



Identifying Priorities for Shark Conservation in the Bay of Bengal, Bangladesh

Mahatub Khan Badhon^{1*}, Md Kutub Uddin², Fahmida Khaliq Nitu³ and Enamul Mazid Khan Siddique⁴

¹ Department of Zoology, University of Dhaka, Dhaka, Bangladesh, ² Voices for Interactive Choice and Empowerment (VOICE), Dhaka, Bangladesh, ³ National University of Bangladesh, Gazipur, Bangladesh, ⁴ Bangladesh Youth Environmental Initiative (BYEI), Dhaka, Bangladesh

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*Correspondence:

Mahatub Khan Badhon
mahatub.badhon@du.ac.bd

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Fisheries bycatch is known as the major threat to Threatened shark species (herein, sharks, skates, and rays) in Bangladesh. But bycatch is not appropriately addressed under the existing wildlife and fisheries conservation management regime. This policy brief evaluates the current scenario of shark conservation and identifies priorities for future interventions. The literature review finds 71 shark species and only four peer-reviewed publications from Bangladesh suggesting the species already known have not yet been studied. In addition, inconsistencies in legal frameworks have limited the capacities and mandates of responsible government agencies. We recommend actionable changes in policy to regulate shark trade, reduce bycatch of Threatened species, improve fisheries data reporting system, and bring consistency between institutional mandate and the capacity of conservation and management agencies.

Keywords: sharks, threatened species, conservation priorities, sustainable fisheries, bycatch, Bay of Bengal, Bangladesh

INTRODUCTION

Conservation efforts to protect shark species (herein, sharks, skates, and rays) are of paramount importance. The IUCN Red List's Shark Specialist Group (Dulvy et al., 2014) estimates that 24% of all extant sharks and chimeras are threatened with an elevated risk of extinction. The utility of shark products is driving targeted and opportunistic shark fishing (Lack and Sant, 2009; Dent and Clarke, 2015). Exposure to fishing mortalities (Bonfil, 1994) and low intrinsic rates of population growth (Musick et al., 2000; Frisk et al., 2001) mean there is a critical need for effective shark conservation measures.

The extensive fishing pressure in the Bay of Bengal (Khan et al., 1997) drives the catch of shark species in Bangladesh. Coastal and marine fisheries operate 67,669 artisanal boats and 253 commercial trawlers (Department of Fisheries [DOF], 2018), and support 2.7 million people (Program Development Office for Integrated Coastal Zone Management Plan [PDO-ICZMP], 2003). The fishing fleet uses the depth zone between 10 and 80 m (Chowdhury, 2017), with fisheries surveys conducted by Hida and Pereyra (1966) and Sætre (1981) concluding that the average proportion of shark catch is higher in this depth zone than in other depths.

Sharks are predominantly taken as bycatch (Haldar, 2010; Hoq, 2010), and among those caught are species listed in the Threatened category (assessed as Critically Endangered, Endangered, or Vulnerable) by IUCN Red List. Targeted and opportunistic shark fisheries also exist in Bangladesh's

water (Bahadur, 2010; Haque et al., 2018). Processing plants in coastal areas prepare export-oriented shark products, where no part of a shark is discarded (Bahadur, 2010; Haque et al., 2018). No local demand for shark fin products has been reported (Hasan et al., 2017; Haque et al., 2018), and only a few small communities of ethnic minorities consume fresh and dried shark meat (Bangladesh Bureau of Statistics [BBS], 2003; Roy et al., 2011; Haque et al., 2018). The evidence is inconclusive on whether only market demand is driving shark fishing (Hoq, 2010), but all types of fishing in coastal and marine areas have threatened shark species as bycatch.

As part of global efforts in advocating shark conservation (Simpfendorfer et al., 2011; Dulvy et al., 2014, 2017; Shiffman and Hammerschlag, 2016a,b), the above-mentioned context has encouraged us to conduct this review to understand the conservation scenario for sharks, and to identify priorities for intervention in Bangladesh. Here, we recommend changes in policies and practices that can be introduced to reduce bycatch of Threatened shark species and mainstreaming shark conservation as an everyday part of Bangladesh's current fisheries management regime.

METHODS

A literature review and key informant (officials from the Department of fisheries, the Forest Department, independent researchers, conservation practitioners, local traders, exporters, and artisanal fisherfolk, and crews of commercial trawlers) interviews were conducted. For the literature review, we searched peer-reviewed articles published between 1970 and 2018 in the ISI Web of Science database using two set of keywords, i.e., "(Shark* OR Chondrichth* OR Elasm*) AND Bangla*" and "(Shark* OR Chondrichth* OR Elasm*) AND Bengal*." The keywords were selected to search all papers related to shark species in the Bay of Bengal, Bangladesh. Out of 15 papers resulting from searches, we found four relevant papers; this number is extremely low compared to better-studied parts of the ocean. To find gray literature, non-systematic search queries were made in Google Scholar using the above-mentioned keywords in different combinations. In total, we eventually reviewed four peer-reviewed papers and other 26 documents, reports, and working papers, and used the framework for biodiversity knowledge shortfalls, reviewed and further developed by Hortal et al. (2015), to determine knowledge shortfalls on sharks.

Before interviewing key informants, we conducted 15 reconnaissance surveys (brief surveys to collect preliminary information on shark fishing, landing, and trading; to identify and locate key informants; and to look for issues, problems, and opportunities not mentioned in literature) in coastal areas since January 2015. These surveys allowed us to identify key informants. Given the legal implications and sensitive nature of shark trade, it took time to build up relationships with key personnel using snowball sampling. At the end of 2017, we used a semi-structured questionnaire (**Supplementary Material A**) to interview 20 individuals. Given the relatively small sample

size, we also used informed participants' observation and perspectives as evidence.

RESULTS

Knowledge Shortfalls on Sharks

The review showed limited taxonomic description and cataloging (Brown and Lomolino, 1998) of sharks in terms of integrating molecular techniques with classical morphological systematics to resolve the taxonomy of shark species, as suggested by Last (2007) and White and Last (2012). The total number of named shark species occurring in Bangladesh is difficult to substantiate as credible taxonomic identification and qualified taxonomists are lacking. The number ranges from 22 to 56 (Hussain, 1970; IUCN, 2000; Roy et al., 2007). Compiling Krajangdara et al. (2008), Haroon's (2011) figures, and Hoq and Haroon (2014), the total number of reported shark species reaches 71 (**Supplementary Material B**). Concerns over accurate taxonomic identification of shark species occurring in Bangladesh have been reported (Bay of Bengal Large Marine Ecosystem Project [BOBLME], 2011; Roy et al., 2014) previously, and the proposed National Plan of Action for shark (NPOA-shark) (Halder, 2010) recognizes this discrepancy on the reported number of species in different literatures.

Taxonomic study provides a critical baseline and functional unit for biological research. Furthermore, one needs to define and enumerate species before developing species-specific conservation strategies. Simpfendorfer et al. (2011) have identified taxonomic research as one of the key conservation research priorities for sharks. We found one paper on *Glyphis gangeticus* (Roberts, 2006) and one taxonomic guidebook on sharks (Hoq and Haroon, 2014) that exclusively contribute to taxonomic research; however, none employed molecular approaches for species identification. Credible taxonomic diagnosis of shark species entails a meticulous examination of morphological systematics, often accompanied by molecular analysis, to eliminate confusion and misidentification of hybrids and species complexes. White and Last (2012) used the case of *G. gangeticus* occurring in the Bay of Bengal claimed by Roberts (2006) as an example to showcase that inadequate taxonomic investigation has the potential to mislead and create confusion.

We found three studies (Roberts, 2006; Rowat et al., 2008; Hossain et al., 2015) that employed historical and oral data from fisherfolk to understand the distribution of sharks. The survey effort and coverage of majority of the studies have been mostly limited to the fish markets and fish landing stations of the southeastern coast (Roy et al., 2007; Karim et al., 2012; Hoq et al., 2012; Hoq and Haroon, 2014). No offshore survey has been conducted to exclusively understand the spatial distribution, movement patterns and migratory routes of sharks. This ultimately results into an inadequate understanding of the geographic distribution of sharks (Lomolino, 2004).

The necessity of research on taxonomy, stock assessment, life history, biology and sustainable utilization of sharks has been suggested by Rahman and Uddin (2010) and Fischer et al. (2012). However, research to minimize the lack of data on

shark species remains significant in Bangladesh. The current unevenness in survey efforts (i.e., lack of species-specific catch data and poor sampling strategy) and coverage (i.e., geographic bias) could result in variation in the quality and reliability of the data available for future conservation planning (Gaston and Rodrigues, 2003; Mace, 2004).

Conservation Management Regime

We have identified 8 instruments that together build the legal and policy framework related to sharks in Bangladesh, namely, Forest Act, 1927, Protection and Conservation of Fish Act, 1950, Marine Fisheries Ordinance, 1983, National Fisheries Policy, 1998, Wildlife (Conservation and Security) Act, 2012, Bangladesh Biodiversity Act, 2017, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Convention on the Conservation of Migratory Species of Wild Animals (CMS). The Department of Fisheries and the Forest Department are the authorized agencies under this framework. The Forest Department is authorized to implement Wildlife (Conservation and Security) Act, 2012 and Forest Act, 1927. It is also the designated agency to represent Bangladesh in CITES and to work as the national authority to issue import and export permits under CITES. Wildlife Act (Government of Bangladesh [GoB], 2012) listed 29 species of sharks as protected; among these protected species, 15 are not listed in the Threatened criteria of IUCN Red List, and there was no national assessment before listing them as protected. Multiple key informants informed that the law is ineffective and poorly implemented because the mandate¹ of Forest Department is not consistent with its responsibility. Under this law, traditionally the Forest Department had species with different types of protection which inhabit terrestrial forest or wetlands but marine areas or fisheries were not part of Forest Department's mandate. Fisheries' bycatch is the main threat to sharks and the Forest Department does not have any mandate to manage marine fisheries thus rendering the protected status of sharks under the Forest Department obsolete.

Convention on International Trade in Endangered Species is a driver to improve the management of listed sharks (Vincent et al., 2014). According to key informants, Bangladesh, as a party to CITES, has not introduced any monitoring or management mechanisms to regulate the trade of shark products. CITES functions as an additional measure to regulate trade of shark products by restricting or controlling the international trade of a limited number of shark species as listed in the Appendix I and II lists (Table 1). The latest evidence detects species from CITES Appendix I (*Pristis pristis*) and Appendix II (*Sphyrna lewini*, *Alopias* sp., *Rhincodon typus*, and *Mobula japonica*) at fish processing plants in Bangladesh (Haque et al., 2018). It suggests that both undocumented trade and lack of monitoring on CITES-listed sharks are underway in Bangladesh. All CITES Appendix II listed species need to have non-detriment findings (NDFs) made for them to ensure that the numbers being removed are sustainable (Vincent et al., 2014). Despite being a range country for nine shark

species listed in CITES Appendix II, Bangladesh is yet to prepare any NDFs. This shows the unpreparedness (i.e., lack of resources, infrastructure, and expertise) of the regulatory agencies to manage fisheries since the requirements for NDFs and sustainable fishery management goals at the domestic level are the same (Cochrane and Douman, 2005). The Forest Department—being the management and enforcement authority of CITES in Bangladesh—has no mandate to manage the fisheries resources of Bangladesh.

Preparing NDFs is not only about setting sustainable quotas, but also about enforcing better bycatch regulations to reduce bycatch of Threatened or protected species, or increase post-release survival rates from non-selective gears (Vincent et al., 2014). Owing to the nature of multi-species fisheries and the absence of species-specific shark catch data (Mundy-Taylor and Crook, 2013), commercial capture of species listed in CITES Appendix II is currently difficult to substantiate. It is even more difficult to inform NDFs. Key informants suggest that resource mobilization, capacity building and collaboration between regulatory agencies (FD and DOF) are required to monitor trade (Appendix I and II) and investigate existing or potential fisheries for shark species (Appendix II). Most of the key informants agreed that if the demand decreases or authorities regulate the trade it will help to reduce the targeted and opportunistic shark fishing, but bycatch mortalities will continue. One key informant said that multi-species fisheries with gill nets in the coastal waters of Bangladesh are key contributors to bycatch mortalities of Threatened sharks.

Bangladesh ratified the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and became a party to the treaty in December 2005. CMS party states have signed into effect the Memorandum of Understanding on the Conservation of Migratory Sharks (CMS Sharks-MoU) in March 2010; the first such global instrument on shark conservation. But, Bangladesh is yet to sign the CMS Sharks-MoU.

The marine fisheries sector in Bangladesh is shaped by laws and policies namely, Protection and Conservation of Fish Act, 1950, National Fisheries Policy, 1998, and Marine Fisheries Ordinance, 1983 focusing on increasing the catch of a few commercially valuable species (e.g., *Tenualosa ilisha*, a herring-like species) through restricting the use of specific fishing gears or delimiting fishing at different spatial and temporal scales (Islam et al., 2016). As the authorized agency under these laws, the Department of Fisheries is not mandated to conserve marine megafauna, the marine turtle is the only exception. Despite legislation on installing turtle excluder devices (TED) in trawl nets (Marine Fisheries Rules, Section 14A) in order to mitigate bycatch mortalities of turtles from commercial trawling, key informants from the trawling industry informed that no trawlers comply with TED regulation. The stringent oversight on commercially valuable fisheries management (Islam et al., 2016), in contrast to no enforcement on TED installment and no bycatch regulations of Threatened sharks, suggests that the prospect of revenue trumps conservation priorities in the current fisheries management regime.

¹<http://www.bforest.gov.bd/site/page/b24cdba5-14e0-4fde-8114-b7a557038915/>

TABLE 1 | List of shark species occurring in Bangladesh that have been listed in the Appendixes of CITES and CMS.

Species	Common Name	IUCN Red List Status	CITES Status	CMS Status
<i>Rhincodon typus</i>	Whale Shark	Endangered (2016)	Appendix II (2003)	Appendix I (2017)
<i>Sphyrna lewini</i>	Scalloped Hammerhead	Endangered (2007)	Appendix II (2013)	Appendix II (2014)
<i>Sphyrna mokarran</i>	Great Hammerhead	Endangered (2007)	Appendix II (2013)	Appendix II (2014)
<i>Sphyrna zygaena</i>	Scalloped Hammerhead	Vulnerable (2005)	Appendix II (2013)	Not Listed
<i>Carcharhinus falciformis</i>	Silky Shark	Near Threatened (2016)	Appendix II (2017)	Appendix II (2014)
<i>Mobula kuhlii</i>	Shortfin Devil Ray	Data Deficient (2009)	Appendix II (2017)	Appendix I (2014)
<i>Mobula mobular</i>	Giant Devil Ray	Endangered (2015)	Appendix II (2017)	Appendix I (2014)
<i>Mobula japonica</i>	Spinetail Devil Ray/ Spinetail Mobula	Near Threatened (2006)	Appendix II (2017)	Appendix I (2014)
<i>Anoxypristis cuspidata</i>	Narrow Sawfish	Endangered (2013)	Appendix I (2007)	Appendix I (2014)
<i>Pristis pristis</i>	Large-toothed Sawfish	Critically Endangered (2013)	Appendix I (2007)	Appendix I (2014)
<i>Alopias</i> sp.	Thresher Shark	Vulnerable (2009)	Appendix II (2017)	Appendix II (2014)

There were regional efforts, for instance, the Bay of Bengal Large Marine Ecosystem (BOBLME) project (2008 to 2013)² of the Food and Agriculture Organization of the United Nations contributed to efforts to integrate conservation of marine megafauna in fisheries sector. But as these kinds of top-down global or regional efforts are not driven by demand of national institutions, after such projects end, national institutions do not internalize the process and do not take the ownership of outcomes. For instance, the Department of Fisheries was the national implementing agency of BOBLME, but it did not officially adopt a National Plan of Action for Sharks (NPOA-sharks) prepared under this project. Key informants have identified lack of resources as one of the key reasons behind this. After the project ended, Department of Fisheries did not allocate any resources to work on adopting NPOA-sharks, they said.

The newly introduced Bangladesh Biodiversity Act, 2017 (Government of Bangladesh [GoB], 2017) has the provisions needed to be the basic legislation for wildlife conservation. No single government ministry or agency is handed down the authority to implement this law. Rather, a multi-agency national committee is authorized to work with a multi-sectoral approach to conserve biodiversity and sustainable use of its resources. There are provisions for determining and protecting endangered species under this law from which Threatened shark species can benefit.

ACTIONABLE RECOMMENDATIONS

The government agencies, academia, and local and international conservation groups working on marine megafauna conservation in the Bay of Bengal should prioritize accurate taxonomic identification of shark species occurring in Bangladesh's waters. The discrepancy on the reported number of species must be resolved, there should be a national register of reported shark species. To develop the critical baseline and functional units for biological research on sharks in Bangladesh, we recommend that the government should facilitate long-term studies through its agencies, such as the Department of Fisheries and the Bangladesh Fisheries Research Institute. These agencies should host a

consortium of relevant experts who will work on taxonomic identification, distribution, and population of sharks to build evidence that will guide the conservation and management of sharks in Bangladesh.

Department of Fisheries should finalize and adopt the NPOA-Sharks; if needed it should seek in-country technical assistance from UN-FAO as outlined in the International Plan of Action for Conservation and Management of Sharks (IPOA-Sharks).

To create evidence, acquiring species-specific data from different fish landing stations is critical because these data could help to initiate the process of national assessment on the status of shark species. We recommend the inclusion of new data attributes in the fisheries resources survey system (FRSS) to ensure species-specific records of shark species. As FRSS is a long-established mechanism under the Department of Fisheries, inclusion of species-specific assessment of shark landing will not require new resources. We strongly recommend that the Forest Department should start facilitating the process to prepare NDF to regulate the trade of shark products. Building capacity and infrastructure for the Forest Department to identify species from shark products and monitor trade for a CITES-compliant trade regime should also be a priority. As the management and regulatory agency of the fisheries sector, the Department of Fisheries should be given the technical responsibility to prepare the NDF.

Bangladesh should sign the CMS Sharks-MoU; it has policy mechanisms to protect highly migratory sharks by prohibiting take (of Appendix I species) or by requiring nations to cooperate on regional management (of Appendix II species) (McClenachan et al., 2012). Also, the MoU will provide Bangladesh with the opportunity to easily develop policy process that could address fisheries bycatch of whale sharks and sawfishes (Hossain et al., 2015; Adnan et al., 2018).

Conservation of sharks should be mainstreamed into fisheries policies and management; existing policy and legal instruments have scopes to do that. Article 8 and 8.2 of the National Fisheries Policy³ should incorporate clear provisions outlining how it will

²https://www.boblme.org/project_document.html

³https://mofl.gov.bd/sites/default/files/files/mofl.portal.gov.bd/policies/13c01764_17a9_40ba_a170_ec758a651724/Jatio%20Matshya%20Niteemala.pdf

reshape legal processes in marine fishing industry to conserve Threatened shark species. It should also include directions about introducing bycatch regulations related to sharks and other marine megafauna. Importance should be given on greater investment in strategies to manage bycatch (i.e., modifications of gear, safe handling and releasing bycatch, reducing post-release mortalities) in artisanal and industrial fisheries.

The multi-agency national committee under the Bangladesh Biodiversity Act should start a national assessment of status of shark species. Species found as nationally Threatened should be protected under the Protection and Conservation of Fish Act. We recommend the Department of Fisheries, as the authorized agency to implement the Fish Act, should be allocated the necessary resources for enhancing institutional capacity and training of its human resources to engage the fishing industry for the protection of sharks and other marine mega fauna.

CONCLUSION

Achieving sustainable outcomes for most or all shark populations requires species-specific identification and understanding of the fisheries in context of a given geographic area (Dulvy et al., 2017; Simpfendorfer and Dulvy, 2017). Based on the paucity of species-specific research and data on sharks, and the poor state of conservation management, we have recommended a mix of priority actions that can transform the mutually exclusive and single sector approach of regulatory agencies (i.e., DOF and FD) to become more integrated. This national preparedness may set a

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strong base for implementing international conventions like CITES and CMS to regulate the trade of shark products and reduce bycatch.

ETHICS STATEMENT

We took written informed consent before audio recording all interviews. The Ethical Review Committee of the Faculty of Biological Sciences, University of Dhaka (72/Biol.Sc./2018–2019), approved the protocol and the approach of this study.

AUTHOR CONTRIBUTIONS

EMKS and MKU planned and designed the policy brief. FKN, MKB, and MKU conducted the literature review, reconnaissance surveys, and Key Informant Interviews. MKB and MKU developed the manuscript. All authors provided critical feedback.

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SUPPLEMENTARY MATERIAL

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