Received: 19 October, 2011

Status of Shark Fisheries in the Maldives

Hussain Sinan, Fisheries Management Agency, Ministry of Fisheries and Agriculture, H. Whitewaves, Malé, Republic of Maldives

M. Shiham Adam, Marine Research Centre, H. Whitewaves, Malé, Republic of Maldives

R. Charles Anderson, P.O. Box 2074, Malé, Republic of Maldives

Summary

Maldivian fishermen have exploited sharks on a small scale for centuries if not millennia. They traditionally targeted large sharks (particularly large tiger sharks), which have enormous livers, from which oil was obtained to treat their wooden fishing boats. Shark meat and fins were of limited interest. That changed between the 1960s and the early 1980s, with the introduction of new fishing techniques (notably longlining for reef and oceanic sharks, netting for reef sharks, and deep vertical longlining for gulper sharks) and the development of new overseas markets for shark products (especially shark fins, but also dried shark meat and squalene-rich liver oil). All of these fisheries prospered, but only for a short time. The deepwater gulper shark fishery went into decline within 5 years, and was effectively finished by the early 1990s. Reef sharks were also soon overexploited, and this fishery was in decline by the mid-1990s. The oceanic shark fishery (which exploited the initially much more abundant oceanic sharks) lasted longer, but even here catch rates were declining by the 2000s, causing many fishermen to desert the fishery. Reef sharks are of great economic importance to diving tourists, and this led to conflict of interest between tourism operators and shark fishermen. Various shark fishery management measurements failed to halt the decline of reef shark abundance. Therefore a national ban on shark fishing was introduced in March 2010, followed by a total trade ban in July 2011.

Introduction

The Maldives has enjoyed a productive fisheries sector for centuries. There is certainly evidence that suggests fishing was an important activity in the Maldives before AH 548 (AD 1153-4) (Anderson and Hafiz, 1996) and it is likely that fisheries have been providing sustainable employment (Anderson and Ahmed, 1993) and trade for over two thousand years.

Even though there is evidence that Maldives had a minor shark fishery for centuries (Anderson and Ahmed, 1993), little importance was attached to the fishery because of its small contribution to the economy. Maldivian fisheries have traditionally been dominated by the tuna fishery, which contributes some 85% of the total catch. The remaining 15% of the catch have been lumped together as ‘reef species’. These are reported as a single category in the national statistics, even though they include a wide variety of species, including reef and oceanic sharks, jacks, scads, snappers, groupers, sailfish, wahoo, rainbow runners and dolphinfish *(mahimahi)* (Adam, 2006).

The aims of this paper are to provide a brief history of shark fisheries in the Maldives, an overview of their contribution to the economy and an update on recent management measures taken.

History of shark fisheries in the Maldives

There is evidence that Maldives has had a minor shark fishery for centuries (Anderson and Ahmed, 1993). Traditionally, all Maldivian fishing boats (*dhoani*) were made of wood, and required regular hauling up on the beach to be cleaned and painted with oil. Shark livers were the main source of this oil. To supply this demand, there was a traditional shark fishery known as *maakeyolhukan* (literally, big line fishing) (Anderson and Ahmed, 1993). This targeted big sharks with big livers, with large tiger sharks being the main catch, although whale sharks and bluntnose sixgill sharks were also taken. This fishery died out in 1960s with the introduction of modern longlining. The impetus for that change was the entry of Japanese tuna longliners into the central Indian Ocean, as well as the opening of a boatyard on Hulhulé island (Saleem, 1987). Shark longlining started to spread through Maldives, replacing the traditional tiger shark fishery (and incidentally usurping the name *maakeyolhukan*).

Widespread motorization of fishing vessels began in the 1970s. At about the same time gillnets were introduced to the country. These did not become widely established, but they were adopted by reef shark fishermen. Also in the mid-1970s, trade developments led to the opening of wider market opportunities for shark products, and higher prices for exports (Anderson and Ahmed, 1993). This in turn encouraged product diversification. The fishery changed from one producing shark liver oil for domestic consumption, with some minor trade in shark fins, to one in which the main product was shark fins for export, with additional exports of salted dried shark meat and high-value shark liver oil plus continued consumption of low-value shark liver oil. The demand for high-value squalene-rich shark liver oil greatly increased in the 1980s, when Japanese buyers visited the Maldives looking for supplies. A small multi-hook handline (vertical longline) fishery soon developed for the deepwater gulper shark (*Centrophorus* spp.) to meet this demand.

Thus by the end of the 1980s, there were three main shark fisheries: for oceanic sharks; for reef sharks; and for deepwater gulper sharks(Anderson and Ahmed, 1993).

Gulper shark fishery

There was a minor fishery for gulper sharks (*Centrophorus* spp.) on the outer atoll slopes in depths of about 250-800m using multi-hook vertical longline, which started in 1980, peaked around 1982-84, and effectively collapsed due to overfishing by the early 1990s (Anderson and Ahmed, 1993). The sharks were caught exclusively for their liver, which forms about 25% of their body weight. The liver oil is rich in squalene and was exported to Japan (Anderson and Ahmed, 1993). In addition to gulper sharks, this fishery took several other species of slope sharks and teleosts (Adam et al, 1998). Anderson and Ahmed (1993) reviewed this fishery, and provided the first records of several species of upper slope sharks. Gulper sharks are known in *Dhivehi* (Maldivian language) as *kashimiyaru* (spine shark) in reference to the spines on the anterior margin of the dorsal fins.

Reef shark fishery

This fishery targeted reef-associated sharks using gillnets, handline and longline. Fins and salted dried shark meat were produced, for export. There was much conflict between reef shark fishermen and tourist resorts, since both fisheries and diving tourism made us of the same stock

(Anderson and Ahmed, 1993). It was largely this conflict of interest that drove shark management and conservation measures over the past two decades.

Oceanic shark fishery

This fishery targeted open ocean sharks, mainly using longline and handline. Some oceanic sharks (notably silky shark) associate with tuna schools, and tuna fishermen would sometimes catch these by pole and line or even by hand. However, most tuna fishermen do believe that the presence of sharks in some way enhances tuna catches (perhaps by keeping the tuna schools together); they therefore oppose oceanic shark fishing in general and longlining in particular. The main products from oceanic sharks were fins and shark meat, for export (Anderson and Ahmed, 1993).

Table1. Shark species caught in Maldivian water, with an indication of the level of catch by fishery. (Sources: (Anderson and Ahmed, 1993, Anderson and Waheed, 1999).

English Name	Scientific Name	Maldivian Name	Fishery Type		
			Deep	Reef	Ocean
Bluntnose sixgill shark	*Hexanchus griseus*	Madu mayaru	**		
Taiwan gulper shark	*Centrophorus niaukang*	Kashimiyaru	***		
Leafscale gulper shark	*Centrophorus squamosus*	Kashimiyaru	***		
Mosaic gulper shark	*Centrophorus tessellatus*	Kashimiyaru	***		
Zebra shark	*Stegostoma fasciatum*	Hitha miyaru		*	
Tawny nurse shark	*Nebrius ferrugineus*	Nidhan miyaru		*	
Whale shark	*Rhincodon typus*	Fehurihi		P	P
Smalltooth sand tiger	*Odontaspis ferox*	Daiydhigu miyaru	*	*	
Crocodile shark	*Pseudocarcharias kamoharai*	Miyaru			*
Pelagic thresher shark	*Alopias pelagicus*	Kandi miyaru			*
Bigeye thresher shark	*Alopias superciliosus*	Kandi miyaru			*
Thresher shark?	*Alopias vulpinus*	Kandi miyaru			*
Shortfinmako shark	*Isurus oxyrinchus*	Woshimas miyaru			*
Longfinmako shark	*Isurus paucus*	Woshimas miyaru			*
False catshark	*Pseudotriakis microdon*	Hikandhithun miyaru	*		
Silvertip shark	*Carcharhinus albimarginatus*	Kattafulhi miyaru		**	*
Bignose shark	*Carcharhinus altimus*	Mendhan miyaru			**
Grey reef shark	*Carcharhinus amblyrhynchos*	Thila miyaru		**	
Silky shark	*Carcharhinus falciformis*	Ainu miyaru			***
Blacktip shark	*Carcharhinus limbatus*	Miyaru		*	
Oceanic whitetip shark	*Carcharhinus longimanus*	Feekanfaiy miyaru			**
Blacktip reef shark	*Carcharhinus melanopterus*	Falhumathi dhon miyaru		**	
Spottail shark	*Carcharhinus sorrah*	Dhon miyaru		*	
Tiger shark	*Galeocerdo cuvier*	Femunu		*	*
Sicklefin lemon shark	*Negaprion acutidens*	Olhufathi miyaru		*	
Blue shark	*Prionace glauca*	Andhun miyaru			*
Whitetip reef shark	*Triaenodon obesus*	Faana miyaru		**	
Scalloped hammerhead	*Sphyrna leweni*	Kaaligandu miyaru		*	*
Smooth hammerhead	*Sphyrna zygaena*	Kaaligandu miyaru			*

*Key: *** major target species, ** regularly taken, *occasionally taken,* P *= protected species under Environment Law.*

Shark fisheries extent and status

Maldives is a tuna fishing nation and there has been little emphasis on other fisheries. As a result there has been almost no effort to collect shark fisheries data. Within the data collection system of the Ministry of Fisheries and Agriculture, sharks are categorized within 'group 3' (i.e. large) reef species. There is no separate data collection mechanism for shark catches. However, as Maldivians do not consume shark meat or shark fins and the whole purpose of shark exploitation is for export, a rough estimate of shark catches can be made using export data (Anderson and Ahmed, 1993; Anderson and Waheed, 1999).

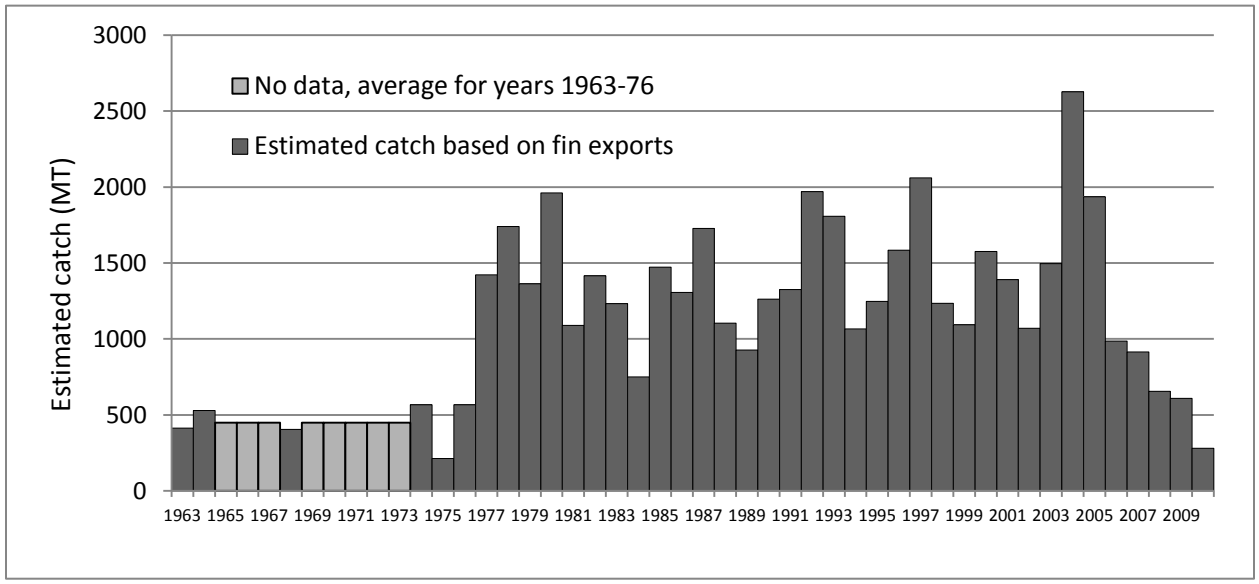

Figure 1: Estimated annual catches of reef and oceanic shark species combined, 1963-2010, calculated from fin export data. Sources: Anderson and Ahmed (1993), Anderson and Waheed (1999), MRC (2009), Customs data compiled by MOFA.

Shark fins are obtained from both reef sharks and oceanic sharks, and the two types are not differentiated in export statistics. Therefore any estimate of shark catch based on fin export quantities will be for the two fisheries combined. In the 1960s and early 1970s, Maldivian shark catches appear to have been relatively low. There was, however, an expansion of shark fishing effort (particularly on reef sharks) from about 1976-77 (Anderson and Ahmed, 1993), and this is reflected in catches. Between 1977 and 2006, estimated reef and oceanic shark catch averaged about 1440 t per year, although varying between about 1000-2000 t per year. During that time, reef sharks probably dominated catches in the late 1970s and 1980s, but then their catches declined due to overfishing. Oceanic sharks dominated catches from the 1990s. Since the peak in 2004, estimated catches of shark have declined dramatically. This is believed to be partly due to reduced catch rates due to overexploitation, and partly due to withdrawal of fishermen from the shark fisheries for a variety of other socio-economic factors.

In general, because of relatively low earnings, and a reluctance of young men to enter the shark fishery, the number of fishermen and fishing vessels engaged in shark fishing has declined over the past couple of decades. This is illustrated for seven shark fishing islands in Table 2.

Table 1: Number of fishing vessels engaged in shark fishering at selected islands (Sources: Anderson and Waheed, 1999; (MRC, 2009)

Atoll/Island	1992	1998	2003	2008	2011
H.Dh. Kulhudhuffushi	10	80	45	10	0
R. Maduvvari	41	22	10	2	0
R. Meedhoo	46	12	12	7	0
A.Dh. Dhangethi	12	5	7	6	0
A.A. Himandhoo	20	12	9	9	0
F. Feeali	24	0	0	1	0
Th. Vilufushi	8	6	1	3	0
Total	161	137	84	38	0

It has been difficult to deduce the status of the shark stocks in the Maldives, since the Maldivian shark fisheries are multispecies ones, and catch data are almost non-existent. However, based the data that are available, on knowledge of shark biology, of reports from tuna fishermen and the tourism sector, it seems clear that sharks stocks have been overexploited in the Maldives.

- For the deepwater gulper shark fishery, export data clearly chart the rapid overexploitation of the resource (Anderson and Ahmed, 1993; Anderson and Waheed, 1999; MRC, 2009).
- For the reef shark fishery, reports from the tourism sector suggested that resources were being heavily exploited by the 1990s; MacAllister and Partners (2002) suggested that reef shark stocks were overexploited; while subsequently research divers reported remarkably few encounters with reef sharks (MRC, 2009).
- For oceanic sharks, both tuna and shark fishermen reported that catch rates of silky sharks had declined significantly over the previous two decades (Anderson and Jauharee, 2009); while research divers again reported remarkably few encounters with oceanic sharks during offshore dives around FADs.

Conflicts between shark fishermen and other stakeholders

In addition to concerns about over-exploitation of shark stocks, two conflicts of interest have driven shark fisheries management in recent decades.

One conflict of interest was between reef shark fishermen and the tourism industry. Sharks in the Maldives do not have exaggerated man-eating reputation that they have in some other countries. As a result reef shark watching by divers is one of the main attractions for tourist divers visiting the Maldives. It was estimated in 1992 that divers spent around US$2.3 million to watch the sharks in the Maldives; in contrast the export of all shark products earned around US$0.7 million in the same year (Anderson and Ahmed, 1993). Tourism is of vital importance to the Maldives, and has been the largest sector of the economy for over two decades. It is heavily dependent on the attractiveness of the marine environment, with one survey in the early 1990s estimating that marine environment contributed to over 70% of tourists' enjoyment during their stay (MOT, 1994). Also at that time, around 38% of tourists went snorkelling, while for around 18% of

tourists diving was the main activity undertaken during their stay in the Maldives(MOT, 1994).The recognition of the economic importance of reef shark watching was of key importance in the introduction of increasingly wide-ranging restrictions of reef shark fishing, leading up to the complete ban on all shark fishing in 2010.

The second major conflict of interest was between oceanic shark fishermen and the tuna fishery. Maldivian fishermen have traditionally targeted surface-swimming skipjack and yellowfin tuna, using pole and line. The fishermen are well aware of the close relation between these tuna schools and sharks, especially silky sharks (Anderson and Ahmed, 1993). Most fishermen believe that the harvesting of silky sharks and other sharks associated with tuna schools has a large negative impact on tuna availability. Pressure from the large tuna fishing industry led to restrictions on shark fishing in the vicinity of tuna schools, and around seamounts and FADS where tuna aggregate.

Management measures

The Ministry of Fisheries and Agriculture has taken introduced various shark fishery management measures since 1981 (Table 3). None of these, however, was entirely successful in halting the decline in shark abundance, or the conflicts of interest between different users of the resource. It gradually became clear that nothing short of complete bans on shark fishing and on shark product exports would be effective. (There is almost no capacity to monitor and enforce a ban on shark fishing. Therefore a ban on shark product exports, which are effectively controlled by Customs, would also be required).

After due consideration, the Fisheries Advisory Board, announced the following on 1 March 2009:

"Since shark species have slow growth rate, late maturation, low fecundity and long reproductive cycle and are among the least resilient of fish species to intense exploitation; and shark fisheries have a huge impact on the main two pillars of the Maldivian economy namely, tuna fisheries and tourism sector; and from the research by the experts of the Ministry of Fisheries and Agriculture it could be deduced that there is an overexploitation of shark species; and by the powers retained under the article 10 of 'Fisheries Act of the Maldives' (Act no: 5/87, the Ministry of Fisheries and Agriculture announces that there would be a complete ban effective from March 1, 2009, on harvesting of any shark species within 12 mile radius from the rim of the Atolls in the Maldives."

The FAB also decided to completely ban all shark fishing in the Maldivian waters after a further one year grace period for the shark fishermen and traders. This decision was further discussed in the cabinet and on 15 March 2010, the Ministry of Fisheries and Agriculture announced a ban on any fishery targeted at killing, capturing or extraction of any shark species within the Maldivian waters.

Table 3. Time-line of developments in shark fisheries and management

1960s	Introduction of longlining, which was soon adapted for sharks
Mid-1970s	Rapid expansion of shark fisheries in Maldives
1980	Start of deep-water gulper shark fishery
10 Nov 1981	Shark fishing prohibited during daytime in tuna fishing areas (Ministry of Fisheries Iu'laan 48/81/34/MF)
1982-84	Peak of deep-water gulper shark fishery
Late 1980s	Collapse of deep-water gulper shark fishery
19 May 1992	Shark fishing with livebait prohibited in vicinity of tuna schools while other vessels are present and fishing for tunas (Ministry of Fisheries and Agriculture Iu'laan 16/92/29FA.A1). This replaced the Iu'laan of 10 Nov 1981.
1992-93	First review of shark fisheries; first valuation of reef shark diving tourism
5 June 1995	Declaration of first Marine Protected Areas (15 dive sites, nine of which were well-known for their reef sharks) (Ministry of Planning, Human Resources and Environment Iu'laan E/95/32)
24 June 1995	Ban on fishing for whale sharks (MOFA Iu'laan FA-A1/29/95/39)
8 Oct 1996	Ban on taking sharks or any type of fishing the might be detrimental to pole and line tuna fishing within 3 miles radius of any FAD (MOFA Iu'laan FA-A1/29/96/39)
28 Nov 1996	Longlining banned in vicinity of seamount between Hadhdhunmathi and Huvadhoo Atolls (MOFA Iu'laan FA-A1/29/96/43)
10 Dec 1997	Longlining banned in vicinity of seamount south of Addu Atoll (MOFA Iu'laan FA-A1/29/96/54)
8 Sept 1998	10-year moratorium on shark fishing within 12 nautical miles of seven (tourism zone) atolls (MOFA Iu'laan FA-A1/29/98/39)
1 March 2009	Ban on shark fishing within 12 nautical miles of any atoll (MOFA Iu'laan FA-D/29/2009/20)
11 March 2010	Ban on shark fishing throughout Maldives from 15th March 2010 (MOFA Iu'laan 30-D2/29/2010/32)
21 July 2011	Ban on capture, keeping, trade or harming sharks (Ministry of Housing and Environment Iu'laan138/1/2011/42)

Measures taken to minimise the impacts by management decisions

The management decision taken on 15 March 2010 to ban shark fishing in the Maldives had a significant impact on the livelihoods of shark fishermen. The Ministry of Fisheries and Agriculture identified possible alternative livelihood opportunities for shark fishermen and initiated a trust fund to raise capital. It was expected that the tourism industry, which will reap the main benefits from the ban, would assist in compensating those who are bearing the main cost. Unfortunately only a few resorts offered help to raise funds.

Since the shark fishery in the Maldives is seasonal, most of the fishermen already had an alternative livelihood for the low shark fishing period. Hence, the Government initiated a MRF 7 million fund to buy back gear used by the shark fishermen which would cover significant losses incurred by the fishermen. It should also significantly reduce the number of illegal shark fishing activities. The scheme was announced in August 2010 and a total of 206 fishermen or gear owners applied. Ministry of Fisheries and Agriculture bought gear from around 70% of the people who applied by the end of September 2010. Money has also been transferred to the respective Island Offices to disperse to around 20% of the fishermen who applied for the scheme. It is expected that all the fishermen eligible for the scheme will be paid by the end of November 2011.

Apart from the gear buy back scheme, priority is also given to former shark fishermen in soft loan schemes initiated by the government. A training program on longline fishing targeting large yellowfin tuna is also planned for former shark fishermen at the end of this year.

The Ministry of Housing and Environment announced a ban on catching, keeping in captivity, trading or harming any species of shark from 21 July 2011. However, the mandate to ban the trade of any commodity lies within the jurisdiction of Ministry of Economic Development. The Ministry of Fisheries and Agriculture has been negotiating with the Ministry of Economic Development to introduce a trade ban of sharks and shark products, and an announcement is expected soon.

Further action

A draft of the NPOA-sharks has been prepared by the Fisheries Management Agency and a stakeholder consultation meeting will be held later this year to finalise the plan.

A shark watch programme has been initiated to monitor the recovery of reef shark populations. This is being administered and coordinated by the Marine Research Centre, under the UK Darwin Initiative Funding[1].

The Ministry of Defence and National Security and Maldives Police Service have the mandate to monitor illegal activities and to enforce management activities. Several cases of illegal activities relating to shark fishing have been reported to Maldives Police Service.

The Government of Maldives announced plans to initiate a local tuna longline fishery in the Maldives on 10 December 2010. Several measures have been taken under the ‘fishing for

[1] The programme will be supported by the Government Funding when Darwin Initiative Funds ceases in two years time.

yellowfin tuna and export regulation' to minimise shark bycatch. Sharks caught alive in the longline operations should be released and sharks which are dead have to be brought to the landing port and declared to a fisheries inspector.

Conclusions

Shark resources are of great importance for the economy of the Maldives. Depletion of shark stocks impacted not only shark fishermen but also the diving tourism industry. The Government's decisions that followed were mainly based on the economics involved in the fishery. The main priority of the Government is now to reduce the impact on the livelihood of the shark fishermen. Lack of funding has been the biggest hurdle in the process.

Bibliography

Adam, M.S., Merrett, N & Anderson, R.C. (1998). Additions to the fish fauna of the Maldives. Part 1. An annotated checklist of the deep demersal fishes of the Maldive Islands. Icthyological Bulletin of JLB Smith Institute, 67(Part 1), 1:19.

Adam, M.S. 2006. Country review: Maldives. *In:* DE YOUNG, C. (ed.) *Review of the state of world marine capture fisheries management: Indian Ocean.* Rome: Food and Agricultural Organisation of the United Nations.

Adam, M. S. 2006. Country review: Maldives. *In:* DE YOUNG, C. (ed.) *Review of the state of world marine capture fisheries management: Indian Ocean.* Rome: Food and Agricultural Organisation of the United Nations.

Anderson, R. & Ahmed, H. 1993. The shark fisheries of the Maldives. *MOFA, Malé and FAO, Rome. 73pp*.

Anderson, R. & Waheed, Z. 1999. Management of shark fisheries in the Maldives. *FAO Fisheries Technical Paper***,** 367-401.

Anderson, R. C. & Hafiz, A. 1996. Status of tuna research and data collection in the Maldives. Colombo: Indo-Pacific Tuna Programme.

MacAllister, E. & Partners 2002. Kulhudhuffushi Shark Fisheries Review, Regional Development Project Northern Development Region. Ministry of Planning and National Development and Asian Development Bank.

MOT. 1994. Tourist Opinion Survey Report.

MRC 2009. Status of the shark fishery 2. Male',: Marine Research Center, Ministry of Fisheries and Agriculture.