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Status of the Shark Fishery Ban in the Maldives and the Implementation of the National Plan of Action on Sharks - An Update with Notes on Turtles and Seabirds

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Abstract

Up until 1970s, the shark fishery of the Maldives was a traditional one, where large sharks were caught in need of shark liver oil. This traditional shark fishery evolved to more export oriented fisheries in 1970s, when highly targeted fisheries for sharks developed in the Maldives. These were the deepwater gulper shark fishery, reef-associated shark fishery and oceanic shark fishery. Shark fisheries were undertaken by a minor community, and had always been in conflict with important stakeholders such as the pole and line tuna fishery and the booming dive tourism industry. The declining status of shark fisheries, exacerbated by unresolved conflicts with other stakeholders led to declaration of total shark fishing ban in 2010. With the shark fishing ban in place, sharks are now caught as bycatch in the Maldivian fisheries. Larger part of shark catch, 99.9% of total shark catch is now from tuna longline fishery. Shark bycatch from pole and line and handline tuna fisheries are virtually nil; contributing 0.06% and 0.08% respectively to total shark bycatch. In the most recent logbook system, launched in 2012, shark bycatch is to be recorded as species-complexes consistent with IOTC requirements. The new logbook system, though not to species level, also accounts for bycatch of turtles and seabirds. Bycatch assessments for shark species-complexes; hammerhead sharks, thresher, sharks, oceanic white tip sharks and mako sharks have been undertaken for the years 2013 and 2014. By 2014, 18 vessels operate in the tuna longline fishery, many of which joining after mid of 2013. Understandably, with increased fishing effort, the shark bycatch in the tuna longline fishery has increased by more than 50% in 2014 when compared to 2013. The majority of shark bycatch, 62% were released with no damage, while 31% were dead sharks at time of retrieval. Interestingly, the logbook records show no bycatch of turtles in pole and line and handline tuna fisheries. The only bycatch of turtles was from tuna longline fishery, where a total of 24 turtles were caught. Seabirds have not been reported by any fisheries in 2014. Hence, it can be deduced that the fisheries of the Maldives have minimal impact on marine turtles and seabird populations. Maldives have now endorsed, its first National Plan of Action for the Conservation and Management of Sharks in April of 2015. Work is ongoing on determining the effectiveness of the shark fishing ban on reef-associated sharks through a citizen-science programme where data collection is done through dive tourism community.

Introduction

For more than a thousand years, fisheries have been the main source of food and income for the Maldives (Anderson and Hafiz, 1996). Tuna has always dominated the catch and for centuries the Maldives has been a tuna fishing nation. It was in the 1970s with the inception of tourism and major developments in trade, small-scale fisheries on reef fishes and sharks developed. Shark fisheries were one of the most lucrative fisheries, among the small-scale fisheries. Higher prices were paid for the exports of shark fins and liver oil of deepwater sharks (Anderson and Ahmed, 1993).

Shark fisheries' contribution to the economy was minuscule compared to the tuna fisheries which dominated the fisheries sector (MRC, 2009). Over the years, the rise in global exploitations on sharks rose concerns over the sustainability of sharks. This led to the rise in awareness on the vulnerability of sharks to over-fishing and called for locally new management measures for sharks in the Maldives.

The objective of this paper is to provide an overview of the past shark fisheries of the Maldives, factors that led to the complete fishery ban and provide an update on the recent developments in shark resources management with some notes on sea turtles and seabirds.

History of Shark Fisheries of the Maldives

Sharks were first exploited in need of their crude liver oil. In olden days, there was a significant demand for the shark liver oil. The fishing boats of the Maldives were made of wood and to prevent the wood from decaying, crude liver oil of sharks were applied to the boats. The high demand for shark liver oil led to the development of a traditional shark fishery, *maa keyolhukan* (literally big line fishing in *Divehi*, local language). Large sharks such as the tiger shark (*Galeocerdo cuvier*) and sometimes the bluntnose sixgill shark (*Hexanchus griseus*) and the whale shark (*Rhinocodon typus*) were targeted. This subsistence shark fishery gradually evolved to a commercial fishery. In the 1960s, Japanese longliners came into the central Indian Ocean and this introduced Maldivian fishermen to new fishing techniques (Anderson and Ahmed, 1993). Further, in the 1970s widespread motorization of the fishing fleet took place and with major developments in trade, new markets were opened for the fishermen. These developments and new fishing techniques led to the development of commercial shark fisheries. By the early 1980s, there were three types of shark fisheries in the Maldives; the deepwater gulper shark fishery, the reef shark fishery and oceanic shark fishery.

Status of the Shark Fisheries

Deepwater gulper shark fishery

In the early 1980s, Japanese buyers came in looking for shark liver oil rich in squalene. Squalene was a substance used for the pharmaceutical products and cosmetics. Livers of gulper sharks (*Centrophorus* spp.) were found to have high levels of squalene. Japansese market for squalene-rich liver oil led to the development of gulper shark fishery. The high price of squalene-rich liver oil attracted many fishermen to the fishery. The fishery boosted in the early couple of years and reached its peak from 1982 to 1984 (Figure 1). After the peak, there was a precipitous decline in catches. The declining trend continued till the economic collapse of the fishery. The sudden drop in catches was attributed to two main factors. Gulper sharks lived in cold deep nutrient deficient waters. Hence they

would have much slower growth rates compared to shallow water sharks. Gulper sharks inhabit depths of 250-800m and in the Maldives, as atoll slopes are very steep, this depth is very limited around the atolls. Since the gulper sharks' habitat is very confined throughout the country, it was believed these deepwater sharks were of a very small stock and the high fishing pressure exhausted the small stock of the gulper sharks (Anderson and Ahmed, 1993).

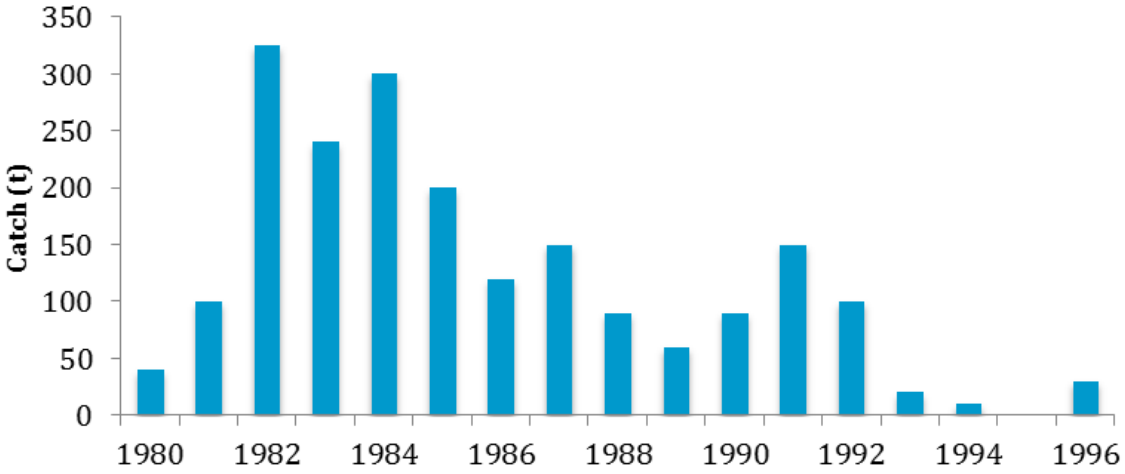

Figure 1 shows the gulper shark catch

Reef shark fishery and oceanic shark fishery

Having introduced to new fishing techniques, the fishermen started exploiting the reef associated sharks. Gillnets and longlines were used to target the reef associated sharks. Some of the reef sharks that were caught were white tip reef shark (*Triaenodon obesus*), black tip reef shark (*Carcharhinus melanopterus*), silver tip shark (*Carcharhinus albimarginatus*) and grey reef sharks (*Carcharhinus amblyrhynchos*).

For the oceanic shark fishery, longlining was carried out. The catch included silky sharks (*Carcharhinus falciformis*), oceanic white tips (*Carcharhinus longimanus*), silver tips (*C.albimarginatus),* thresher sharks (*Alopias* spp.) and mako sharks (*Isurus* spp.)

Since shark fisheries were a minor fishery, little importance was given in collecting catch and effort information on shark fisheries. The shark fisheries was a solely an export-oriented one, the local consumption of sharks would be negligible it was assumed the whole shark catch would be exported. As a result, assessments on shark fishery status were carried out by estimating catch from the export data of shark fins. The exported fins were not distinguished by the type of fishery; hence the estimated catch was the combined catch from reef shark and oceanic shark fisheries.

Prior to 1970s, shark catches were estimated to be roughly 500mt (Figure 2). From the late 1970s, a steep rise in shark catches was seen. This was the time when commercial shark fisheries developed. For most of the years, the average annual catch was 1400mt with 1000-2000mt of inter-annual variations in the catch. The differences in shark catch in between the years could be due to the demand of fins in the export market (MRC, 2009). In 2004, shark fisheries attained its peak of

2,700mt. After the peak, the fishery showed significant declines in catches and by 2008 had equaled to the level of shark fishing prior to late 1970s (Figure 2).

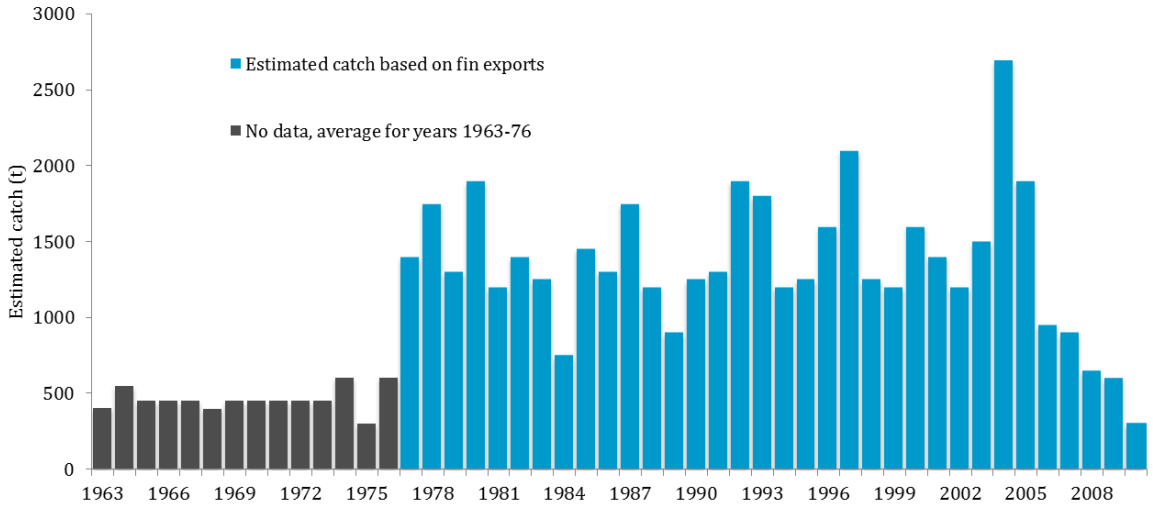

Figure 2 shows estimated shark catch for reef shark fishery and oceanic shark fishery

The significant drop in shark catch after 2004 was believed to be caused by over-exploitation of shark stocks (MacAllister and Partners, 2002) or the decrease in fishing effort (Sinan et al., 2011). For many of the prominent shark fishing islands, the number of fishing vessels engaged in shark fishing has decreased over the years. The most prominent shark fishing island, *Kulhudhuffushi*, in 1992 had 80 boats which was reduced to 10 in 2008 (Sinan et al., 2011). Many socio-economic factors had driven the fishermen away. In a study done by Anderson et al., (2011), it was found that the number of youth entering the shark fishery in *Kulhudhuffushi* were becoming less and the fishing group of the island had aged. However, this particular issue was not only affecting the shark fishery, the entire fisheries sector was being affected.

Conflicts between shark fishermen and other stakeholders

Since its inception, the shark fisheries had major conflicts with other stakeholders. The dive tourism industry had issues with reef shark fishermen and pole and line tuna fishermen had issues with shark fishermen. Divers complained that due to reef shark fishing, reef sharks sightings were becoming few. A study in 1993 revealed that a single grey reef shark allowed to live in its habitat would generate about 3,300USD per year than when fished in need of its fins which would generate only 32USD (Anderson and Ahmed, 1993).

Pole and line tuna fishermen complained of low tuna catch due to fishing of oceanic sharks. The fishermen believed that having sharks particularly silky sharks (*C. falciformis*) around the tuna schools helped to keep the school together and thus increased the availability of tuna catch.

Shark management measures

Most of the management measures on shark fisheries were taken to reduce these conflicts. The first management measure on shark fisheries was to prohibit shark fishing in tuna fishing grounds during daytime. To reduce the conflict with dive tourism industry, nine prominent shark watching points were included in the first 15 marine protected areas of the Maldives. Furthermore to reduce this conflict, a ten year moratorium on shark fishing was announced in 1998 in seven atolls important for tourism. However, in 2008, even after 10 years of a moratorium on reef shark fishing in the major tourism zones, dive tourism industry complained of diminishing reef shark sightings. The tourism industry is the main foreign income generating sector, and shark watching is considered as an important part of diving. In addition to growing importance of conserving sharks for the dive tourism industry, the decreased status of shark fisheries pressed for immediate management actions. As a result, with the purpose of conserving the reef associated sharks, a fishery ban on reef sharks was imposed in 2009. A year later in 2010, as oceanic shark fishing could pose negative impacts on the pole and line tuna fishery, a complete ban on shark fishing within the entire Exclusive Economic Zone (EEZ) was declared.

Measures to minimize the impact of shark fishing ban on fishermen

After the declaration of the complete shark fishing ban in 2010, a gear-buy-back scheme was implemented for the shark fishermen. Two hundred six fishermen participated in the scheme and shark fishing gear, longlines and nets were bought at depreciated values. Majority of the fishermen has received compensations. In addition to the gear-buy-back scheme, the former shark fishermen were given priority in a soft-loan scheme implemented by the government. Few months after the complete ban was declared, Ministry of Fisheries and Agriculture (MoFA) initiated a Shark Trust Fund. The main purpose of the trust fund was to provide assistance to shark fishermen in finding alternative livelihoods. Since the dive tourism industry would largely benefit from the reef shark fishing ban, the tourism sector was asked to contribute to the Shark Trust Fund. However, having over 98 tourist resorts, only two resorts contributed to the trust fund.

Socio-economic impact of shark ban on former shark fishermen

A study led by the Marine Research Centre of MoFA, in collaboration with the Bay of Bengal Large Marine Ecosystem (BoBLME) Project assessed the socio-economic impact of complete shark ban on former shark fisherfolk. Seven islands notable for shark fishery were chosen for the study and about 125 fishermen took part in the survey. Survey findings have been published in 2015.

Issues in the full implementation of Shark Ban

After complete ban on shark fishing was declared, the major issue faced in the implementation of shark ban was the ongoing sale of shark souvenirs. Shark jaws were being sold at a majority of souvenir shops. MoFA was hugely criticized, for not being able to stop the trade of shark souvenirs. The fishery ban imposed by MoFA only prohibited the exploitations on sharks but it did not ban the trade of shark products. The regulation of trade, import and export of any commodity including marine products in the Maldives is in the mandate of the Ministry of Economic Development. Since the beginning of complete shark ban, MoFA has been negotiating with Ministry of Economic Development to impose a ban on local and international trade of shark souvenirs within the Maldives.

Interactions with sharks, sea turtles and seabirds in tuna fisheries

In year 2013, 16 vessels operated in tuna longline fishery whereas 18 vessels were engaged in longlining in 2014. Longlining for tuna is allowed from 100nm up to the limit of the Maldives' EEZ and later on the high seas. In 2012, new logbooks on tuna longlining were launched. The new logbooks ensure the bycatch of sharks to be recorded to species-complex levels. The condition of shark bycatch are also to be recorded as whether the incidentally caught shark was released with no damage, released with minimal damage, released with major damage or was dead at the time of release. In January of 2013, taxonomy trainings on oceanic sharks were provided to the crew of two longline vessels. The training was provided with assistance from BoBLME Project by the Marine Research Centre in collaboration with Fisheries Management Division of MoFA The training materials for the workshop was obtained from the Indian Ocean Tuna Commission's (IOTC) identification guides on Shark and Ray Identification in Indian Ocean Pelagic Fisheries.

Almost all shark catch was from tuna longline fishery. Sharks are mainly caught as bycatch in tuna longline fishery. Shark bycatch from pole and line and handline tuna fisheries are minimal; contributing 0.06% and 0.08% respectively to total shark bycatch (Table 1).

Table 1 Percentages of interactions of sharks, turtles and sea birds in pole and line, hand line and longline fisheries for tuna

	PL			HL			LL		
	Sharks	**Turtles**	**Seabirds**	**Sharks**	**Turtles**	**Seabirds**	**Sharks**	**Turtles**	**Seabirds**
Catch	3	0	0	4	0	0	4,999	24	0
Percentage	0.06	0.00	0.00	0.08	0.00	0.00	99.88	100.00	0.00

In tuna longline fishery total of 7,730,281 hooks were deployed in 2014. Incidental catch rates (per 1000 hooks) for sharks, sea turtles and seabirds were quite low and insignificant; 0.65, 0.31 and 0 respectively (Table 2). Catch composition for year 2014 shows sharks comprised 7% of the total catch, whereas, percentages of turtles and seabirds was negligible (Figure 3).

Table 2 Incidental catch rates for sharks, turtles and seabirds

Incidental catch	**Total interactions**	**Incidental catch rate (per 1000 hooks)**
Sharks	4,999	0.65
Sea turtles	24	0.31
Sea birds	0	0.00

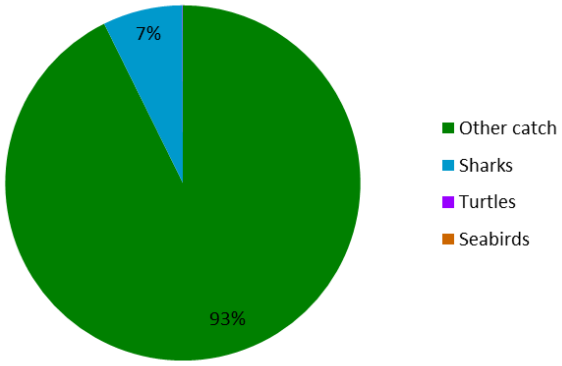

Figure 3 Composition of total catch in tuna longline fishery

Figure 4 shows the shark bycatch from a total of 16 longline vessels in 2013, and 18 longline vessels in 2014. An increase of more than 50% in longline bycatch has been observed from 2013. This could be due to the reduced fishing effort for the most part of 2013, as majority of the vessels joined the tuna longline fishery in the latter part of 2013 and could also be an artifact of reporting as there is a possibility of under-reporting in latter part of 2013. Except for hammerhead sharks, all shark species-complexes showed an increase in catch. In 2014, the most frequently caught species-complex of sharks was oceanic white tip (*C. longimanus*), where as in 2013, the most common bycatch of sharks were mako sharks (*Isurus spp.)* The least caught species-complex for both years was hammerhead sharks (Figure 4).

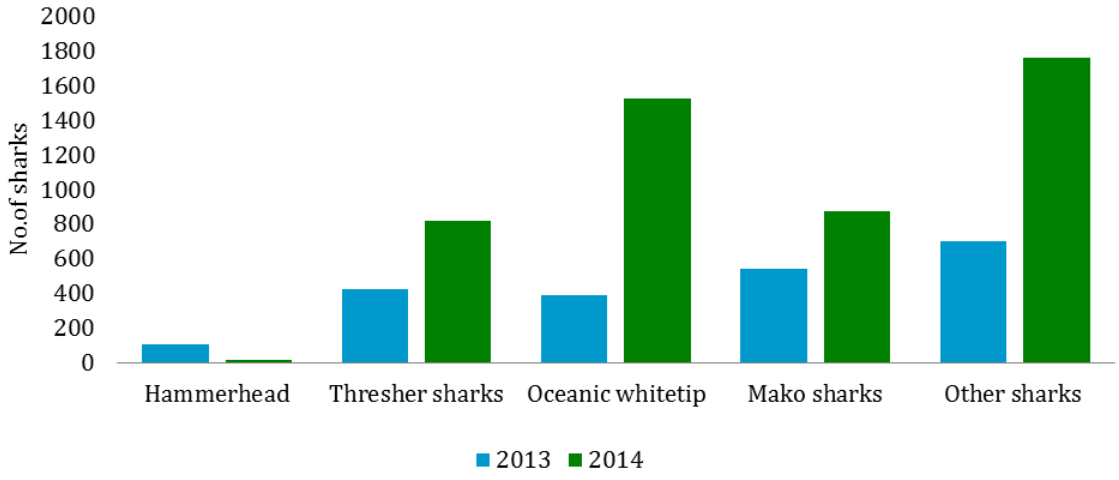

Figure 4 Number of sharks caught per species-complexes in year 2013 and 2014

Handling information on shark bycatch shows majority of shark bycatch, 62% were released with no damage, while 31% were dead sharks (Figure 5). Interestingly, the logbook records show no bycatch of turtles in pole and line and handline tuna fisheries. The only bycatch of turtles was from longline

fishery, where 24 turtles were caught and majority was released with no damage (Figure 6). Bycatch of seabirds has not been reported by any fisheries in 2014.

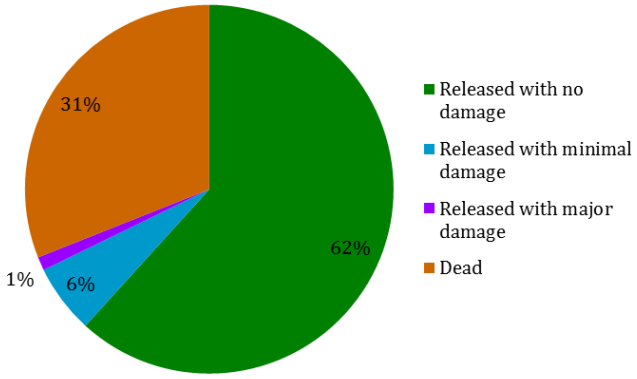

Figure 5 Status of shark bycatch upon release

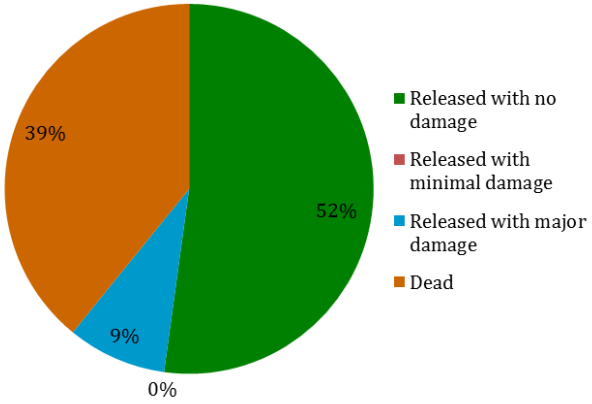

Figure 6 Status of sea turtle bycatch upon release

Figure 7 shows a breakdown of shark bycatch of 2013 per species-complexes by month. An increasing trend for shark bycatch has been noticed in 2013. The highest number of sharks was recorded during the period August to December. This could be due to increased effort in collecting logbook information by the longline vessels and more vessels joining the fishery. In the beginning of 2013, five vessels were operating and by December of 2013 a total of 16 vessels were in the fishery.

Thresher sharks (*Alopias* spp.) were recorded to be fairly the same for most of the months, with an average of 30 sharks per month, except for May which recorded more than 50% rise in catch in comparison to the other months (Figure 7). Although the oceanic white tip shark (*C. longimanus*) catch dominated the shark bycatch in February, March and July did not show any significant peaks in

catch and the catch remained fairly the same throughout the year except in January. Hammerheads (*Sphyrna* spp.) were the least recorded shark with many months without any catch. However, hammerheads showed an unexpected peak in June, where it even dominated the shark bycatch for the month, before dropping to zero catch for the next three months. Mako sharks (*Isurus* spp.) were the most recorded species-complex and dominated the catch for the months, April, May, August, October and November (Figure 7).

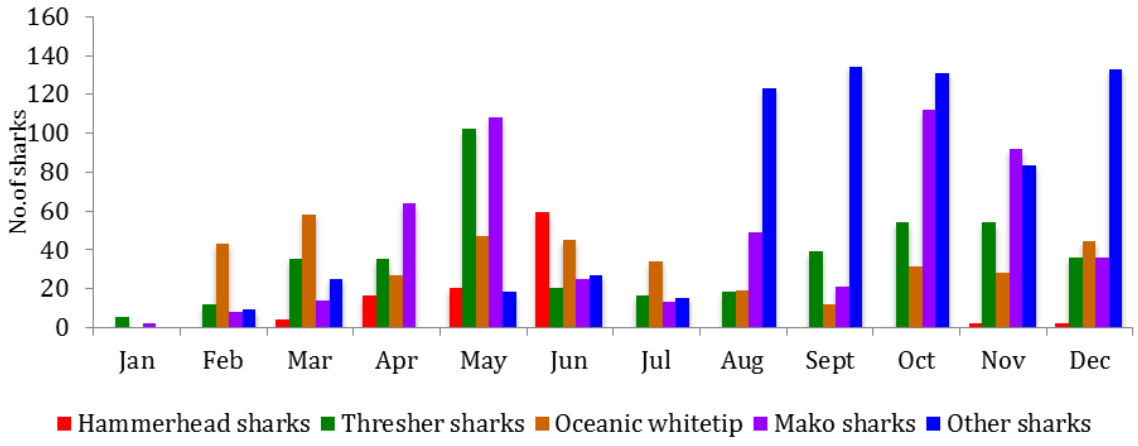

Figure 7 shows a breakdown of types of sharks caught by month for year 2013

Figure 8, shows another breakdown of shark bycatch by species-complexes by month for year 2014. Majority of sharks were caught in the months January to March. The mid of the year showed a declining trend in shark bycatch with the least shark numbers observed in June and July. This seems to be due to the reduced fishing effort at this time of the year. From July to October, shark bycatch was on the rise again, but a drop in shark bycatch was observed for November and December. Except for hammerhead sharks, all other shark species-complexes were observed in all the months.

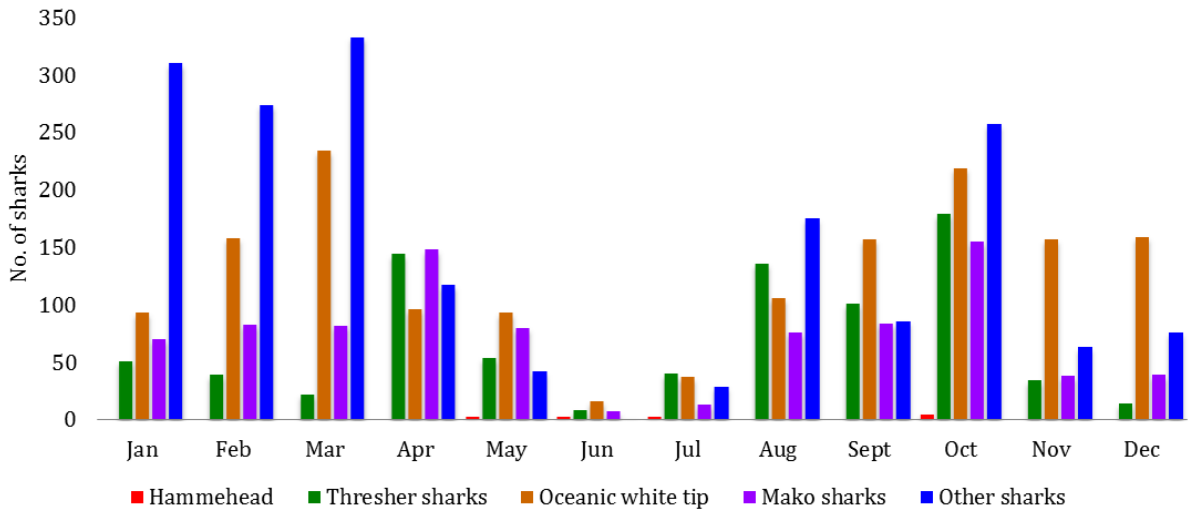

Figure 8 Breakdown of types of sharks caught by month for year 2014

For most part of the year, oceanic white tip sharks dominated the catch (Figure 8). Oceanic white tip shark catch showed an increasing trend from January reaching a peak of 234 sharks in March and then showed a declining trend till June. Another increasing trend in catch for oceanic white tips was again observed from July to October, and then showed a slight drop in catch in November and December. High numbers of thresher sharks (*Alopias* spp.) were seen in April and August to October. Although mako sharks (*Isurus* spp.) were observed throughout the year, high numbers were only observed in April and October. Hammerhead sharks (*Sphyrna* spp.) were the least observed with a catch of 14 sharks and appeared in the catch only in May to July and in October (Figure 8).

Maldives Sharkwatch Program

After the fishery ban on reef associated sharks was declared in 2009, Sharkwatch Program was initiated under the Darwin Reef Fish Project, collaboration between the Marine Research Centre and Marine Conservation Society (UK). The purpose of the program was to assess the effectiveness of the reef shark ban as well as gain an understanding of the abundance of reef associated sharks at the time of the reef shark ban. Sharkwatch is a citizen-science program and tourism sector is largely targeted for data collection. The country having over 100 tourist resorts, and majority having a dive centre on it, on a single day numerous dives would be undertaken by the dive tourism industry; hence the dive centres were encouraged to take part in data collection.

Sharkwatch uses the roving diver technique, where the surveyor swims for approximately 45-50 minutes and counts the number of sharks encountered on that dive. Over the four years of the Sharkwatch program, an increasing effort in surveying and an increase in shark encounters were noticed. The increase in shark sightings could be due to the increased effort in surveying. Results of the four years showed the most encountered shark has been white tip shark (*T. obesus*), followed by grey reef shark (*C. amblyrhynchos*), and the black tip reef shark (*C. melanopterus*). The programme has also assisted in identifying hotspots for sharks (Sattar el at., 2014).

Current management

NPOA-Sharks

In collaboration with BoBLME project, the Maldives has developed the National Plan of Action on the Conservation and Management of Sharks (NPOA-Sharks). A stakeholder consultation to present the NPOA-Sharks took place on 10th of April 2014. Stakeholders including former shark fishermen, relevant government authorities, and representatives of tuna longline fishery, attended the one day workshop. The overarching goal of the Maldives NPOA-Sharks is to ensure the implementation and observation of the total shark fishing ban. Some of the actions of the NPOA-Sharks include strengthening of the existing Shark Trust Fund, developing a local shark identification guide and conducting taxonomy trainings targeting longline fishermen. NPOA-Sharks has been formally endorsed by Ministry of Fisheries and Agriculture on 12th of April 2015.

Compliance issues

Maldives enforcing a complete shark fishing ban in the entire EEZ, prohibits the retaining of any incidental catches of sharks. The Regulation on Fishing and Export of Yellowfin and Bigeye Tuna, has provisions to release all live shark bycatches and in any circumstance where dead shark bycatches were landed, the regulation requires it to be declared to a fisheries observer or fisheries enforcement officers for confiscation. As the Maldives currently do not have a fisheries observer scheme or fisheries enforcement officers in place, dead shark bycatch is not landed and is discarded to the sea. Since the management measure prevents retaining of shark bycatch, the Maldives is unable to fully comply with the IOTC Res.10/02 and Res.05/05 which entails size frequency data be taken for shark species as well.

Conclusion

With declined status of shark fisheries, if shark fisheries were to continue, it could have adverse effects on the most prominent economic sectors; the tourism industry and pole and tuna fishery, hence a complete ban on shark fishing was declared. For further management of shark resources, a NPOA-Sharks has been developed and is being implemented. Future efforts would be focused towards effective monitoring of shark ban and improving the reporting mechanism of shark bycatch. Enforcement of the full fishery ban on sharks also prohibits the utilization of sharks. Given these and considering the context of Res. 05/05, the Maldives had discussed with IOTC during the last compliance meeting on August 2015 in the Maldives, on a course of action where the Maldives can fully comply with resolutions concerning sharks, and at the same time allowing for the full observation and implementation of the complete shark fishing ban.

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