



Maldivian
Manta Ray Project

Oceanic Manta Ray | Summary Report 2020-2021

*Conservation through
research, education, and collaboration*

- The Manta Trust





WHO ARE THE MANTA TRUST?

The Manta Trust is a UK and US-registered charity, formed in 2011 to co-ordinate global research and conservation efforts around manta rays. Our vision is a world where manta rays and their relatives thrive within a globally healthy marine ecosystem.

The Manta Trust takes a multidisciplinary approach to conservation. We focus on conducting robust research to inform important marine management decisions. With a network of over 30 projects worldwide, we specialise in collaborating with multiple parties to drive conservation as a collective; from NGOs and governments, to businesses and local communities. Finally, we place considerable effort into raising awareness of the threats facing mantas, and educating people about the solutions needed to conserve these animals and the wider underwater world.

Conservation through research, education and collaboration; an approach that will allow the Manta Trust to deliver a globally sustainable future for manta rays, their relatives, and the wider marine environment.



MALDIVIAN MANTA RAY PROJECT

Formed in 2005, the Maldivian Manta Ray Project (MMRP) is the founding project of the Manta Trust. It consists of a country-wide network of dive instructors, biologists, communities and tourism operators, with roughly a dozen MMRP staff based across a handful of atolls.

The MMRP collects data around the country's manta population, its movements, and how the environment and tourism / human interactions affect them. Since its inception, the MMRP has identified over 5,000 different individual reef manta rays, from more than 70,000 photo-ID sightings. This makes the Maldives manta population the largest, and one of the most intensively studied populations in the world. The MMRP has also identified over 800 different individual oceanic manta rays.

The long-term and nationwide data collected by the MMRP has allowed researchers to record and identify key patterns within this population over time. Not only does this invaluable information improve our understanding of these animals, but it informs their ongoing management and protection both in the Maldives, and around the world.



THE CONSERVATION CHALLENGE

In the last two decades, manta and mobula rays have faced increasing threats from both targeted and bycatch fisheries, due in part to a growing trade in Asia for their gill plates. The gill plates are what these rays use to filter zooplankton from the water. In Traditional Asian Medicine, it is believed these gill plates will filter the human body of a variety of ailments when consumed in tonic. There is no scientific evidence to support this claim.

Unregulated and badly managed tourism is also negatively affecting manta rays, and in turn the tourism industry, while climate breakdown, reef degradation and pollution is reducing the manta's food supply and suitable habitat.

Manta and mobula rays are particularly vulnerable because of their aggregating behaviour and conservative life-history; they grow slowly, mature late in life, and give birth to few offspring. These traits make it very easy to wipe out entire populations in a relatively short period of time. With protection in place, populations are still slow to recover.



EXECUTIVE SUMMARY

This report presents data collected by the Maldivian Manta Ray Project (MMRP) on the oceanic manta ray (*Mobula birostris*) population sighted throughout the Maldives Archipelago in 2020 and 2021, with a focus on the oceanic manta ray peak sightings period (March-April). The Maldives is widely regarded as one of the best places in the world to see reef manta rays (*Mobula alfredi*). However, the Maldives is also frequented by their larger oceanic relative. Both manta species have been continuously studied since 2007 by the MMRP, the founding project of the UK-registered charity, the Manta Trust; a non-profit, independent conservation, research, and education focused organisation.

The global COVID-19 pandemic prevented the Manta Trust's research season from happening in Fuvahmulah and had widespread impacts on the dive tourism industry in the Maldives. The greatly reduced dedicated research and citizen science dive survey effort in 2020 is likely the reason only eight sightings of oceanic manta rays were submitted, including just a single sighting from Fuvahmulah that year.

Throughout 2021, there were 77 sightings of 73 individuals. The 2021 peak sighting period commenced later than previous years and ran from April 20th - 29th, during which a total of 54 sightings of 50 individuals were recorded directly by Manta Trust researchers or submitted by citizen scientists. All but one of the individuals recorded this year were new to the database. The re-sighting rate of individuals within the season was very low (5%), suggesting a transient population with minimal residency around Fuvahmulah

Atoll. As with other years, the primary behaviour recorded was 'cruising'.

Sri Lanka and India, situated 300 kilometres to the northeast of the Maldives, are home to some of the largest manta and devil ray fisheries in the world. Fisheries research studies conducted by the Manta Trust in Sri Lanka have estimated that thousands of these threatened rays are landed every year across the country. The relatively close distance (1,000 km) between the aggregation sites in the south of the Maldives and the extensive fishery in Sri Lanka is a cause for concern, especially as the Sri Lankan fleet fishes intensively throughout this region of the Indian Ocean. However, at present we have no knowledge of the extent, if any, of the connectivity between these populations.

In 2021, the Manta Trust team further increased their research efforts at Fuvahmulah Atoll. It is now clear that the reefs around this island are a world class location for both recreational diving and marine research because of the abundance and diversity of marine megafauna. A dedicated environmental research and education centre has been agreed for Fuvahmulah, which would benefit visiting researchers, and involve local scientists from Fuvahmulah and the Maldives. We will be working with Fuvahmulah City Council over the coming years to implement these plans. Our hope is that such a centre will inspire and educate the next generation of Maldivians about the incredibly unique biodiversity surrounding Fuvahmulah Island.

STUDY PERIOD & SAMPLING METHODOLOGY

This report builds on the findings summarised in the Manta Trust's Oceanic Manta Ray Summary Report 2018 and 2019. Due to the COVID-19 pandemic, limited data was collected on the oceanic manta rays in the Maldives in 2020, and as a result, all the 2020 and 2021 data has been compiled into this report. However, the report focuses primarily on the oceanic manta season from April 20th to 30th 2021 in the sub equatorial atoll of Fuvahmulah in the Maldives.

The two most frequently sighted locations of oceanic manta rays in Fuvahmulah are the southernmost tip of the reef spur and the northeast corner of the Island, hereafter referred to as Farikede Faru and Thundi Faru, respectively (Fig. 1). On the spur reef there is a shelf plateau at approximately forty-five metres depth which extends out from the reef.

In 2021, the Manta Trust conducted its most extensive research fieldtrip to Fuvahmulah Atoll to study the oceanic manta population. From the 28th of March until the 6th of May, the Manta Trust had researchers based on Fuvahmulah Island conducting four-hour snorkel and boat

surveys daily to collect photo-ID data on the oceanic manta rays on 32 days. This period coincides with the period in which the highest numbers of sightings have been recorded in previous years. Additional drone surveys were used to survey for manta rays in the surface waters across larger areas in a shorter period. In addition, through collaborations with local dive schools and liveaboard operators, the Manta Trust has grown an extensive network of citizen scientists who submitted sightings during the season. These sightings are included in this report's findings.

In-water, individual manta rays were documented by photographing the unique spot patterns on their underside (ventral surface). The whole team were experienced scuba divers and free divers, allowing them to obtain photo-ID shots whilst ensuring minimum disturbance to the animals. For the purposes of this report, a sighting is defined as a confirmed photo-ID of an individual manta ray on a given day, multiple sightings, or submissions of the same individual from the same location on the same day were counted only once.

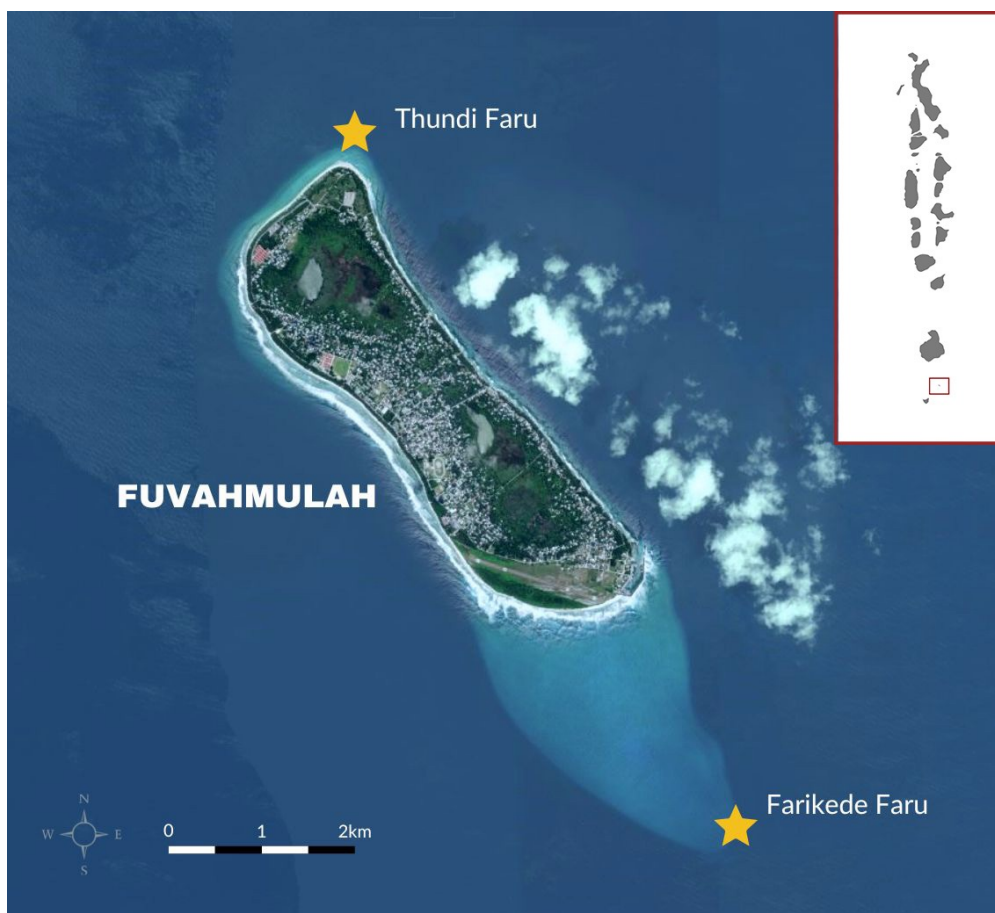


Figure 1: Map of Fuvahmulah Atoll in the Maldives archipelago (inset) with the two main locations where oceanic manta rays (*Mobula birostris*) have been sighted.

MANTA RAY SIGHTINGS

Nationwide

Throughout the Maldives Archipelago, a total of 861 sightings of 791 oceanic manta ray individuals have been recorded between 1996 and the end of 2021. These sightings were obtained from 16 of the 26 geographical atolls of the Maldives: from Thiladhunmathi Atoll in the north through to Addu Atoll in the south (Fig. 2). In 2020, a sighting was submitted from Gaakoshinbi Faru in Thiladhunmathi Atoll, which represents the most northerly confirmed sighting in our database of the Maldives.

Throughout the country, there were eight sightings of oceanic manta rays in 2020 and 78 in 2021 (Fig. 3). A

significant difference has been identified over the years between sightings of oceanic manta rays in the deep south of the Maldives (Fuvahmulah and Addu) and the rest of the country. For this reason, sightings from these regions will be analysed separately.

The recorded photo-IDs showed no significantly biased gender split (sex ratio 1F:1.14M, $\chi^2 = 3.24$, $df = 1$, $p < 0.05$), across the total recorded population with 395 males (50%) and 346 females (44%). However, there are 50 individuals (6%) with unknown gender.

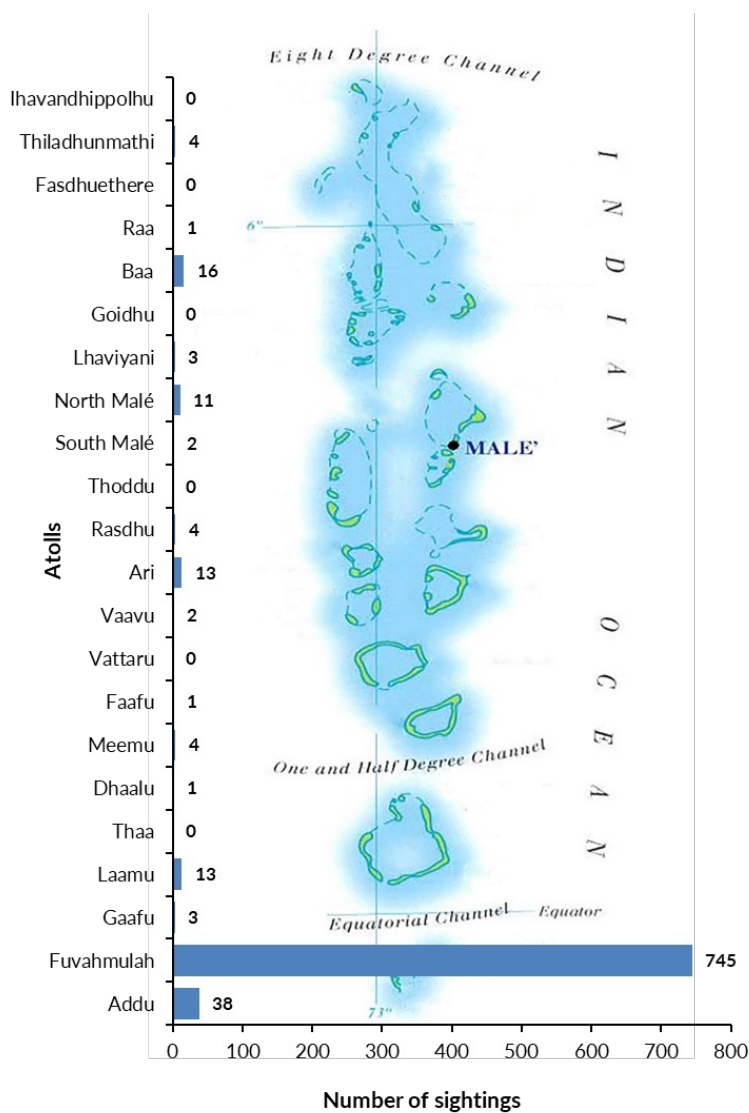


Figure 2: Number of sightings ($n=861$) of oceanic manta rays (*Mobula birostris*) across atolls throughout the Maldives (1996 – 2021). Note – some individuals have been sighted in more than one atoll throughout the Maldives Archipelago.

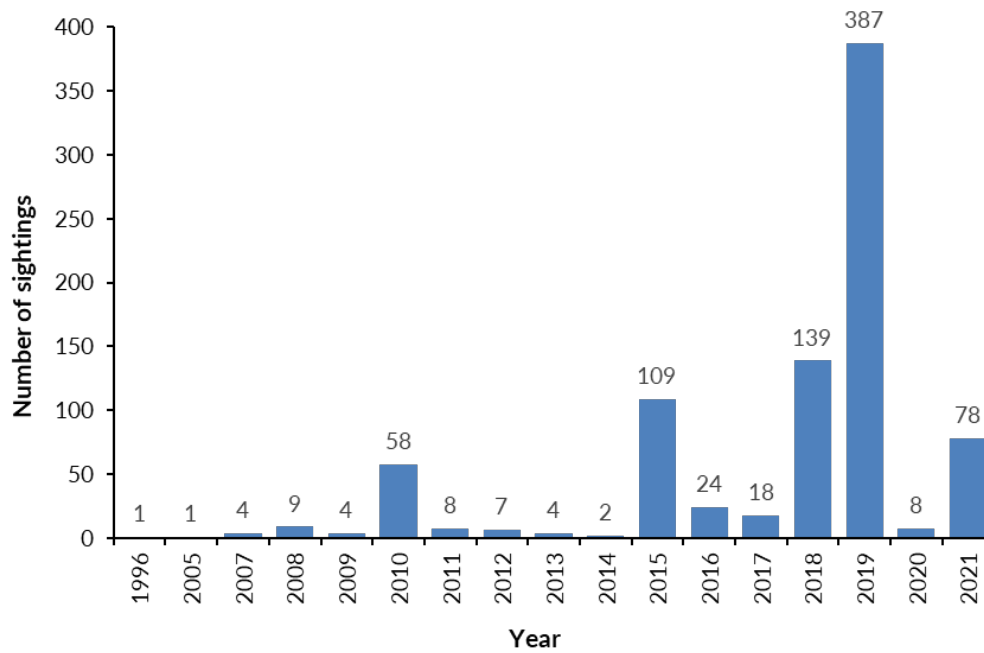


Figure 3: Number of oceanic manta ray (*Mobula birostris*) sightings throughout the Maldives (1996 – 2021).

NATIONWIDE (EXCEPT FUVAHMULAH & ADDU)

Manta Ray Sightings

Between January 2020 and December 2021, 21 sightings of 19 individuals were recorded outside of Fuvahmulah Atoll (Table 1).

Due to the low number of sightings for most atolls in the Maldives, further analysis on sightings and seasonality was not conducted in this report.

Table 1: Number of individual oceanic manta rays (*Mobula birostris*) sighted in atolls through the Maldives in 2020 and 2021.

Atoll	2020	2021
Ari Atoll	4	3
Baa Atoll	0	2
Dhaalu Atoll	0	1
Laamu Atoll	0	1
North Malé Atoll	0	2
Rasdhu Atoll	2	0
Thiladhunmathi Atoll	1	3
Vaavu Atoll	0	2
Total	7	14

Re-sightings

Two of the sightings in 2021 were re-sightings of individuals from 2020. Fascinatingly, these two individuals (a male and a female) were seen engaged in courtship off Maamigili Beyru, Ari Atoll in December 2020 and then re-sighted again in courtship off Moofushi Bojamhadi, Ari Atoll 29

days later (Fig. 4). The dates and locations of these sightings were verified with the submitters. It is impossible to know if this courtship event lasted the entirety of that period, however the chances of the same two individuals being sighted again together would be extremely low.



Figure 4: Locations of initial and secondary sightings of a pair of oceanic manta rays (*Mobula birostris*) observed in courtship in South Ari Atoll. The dotted line illustrates connectivity between the sites, however the actual route of the manta rays is unknown.

Population Demographics

Of the seven individuals recorded in 2020, five were female and two were male. In 2021, there were also more females recorded than males (sex ratio 2.5F:1M) with nine females and five males. In both years, low sample sizes make statistical analysis on significant differences not possible.

When not considering Fuvahmulah and Addu, none of the oceanic manta rays sighted in 2020 or 2021 throughout the rest of the Maldives were melanistic, all were chevron colour morphs.



Behavioural Observations

The primary behaviour that the manta rays were exhibiting was recorded during each encounter. Most sightings throughout 2020 and 2021 were of cruising or just swimming individuals (Table 2).

In addition to the two courtship events mentioned above, a single sighting of an oceanic manta ray was made at a cleaning station on Gaakoshinbi Faru in Thiladhunmathi Atoll in 2020, and a single sighting of an oceanic manta ray feeding was made in Hanifaru Bay in Baa Atoll in 2021.

Table 2: Primary behaviour recorded during oceanic manta ray (*Mobula birostris*) encounters in the Maldives (except Fuvahmulah & Addu) in 2020 and 2021.

Behaviour	2020	2021
Cleaning	1	0
Courtship	2	2
Cruising / Just Swimming	4	11
Feeding	0	1

FUVAHMULAH & ADDU ATOLLS

Manta Ray Sightings

Fuvahmulah and Addu Atolls, the two southern most atolls of the Maldives, have historically been the area with the most oceanic manta ray sightings. In 2020, only a single sighting was recorded from Fuvahmulah Atoll and no sightings from Addu. However, due to the impacts of the COVID-19 pandemic, dive tourism was greatly reduced, and the Manta Trust team were unable to visit Fuvahmulah. Without confirmed survey effort, it is not possible to determine if there was an absence of manta rays or merely

a lack of survey effort throughout this period.

In 2021, there were 64 confirmed sightings of 61 oceanic manta ray individuals from Fuvahmulah Atoll, and zero from Addu Atoll (Fig. 5). Of the 64 sightings, 54 of these were recorded during a ten-day period between April 20th and April 29th (Fig. 6). Seasonality of sightings around Fuvahmulah in 2021 align with those in previous years, with a peak sighting period around March to April time (Fig. 7).

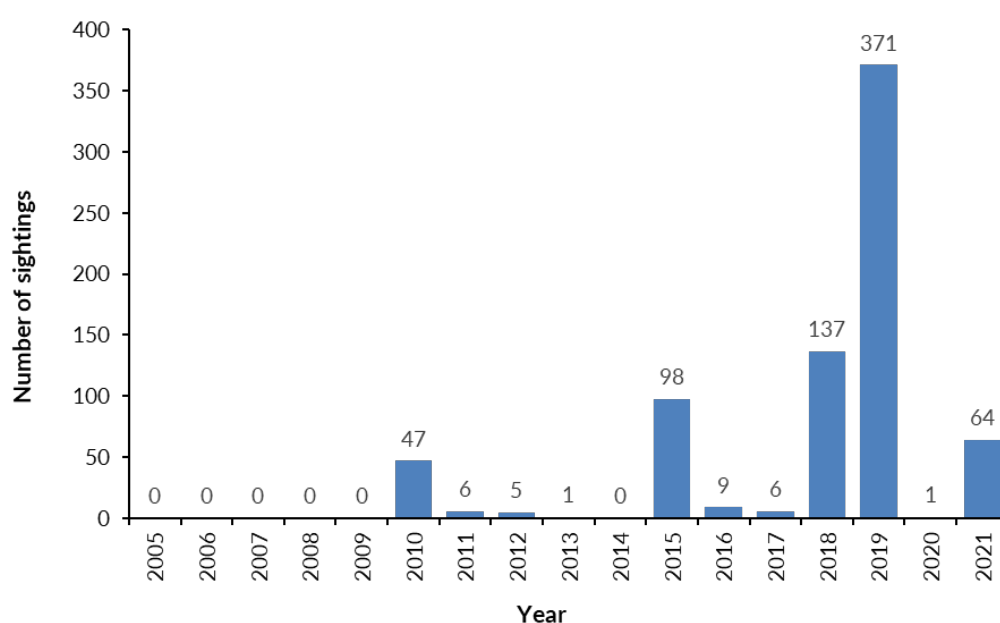


Figure 5: Annual total number of sightings of oceanic manta rays (*Mobula birostris*) from Fuvahmulah Atoll (2005 - 2021).

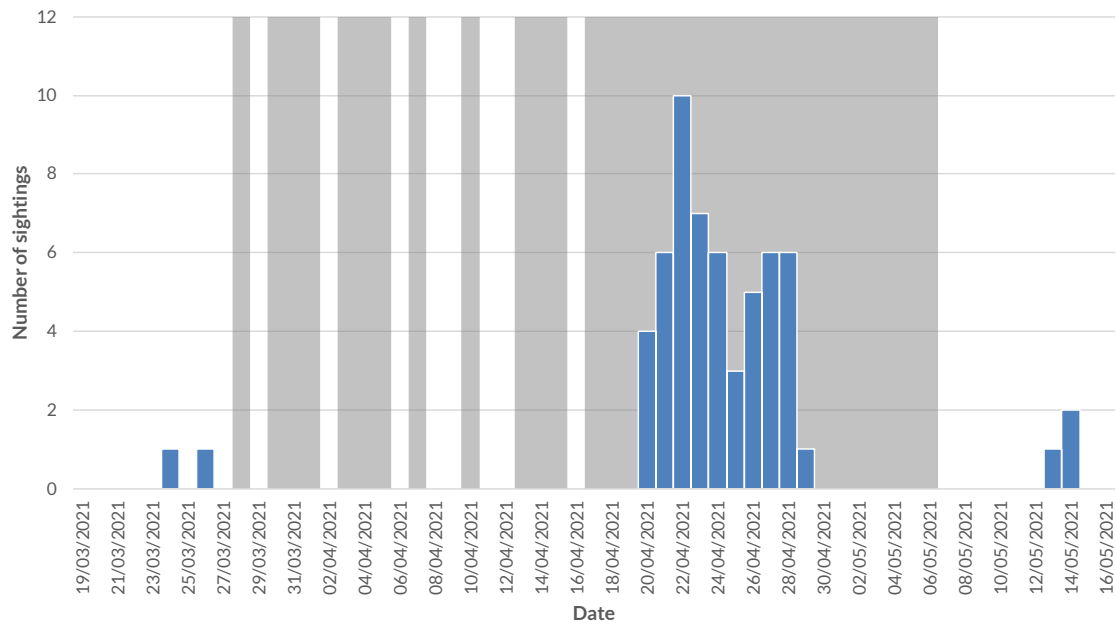


Figure 6: Number of oceanic manta ray (*Mobula birostris*) sightings per day (blue bars) between March 19th and May 16th, 2021. Manta Trust research team survey days (n=32) are greyed out.

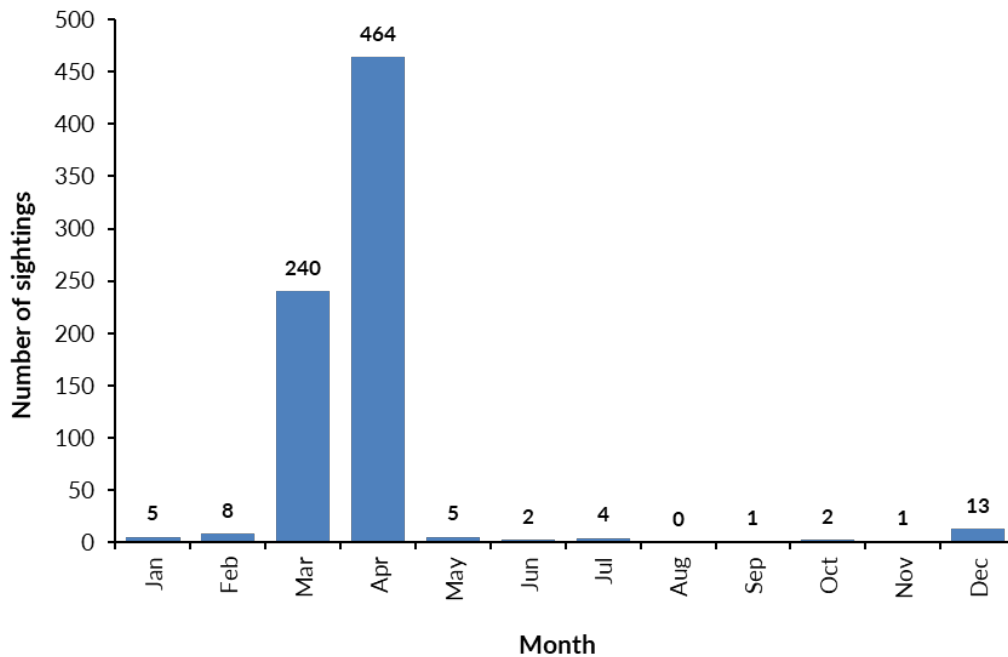


Figure 7: The total number of oceanic manta ray (*Mobula birostris*) sightings each month from Fuvahmulah atoll (2008 – 2021).

Although the Manta Trust do not have standardised survey effort throughout the year, the dive logs from a local dive operator show that there are dives at Farikedede Faru year-round. Despite this year-round diving effort from local dive operators, reports of manta ray sightings and citizen science

submissions outside of March and April are rarely received. The Manta Trust team conducted surveys around the whole island (Fig. 8), although we focused on the two primary sighting locations of Farikedede Faru and Thundi Faru. All but one sighting came from these sites.

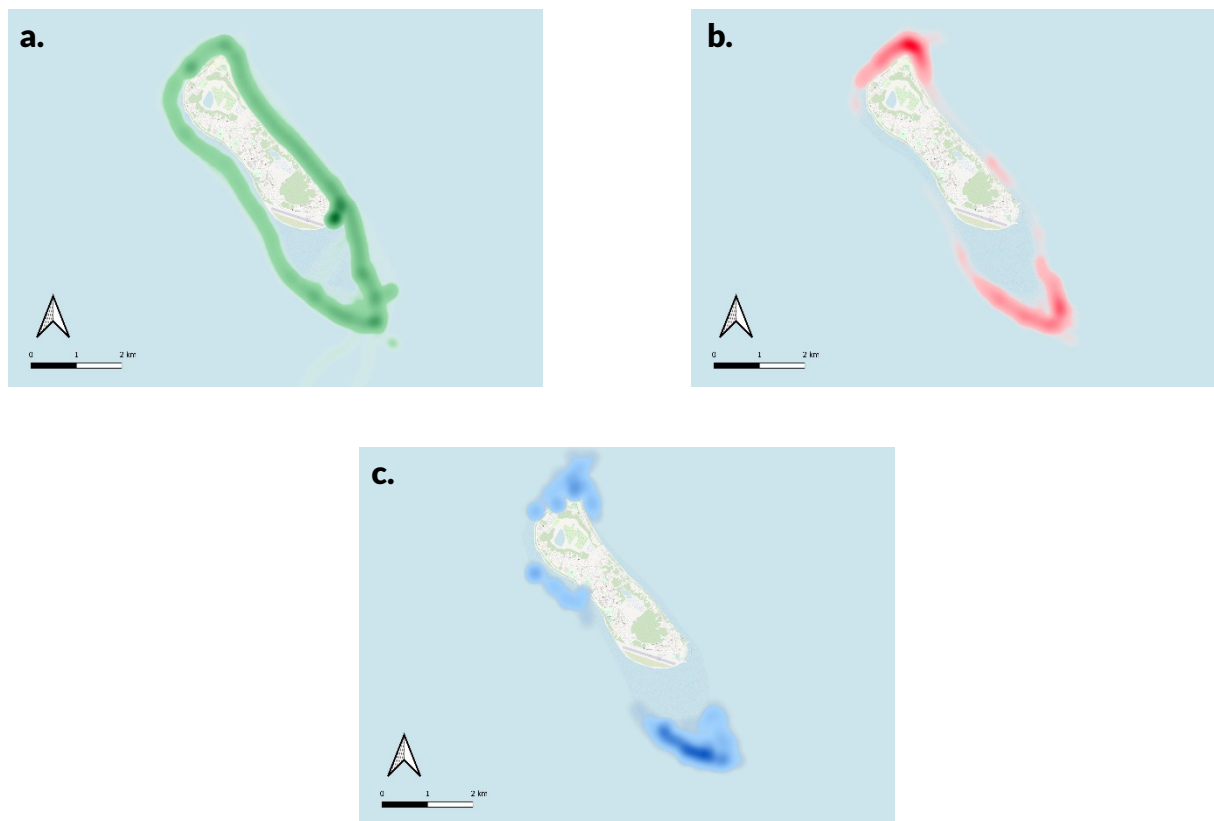


Figure 8: Heat maps of survey effort around Fuvahmulah atoll in 2021 from a) boat surveys (total survey time = 34 hours), b) in-water snorkel surveys (total survey time = 52 hours), and c) drone surveys (total survey time = 4 hours). Note: Heatmap scales are independent from one another.

Re-sightings

Less than 2% ($n=1$) of individuals were already recorded in the database prior to the 2021 study period. This single individual, first recorded in 2019 in Fuvahmulah, was re-sighted again in 2021 (754 days after the initial sighting). Such a low incidence of resighted individuals suggests that a very large population of this species is likely to exist in the region, numbering from thousands to possibly tens of thousands.

There were a further three re-sightings of individuals around Fuvahmulah within the 2021 season. This equates to just 5% of the individuals being re-sighted. The remaining 95% of individuals ($n=49$) were only sighted once, despite near daily surveying during the peak manta ray period. The periods between these three re-sightings were one and two days.



Table 3: Demographics and details of the re-sighted oceanic manta rays (*Mobula birostris*) ($n=4$) around Fuvahmulah Atoll in 2021.

Manta ID Code	Demographic	Initial Sighting Date	Initial Sighting Location	Re-Sighting Date	Re-Sighting Location	Days Between Sightings
MV-MB-0518	Adult female	31/3/2019	Fuvahmulah	24/4/2021	Fuvahmulah	754
MV-MB-0729	Adult female	21/4/2021	Fuvahmulah	23/4/2021	Fuvahmulah	2
MV-MB-0735	Adult female	22/4/2021	Fuvahmulah	24/4/2021	Fuvahmulah	2
MV-MB-0751	Adult female	24/4/2021	Fuvahmulah	25/4/2021	Fuvahmulah	1

Population Demographics

There was no significant difference ($\chi^2 = 3.596$, $df = 1$, $p < 0.05$) between the number of male ($n=17$) and female ($n=30$) manta rays observed in the 2021 peak period around Fuvahmulah (for 3 individuals the sex was unable to be determined) (Fig. 9).

Of the 30 females observed, 26% ($n=8$) had visible mating scars or wounds. However, only a single female was recorded with fresh reproductive wounds. No pregnant females were recorded in 2021 and all individuals, both male and female, were assessed to be adults. This is in accordance with previous years' observations, which have been represented

predominately by an adult population with low incidences of pregnancies.

Of the 64 newly identified oceanic manta rays in 2020 – 2021 around Fuvahmulah, just 2.5% ($n=2$) were melanistic. This is in line with the long-term trend, with melanistic oceanic manta rays making up just 2.2% ($n=17$) of the known population ($n=791$). Interestingly, there has never been a sighting of a black morph reef manta ray recorded in the Maldives despite it hosting the largest known population of this species in the world.

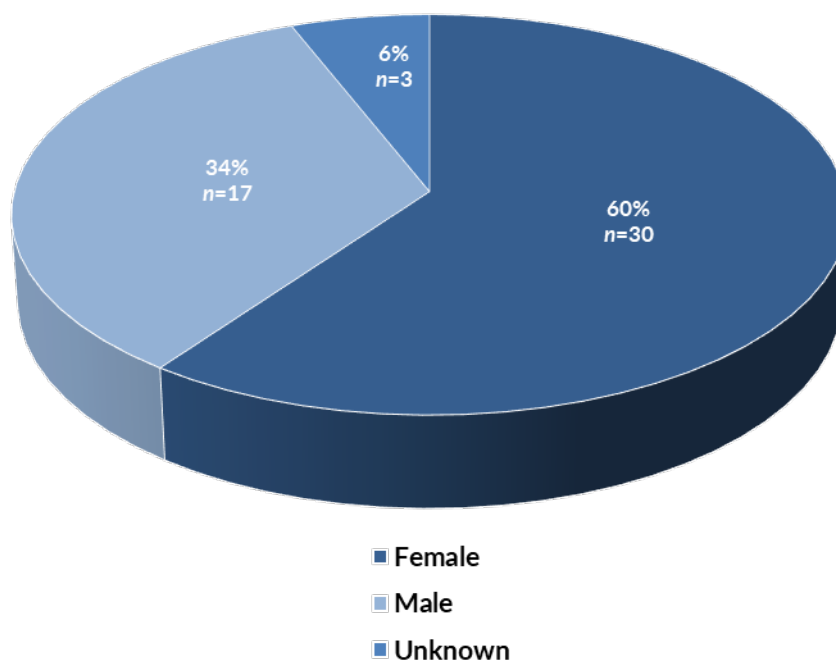


Figure 9: Number of male and female oceanic manta rays (*Mobula birostris*) recorded around Fuvahmulah Atoll of the Maldives in 2021.

Behavioural Observations

The primary behaviour observed during each manta encountered was noted. Only one behaviour was recorded this year: 54 encounters of 'cruising' individuals. There were no confirmed sightings of feeding, courtship, or cleaning

individuals in 2021. Sightings were from throughout the water column, from the surface waters down to the limits of recreational diving at 30 metres.

MARINE RESOURCE MANAGEMENT & PROTECTION MEASURES

Education & Outreach

With a larger research team on Fuvahmulah in 2021, the Manta Trust, along with the Maldives Whale Shark Research Programme, were able to conduct extensive marine education and outreach sessions. The team ran one-hour presentations on whale shark and oceanic manta ray research with over 530 students from Fuvahmulah Atoll Education Centre, Hafiz School, Mohamed Jamaluddin School, Kangaroo Kids Primary School, Billabong Primary

School, and Zikura School.

Presentations about our ongoing research objectives and findings were given to 11 dive staff, 6 tourists, and 56 community members (guesthouse owners, Fuvahmulah Nature Park staff, teachers, etc.) as a part of our efforts to include as much of the community in our research and conservation work as possible.



Tourism

Anecdotal observations of tourism numbers in Fuvahmulah suggest a sharp increase in divers in recent years. Before the COVID-19 pandemic the number of safari boats visiting Fuvahmulah between December and April (Iruvai Season), appeared to be increasing.

Although there is no data on the total number of liveaboards or divers visiting Fuvahmulah, there has been an increase in the number of dive centres operating on the island (Fig. 10). Similarly, the number of guest houses and accommodation facilities, and therefore the number of beds, has also been increasing in recent years (Fig. 11). It is expected that this trend will increase as awareness and promotion of Fuvahmulah as a world class dive destination continues.

There are very few locations worldwide where divers can

see whale sharks, oceanic manta rays, thresher sharks, tiger sharks, silvertip sharks, and hammerhead sharks during a single trip, and as a result, the marketability of Fuvahmulah as a top dive destination is very high. However, there is growing concern among the local dive community and within marine conservation groups (including the Manta Trust) that the number of divers may soon reach unsustainable levels. Much of the diving in Fuvahmulah is centred around Farikedu and Thundi Faru. As a result, all the local dive operators and the visiting liveaboards often dive these sites en masse, leading to overcrowding. The Manta Trust recommends limiting the number of divers and operators either per day, and/or per season, to prevent detrimental impacts on the reefs and megafauna from unrestricted tourism.

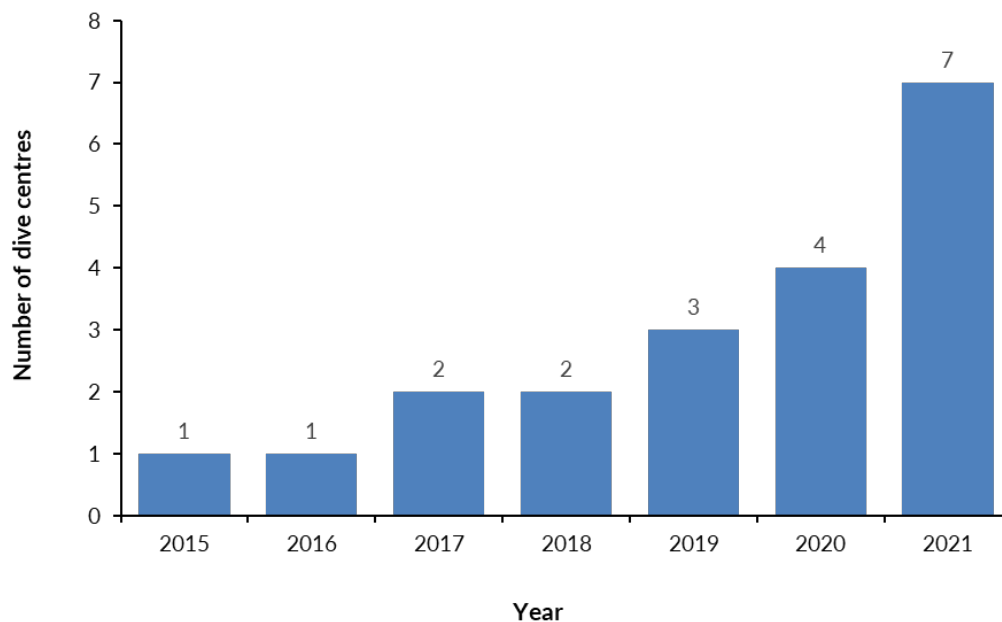


Figure 10: Number of operational dive centres on Fuvahmulah Island.

Marine Protected Areas

In 2020, Addu and Fuvahmulah Atolls were listed as UNESCO Biosphere Reserves. Data on the presence of oceanic manta rays around these islands supported the application.

The Manta Trust have been informed that we will be consulted as a stake holder in the planning stages of the UNESCO Biosphere Reserve management plan. However, to date, we have not been contacted regarding this.

Fuvahmulah Environmental Research & Education Centre

Fuvahmulah is a unique diving destination in the Maldives, on par with some of the best diving locations in the world. Numerous pelagic species visit the single island atoll, which are rarely seen elsewhere in the Maldives, or globally. For this reason, Fuvahmulah lends itself to being a prime location for marine research and education. The Manta Trust envisages a dedicated environmental research and education centre on Fuvahmulah Island where visiting scientists and researchers can be based, using onsite facilities to further education and research. This centre would include both laboratory and computer facilities, but also a tourist and local visitor centre where people can learn about the flora and fauna unique to Fuvahmulah and its coastal waters.

It is important that the local community is involved with, and benefit from the research activities being conducted, and this will be facilitated by a marine research and education centre. The Manta Trust put forward a proposal to the Fuvahmulah City Council and obtained their support

for such a project. The marine research and education centre will encompass a visitor centre full of information about the maritime history of Fuvahmulah, information about the marine biodiversity and species around the island as well as on-going research. This information will be in both English and Dhivehi. Additionally, the centre will have a multipurpose function room, classrooms, office space, marine biology lab, and accommodation for visiting researchers. The lab facilities will be available for Fuvahmulah and visiting Maldivian school groups to use.

Depending on the plans of the UNESCO Biosphere Reserve in Fuvahmulah, it would make sense to incorporate any staff, rangers, and ticketing office into this facility. Plans and developments for the centre progressed in 2021 and a more detailed account of the facilities. It is apparent that for the longevity of such a centre there would need to be a continual source of funding with the obvious solution being a portion of any biosphere visitor fees being allocated to such a centre.

CONCLUSIONS

Little is known about the population of oceanic manta rays which frequent the Maldives. Most sightings, particularly from the aggregations in the southernmost atolls, are of individuals primarily just cruising through the site. Around 97% of individuals sighted annually were only seen once (a trend recorded in previous years as well) suggesting the population is transient, and only passing through the waters of Fuvahmulah, Addu, and Gaafu, rather than using it as a location for foraging, cleaning, or mating. However, the varying sex ratios of the individuals sighted during the season suggest that these migrations may be linked to reproductive drivers and/or differences in foraging strategies between the sexes.

The 2021 season saw re-sightings of individuals from previous years, and although this formed a very small proportion of the sightings, it adds to proof that some of the individuals return each year. It is expected that with further research and increased survey effort, more returning individuals will be recorded.

Despite the growing knowledge of this species in Maldives waters, the threat from Sri Lankan and Indian fishing fleets outside the Maldives Economic Exclusion Zone remains a major concern. Every year, our understanding of the oceanic manta ray aggregation around Fuvahmulah grows, yet nothing is known about where these animals travel, and what they are doing, when they leave the reefs of these southern atolls. With a growing tourism industry relying heavily on the oceanic manta rays as one of the main attractions, it is important to develop our understanding of their movements so they can be effectively protected. To address these protections, research efforts will rely heavily on the ability to conduct telemetry studies, and to take biopsy tissue samples for stable isotope, fatty acid, and genetic analysis. It is hoped that these will be permitted research methods for marine scientists in the Maldives soon.

This report was made possible thanks to



MALDIVIAN MANTA RAY PROJECT (MMRP)

The MMRP is highly regarded within the scientific community. It is the largest and one of the longest running manta ray research programmes in the world. We would welcome the opportunity to continue to work with the Maldives government and our other partners for the long-term management and conservation of these species in Maldivian waters. The opportunity we have to learn about manta rays in the Maldives is unique and has many implications on a global scale for manta ray conservation.

The MMRP and the Manta Trust are happy to share with the Maldives government any data collected as part of this study.

The Manta Trust would like to extend a special thank you to Farikede Divers, Tigershark Residence, Fuvahmulah Dive School, Pelagic Divers Fuvahmulah, Dive Point Fuvahmulah, Olige Store, Shark Island Divers, all the liveaboard operators, and citizen scientists for submitting photo IDs of oceanic manta rays throughout 2020 and 2021.



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