GUIDE TO THE MANTA & DEVIL RAYS OF THE WORLD

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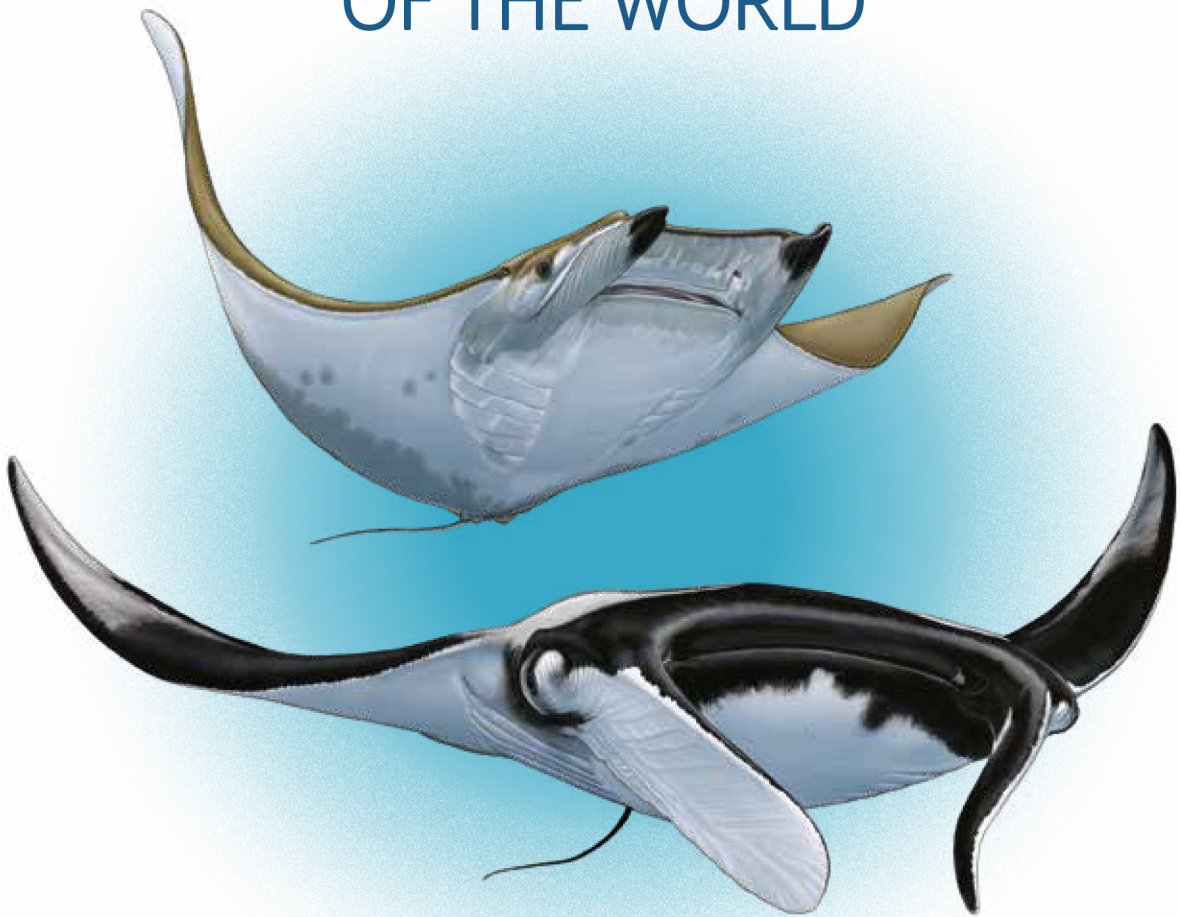

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Data collection protocols

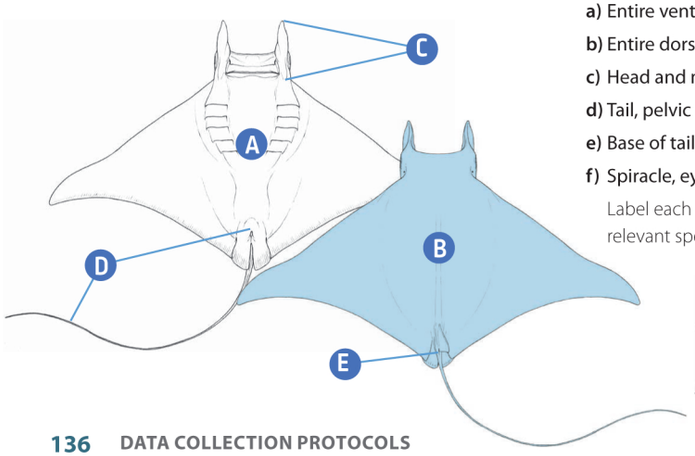
Data collection of mobulid rays across the world is essential if we are to learn more about these threatened species and, in so doing, better conserve them. Therefore, we encourage readers to keep good records of your observations. As citizen scientists or local researchers, you are key contributors to our knowledge of these species. We do, however, note that data collected from living animals versus data collected from dead animals (fishery landing sites, strandings, accidental entanglements, etc.) are two very different scenarios. For in-water photo-ID sightings of manta rays, refer to the Citizen Science section of this guide book for further information on how to contribute images and sightings data to our *IDtheManta* global database. Detailed below are protocols for collecting data on live and dead specimens of **any** mobulid species. Any images and data collected can be submitted to the Manta Trust at **info@mantatrust.org** and will be passed on to the scientists researching the species in question in the region where the data was collected. We always endeavour to provide feedback on any data submitted to us as soon as possible.

Data collection from live specimens

***Note:** please adhere to the Manta Trust's Code of Conduct while interacting with wild animals;* **www.swimwithmantas.org.**

Where possible, the following should be collected:

1. **Name** and **contact information** of data collector.
2. **Date, time** and **location** of encounter; including habitat type, dive site, water depth, etc.
3. **Images of the individual** (if an underwater camera is available). Ideally images should be taken from above, side-on (especially head), and underneath (including spot patterns if any, and genital region.
4. **An estimate of size**; disc width (DW = wing-tip to wing-tip).
5. **Species identification**; using this field guide, determine the species of the observed individual.



Data collection from dead specimens

***Note:** any specimens encountered at fishery landing sites, either as target or bycatch fisheries, or that may have washed up dead on shore, may be recorded. However, any data collection must not incentivise fisher folk, or others, to target or collect additional specimens for scientific purposes. Where applicable, permission must also be obtained from the relevant local authorities before data is collected.*

Where possible, the following should be collected:

1. **Name** and **contact information** of data collector.
2. **Date, time,** and **location** where specimen was recorded.
3. **Specimen number.** This is only required if multiple individuals are encountered (especially if images of multiple specimens are taken).
4. **Photograph** of each encountered individual. Where possible, images showing each of the following characteristics should be recorded for ***each*** specimen:

a) Entire ventral surface including any markings, if present

b) Entire dorsal surface

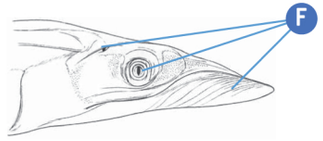
c) Head and mouth

d) Tail, pelvic fin, and genital region

e) Base of tail showing presence or absence of spine

f) Spiracle, eyes, and cephalic fins.

Label each photograph so it can be matched to the relevant specimen.



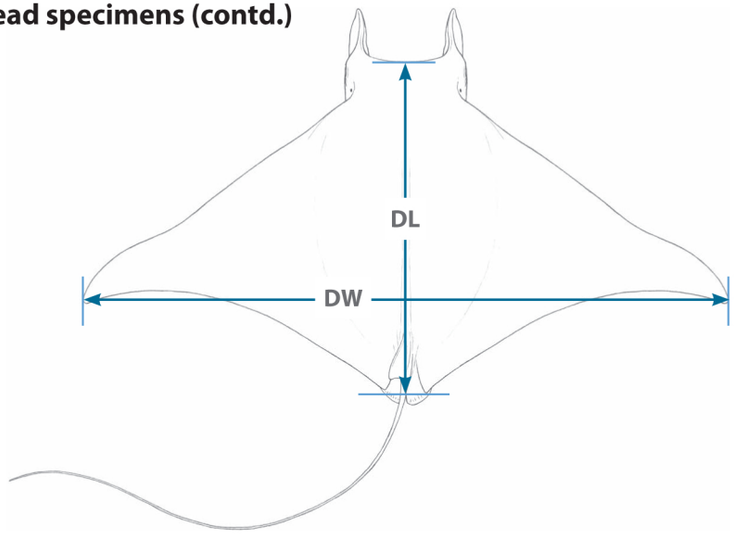
Data collection from dead specimens (contd.)

5. Measurements:

***Note:** it is critical that the measuring tape is **not** bent, and does **not** follow the contours of the body. In other words, the width or length of an animal should not be affected by how 'fat' or 'thin' it is. The tape should be held straight from point to point.*

a) Disc width (DW): length in centimetres (cm) from pectoral fin tip to fin tip in a straight line.

b) Disc length (DL): length in centimetres (cm) from the central point of the top jaw (***not*** the cephalic fins), to the base of the ray's pectoral fins (***not*** the pelvic fin or claspers).



6. Sex and maturity:

a) Sex (male or female) – check for the presence of claspers for males, and take a photograph (as shown opposite) to help judge maturity. For more information on sexing mobulid rays, see page 64 of this guide.

b) Maturity (juvenile, sub-adult, adult) – maturity of females is difficult to determine unless a pregnancy, or mating scars (see pages 46–49 of this guide), are observed. For males, maturity can be judged based on size and extent of calcification of the claspers. In general:

Claspers that extend beyond the pelvic fins and appear, or feel, fully calcified, can be classified as **mature males**.

Claspers that extend up to the pelvic fin, and are partially calcified (flexible), can be classified as **sub-adults**.

Juvenile males have undeveloped claspers that are not calcified.

7. Species identification: using this field guide, determine the species of the observed individual.

8. Additional information:

Catch location – distance from shore and, ideally, GPS coordinates.

Catch method – determine the fishing method used (e.g. gill nets, longline, purse-seine).

Other information – this should include data such as unusual markings (e.g. shark bites or scars) on the specimen, presence of remoras, information such as the boat registration number, the quality of the landed specimen (i.e. was the meat fresh or rotten?), if the ray was killed or alive when brought onto the boat.

Example of data log entry form:

Data Entry Log Sheet for Mobulid Rays

Manta TRUST

Date: Sheet Number:

Location: Collected by:

Specimen Number	Picture Number	DNA Sample Number	Species	Gender (M/F)	Maturity (Yes/No)	DW (cm)	BL (cm)	Catch Location and Method	Additional Info (boat registration, shark bites, remoras, scars etc.)

Collecting tissue samples from dead specimens

***Note:** the collection of tissue, or other, samples for scientific purposes such as genetic studies should be conducted in accordance with local and national regulations. These vary from country to country. The following instructions are intended for the collection and preservation of samples to be used primarily for genetic purposes (extraction of DNA) and should only be undertaken from dead specimens with the necessary permits.*

Equipment

Ethanol: it is essential that **pure lab-grade Ethanol** (>70%, and ideally 99% for long-term storage) is used to store samples. Over-the-counter ethanol contains ***methanol***, a chemical added to make ethanol poisonous for human consumption. However, methanol degrades tissue samples, making genetic tests impossible. In order to avoid this, it is essential that ethanol is purchased from a recognised laboratory or pharmaceutical company that specialises in ethanol for laboratory/genetic purposes. Ensure that the ethanol is not more than two years old from date of production as it decreases in strength. Make a note on storage tubes when ethanol was dispensed into them.

Storage tubes: 2ml screw-cap tubes (with an O-ring to prevent leakage) to store the samples in. These can be purchased at laboratory supply stores (usually similar to the ethanol supplier) or through universities.

Scalpels: scalpel blades (surgical blades) with a scalpel handle are best suited to obtain a sample. They can be purchased at most pharmacies.

Sampling kits

If you have the necessary permits along with access to dead fishery specimens but are unable to obtain the necessary vials or ethanol, please contact the Manta Trust **info@mantatrust.org** for a complete sample kit. ***Do not*** use ethanol you are unsure of, as you may damage the samples, making them worthless for genetic studies.

2ml screw cap storage tubes, with an O-ring to prevent leakage, used to store the tissue samples.

Procedure

Collect all possible biological data from the specimen as stated in the above sections. Each tissue sample should correlate with the respective data entry and images of the specimen.

Cut a thin strip of meat/muscle tissue from the specimen. A small piece of tissue is best, but a piece of the tail will also suffice. This should be around 1–2cm long and should fit inside the 2ml storage tube (pictured opposite).

Completely immerse the sample in ethanol inside the tube. The sample should ***not*** be too large and the ratio of ethanol should be equal to or greater than the size of the tissue sample. **This is really important:** samples that are too big will not preserve properly in the amount of ethanol contained within a 2ml tube.

Clearly **label** and **number** the tube using a ***permanent*** marker pen:

Name of specimen – e.g. *M. mobular*
Date of collection – e.g. 10/05/2017 (DD/MM/YYYY)
Sample number – e.g. 523

***Note:** even a permanent marker can be erased by ethanol. Ensure that ethanol does not leak out of the tubes (use caps with O-rings) and store the tubes in a chronological order, along with a copy of collected sample data on a backed-up spreadsheet. **Duplicate the sample number** by also marking the storage tube lid as well as the side of the tube.*

Place the sample tube upright in a tube storage rack or cryogenic box.

Store samples in a cool, dry location (away from direct sunlight). Ideally keep samples in a freezer (below -4°C or if possible, ideally at -80°C). However, if you live in a region with frequent power-failures resulting in the repeated freezing and thawing of samples, store samples in the refrigerator instead or outside in a cool, dry location.

If samples are not being shipped immediately, change the ethanol (with pure-lab grade ethanol) in the tubes once after 3–7 days of collection. This ensures that all the water extracted from the sample is removed and replaced with fresh ethanol. For information on other tissue sampling procedures (stable isotope, heavy metals, etc.), or if you have any further questions about our data collection protocols, please don't hesitate to contact the Manta Trust at **info@mantatrust.org**.

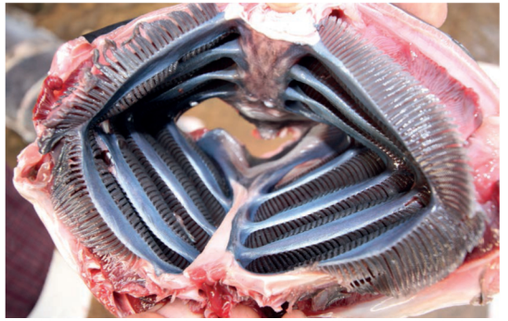
Law enforcement and trade monitoring guide to the gill plates of mobulids

All mobulids (manta and devil rays; Mobulidae) are listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Found throughout the world's tropical and temperate oceans, mobulid rays are large animals with few natural predators. Their biological characteristics, including their late maturity, long gestation periods, and low fecundity (giving birth to one single pup), make them highly vulnerable to directed or bycatch fisheries.

Gill plates (prebranchial appendages)

All mobulids are filter feeders, using their huge mouths and modified gill plates to strain plankton and small fishes from the water. Each mobulid ray has five pairs of gill arches, each of which is encircled internally by a ring of feathery gill lobes known as prebranchial appendages or gill plates.

Five pairs of gill slit openings of a Reef Manta Ray *Mobula alfredi*.



Feathery prebranchial appendages encircle the gill arches inside the mouth of the mobulid ray.

Gill plate trade

Although gill plates from five different species of manta and devil rays have been found in the gill plate trade, only the mantas and two largest mobula species (*Mobula tarapacan*a and *M. mobular*) are regularly traded. Gill plates from the two species of manta rays can be visually differentiated from any devil ray species, and the gill plates of these two most-traded devil ray species can also be easily distinguished from one another.

The gill plates of manta and devil rays are used in Asian medicine. Growing demand is driving a global fishery for these species. When the gill plates are removed from the dead animals (left), they are cut in half before being dried (above) and then shipped to the point of sale.

Effective enforcement and monitoring of international trade in these CITES-listed species will be enhanced through the ability to easily identify these gill plates, and the ability to distinguish between the gill plates of the different manta and devil rays being traded. This guide is therefore intended to help fisheries, enforcement, and customs personnel in the identification of mobulid gill plates. Definitive DNA tests are also available to confirm visual identification if needed for prosecution or verification purposes.

Above: customs officials in Indonesia with hundreds of seized manta ray gill plates which were being traded illegally.

Left: gill plates from the Sicklefin Devil Ray *Mobula tarapacana* are known as 'flower gills' in the gill plate trade.

Gill plate features

There are three key features that can be used to easily identify each gill plate type:

1. Gill plate size
measured as the total length of the traded gill plate.

2. Gill plate colour
uniform (above) or bicoloured (below).

3. Gill plate lobe edging
smooth (above) or separated/bristled (below).

Key to visual identification of the most commonly traded mobulid ray gill plates

Question 1:

Is the gill plate longer than 30cm and uniform brown/black in coloration?

YES = manta rays **NO → 2**

Manta rays *Mobula birostris* and *M. alfredi*

1. Size = medium/large (usually more than 30cm).
2. Colour = uniform brown/black (rarely white).
3. Lobe edging = smooth.

Question 2:

Does the gill plate have a white central coloration and smooth lobe edging?

YES = Sicklefin Devil Ray **NO = Spinetail Devil Ray**

Sicklefin Devil Ray *Mobula tarapacana*

1. Size = medium.
2. Colour = bicoloured (white central).
3. Lobe edging = smooth.

Spinetail Devil Ray *Mobula mobular*

1. Size = small/medium.
2. Colour = bicoloured (white edging).
3. Lobe edging = jagged.

Conclusions

Mobulid gill plates can be easily identified using this simple visual identification guide.

The size, colour patterning, and lobe edging of the gill plates can be used as an effective and easy indicator to determine the species of origin.