of the dorsal coloration extending down onto the ventral area along the leading edge of both pectoral fins at the mid-point.
10. Pectoral fins have a dark brown strip which runs along the leading edge of each fin.
11. The angle of the leading edge of the pectoral fins sweeps back from the head more acutely than in the other small mobula species.



Acknowledgements & Thanks

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