



# Maldivian Manta Ray Project 2011

## Season Summary

### Executive Summary

In recent years Baa Atoll and more specifically Hanifaru Bay, have gained international reputation as one of the most reliable places in the world to see manta rays (*Manta alfredi*) and whale sharks (*Rhincodon typus*). These animals aggregate in Baa Atoll and at Hanifaru Bay during the Maldives Southwest Monsoon in order to feed on the abundant planktonic food generated by the weather conditions created by this monsoon between May and November each year.

Tourism, due to sightings of these animals, in Baa Atoll has seen a sharp and steady increase in recent years and in line with this the Maldivian government has protected key areas for these species. Protection has come in the form of the designation of two Marine Protected Areas (MPAs), restricted access to key sites, a full time team of rangers and an in depth management plan for Hanifaru Bay.



This report presents data collected by the Maldivian Manta Ray Project (MMRP), a non-profit and independent conservation and research focused organisation. Formed in 2005 the MMRP began extensive, long-term research into the manta rays of Baa Atoll in 2007. With such long running records, not only on the manta rays, but also on environmental and climatic factors as well as tourism and human interactions, the MMRP are able to monitor the population of manta rays in Maldivian waters and identify trends within it.

2011 was possibly the most interesting season for mantas in Baa Atoll since MMRP records began. The MMRP observed the lowest number of sightings and the least number of manta rays seen since the start of our research.

One of our key activities this season was the investigation of reasons for these observed reductions in the numbers of manta rays. Our investigations strongly suggest that the weakened monsoon winds observed in 2011 are responsible for a lack of primary production and therefore



a lack of food for manta rays. These changes seem to be an effect of the Indian Ocean Dipole (a climatic event linked and similar in nature to the ENSO) and might be part of the wider changes we are seeing as global climate and weather patterns alter. If this is the case it has alarming implications for mantas, in terms of both food availability and upon reproductive rates, as well as impacts for other marine species which rely on the enhanced productivity seen during the Maldives Southwest Monsoon.



Despite a decreased number of sightings during the 2011 Southwest Monsoon season, there have been very positive steps forward in terms of conservation management for mantas in the Maldives this year. The declaration by UNESCO at the end of June that Baa Atoll was to become a UNESCO World Biosphere Reserve was one of the main highlights of

the 2011 season, especially with the designation of Hanifaru Bay as a core protected zone. Another highlight of 2011 was the implementation of the Hanifaru Bay Management plan with stricter regulations for site use and a team of rangers in Baa Atoll to help monitor tourism activities.

With these positive steps taken for conservation and management in Baa Atoll there is much to look forward to in 2012 and beyond. However, it is imperative that active research into manta rays continues in order to monitor the effects of both tourism, with the new management initiatives in place and environmental change. Manta rays are an incredibly important ecological and economic resource for the Maldives bringing tens of thousands of people to the country each year to dive and snorkel with them. Being able to pinpoint the reasons for any observed trends in the Maldivian manta ray population is crucial for the ongoing management and protection of these animals.



## Understanding the Southwest Monsoon

Understanding the effects of the Maldives Southwest Monsoon are critical to understanding the reasons for the abundance of manta rays and indeed whale sharks that are seen in Baa Atoll during this season.

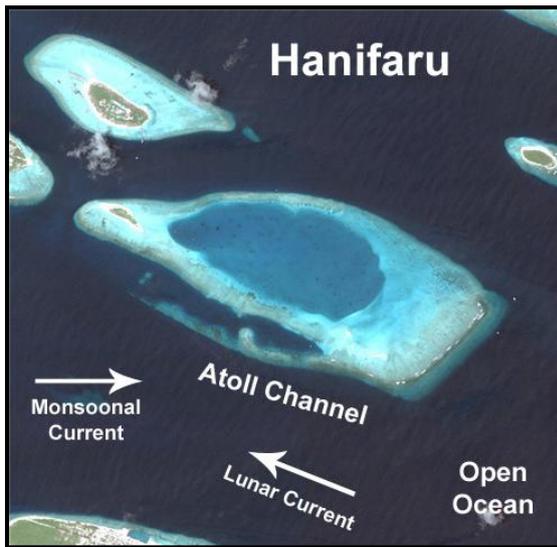
The monsoons, which dictate the weather in the Maldives, are characterised not by heavy rain as is often assumed, but by their winds, which blow consistently and reverse their direction seasonally. The Maldives Southwest Monsoon, or Hulhangu, runs from May-October, while the Northeast Monsoon, or Iruvai, runs from December-March each year, with the months of November and April acting as



transitional periods of change in between. The Southwest Monsoon typically brings with it much more rain and cloud cover, with reduced visibility and rougher seas, while the Northeast Monsoon usually heralds blue skies and exceptionally clear waters for much of the time.

Rising 2,000 metres straight up from the depths of the Indian Ocean, the Maldivian Atolls straddle the Indian Ocean and act as a barrier to these monsoonal currents. Just as the Himalayas create a vast obstacle for the monsoonal winds on land, the underwater mountain range of the Maldives forces the monsoonal currents upwards as they flow across the Indian Ocean and through the Maldivian Archipelago. These currents create deepwater upwelling around the atolls, bringing nutrient rich water to the surface and within reach of the sun's life giving energy, kick starting the food chain.

By the time the nutrient laden currents have reached the leeward sides of the atolls, primary productivity is reaching its peak and the zooplankton food upon which the manta rays feed is so abundant that Maldivian waters support the world's largest known population of reef manta rays all year round. During a typical Southwest Monsoon the wind blows consistently and steadily from the southwest, causing the greatest concentrations of the mantas planktonic food on the monsoonal down-current edges of the atolls. Stronger monsoonal winds generate more primary productivity, which in turn generate more of the zooplankton food upon which the mantas feed, therefore attracting higher numbers of these animals.



Hanifaru Bay is just one site where manta rays can be observed in Baa Atoll and long-term studies at the site by the MMRP have highlighted the unique nature of the bay and have given rise to an in-depth understanding of its capacity to attract large numbers of manta rays and numerous whale sharks to feed. The bay lies at the end of a 1600m long channel. The channel and bay are positioned such that during the Southwest Monsoon a unique phenomenon occurs, with the incoming lunar tide and prevailing monsoonal current opposed to one another, creating a back-eddy at the channel mouth forcing the plankton rich water brought into the atoll by the

tide down into the bay area. Any water flowing out of the bay is picked up again by the incoming tide and so a cycle begins concentrating plankton into the bay. It is this concentrating effect that attracts large numbers of manta rays and whale sharks to feed, with over 200 manta rays having been observed in the bay during a single feeding event.

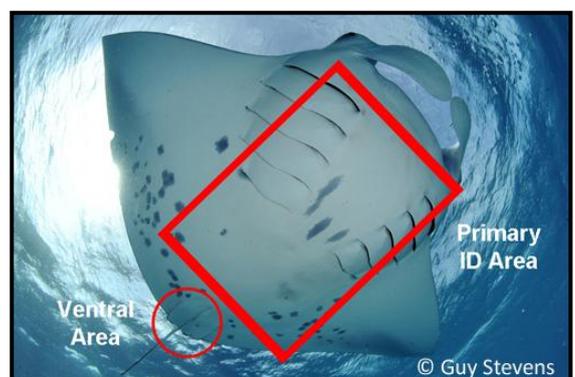
## Manta Ray Sightings

Surveys to look for manta rays were carried out in Baa Atoll between the 1<sup>st</sup> June 2011 and 30<sup>th</sup> November 2011 on as many days as possible where conditions allowed. Survey trips were made on 155 days within this 183 day survey period.

Due to the management initiatives at Hanifaru Bay MPA access was more restricted than in previous seasons and as such surveys were also carried out at other sites around the eastern border of Baa Atoll. To account for changes in sampling efforts at key sites during 2011, data from all years was standardised. For the purposes of this report a sighting is defined as a confirmed photo identification of a manta ray on a given day.

On each trip locations, wind strength and direction and other environmental weather conditions were noted alongside manta ray numbers and prevalent behaviours. In the water individual mantas were documented by photographing the unique spot patterns on their undersides (ventral surface). The

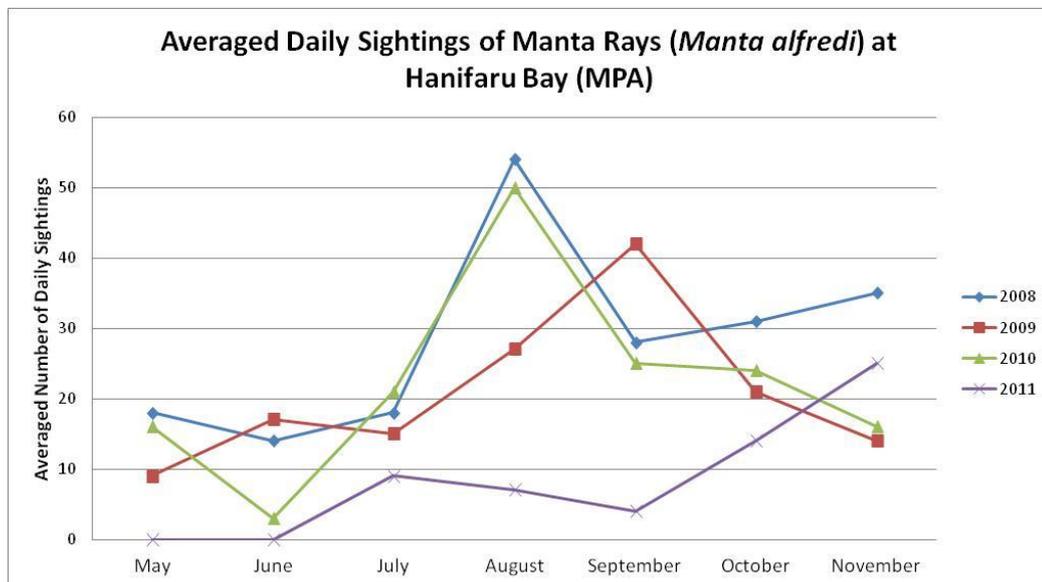
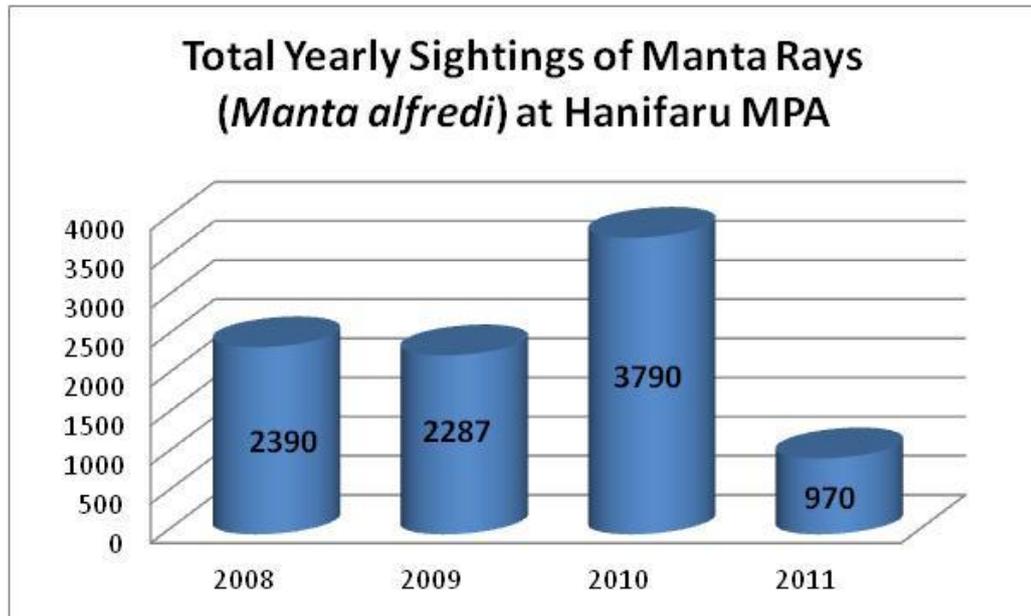
whole team were experienced free divers, using this advanced snorkelling technique to allow them to take photo ID shots with the minimum of disturbance to the animals.





## Sightings at Hanifaru Bay MPA:

Sightings of mantas rays at Hanifaru Bay (MPA) were significantly lower in 2011 than in previous years even when decreased sampling effort was accounted for. The graphs below show the total numbers of sightings at Hanifaru per year and the averaged numbers of mantas observed per day (standardised for effort) between the months of May and December each year since 2008:

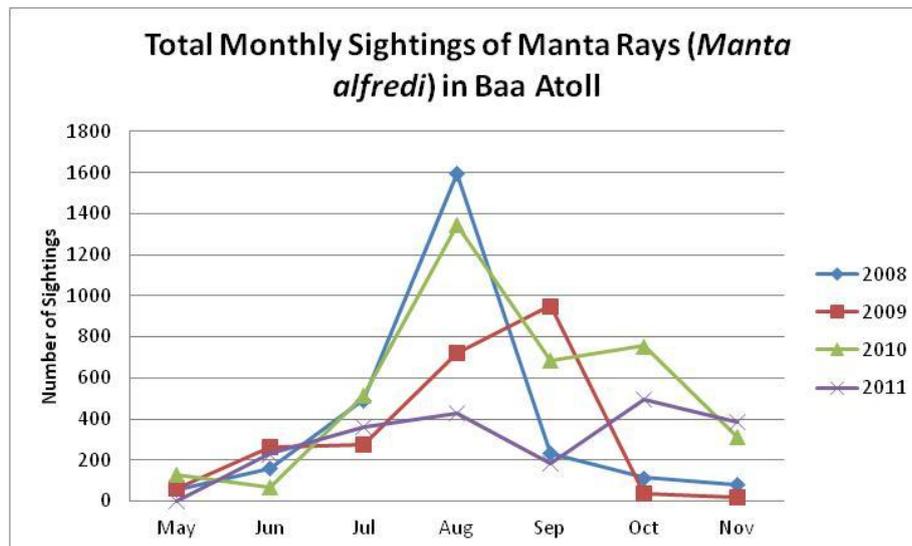
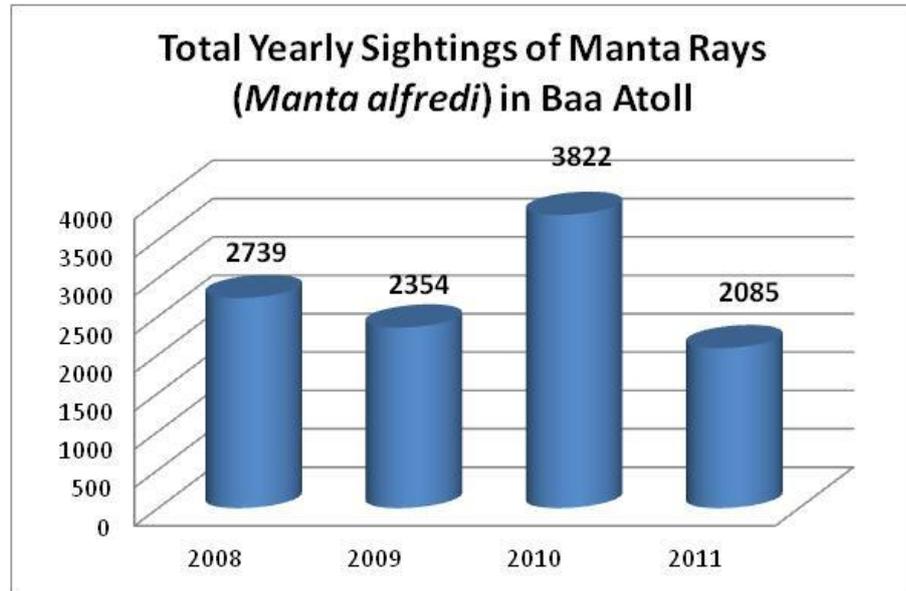


In 2011 the highest average daily sightings at Hanifaru were observed in November with an average of 25 mantas seen per day of survey. The sightings during the usual peak months of August and September were particularly low this season with averages of 7 and 4 mantas per day respectively. This is a very noticeable dip in numbers with average sightings in July and August usually in the range of 27-54 mantas per day.



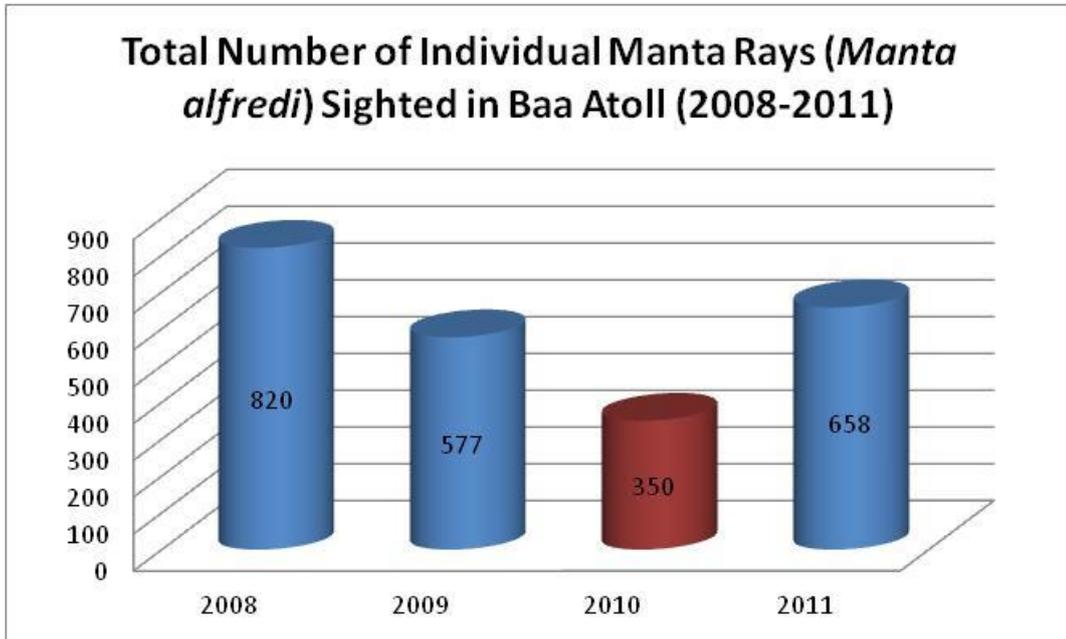
## Total Baa Atoll Sightings:

Comparing sightings across the whole of Baa Atoll, not just at the key site Hanifaru, a similar trend of decreased manta numbers is apparent for 2011 both overall and on a monthly basis:



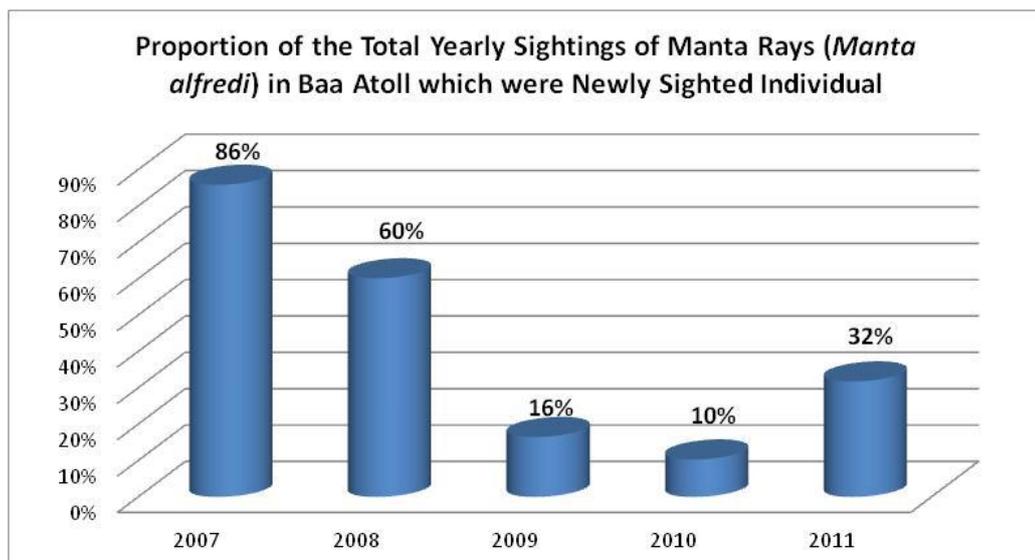
## Total Number of Manta Rays:

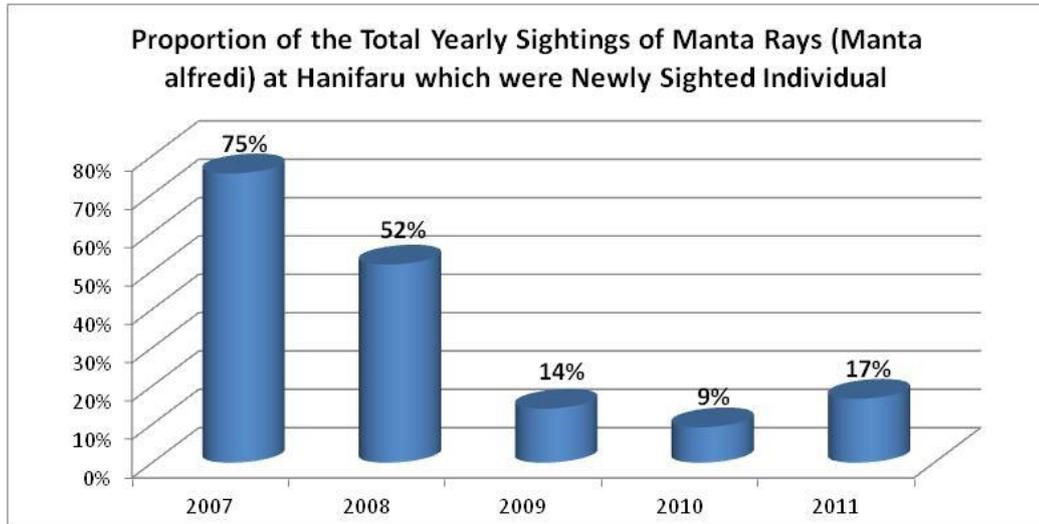
Although overall manta ray sightings were significantly down in Hanifaru and across Baa Atoll during the 2011 Southwest Monsoon, the total number of individual manta rays sighted remained high. In previous years repeat sightings of individual manta during the season was much higher, this data therefore suggests the manta rays were moving through the atoll and not staying for any length of time, possibly due to a lack of food.



**Note:** 2010 data (red) remains incomplete as half the seasons sightings are still awaiting individual identification. However, total individuals sighted is expected to exceed 600.

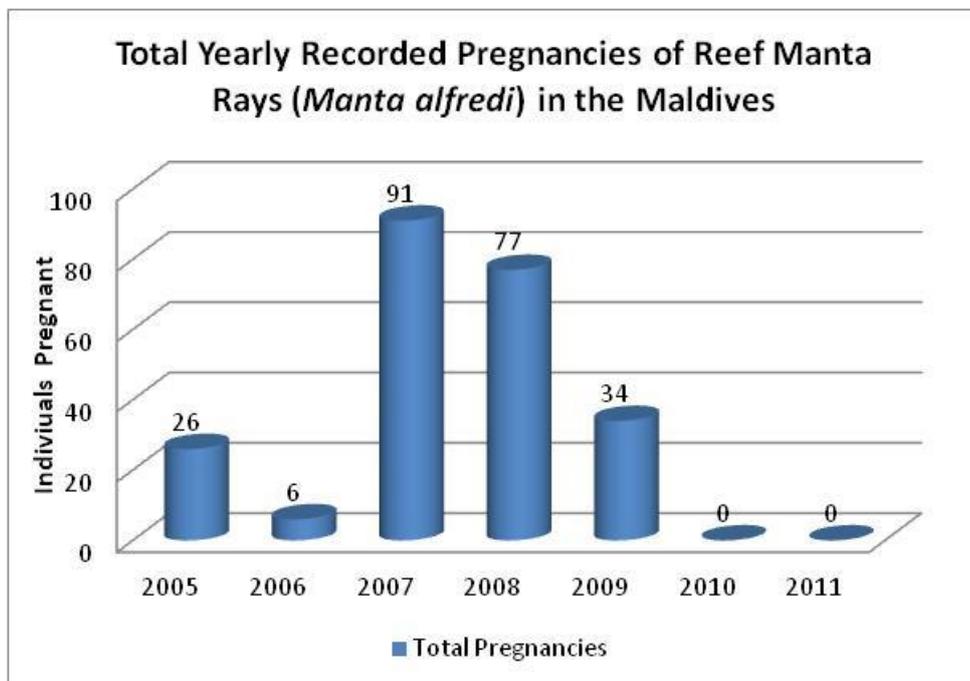
The graphs below show how the percentage of newly sighted individuals in the population within Baa Atoll rose significantly in 2011. This increase is probably due in part to sampling new manta rays aggregation sites within Baa Atoll, however it was also noticeable that the percentage of new manta rays sighted within Hanifaru itself also rose (see graph below). This increase is possibly also a reflection of the more transitory nature of the manta ray population within the Maldives during the 2011 Southwest Monsoon:





### Total Number of Pregnant Manta Rays:

Despite considerably increased data collection and sampling of the manta ray population across the entire Maldivian Archipelago in recent years, there has not been a single recorded observation of a pregnant manta ray for the last two years:

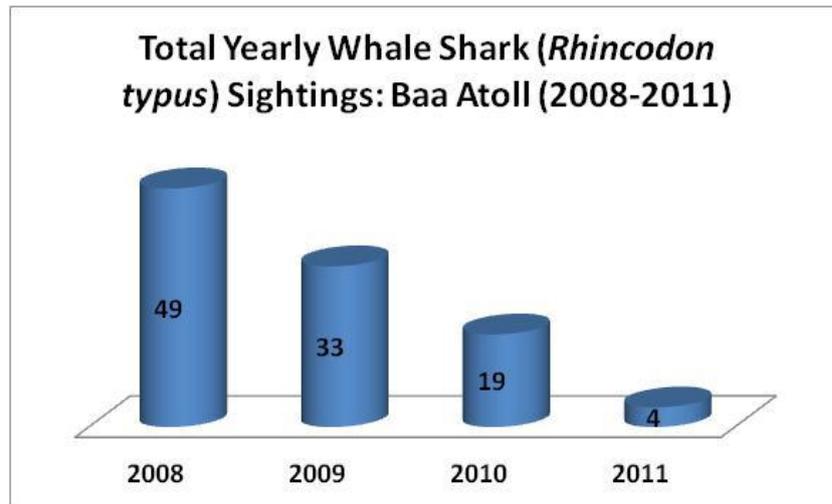


Potential reasons for these decreased numbers of pregnancies are numerous, but might include the effects of the 2011 weakened monsoon and associated lack of food. Identifying the reasons for this is a priority in the ongoing work of the MMRP as it could have long term implications for the stability of the population of mantas.



## Whale Shark Sightings

Surveys for manta rays as described above also looked for whale sharks as the two species often coincide as they feed on the same planktonic food source. During the 2011 season in Baa Atoll whale sharks sightings were also significantly reduced, with only 4 confirmed sightings over the course of the full survey period. In previous years sightings have numbered 49, 33 & 19 from 2008-10 respectively:

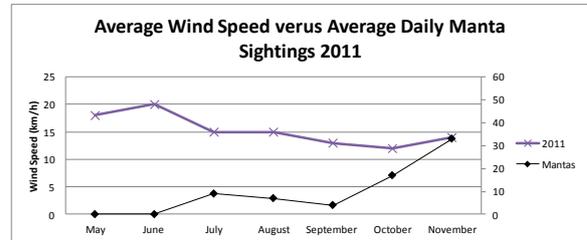
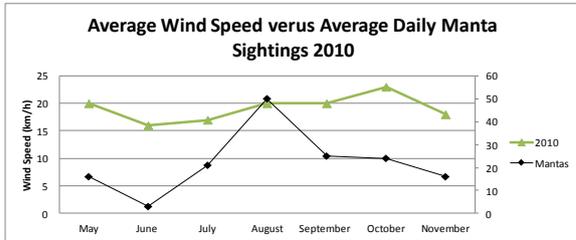
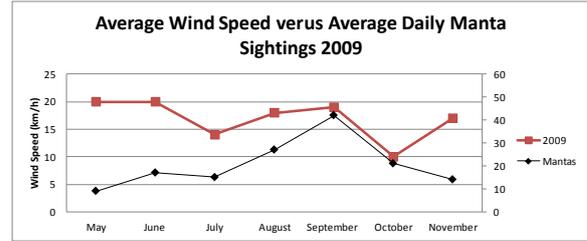
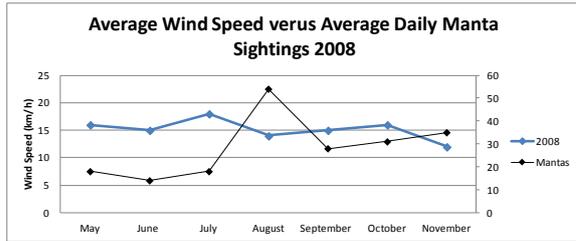


## Weather and Climatic Variation

Coupled with the lack of manta rays and whale sharks observed during the 2011 Southwest Monsoon, it was also noted by experienced observers that there was less of the planktonic food these animals feed upon in the water column. Even with the usual patterns of wind direction and incoming tides which usually bring plankton rich water from the outside of the atoll in through the channels, the numbers of megafauna encountered were not as expected.

Whilst several theories, such as the effects of increased tourism and local construction projects (dredging at Daravandhoo Airport), were initially cited as potentially influencing the reduced numbers of mantas observed during the 2011 season at Hanifaru, the MMRP also considered the broader scale climate and weather patterns observed in 2011 compared to those in previous years. All ideas were investigated thoroughly, however by comparing historical data collected by the MMRP on average daily manta numbers compared to archive data on wind speed and direction, the influence of wind speed compared to numbers of mantas showed a very close correlation.

Whilst wind direction observed in 2011 followed very similar trends to previous years, wind speeds observed in 2011 were significantly lower. Without the wind and therefore the strong monsoonal currents required to kick start the plankton production, food availability for these planktivorous species was greatly reduced:



On a broad scale across many Indian Ocean nations changes in weather were also noticed. A lack of wind in Sri Lanka, for example, meant that the international surf championships which take place in June and July were pushed back by a month in the hopes that the monsoon was simply late. In the Seychelles, where whale sharks have been monitored since 2001, there were a decreased number of whale sharks observed in coastal waters during the Southwest Monsoon compared to previous years. In Pakistan and Northern India uncharacteristic weather resulted in severe flooding due to heavy rain from the unusual monsoon.

These apparently wide ranging weather patterns need to be considered at a larger scale and phenomena such as the Indian Ocean Dipole (IOD) and its Pacific Ocean equivalent the El Nino Southern Oscillation (ENSO) were considered by the MMRP in their investigations.

The Indian Ocean Dipole (IOD) is a measure of the east-west heat distribution across this ocean. The state of temperature distribution across the Indian Ocean has heavy bearing upon patterns of rainfall across the ocean basin and its borderlands, which happen to be dominated by monsoons (seasonal winds and resulting rainfall patterns).

The all-important Southwest Monsoon of South Asia is driven, at least in part, by heat energy entering the atmosphere from the Indian Ocean. Therefore, it should follow that the behaviour of the Southwest Monsoon, including wind strength, distribution and amount of rainfall, would hinge upon the temperature state of the Indian Ocean (the IOD).

In both 2010 and 2011 the Maldives monsoonal weather appears to have been affected by ENSO and IOD events occurring throughout the region, resulting in unseasonal monsoonal conditions. This reduction in the strength of the Southwest Monsoonal winds had a knock on effect on the productivity of planktonic upon which the manta rays and so many other reef inhabitants depend.

It is very likely that this lack of food, brought about by the weakened Maldives monsoon, is responsible to some extent for the lack of pregnancies observed in the Maldivian manta ray

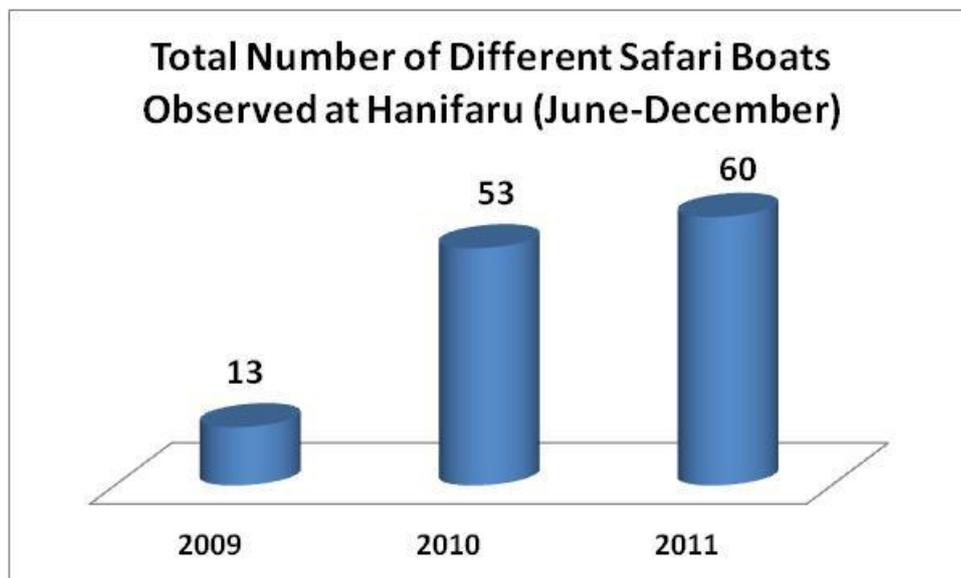


population in recent years. Elasmobranch reproduction varies widely between species and reproduction within the genus *Manta* is very poorly understood, with most of what we know coming from a manta reproducing under aquarium conditions. Sharks and rays within the subclass Elasmobranchii have a wide range of reproductive techniques with some species able to store sperm or to repress or stagger pregnancies. It is likely these strategies have been developed in order to provide offspring with the best chances of survival. It is not unlikely that manta rays might use such strategies to ensure that their offspring are born during years which have a greater abundance of food to increase their chances of survival.

## Tourism

A combination of factors reduced the amount of people using Hanifaru Bay this season and due to restrictions in place to manage site use extensive surveys of tourism levels were not carried out in 2011.

It is however important to note that in line with previous observations, numbers of manta rays and whale sharks have a direct and positive correlation to the numbers of divers and snorkelers using the bay. The lack of manta ray sightings in 2011 therefore meant that there was less desire from all parties who might usually use the bay to visit. However, potential for tourism at the site was higher than in previous years with one new additional resort open and a total of 60 different safari boats observed in the atoll between June and December.



Note: Of the 7 resorts in Baa Atoll, all were observed using the MPA during the season.



## Conservation and Management

The declaration by UNESCO at the end of June that Baa Atoll was to become a UNESCO World Biosphere Reserve was one of the main highlights of the 2011 season. This designation has big implications for the manta rays of Baa Atoll with Hanifaru Bay MPA, a key site for these animals, receiving protection as a core zone of the reserve. The core values of the Biosphere Reserve, promoting solutions to reconcile conservation of biodiversity with sustainable use, also have big implications for Baa Atoll and manta rays, especially with regards to the expansion in tourism related to these animals. Another key highlight for 2011 was the implementation of the Hanifaru Bay Management plan with stricter regulations for site use and a team of rangers in Baa Atoll to help monitor tourism activities.

## Maldivian Manta Ray Project (MMRP)

The MMRP is highly regarded within the scientific community as one of the longest running manta ray research programmes in the world. We would welcome the opportunity to continue to work with the Maldivian government for the long term management and conservation of this 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.

**This report was compiled on behalf of the MMRP and the Manta Trust by:**

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The MMRP and the Manta Trust are happy to share any data collected as a part of this study. For further information or please email: [guy@mantatrust.org](mailto:guy@mantatrust.org) or [katie@mantatrust.org](mailto:katie@mantatrust.org)