

Note on incidents of oceanic manta ray (*Mobula birostris*) fishing gear entanglements from the Maldives

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Abstract

This note highlights incidents of oceanic manta ray (*Mobula birostris*) entanglement in fishing gear from the Maldives. In 2023, 11.5% of oceanic manta ray sightings from the Maldives had entanglement injuries or were still entangled in fishing gear. Gear removed from entangled individuals suggests these oceanic manta rays are encountering foreign fishing fleets. We hope to use entanglement data to shed light on potential movements and migrations whilst satellite telemetry studies in the Maldives are still restricted.

Introduction

Oceanic manta rays have been documented in several locations throughout the Indian Ocean, however documented populations remain relatively small (Carpenter et al., 2023; Knochel et al., 2022; Venables et al., 2019). Oceanic manta rays, like all mobulids, have conservative life history traits (Dulvy et al., 2014) which makes them susceptible to pressures from fisheries (Croll et al., 2016).

In the Maldives, a sizeable population of oceanic manta rays make a seasonal migration through the southern atolls of the country with a few additional sightings reported annually from the rest of the country (S. Hilbourne unpubl. 2023). Oceanic manta rays, along with all other species of sharks and rays have been protected since 2014 (Batoidea Maldives Protection Gazette No. (IUL) 438-ECAS/438/2014/81, 2014). Despite this, both reef and oceanic manta rays are known to get entangled in fishing gear across the country's Exclusive Economic Zone (EEZ) (Strike et al., 2022).

Oceanic manta rays are capable of travelling large distances of up to 1,500km (Hearn et al., 2014), however more recent studies using satellite telemetry and stable isotope analysis, have shown that the species likely inhabits more restricted ranges for large periods of time (Garzon et al., 2023; Graham et al., 2012; Stewart et al., 2016). Being planktonic filter feeders, oceanic manta rays often inhabit similar pelagic niches as tuna species (Martin, 2020; Shahid et al., 2018).

Throughout the Indian Ocean, mobulids are known to interact with numerous fishing gears from tuna fisheries from India, Pakistan, Sri Lanka, Philippines and Indonesia (Shahid et al., 2018). In neighbouring Sri Lanka, an extensive catch of oceanic manta rays by non-selective artisanal gill net fisheries has been recorded with over 1,000 oceanic manta rays landed annually between 2011 and 2019 (Fernando & Stewart, 2021).

Methods

Photo identification images of oceanic manta rays in the Maldives were collected from citizen science contributions throughout the Maldives since 1996. Dedicated Manta Trust survey seasons were conducted around Fuvahmulah Atoll in the south of the archipelago between 2018 and 2023. During this time, dive and snorkel surveys were conducted around the island over a four-to-six-week period over the peak sighting period. Photo identification images of the ventral spot patterns of individual manta rays were taken when possible. Entanglements were recorded when fishing gear was still visible or when injuries could be attributed to entanglement events in the photo identification images.

In 2023, when researchers or citizen scientists encountered an entangled manta ray, we requested that divers preserve any items removed from the entanglement event for further inspection.

Results

Anthropogenic, sub-lethal injuries from fishing hooks and line account for 30% ($n = 32$) of identified injury types on oceanic manta rays in the Maldives (Strike et al., 2022). In 2023, 11.5% of sighted oceanic mantas ($n=9$) had injuries that could be attributed to entanglements in fishing line or nets.

In 2023 so far, five entangled oceanic manta rays were cut free from longline fishing gear (Fig. 1a). Two hooks (Fig. 1b), one squid lure (Fig. 1c), and three samples of fishing line were removed (Fig. 1d). Both hooks removed were all nearly identical. They were circle hooks with a ring eyelet. The fishing line associated with the hooks was monofilament line of 0.18 cm thickness.

Two segments of gill net were removed during two separate encounters around Fuvahmulah in April 2023 and then North Male Atoll in August 2023 (Table 1, Fig. 1e-g). The nets appear to be from gill nets.

Table 1: Characteristics of nets removed from oceanic manta rays (*Mobula birostris*) in the Maldives.

Net Characteristic	Value
Webbing dimension	7.5cm x 7.5cm
Stretched mesh size:	14.7cm
Net construction:	Knotted
Twine:	Twisted
Number of strands:	3
Material:	Natural Fibre Yarn
Twine Diameter:	1mm
Colour:	Green

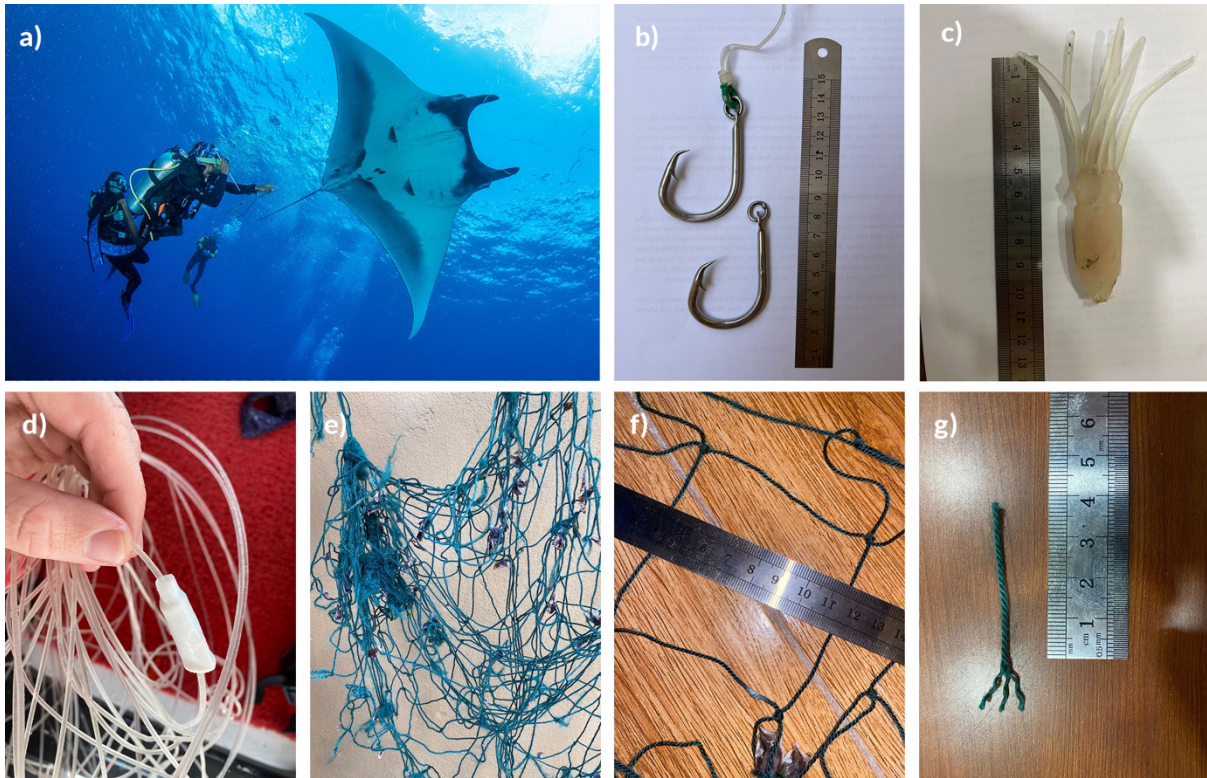


Figure 1: Fuvahmulah Dive School dive guides removing fishing line from an entangled oceanic manta ray in the Maldives (a). Two hooks (b), a squid lure (c), segments of monofilament fishing line (d), and gill net (e-g) were cut from during various encounters and preserved.

Discussion

Oceanic manta rays appear to be seasonal visitors to the Maldives with 86% of sightings coming from the southern atoll of Fuvahmulah (S. Hilbourne, unpublished 2023). Sightings in this region peak between March and May with sightings lasting only a few weeks. Outside of this period, sightings are rare around coastal waters suggesting the population has moved offshore. However, without satellite telemetry data due to research restrictions in the Maldives, habitat range and migration routes are unknown.

Fishing gear removed during opportunistic encounters with divers does not match fishing gear used by Maldivian fishing fleets. Gill net fishing is illegal within the Maldives' Exclusive Economic Zone (EEZ) (Ministry of Fisheries Marine Resources and Agriculture, 2019) and the longline tuna fishery closed in 2019. Hence, these incidents of entanglement are a result of three potential scenarios:

- a) Oceanic manta rays were entangled in other nation's EEZ before migrating into Maldivian waters.
- b) Oceanic manta rays were entangled in the high seas before migrating into Maldivian waters.
- c) Oceanic manta rays were entangled by illegal fisheries operating within Maldivian waters.

Without the current ability to track individuals using satellite telemetry in the Maldives, it is impossible to know the range of this population and where manta rays might be travelling

from or to. However, based on satellite tagging studies of oceanic manta rays from other regions worldwide, the 200 nautical mile journey to the edge of the Maldives' EEZ is feasible (Graham et al., 2012; Hearn et al., 2014; Stewart et al., 2016).

Mortality rates from entanglement incidents like those reported in this note are unknown, however, post-release mortality of over 57% has been recorded for other mobulids in purse seine fisheries (Francis & Jones, 2017). Mobulids caught in other longline fisheries have been reported to be released injured and with low levels of at-vessel-mortality of 1.4-5.4% (Coelho et al., 2012; Mas et al., 2015; Tremblay-Boyer & Brouwer, 2016).

It is also not known whether the individuals seen in the Maldives broke free from the fishing gear or were cut free and released by fishers. Retention of caught oceanic manta rays is likely to occur in artisanal fisheries from nearby nations including Sri Lanka and India.

This note highlights that oceanic manta rays sighted around the Maldives are encountering longline and gill net fisheries despite these operations being illegal within the Maldivian EEZ. It highlights the need to investigate further where such interactions are happening. Understanding where this population of oceanic manta rays migrate to and where they are encountering fisheries will be an important first step to reducing the number of potentially fatal encounters with fisheries. It is also important to understand the capture rate, retention rate, and mortality rate of released oceanic manta rays for both net and longline fisheries in the central Indian Ocean.

Call for help

Without the ability to satellite tag individuals in the Maldives currently, we are looking to try and use fisheries entanglement information to identify potential habitat range and movements. We are aware that these styles of net and hook are commonly used by numerous fisheries across the Indian Ocean, however if you have encountered these styles of hooks and nets, please reach out to simon@mantatrust.org with information.

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