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13D Reef Shark and Coral Reef

Maldives Sharkwatch Report for 2009 – 2010

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Abstract. Sharks are top predators playing an important ecological role on coral reefs. Due to their slow growth, late maturity and low fecundity, many sharks are very vulnerable to over-exploitation. Historically fished in the Maldives for their liver oil, the fishery intensified in the late 1970s because of the value of dried shark's fin and salted shark meat as export commodities. After 1975, the estimated annual shark catch of 575 metric tonnes (MT) rose rapidly to 1,500 MT and subsequently fluctuated between 1,100 MT and 2,000 MT annually until 1998, when a 10 year moratorium on all types of shark fishing inside and within 12 miles of 7 major 'tourism' atolls was declared in order to minimize the conflict between the shark fishery and the tourism industry. However, shark sighting reports continued to decline, leading to the eventual ban of shark fishing inside and within 12 miles of the outer atoll rims of all atolls of Maldives in 2009 and a total ban on shark fishing from Maldivian waters in 2010. 'Sharkwatch' with the participation of the tourism industry and resorts, was launched in July 2009 to collect baseline information and monitor the outcomes and effectiveness of the ban. This is the first time that stock surveys have been attempted in the Maldives and the data collected will be invaluable in providing a better understanding of the current population of reef shark species and the effectiveness of recently implemented management measures.

Key words: Sharks, Sharkwatch, Maldives, Management, Fisheries

Introduction

Sharks are top predators in their food chain. They play an important ecological role on the marine environment, particularly on the coral reef. Due to their biological characteristics of slow growth, late maturity and low fecundity, sharks are very vulnerable to over-exploitation and stock recovery in such instances is very slow.

Shark liver oil was historically used in the Maldives in the boat building industry. The fishery for sharks intensified in late 1970's due to the realization of the export value of shark products, such as dried shark fin and. salted shark meat. Shark liver oil started contributing towards exports in mid 1980s. After 1975, the estimated annual catch of sharks which was then around 575 metric tonnes (MT) rose rapidly to 1,500 MT and afterwards fluctuated between 1,100 MT and 2,000 MT annually until 1998 (MRC, 2008). Anderson and Ahmed (1993) provide a detailed description of the development of the shark fisheries in the Maldives, including details of fishing methods, species exploited, shark products and exports.

The development of the shark fishery coincided with the development of the tourism industry in the Maldives (1972 to date), resulting in a direct conflict between the two industries. A large number of tourists come to enjoy the underwater beauty of the Maldives, and some pay large amounts to see live sharks in the wild. One study estimated that US$ 2.3 million was earned in 1992, solely from shark watching dives in the Maldives (Anderson and Ahmed, 1993). In comparison, export of shark meat and fins earned US$ 0.7 million in the same year (Anderson and Ahmed, 1993). Furthermore, the same survey showed that a live shark generates US$ 3300 in revenue per year, hence stressing again the point that sharks are worth more alive than dead, both economically and ecologically.

The Maldives shark fishery also came into conflict with the pole and line tuna fishery which plays a dominant role in the Maldivian fishing industry. Anderson and Ahmed (1993) document the association of various pelagic sharks, especially silky sharks (*Carcharhinus falciformis*) with tuna schools. It is widely believed that the removal of sharks from the vicinity of tuna schools negatively affect tuna catches (Anderson and Waheed, 1999).

To minimize these conflicts the government has enforced a set of legislations pertaining to the shark fisheries since the late 1990s. A 10 year moratorium was declared in 1998 on all type of shark fishing inside and within 12 miles from the rim of 7 major tourism atolls in the Maldives (MRC, 2008). However, weak enforcement and implementation of the ban resulted in continued fishing within these atolls. Shark fishing in

the vicinity of tuna schools when other vessels are in the area fishing for tuna, and long lining for sharks in certain hotspots for tuna fishing was banned in order to address the conflict with the tuna fisheries industry. An additional 25 sites which are well known dive sites were also protected in 1995 and 1999 under the Environment Protection and Preservation Act, for conservation purposes.

A survey of fishers carried out in 2008 shows that shark fishing was being carried out in 8 atolls involving a total of 46 vessels and 184 fishermen, accounting for approximately 1.5% of the total number of fishermen in the Maldives. The effectiveness of the 10 year moratorium was reviewed during 2008, and data showed a decline in shark catch (MRC, 2008). This together with added pressure from the tourism sector led the government to announce a ban on all reef shark fishing activities from 1st March 2009. Under this legislation it was prohibited to kill, capture or extract any species of shark within 12 miles from the outer rim of all Maldivian atolls. A year later, the government of Maldives announced a total ban on all shark fishing, capture, killing or extraction from Maldivian waters from 15th March 2010. Additionally, the whale shark (*Rhincodon typus*) has been declared a protected species since the 24th of June 1995.

'Sharkwatch' was launched in July 2009 as part of the Darwin Reef Fish Project which is a four year collaborative project between the Marine Research Centre of Maldives and the Marine Conservation Society of UK. The programme's aim is to collect baseline information on shark populations and assess the effectiveness of the ban in terms of changes to the shark populations in Maldivian waters.

Materials and Methods

Sharkwatch uses the 'Roving Diver Technique (RDT)' (Schmitt *et al*. 2002) which is a quick and effective estimation technique that can be used by volunteers to collect shark abundance data. Since maintaining healthy populations of sharks on Maldivian reefs is of great interest and importance, especially to the tourism industry, it is appropriate that divers play a key role in the Sharkwatch programme. Twenty-seven resorts and dive centres in the Maldives expressed an interest in participating in Sharkwatch. However, during the period July 2009 – June 2010, a total of 14 resorts/dive centres submitted data.

Surveys are conducted by the dive school staff or marine biologists at the resorts, during their scheduled dives with guests at specific sites which have been previously identified by the resorts. Prior to the start of the survey effort, training is provided to all at the resort who wish to participate in the Sharkwatch programme. The training includes a halfday classroom session and an underwater session. Participants are also then trained on how to enter the data collected, once the data collected on the training dive has been checked by our training team. The 8 species of sharks which are most likely to be encountered are included on the survey sheet (Table 1). Additional species are counted under the 'others' category. Environmental data such as current strength, visibility and depth are also recorded.

English Name	Scientific Name	Code
Blacktip Reef Shark	*Carcharhinus melanopterus*	BRS
Whitetip Reef Shark	*Triaenodon obesus*	WRS
Grey Reef Shark	*Carcharhinus amblyrhynchos*	GRS
Scalloped Hammerhead Shark	*Sphyrna lewini*	SHS
Silvertip Shark	*Carcharhinus albimarginatus*	SS
Tawny Nurse Shark	*Nebrius ferrugineus*	TNS
Variegated Shark	*Stegostoma fasciatum*	VS
Whale Shark	*Rhincodon typus*	WS
Other		OT

Table 1: Shark species listed in the survey sheet.

The results of each Sharkwatch recording dive are entered into an excel spreadsheet and submitted monthly to the Marine Research Centre. Survey dives at sites where sharks are *not* sighted are also included as these provide a vital 'zero' baseline against which recovery (if it occurs) can be monitored.

Results

Sites surveyed

Over the period July 2009 – June 2010, a total of 1,661 Sharkwatch surveys were carried out at 196 sites. In cases where the same dive site was surveyed by different Dive Centres the results have been combined. A list of the dive sites and maps of survey locations are available in the original report (Ushan and Wood, 2010).

Survey effort varied according to the dive schedule of the resorts, and the popularity of different sites. This is illustrated in Fig. 1 below.

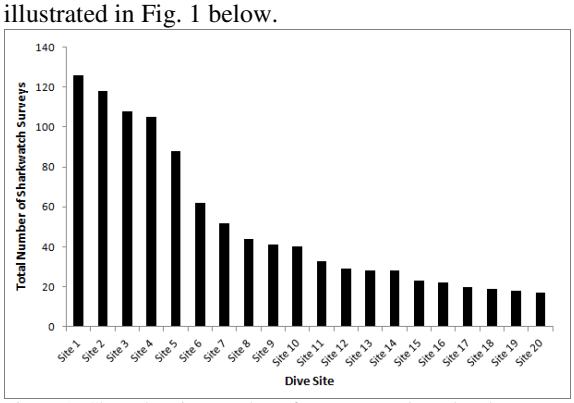

Figure 1: Chart showing number of surveys conducted at the most frequently-surveyed sites during the period July 2009 - June 2010.

As observed in Fig. 1, 126 surveys were carried out at the most popular site. The dive site names have been kept anonymous at the request of the dive centers.

Frequency of occurrence of shark species

From July 2009 to June 2010 a total of 3,630 sharks were recorded. White tip reef sharks (*Triaenodon obesus*) and grey reef sharks (*Carcharhinus amblyrhynchos*) were the most frequently recorded species accounting for 62% and 23% of all sightings respectively (Fig. 2).

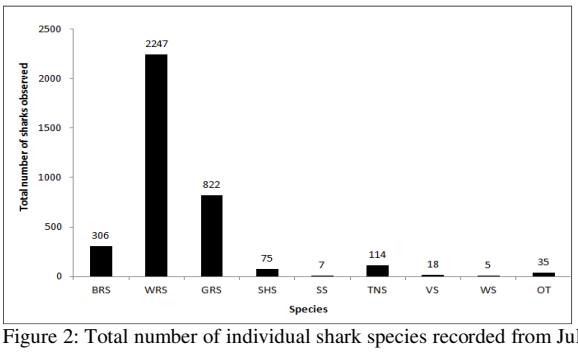

Figure 2: Total number of individual shark species recorded from July 2009 – June 2010 (numbers represent number of sightings)

Average number of sharks recorded per survey

Sharks were seen at 85% of the 196 sites surveyed during the period July 2009 – June 2010. 44% of sites had an average of 1-2 sharks recorded per survey and only 3% of sites had an average of more than 10 sharks recorded per survey (Fig. 3).

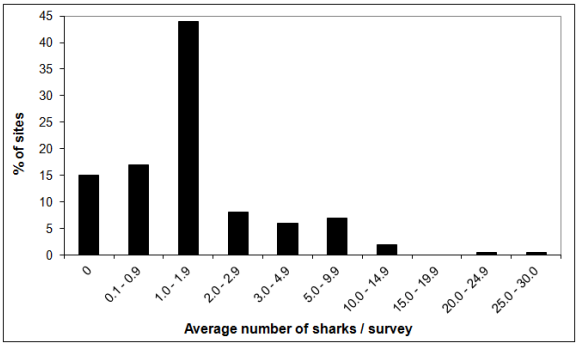

Figure 3: Average number of shark seen per survey across the 196 sites covered by Sharkwatch

The 'top site' for sharks had an average of over 27 sharks per survey (n= 4) while the second best site had 21 sharks per survey (n= 5). The other sites in the 'top twenty' had an average of between 5 and 10 sharks per survey (Fig. 4).

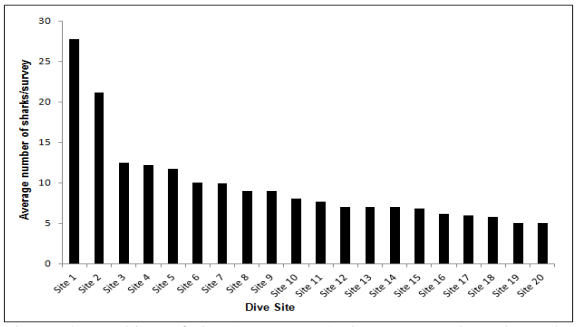

Figure 4: Ranking of the 'top twenty' sites surveyed to show those with the highest average number of sharks recorded per survey.

Abundance by species and month

Analysis of the average number of shark species seen per 10 surveys shows an increased abundance of white-tip reef sharks over the period from December 2009 – April 2010, with a peak in February. It remains to be seen whether this pattern is repeated in subsequent years as it was not seen for other species.

The other notable feature of the monthly records is the high number of grey reef sharks recorded in July 2009. However, during this first month only 13 sites were surveyed and they happened to be ones where grey reefs sharks were abundant. In the following months many more sites were surveyed but no further records from the 'grey reef' sites were submitted after September 2009. Thus the high peak is probably a sampling anomaly rather than an indication of seasonal grey reef shark population fluctuations.

Discussion

One of the most critical findings of these surveys was that sharks to date have been sighted in 85% of sites surveyed. While most of the sites selected for the survey are those popular for shark watching, the absence of sharks at some sites could reflect early fishing pressure or maybe due to environmental factors such as current flow at the time of survey(s). Some of the survey sites are not popular shark watching sites, but rather sites which are visited during normal dives. While these sites were selected for the ease of regular surveying, it is also important that surveys continue to focus on sites which are popular shark watching sites, as only then will we be able to correctly observe the effectiveness of the ban.

Another factor that could affect the data is the fact that resorts undertake survey dives at shark watching sites (which at times are in the channels and have strong currents) based on their dive schedule and staff availability. Furthermore, surveys may not always be completed during normal dives when dive staff are busy ensuring the safety and enjoyment of dive tourists on the trip. Hence, specific survey trips sometimes have to be made to the sites to conduct the surveys. This affects the frequency at which different sites are surveyed.

These early results stress the importance of participation by more resorts and dive centers. This would allow greater coverage of sites and geographic area throughout the Maldives. While there are about 100 tourist resorts in the Maldives, only 14 of the resorts are currently participating in the program. Many dive schools have said they are very busy and cannot take data on the dives. This matter has been raised with the Ministry of Tourism and an appeal has also been made to them to encourage more resorts to participate in this programme.

To accurately observe the effectiveness of the ban it is very important that the Sharkwatch programme is continued over the long term. This would enable us to identify seasonal trends in shark populations and differentiate between increases due to seasonal trends and true increase in shark population numbers. Since the programme comes at no cost to those who participate, and surveying can be undertaken during their normal dives to the sites, it is foreseen and hoped that reports of successes to date might be an incentive for participation by more resort dive centers and shark ban itself.

Lastly, to make the fishing ban fully effective we also need to implement a ban on trade and export of shark products. While the ban on trade and export of all shark products was scheduled to be announced in 2010, this was delayed due to lobbying from shark product exporters and souvenir shop owners. A trade ban was finally implemented under the Environmental Protection and Preservation Act. This ban extends to all trade on shark products, effectively ending the market for shark fisheries in the Maldives. The importance of running more awareness programmes for the fishermen and other stakeholders is self-evident and necessary to increase community and industry compliance with the ban on shark fishing. Fishermen and exporters need to be made aware of the crucial role sharks play in the Maldives ecosystem, and the reasons for maintaining a healthy population of sharks in the Maldivian waters, which is also home to many other resources of economic importance.

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