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EVOLUTIONARILLY DISTINCT & GLOBALLY ENDANGERED

Survival Blueprint

Largetooth sawfish, *Pristis pristis* Bangladesh

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Suggested citation: Haque, A. 2021. A Survival Blueprint for the Conservation of the Largetooth Sawfish, *Pristis pristis* in Bangladesh. EDGE of Existence Programme, Conservation and Policy, Zoological Society of London.

1. STATUS REVIEW

Sawfishes belong to the most threatened chondrichthyan family (Pristidae) in the world (Dulvy et al., 2016; Harrison & Dulvy, 2014; Faria et al, 2013; Feitosa et al., 2017). Historically, sawfishes have been globally exploited for their skin, meat, rostrums, bones, and fins. Overall, all populations of these species are under tremendous threat owing to unregulated and unsustainable fishery practices and habitat loss (Harrison & Dulvy, 2014). The sale of sawfish fins for the shark fin trade (Dulvy et al., 2016), entanglement of rostra in gill nets and demersal trawl nets (Feitosa et al., 2017; Leeney, 2017) in addition to the loss of critical mangrove and coastal habitats, are thought to have driven sawfish population decline globally. However, information on the historical range, species composition, current distribution and conservation status of sawfishes is lacking across much of the species' range within low- and middle-income countries, hindering efforts for their management and conservation.

The largetooth sawfish (*Pristis pristis*) has gone through significant decline and is reported as extinct in many of its former range states (Kyne et al., 2013; Yan et al., 2021). Its geographical range has contracted by almost 61% (Yan et al., 2021) and its population has declined by 80% over the last three generations (from 1960s) (Dulvy et al., 2016). Once considered widespread in the Indo-west Pacific, including the Bay of Bengal, the current status of the largetooth sawfish in this region is not well understood.

Sawfishes are shallow dwellers harbouring the marine and estuarine coasts across the world, including rivers, freshwater areas, canals in estuaries and sometimes in river mouths associated with mudflats and mangroves in inshore areas (Leeney, 2017; Harrison and Dulvy, 2014). Bangladesh is a riverine and estuarine country, has the potential to host many key habitats for sawfishes, including the Sundarbans mangrove forests (world's largest halophytic mangrove forest) in the southwestern part of Bangladesh, which receives vast an important influx of nutrient-loaded sediments. This makes the Sundarbans nutrient-rich making it a unique estuarine ecosystem for distinct populations of marine and estuarine megafaunas like sawfishes and guitarfishes. Hence, these areas being so ecologically active, experience tremendous fishing pressure for hosting it harbours commercially and culturally important species of conservation importance (Amaral et al., 2016).

Four species of sawfishes are believed to have been historically present in Bangladeshi waters: the largetooth sawfish *Pristis pristis,* the smalltooth sawfish *P. pectinata,* the green sawfish *P. zijsron,* and the narrow sawfish*, Anoxypristis cuspidata.* A recent study confirmed the persistence of *P. pristis, P. zijsron* and *A. cuspidata* (Haque et al., 2019; Haque et al., 2020; Hossain et al., 2015), and documented a decline in sawfish observations over several decades potentially attributable to high levels of bycatch, particularly in drift gill nets (Hossain et al. 2015). The first three sawfish species are listed as Critically Endangered, while the narrow sawfish is listed as Endangered by the IUCN Red List of threatened species (D'Anastasi et al., 2013; Kyne et al., 2013; Simpfendorfer, 2013). However, few studies have reported sawfish from Bangladesh (Hossain et al, 2015; Hoq et al., 2011; Roy et al., 2010; Quddus & Shafi, 1995), indicating both the extreme lack of research and monitoring of catches of these species in the country (Haque et al., 2020) and potentially that these have become increasingly rare.

Critical sawfish habitats are being overexploited by illegal timber acquisition, shrimp aquaculture (Hossain et al., 2015; Islam et al., 2011), illegal poison fishing, and unauthorised fishing gears usage in the Sundarbans Reserve Forest (Debnath, 2009). In addition, artisanal and industrial vessels operating from Bangladesh further increase the pressure on sawfish populations. Furthermore, the lack of baseline data paired with unregulated and undocumented catch and trade of sawfishes with an

existing market for sawfish products (Haque et al., 2020) advocates for effective conservation recovery plans to protect these endangered groups from regional extinctions and biogeographic shifts.

1.1 Taxonomy:

Faria *et al.* (2013) determined a total of five species of sawfish in two genera modifying the previously accepted taxonomy. *P. pristis, P. microdon* and *P. perotteti* were synonymised as *P. pristis*. Although *P. pristis* is best considered as a single species, it can be comprised of a several geographical units or subpopulations. These subpopulations are not genetically distinct but may be ecologically different (IUCN 2021, Faria et al., 2013).

P. pristis was previously denoted by several other names throughout its range. For example, *P. pristis* was formerly known as *P. perotteti* in the Atlantic and sometimes in the Eastern Pacific, and *P. microdon* in the Indo-West Pacific (IUCN 2021). Other synonyms include *Pristis zephyreus* and *Squalus pristis*.

So far, a total of four distinct subpopulations of *P. pristis* are recognised. They are: Eastern Atlantic, Western Atlantic, Eastern Pacific and Indo-West Pacific

Kingdom: Animalia
Phylum: Chordata
Class: Chondrichthyes
Subclass: Elasmobranchii
Order: Rhinopristiformes
Family: Pristidae
Genus: *Pristis*
Species: *pristis* (Linnaeus, 1758)
Common name: Largetooth sawfish
Local name: Aissha (আইশশা), Chat Baila (চাট বাইলা), Korate Baila (করাতে বাইলা), Korat Mach (করাত মাছ)

1.2 Distribution and population status:

Formerly widespread in tropical countries (Kyne et al., 2013), the largetooth sawfish population is divided into four sub-populations (Eastern Atlantic, Western Atlantic, Eastern Pacific and Indo-West Pacific). Substantial population declines have been documented in all four subpopulations with apparent extinctions in many former range countries. Overall, a population decline based on a reduction in extent of occurrence (EOO) of ≥80% over a period of three generations (i.e., 1960s to present) is inferred (IUCN, 2021; Harrison and Dulvy, 2014). According to the IUCN Red list (IUCN, 2021; last assessed 01 March 2013) at least 30 nations have lost largetooth sawfish and declared as locally extinct owing to an array of threats particularly fisheries.

1.2.1 Global distribution:

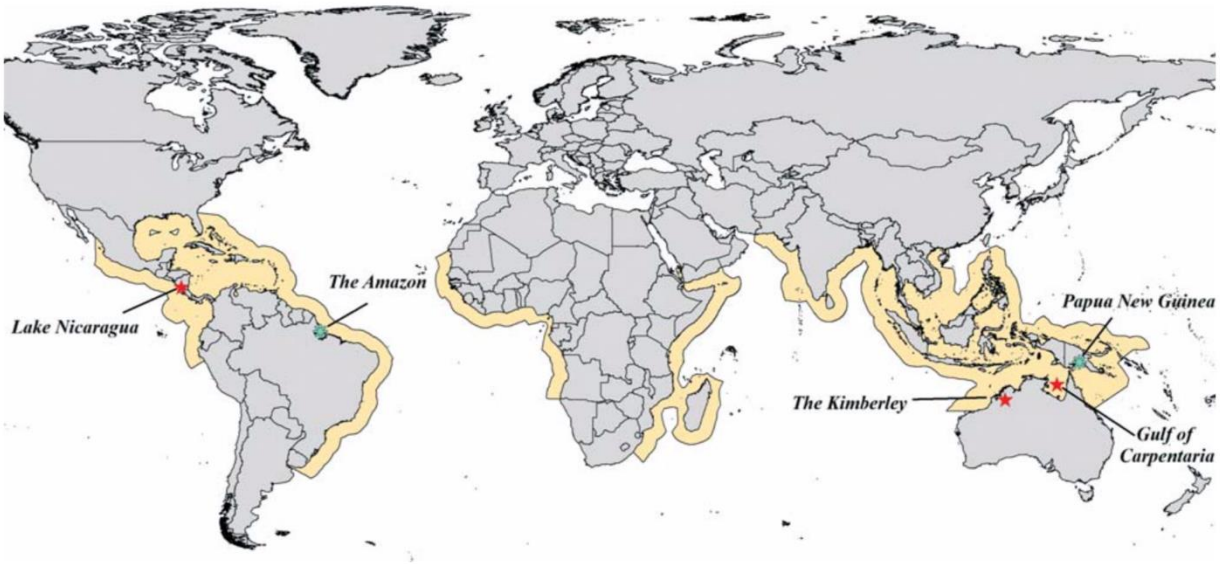

Figure 1 a. Generalised historical distribution of *Pristis pristis*. Source: Kyne et al., 2021.

Figure 1b. Global distribution of *P. pristis*. Taken from IUCN SSC Shark Specialist Group 2013. *Pristis pristis*. The IUCN Red List of Threatened Species. Version 2021-1

Subpopulations /Different populations	Population estimates (plus references)	Distribution	Population trend (plus references)	Notes
Global	Unknown	Global, ~90 nations	Decreasing	Information taken from IUCN, 2021; Kyne et al., 2013.
Eastern Atlantic	Unknown	Historically, largetooth sawfish were found along the coast of West Africa (Faria et al., 2013), particularly in Senegal (1841–1902), Gambia (1885–1909), Guinea-Bissau (1912), Republic of Guinea (1965), Sierra Leone (date unknown), Liberia (1927), Côte d'Ivoire (1881–1923), Congo (1951–1958), Democratic Republic of the Congo (1951–1959), Angola (1951), and Mauritania (Burgess et al. 2009). It is possible, however, that many of those records were confused taxonomically with other species. Unpublished notes from a survey conducted in the 1950's show 12 largetooth sawfish from Mauritania, Senegal, Guinea, Côte d'Ivoire, and Nigeria. In the past decade, there have been only two countries with confirmed records from this region (Guinea-Bissau in 2003, 2004 and 2005; Sierra Leonne in 2003) and unconfirmed records (Pristis sp.) from Mauritania in 2010. Areas surrounding Guinea-Bissau are possibly the last spaces where sawfish can be found in West Africa (Mika Diop pers. comm. 2012). The presence of sawfishes in the Mediterranean Sea remains uncertain (Whitehead et al., 1984; Bilecenoğlu & Taşkavak, 1999). While it is true that largetooth sawfish were seen in historic faunal lists (Serena, 2005), whether sawfishes occurred as part of the Mediterranean ichthyofauna or as a vagrant species as seasonal migrants from areas off West Africa is a matter of debate.	Decreasing (IUCN, 2021; Kyne et al., 2013)	
Western Atlantic	Unknown	In the Western Atlantic, largetooth sawfish were abundant throughout the tropical and subtropical marine and estuarine waters. They were found from Uruguay through the Caribbean and Central America, the Gulf of Mexico, and also seasonally around the United States (Burgess et al., 2009; Faria et al., 2013). As of now, largetooth sawfish are believed to primarily occur in the freshwater habitats of Central and South America and have been	Decreasing (IUCN, 2021; Kyne et al., 2013)	

		recorded in locations at least 1,340 km from the ocean in the Amazon River, as well as in Lake Nicaragua and the San Juan River and other east coast Nicaraguan rivers. They have also been reported in coastal systems of a range of South American countries, such as, Brazil, French Guiana, Suriname, Guyana and Colombia. In Central America, there have been scattered reports of largetooth sawfish in Panama, Costa Rica, Nicaragua, Honduras and Belize. The dearth of records in Mexico is a possible indicator that the species is no longer found west of the Yucatan Peninsula (R. Graham pers. comm., 2012). Across the Caribbean Sea, the presence of the largetooth sawfish was always uncertain and early records may have been for the smalltooth sawfish (P. pectinata). Although historically reported in the United States, the largetooth sawfish was there in abundance and was more likely a seasonal migrant. Since the 1960s, the species has not been reported in the United States (Burgess et al., 2009).		
Eastern Pacific	Unknown	In the Eastern Pacific, the historic range of largetooth sawfish which is believed to occur from Mazatlán, Mexico to Peru (Chirichigno & Cornejo, 2001; Cook et al., 2005; Faria et al., 2013) was limited by cooler California current to the north of its range and the Humboldt Current in the south (V. Faria pers. comm., 2012 in IUCN, 2021). Amezcua-Linares (2009) suggests that they occurred south from Topolobampo (some 440 km further north than Mazatlán), in turn indicating the uncertainty over its historic range. It is possible that the largetooth sawfish in Peru may have been seasonal migrants from the species' core range in Central America. According to Cook et al. (2005), the largetooth sawfish were reported from several freshwater systems in the Eastern Pacific.	Decreasing (IUCN, 2021; Kyne et al., 2013)	
Indo-West Pacific	Unknown	Although now patchy at best, the largetooth sawfish from Indo-West Pacific once ranged wide from parts of the Western Indian Ocean through India, the Bay of Bengal and Southeast Asia to New Guinea and northern Australia. In the past, they were reportedly seen in several major river systems of Papua New Guinea, Indonesia and Malaysia (including Borneo), Cambodia, Viet Nam and the Philippines (Roberts, 1978; Tan & Lim, 1998; Compagno et	Decreasing (IUCN, 2021; Kyne et al., 2013)	

		al., 2005; Stevens et al., 2005). In many of these systems, their presence is now either uncertain or non-existent. It is likely that the largetooth sawfish is extinct in several range states, including South Africa, the Seychelles, Thailand and others. In other regions its population has severely depleted. Australia may be the last viable population stronghold in the Indo-West Pacific, particularly across tropical northern Australia from the northeastern coast of Queensland, across Cape York, the Gulf of Carpentaria, the Northern Territory and the Kimberley region (Western Australia). It has also occurred as a vagrant in southwestern Australia (Last & Stevens, 2009).		

The data given at country level is specific to the Indo-West Pacific region:

Country	**Population estimate (plus references)**	**Distribution**	**Population trend (plus, references)**	**Notes**
Australia	Unknown	Western Australia, Queensland, Northern Territory, Gulf of Carpentaria, Fitzroy River, Daly and Victoria Rivers, rivers of western Cape York, Cape Naturaliste, southwest Australia (Stevens et al., 2005; Phillips et al., 2011; 2012; Peverell 2005; Morgan et al. 2011; Chidlow 2007; Harrison & Dulvy, 2014)	Decreasing (IUCN 2021)	Extant (resident)
Bangladesh	Unknown	(Faria, 2007; Raje & Joshi, 2003; Hoq et al., 2011; Hossain et al., 2015)	Decreasing (IUCN 2021)	Extant (resident)
India	Unknown	Maharashtra State, Andaman and Nicobar Islands (IUCN, 2021; Fishbase; Harrison & Dulvy, 2014)	Decreasing (IUCN 2021)	Extant (resident)
Madagascar	Unknown	Western Madagascan Rivers, Northwestern Madagascar, Mauritius, Reunion Island and The Seychelles, Betsiboka River (Faria et al., 2013; Taniuchi et al., 2003; Letourneur et al., 2004; Nevill et al., 2007; IUCN, 2021; Harrison & Dulvy, 2014)	Decreasing (IUCN 2021)	Extant (resident)
Mozambique	Unknown	Southern Mozambique, Zambezi River, Maputo, Gaza and Inhambane Provinces, Inhaca Island Near Maputo, Quirimbas Archipelago, KwaZulu-Natal coast, Niani Maru, Senegal, Devil's Point, Balingo, Kartung Beach, Lake Nicaragua–Río San Juan, Kuntaur, Wassadougou (Kiszka, 2012; Faria et al., 2013; IUCN, 2021; Harrison & Dulvy, 2014; Leeney & Carlson, 2015; Leeney & Poncelet, 2013; Leeney & Downing, 2015; Pierce, 2014, Everett et. al., 2015)	Decreasing (IUCN 2021)	Extant (resident)

Pakistan	Unknown	Gwadar, Western Balochistanm (Faria, 2007; Raje & Joshi, 2003; Hoq et al., 2011; IUCN, 2021; Harrison & Dulvy, 2014)	Decreasing (IUCN 2021)	Extant (resident)
Papua New Guinea	Unknown	Lake Sentani, Sepik, Ramu, and Keram rivers, Chambri Lake, Kubkein (Polhemus et al., 2004; IUCN, 2021; Harrison & Dulvy, 2014)	Decreasing (IUCN 2021)	Extant (resident)
East Africa	Unknown	Tanzania, Zanzibar, Kenya, Somalia, Unguja Island (Barnett, 1997; Okeyo, 1998; Musse & Mahamud, 1999; Faria et al., 2013; IUCN, 2021; Harrison & Dulvy, 2014)	Decreasing (IUCN 2021)	Extant (resident)
Cambodia	Unknown	Khone Falls, Mekong (Rainboth, 1996; IUCN, 2021; Harrison & Dulvy 2014; Leeney et. al., 2018)	Decreasing (IUCN 2021)	Possibly Extinct
Lao People's Democratic Republic	Unknown	-	Unknown	Possibly Extinct
Malaysia	Unknown	Borneo, Kinabatangan River, Sabah, Sarawak, Sukau (Last et al., 2010; IUCN, 2021; Harrison & Dulvy 2014)	Decreasing (IUCN 2021)	Possibly Extinct
Seychelles	Unknown		Unknown	Possibly Extinct
Singapore	Unknown		Unknown	Possibly Extinct
South Africa	Over 100 (S. Dudley pers. comm. 2012 in Harrison and Dulvy, 2014)	Lake St. Lucia, KwaZulu-Natal (KZN) coast (Smith & Heemstra, 2003; Wallace, 1967; Compagno et al., 2006b; 2006a; Faria et al., 2013; IUCN, 2021; Harrison & Dulvy 2014).	Decreasing	Possibly Extinct
Other countries	Unknown	The presence of the species is uncertain in the following countries: Brunei Darussalam, China, Kenya, Myanmar, Philippines, Sri Lanka, Tanzania, Vietnam and Yemen	Unknown	Possibly Extinct
Indonesia	Unknown	Arafura/Banda Sea region (W. White pers. Comm., 2012 in Harrison and Dulvy, 2014)	Unknown	Presence Uncertain

1.2.2 Local distribution:

In the Bay of Bengal in the early 1900s, sawfishes in general were reported abundantly and were considered to be either “very common” or “common” in the estuaries and mouths of the Ganges and Brahmaputra rivers (Annandale 1909). Sawfish rostra were reported to be ‘all over the beach’ of Cox’s Bazaar in the 1960s (Anonymous, 2010). The Sundarbans, the largest mangrove ecosystem in the world (Chowdhury, 2017) and which includes freshwater, estuarine and marine habitats, has been suggested as likely providing key habitats for sawfishes (Hossain et al., 2015). However, a decline in sawfish observations over several decades has been documented in Bangladesh, potentially attributable to high levels of bycatch, particularly in drift gill nets (Hossain et al., 2015). Similar declines have been reported from many parts of the northern Indian Ocean, southern India (Joel & Ebenezer, 1999; Manojkumar et al., 2002) and Sri Lanka (De Bruin et al., 1994). Hossain et al., 2015 reported museum specimens which were caught from upstream the rivers Meghna, Jamuna and Karnafuli. While sawfishes are still caught by fishers in the Bay of Bengal, there is information to suggest that numbers have declined significantly (S.M.A. Rashid pers. comm. 2012 in Harrison and Dulvy, 2014). A socio-ecological approach to identify critical habitats for sawfish evaluated the coast-wide historical presence; however, the reports of the species catch have been concentrated most to the

southwestern region near Sundarbans and rarely in southcentral region, mostly for landing. The details are as follows for Bangladesh:

Region / province	Site	Level of Protection	Population size	Reference(s)	Notes
South-east region	Chattogram	None	Unknown	Hossain et al., 2015; Haque et al., 2020; Haque unpubl. data	8 sawfish landings were reported on December 2016, March and April 2017. Two sawfish rostra were encountered on January 2017.
	Cox's Bazar	Ecological Critical area (ECA)	Unknown	Hossain et al., 2015; Haque et al., 2020; Haque unpubl. data; Anonymous, 2010; Harrison & Dulvy, 2014.	Three juvenile sawfish, *P. pristis* were landed at Cox's Bazar on 18 November 2011 and 29 April 2012 (Hossain et al., 2015). Fifty-three sawfish recorded between July 2010 and June 2011 by BFRI unpublished report (Hossain et al., 2015). Three sawfish rostra were encountered on November 2016 and August 2017 (Haque et al., 2020).
	Kutubdia	ECA	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Moheshkhali	ECA	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Soandia	ECA	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	St.Martin's Island	ECA	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Galachipa	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Lal Dighir Char	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Teknaf	ECA	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
South-central region	Alipur	None	Unknown	Haque in prep. 2021	Probably still present (mostly landings)
	Bhola	None	Unknown	Haque in prep. 2021	Probably still present
	Bishkhali River	None	Unknown	Haque in prep. 2021	Probably still present (mostly landings)
	Bolesshor	None	Unknown	Haque in prep. 2021	Still present (recent catch records)
	Char Gangamoti	None	Unknown	Haque in prep. 2021	Probably still present
	Char Montaz	None	Unknown	Haque in prep. 2021	Probably still present
	Dal char	None	Unknown	Haque in prep. 2021	Probably still present
	Hatia	None	Unknown	Haque in prep. 2021	Unknown

	Khajurar Char	None	Unknown	Haque in prep. 2021	Probably still present
	Kuakata	None	Unknown	Haque et al., 2020; Haque in prep. 2021	One sawfish rostrum was encountered on 2008. Four largetooth sawfish were caught from this region in 1998 and the rostra were kept in Brojomohun College, Barisal (Hossain et al., 2015). Historical presence (mostly landings)
	Khepupara	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Mohipur	None	Unknown	Haque et al., 2020; Haque in prep. 2021	Twelve largetooth sawfish landing was reported on October 2016; February, March, May, August, and September 2017. Probably still present (mostly landings).
	Patharghata	None	Unknown	Haque et al., 2020; Haque in prep. 2021	Two sawfish rostra were encountered on August 2017. Probably still present (mostly landings)
	Parerhat, Piirojpur	None	Unknown	Chowdhury et al., 2018	Five juvenile sawfish were caught and landed in Parerhat Pirojpur in 2017
South-west region	Alor Kol	Sanctuary, ECA	Unknown	Haque in prep. 2021	Still present (recent catch records)
	Andharmanik	Sanctuary, ECA	Unknown	Haque in prep. 2021	Probably still present (mostly landings)
	Arpangasia	Sanctuary, ECA	Unknown	Haque in prep. 2021	Still present (recent catch records)
	Badamtola		Unknown	Haque in prep. 2021	-
	Bangabandhu Char	Sanctuary, ECA	Unknown	Haque in prep. 2021	-
	Bakkhali River		Unknown	Haque in prep. 2021	Probably still present
	Behela, Kohela Char	None	Unknown	Haque in prep. 2021	Probably still present
	Bonduri diya	None	Unknown	Haque in prep. 2021	Probably still present
	Chalnar boya	None	Unknown	Haque in prep. 2021	Probably still present
	Dim Char	None	Unknown	Haque in prep. 2021	Probably still present
	Dublar Char	Sanctuary, ECA	Unknown	Haque et al., 2020; Haque in prep. 2021	Two sawfish landing was reported on December 2016 and November 2017. Probably still present.
	Gulir Dhar	None	Unknown	Haque in prep. 2021	Probably still present
	Hiron Point	Sanctuary, ECA	Unknown	Haque in prep. 2021	Probably still present
	Jahajfora	None	Unknown	Haque in prep. 2021	Probably still present

	Kalir char	None	Unknown	Haque in prep. 2021	Probably still present
	Khulna	None	Unknown	Haque et al, 2020; Haque in prep. 2021	Three sawfish landing was reported on April 2018 and July 2019. Historical presence (Fishers' interview).
	Kuchikhali	None	Unknown	Haque in prep. 2021	-
	Mathavanga	None	Unknown	Haque in prep. 2021	-
	Mongla	None	Unknown	Haque in prep. 2021	Probably still present
	Narikelbaria	Sanctuary, ECA	Unknown	Haque in prep. 2021	Probably still present
	Pokkhir Char	None	Unknown	Haque in prep. 2021	Probably still present
	Ray Mangal	Sanctuary, ECA	Unknown	Haque in prep. 2021	Probably still present
	Rupshaghat	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Shibchar	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Shipsha	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Sonar char	Sanctuary, ECA	Unknown	Haque in prep. 2021	Probably still present
	Sundarbans	Sanctuary, ECA	Unknown	Haque et al, 2020; Haque in prep. 2021	Two sawfish landing was reported on August 2017 and January 2020. Probably still present.
	Swarch of no ground	Marine Protected Area (MPA)	Unknown	Haque in prep. 2021	Anecdotal information (probably not true)
	Pirojpur		Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Bagerhat	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Patuakhali	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)
	Firingi Khal	None	Unknown	Haque in prep. 2021	Eight encounters reported (probably caught from further deeper waters)
	Poshur river	None	Unknown	Haque in prep. 2021	Probably still present
Upstream	Jamuna river	None	Unknown	Haque in prep. 2021	Historical presence (Fishers' interview)

1.3 Protection status:

Largetooth sawfish in Bangladesh are protected by the Appendix I of the 'Wildlife (Conservation and Security) Act 2012' and listed in CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) also under Appendix I. Although fishing is permanently prohibited in three wildlife sanctuaries of the Sundarbans reserve Forest (SRF) (32,386 ha) by Wildlife Sanctuary Regulations (1999), the findings of a two-year project focused on the species, led by the author indicate low compliance to these regulations (Haque in prep. 2021). Although these sanctuaries should, by default, provide some protection to sawfish (assuming they use the waters within the SRF), a lack of monitoring and enforcement limits their effectiveness. Awareness about the protection status amongst the fishers and traders is limited. Moreover, these stakeholders have no knowledge about specific regulations as to what needs to be done if a sawfish is entangled accidentally live or dead.

Reported international trade in sawfish products is therefore cause for concern and suggests that this legislation is not being effectively implemented. Fishers and traders are often not aware of national legislation pertaining to protected species (Haque and Spaet, 2021; Haque et al., 2021 a; Haque et al., 2021 b; Haque et al., 2020). A more effective implementation of existing CITES legislation, which prohibits the trade in sawfish products, would reduce (or ideally eliminate) overseas demand for sawfish products from Bangladesh. This, combined with an educational programme highlighting the endangered status of sawfishes in Bangladesh, and encouraging fishers to release them alive, may be appropriate. However, enforcement of fisheries-related legislation and monitoring of trade can be challenging for developing countries with limited resources. There are also ethical issues surrounding the prohibition in the use of natural resources by impoverished communities, who often have few livelihood alternatives. A better understanding of the likely impacts of prohibiting catch (directed and accidental) of sawfish on artisanal fishing communities would allow for better design of realistic management strategies in which conservation objectives will not conflict with social justice.

1.4 Ecology, behaviour and habitat requirements:

Largetooth sawfish inhabit freshwater (inland waters) and marine systems within wetlands (inland), marine neritic, and marine intertidal habitats. In Bangladesh it predominantly inhabits marine and estuarine habitats in shallow coastal areas including rivers, freshwater areas in estuaries; sometimes in river mouths associated with mudflats and mangroves in inshore areas (Leeney, 2017; Harrison & Dulvy, 2014). Given that a large proportion of Bangladesh's coastal land cover is riverine, many potential key habitats for sawfishes have been reported, especially within the Sundarbans mangrove forest in the south-western coastal region (Hossain et al., 2015).

Largetooth sawfish are reported from <10m up to 26 m depth in coastal, estuarine, and fresh waters. Most information on the ecology of the species was documented from Lake Nicaragua (Thorson, 1982) or Australia (Kyne et al., 2021). The species uses the rivers and their estuaries as nursery grounds (Wittey et al., 2017). It is able to move in different salinity gradients where the juveniles use the freshwater river systems or floodplains for 4-5 years and in adulthood reaches the marine systems (Thorburn et al. 2007, Peverell 2008, Whitty et al. 2008, Whitty et al. 2009, Kyne et al., 2021, Kyne et al., 2013).

The maximum size reported is of at least 705 cm total length (TL), with a size-at-birth of 72−90 cm TL, a female size-at-maturity is 300 cm TL, a male size-at-maturity is 280−300 cm TL, and age-at-maturity of 8−10 yr. The longevity is estimated at around 30−36 yr, with a litter size ranging in between 1 and20 pups (mean of 7.3 in Lake Nicaragua) (Kyne et al., 2021). It is reported that largetooth sawfish performs

lecithotrophic viviparity as a reproductive method (Thorson 1976). Although the reproductive cycle is reported as biennial in Lake Nicaragua, in the Indo-west Pacific (Australia) it is annual. It is a slow-growing, late maturing animal with low fecundity, all k-selected traits. A range of intrinsic rate of increase has been reported. Simpfendorfer (2000) estimated it to be 0.05 to 0.07 per year with population doubling times of 10.3–13.6 yr given the ecological condition is ideal. For the Indo west Pacific, Moreno Iturria (2012) reported the intrinsic rate to be 0.12 yr^{-1}, a population doubling time of 5.8 yr and a generation time of 14.6 yr (Kyne et al., 2013).

1.5 Threat analysis:

Threats	**Types**	**Description of how this threat impacts the species**	**Intensity of threat** *(low, medium, high, critical or unknown)*	**IUCN Red List Threat category**
Fisheries	Artisanal longline	About 80 fishing vessels targeting benthic rays using un-baited hooks in a long line operates in the southcentral region. Such practices are also present in the southeast regions; however, they exploit similar fishing grounds. Although these vessels do not target sawfish particularly, their targets expand from rhinopristiformes rays to all other benthic rays. Due to the high retention rate owing to high market price, this is a significant threat.	High	5.4.1 Intentional Use: subsistence/small scale (species being assessed is the target)
	Artisanal nets	Most sawfish capture and retention reported within the study period and reports from literature were caught in non-target artisanal fisheries practices. These fisheries target an array of other fishes using different gillnets, set bag nets, seine nets, trammel nets etc. Due to the structure of the species' rostrum they get entangled in the net and thus get caught.	Critical	5.4.1 Intentional Use: subsistence/small scale (species being assessed is the target); 5.4.3 Unintentional effects: subsistence/small scale (species being assessed is not the target)
	Trawling (Commercial)	There are reports that the commercial trawling vessels come very near to the shallow waters (within 5-10 m depth) and thus catch sawfish. Haque et al., 2020 and Haque unpubl. data reported several sawfish catch from trawling operations from Chattogram.	High	5.4.2 Intentional Use: large scale (species being assessed is the target); 5.4.4 Unintentional effects: large scale (species being assessed is not the target)

	Subsistence fisheries	There are anecdotal reports of small subsistence boats in the Sundarbans area catching juvenile sawfishes.	Medium	5.4.1 Intentional Use: subsistence/small scale (species being assessed is the target); 5.4.3 Unintentional effects: subsistence/small scale (species being assessed is not the target)
	Illegal fish poisoning	In the Sundarbans area, the practice of catching fish using poison is prevalent. This affects other species and deteriorates critical habitats and nursery grounds for sawfish.	High	5.4.3 Unintentional effects: subsistence/small scale (species being assessed is not the target)
	Illegal, unregulated fisheries (IUU)	High percentage of Illegal, Unreported, and Unregulated Fishing has been reported in Bangladesh. Most elasmobranchs are caught in the artisanal fishery (Halder, 2010; Ullah et al., 2014; Haque et al., 2018). Although the main marine fish landing sites are operated by the Bangladesh Fisheries Development Corporation (BFDC), there are numerous other informal landing sites along the coastline. Therefore, a significant amount of the commercial catch is under-reported (Ullah et al., 2014).	High	5.4.1 Intentional Use: subsistence/small scale (species being assessed is the target) 5.4.2 Intentional Use: large scale (species being assessed is the target)
Habitat degradation and loss especially of nursery grounds in freshwater systems is a serious problem	Shrimp aquaculture	Shrimp aquaculture is prevalent in the coastal region degrading soil and water quality at a large scale. The run-off to the river systems degrades water quality and increases pathogens.	Medium	2.4.1 Subsistence/Artisanal Aquaculture; 2.4.2 Industrial Aquaculture
	Increasing salinity	Increasing salinity in the coastal habitats due to both nutrient loads, agricultural run-off and climate change in is altering the habitats to an unknown scale.	Medium	11. Climate Change & Severe Weather; 9.1.2 Run-off; ; 9.3.1 Nutrient Loads
	Mangrove exploited for timber	Exploitation of timber and other forest products is a common phenomenon in the Sundarbans. excessive collection of forest products degrades quality of mangroves leading to reduction in the nursery grounds for sawfish.	High	5.3 Logging & Wood Harvesting

	Pollution	Pollution from agricultural and aquacultural run-off; oil spills from boats, and accidental coal spills in the rivers of SFR; soil erosion, sedimentation; plastic and solid waste all aggregate putting a composite pressure on habitats degrading its quality.	High	9.1.2 Run-off; 9.2.1 Oil Spills; 9.3.1 Nutrient Loads; 9.3.2 Soil Erosion, Sedimentation; 9.4 Garbage & Solid Waste
Infrastructural development/ Ecosystem modification	Coal power plant	There have been several cases of commercial oil spills and drowning of coal loaded ships in the rivers of Sundarbans happened in the past few years. This is due to the Coal power plant being created very near to the sawfish habitats.	High	1.2 Commercial & Industrial Areas
	Unplanned tourism	Unplanned tourism in the Sundarbans is a common phenomenon polluting the rivers and the peripheral forests.	Unknown	1.3 Tourism & Recreation Areas
Fin and meat trade	International	The high demand of high-quality meat and fins from Sawfish are traded from Bangladesh with a high market price (Haque unpubl. data). The kg of fins can bring as much as 400 USD and the meat can be dried and exported as well. This creates easy access to markets, high demand and thus high retention rate of accidentally caught individuals.	Critical	5. Biological Resource Use
	National	The majority of coastal communities culturally believes that sawfish meat can cure cancer hence there is a sizable local demand for the meat. The kg of meat can be sold as high as 40 USD. The rostrum is also sold as a souvenir. The cartilages and the rostrum are also reported to be used by village medicinal practitioners.	Critical	
Climate change	The effects of Climate change interacts with and exacerbates most of the localised threats described above and are becoming indirect drivers of many of them.	The low-lying coastal areas are impacted by climate change. There are no studies looked into the impacts of climate change in sawfishes but it is evident that the indirect impacts from ocean acidification jeopardising water quality, temperature rise creating physiological problems and finally modification of habitats may become hazardous for the survival of sawfish in Bangladesh. Climate change can lead habitat shifting & modification, ocean acidification, temperature rise and weather severity all evident in coastal Bangladesh.	Unknown	11.1 Habitat Shifting & Alteration 11.4 Storms & Flooding; 11. Climate Change & Severe Weather 11.3 Temperature Extremes 11. Climate Change & Severe Weather.

Debris in ocean	Micro-plastic pollution/Plastic pollution	Plastic pollution in the riverine, coastal and marine waters in Bangladesh is high yet less studied (Chowdhury et al., 2020; Hossain et al., 2021; Nelms et al., 2021). The River Ganges contributes the second largest amount of plastic to oceans (Chowdhury et al., 2020) from various sources including fishing nets compromising aquatic species' health and survival including elasmobranchs (Nelms et al., 2021). Heavy loads of microplastic was also found in river bottoms in Bangladesh which are potential habitats for sawfish (pers. comm.). If these debris are consumed by the sawfishes then these will build up in the fish's digestive system over time, causing it to become unable to feed properly and eventually die.	High	9.4 Garbage & Solid Waste
	Ghost nets	Tangling in drifting ghost nets is a common phenomenon for elasmobranchs. Discarded nets in the rivers and coastal waters can be entangled in the rostrum, around gills and fins, which can subsequently suffocate or starve the species to death.	Medium	9.4 Garbage & Solid Waste

1.6 Stakeholder analysis:

Stakeholder	**Types**	**Stakeholder's interest in the species' conservation**	**Current activities**	**Impact** *(positive, negative or both)*	**Intensity of impact** *(low, medium, high or critical)*
Artisanal fishers	Boat owners	Fishers have an array of socio-cultural interests. They possess cultural and sentimental value for such a charismatic species and worry about their decrease. Many also happened to believe that the sawfish is important for the ocean health maintenance and fish production. Their interest may also reflect the possibility of government facilitation for best practices in fisheries. By adhering to such positive actions social respect can be earned as well.	Operate artisanal fisheries by lending money, boat and nets to the fishers and have the power to take any decision regarding fishing activities in their boats	The impact can both be negative and positive depending on context. Fishing inherently has negative impacts on sawfishes in Bangladesh, however, these fishers do possess some cultural values and understand the importance of such fishes if the messages are portrayed correctly; hence they have positive impacts as well. If appropriate facilitation and incentives are provided, they can have real positive conservation impacts.	Critical
	Captains		Captains are the most important crew members in a single boat and has the decision taking power in the boat he is operating		Critical
	Labourers/ fishers		Fishers working in the boat		High
	Motorist		A technician in each boat is responsible for the engine and helps in fishing		Low
	Fishing company owners (artisanal)	Unknown	Owns several boats and have access to power and resources	Having no connection to actual fishing, the fishing company owners may only be interested in monetary profits by increasing fishing activities and hence may have negative impacts	Critical
Commercial fisheries	Fishers	Unknown	Fishers in commercial scale trawl vessels.	Given the limited power they have in contrast to the company owners in	High

			Employees of the fishing companies	taking fishing related decisions, they mostly have negative impacts;	
	Company owners	Unknown	Owns mid-water and bottom-trawling vessels and has access to recourses. Large scale operations.	Having no connection to actual fishing, the fishing company owners may only be interested in monetary profits by increasing fishing activities and hence may have negative impacts; however, with negative incentivising by laws and making them as best practitioners of such laws turn the impacts into positive.	High
Traders	Exclusive traders	Existing laws disincentivise traders to trade on sawfishes. However, that depends on the capacity to enforce and monitor. Traders are interested in high value fins for international markets and meat for national market.	Trades only on sharks and rays including sawfish	Depending on the power and resources these stakeholders possess, the decision-making ability varies (e.g. exclusive traders having more power and processing centre owners having limited power). And hence, currently these stakeholders mostly have negative impacts. However, innovative incentives to follow the legal framework for trading sawfish may change their impact to positive	Critical
	Opportunist traders		Opportunistically trades in sawfish, but usually trades on other elasmobranchs as well.		Critical
	Middlemen		Buys the sawfish from fishers and sells it to the exclusive traders		Low
	Fish traders		Usually trades on other teleost fishes but if opportunity arises trades in sawfish as well		Low
	Agent for international trade		Arranges international export for sawfish meat and fins alongside other elasmobranchs		Critical
	Processing centre workers		Workers who cut and process the sawfish		Low
Consumers	International	Fin soup is a delicacy in many Asian countries and meat of	Consumers in Myanmar, China, etc.	Although the national consumers are mostly posing	Low

		elasmobranchs are also demanded in many European and Asian countries.		negative impacts on sawfishes in Bangladesh (believing in the cancer-curing myth); they are key to change behaviours and act as protectors by not consuming sawfishes and diminishing the demand in national markets. With proper campaigns the national consumers can act as real pioneers of sawfish conservation and have positive impacts.	
	National	The coastal communities believe in the cancer-curing properties of sawfish meat hence want to collect and store some of it. However, Interest to conserve a charismatic species, access to alternatives, awareness about the importance of the species are also there in different contexts.	Coastal communities and tribal communities		Critical
Policy makers/ government bodies/ Implementing bodies	Department of Fisheries	As a constitutional mandate for the institution, they are responsible for securing compliance with the Protection and Conservation of Fish Act, 1950 and the Marine Fisheries Ordinance, 1983 which are two key laws dealing with the regulation of marine fisheries.; which includes the potential of protection of elasmobranchs, however nothing is mentioned separately for sawfishes.	Manages fisheries related activities through policies and laws	Creating and implementing appropriate policies and regulations and ensuring the facilitations for the primary stakeholders to adhere to these laws, they can have positive impacts.	Critical
	Department of Forest (Forest officers)	As a constitutional mandate for the institution, they are responsible for securing compliance with the Wildlife (Conservation and Security) Act, 2012 which includes the protection of the largetooth sawfish in	Manages wildlife related activities through policies and laws		Critical

		Schedule I. They are also responsible for fulfilling the mandates for CITES, as largetooth sawfish is listed in App I.			
	BFDC	Govt. mandates to account for marine fish landing at the formal landing sites throughout the coats of Bangladesh. Responsible for accounting and reporting of the marine catch. However, currently do not have the capacity account for species-specific data for elasmobranchs including largetooth sawfish.	Monitors and report the fish landing at major coastal sites		High
Law enforcing agencies	Bangladesh Navy, Coast Guard, Police, Customs offices, airport authorities, Boarder Guard Bangladesh (BGB)		Monitoring fishing and fish landing activities in the coastal waters.	Through implementing govt. mandates and monitoring the field level work and fishing practices, these agencies can have high positive impacts.	High
Research organisations	Universities	Research and conservation science, social responsibility	Marine fisheries research projects	Through providing advanced and applicable conservation research for sawfish, universities and other fisheries research institutes can have positive impacts	Medium
	BFRI	Research	Marine fisheries research projects		Medium
	Institute of Marine Sciences	Research			
NGOs	International	Halt the decline in biodiversity	Elasmobranch conservation projects	By implementing conservation projects, conservation NGOs can have high positive impacts	High
	National	Halt the decline in biodiversity	Marine fishers related projects		High

1.7 Context and background information that will affect the success of any conservation action for this species:

	Description	Barriers to conservation	Opportunities for conservation
Socio-cultural effects and cultural attitudes	There are an array of socio-cultural effects attitudes in different communities and belief systems: -The majority of coastal communities (and fishing communities) believe that sawfish meat cures cancer. As a result, they consume it and store it depending on availability. Traders also store to sell the meat later when there is a demand for it to sell in a high price. -Fishing communities also have some extent of emotional/sentimental feeling towards this species as it is charismatic, big and many of the fishers have not seen/caught it in a long time. Seeing such a species disappearing in front of their own eyes makes many of them think about getting them back to their waters. -Some negative (rarely) attitudes were recorded during surveys, from some members of the fishing communities regarding live releases as this may require that theirs nets be cut. -The rostrum is highly regarded by collectors as souvenirs.	-The myth of cancer curing properties associated with consuming sawfish meat is a big barrier to mitigate retention rates if accidentally caught. The collectors of the rostrum may also provide some incentives for high retention rates.	-Debunking the myth in the coastal communities using culturally appropriate campaigns will reduce the national demand and disincentivise the fishers and traders to retain the catch -Disincentivizing the collectors for rostrum collection by raising awareness and alternative non-animal curios will reduce the market demand for unconventional products. -Inclusive and democratic strategy creation for the conservation of largetooth sawfish will ensure ownership of these actions and hence a better chance to be effective and successful. It will also ensure social justice and local integration.
Economic implications	-The largetooth sawfish is one of the most expensive elasmobranchs in Bangladesh. Moreover, fishing on marine species is the only means of livelihood generation for most of the coastal and marine fishers. These people are vulnerable	-Fishing ban may cause loss of livelihoods -Loss of jobs if caught individuals are released without consulting the boat owner.	- There is opportunity to create an innovative incentive-based live release program whereby the various financial vulnerabilities of the fishers are mitigated in exchange for releasing a sawfish alive.

	financially and are victims of a debt-driven fisheries operation without much to earn or having a say in the action. -Shark fin soup is regarded as a delicacy in many countries. As a result, there is clear demand and markets for local traders to participate in sawfish fin trade.	-In pursuit of releasing a sawfish alive, there can be loss of resources like nets or other gears. -The Asian and European fin markets provide the much-needed demand for the continuous supply for the fins.	-on-board monitoring of by-catch and live release using log-booking or cctv monitoring technology is also possible. This will create a better monitoring regime and also incentivise fishers by mitigating any safety related vulnerabilities. -International trade ban enforcing the existing laws and international commitments (CITES) more effectively will disincentivise traders to trade in high value products and fishers to not retain any by-caught species.
Existing conservation measures	Largetooth sawfish in Bangladesh are protected by the Appendix I of the 'Wildlife (Conservation and Security) Act 2012' and listed in CITES Appendix I. Catch/hunting and trade of Schedule I species are prohibited which can otherwise lead to imprisonment and/or fine. Moreover, this species gets some protection by-default in the Sundarbans sanctuaries and the two MPAs in the territorial waters of Bangladesh. If any person kills any cheetah, lam cheetah, hoolock, sambar deer, crocodile, gharial, whale or dolphin mentioned in schedule I, he shall be deemed to have committed an offence and for such offence, be punished with either, or both, imprisonment for a term not exceeding 3 (three) years and a	The protection of species by the Wildlife Act is more prominent with terrestrial species and very new to enact for sharks and rays. No specific direction in the law about by-catch species or dead species processing or even the punishment for this species.	A coordinated National Action for the last remaining largetooth sawfishes in Bangladesh can be initiated which will drive the political will and possible funding for the actions to be implemented at the local level. Raising awareness about the protection status of the species according to the Wildlife Act 2012, could help reduce the number of individuals that are kept when caught incidentally by fishers and could help deter traders from commercialising

	fine of Taka not exceeding 3 (three) lac or In case of his repetition of the same offence, he/she shall be punished with imprisonment for a term not exceeding 5 (five) years or with a fine of Taka not exceeding 5 (five) lac or with both If any person collects, acquires or purchases or sells or transports any trophy, uncured trophy, meat, parts of body of cheetah, lam cheetah, hoolock, sambar deer, crocodile, gharial, whale or dolphin mentioned in schedule I, he shall be deemed to have committed an offence and for such offence, be punished with imprisonment for a term not exceeding 2 (two) years or with a fine of Taka not exceeding 1 (one) lac or with both, and in case of his repetition of the same offence, he shall be punished with imprisonment for a term not exceeding 4 (four) years or with a fine of Taka not exceeding 2 (two) lac or with both The Department of Forest and The EWC Bangladesh is creating a National Plan of Action for elasmobranchs, where sawfish may be included. Department of Zoology, Dhaka University also working towards community-led conservation of sawfish in Bangladesh.	Less coordination among different interested and involved government bodies. Fishers and traders are not aware of the legal framework protecting the species. Limited on-board monitoring in the fishing vessels or at landing sites.	products of the species. For example, a reward-based adoption of the law can be initiated. The Largetooth sawfish can be introduced as a flagship species of the coastal waters of Bangladesh, the largetooth sawfish can bring in much needed attention to conservation of coastal animals as opposed to just resources being utilised or fished.
Administrative/ political set-up	The administration set up is multi-layered in Bangladesh regarding management of marine species. There are 8 divisions and 64 districts in Bangladesh. Each district is further subdivided into Upazila, also known as	The absence of a coherent legal framework for facilitating marine mega-fauna conservation in Bangladesh	Rapport and capacity building of all parties mandated for conservation and management will ensure a more collaborative, coherent and transparent

	subdistricts. Each subdistrict is divided into several unions consisting of villages. Direct elections are held for each union (or ward), electing a chairperson and a number of members. The Ministry of Local Government, Rural Development and Co-operatives stands at the core of all matters relating to local government in Bangladesh. In Bangladesh, there are two forms of local government, namely, urban local government and rural local government, along with Special affairs Division of Hill district. At the district level, there is the District Commissioner of the District Council or Zilla Parishad which is essentially the local government at the district level. The Deputy Commissioner, also popularly abbreviated as 'DC' is the executive head of the district. The Upazilla Nirbahi Officer (UNO) is a non-elected administrator of an Upazilla or subdistrict. It's also worth mentioning that each Upazilla Parishad or council has a Chairman and a range of other persons elected through direct elections. Finally, the Union Council or Union Parishad is the smallest rural administrative and local government unit in Bangladesh. The **Bangladesh Forest Department** is led by the Chief Conservator of Forests (CCF) under whom there are four Deputy Chief Conservator of Forests (DCCF) responsible for matters relating to management, planning, education and training and social forestry. Under the DCCF of the Forest Management Wing, there are 5 Conservator of Forest (CF) covering the Coastal, Central, Chittagong, Rangamati and Khulna Circles. Under the DCCF of the Planning Wing, there are	contributes to the lack of control over the elasmobranch trade. The presence of multiple jurisdictional bodies but lack of communication and collaboration among them may raise jurisdiction conflicts, especially in the face of different priorities. -Complex and bureaucratic hierarchy makes it difficult to implement actions and makes it too lengthy and not time appropriate.	initiative with enhanced possibilities of success. All involved parties have their own expertise and area of reach which sometimes are exclusive of that department/Institution (e.g. Fisheries Department is more capable of coastal and in-shore fisheries management, practically impossible for Department of Forest per say). Active involvement of high officials in conservation mandates. This will ensure speedy decision-making by-passing a long chain of bureaucracy which sometimes hampers timely actions. Taskforce generation for sawfish/elasmobranchs with representatives of all involved parties for making the process of action quicker and easier.

	two Deputy Conservator of Forest, two Assistant Chief Conservator of Forest and one Divisional Forest Officer. Under the DCCF of the Education and Training Wing, there are five Directors leading the Forest Academy in Chittagong and four Forestry Science and Technology Institutes. Finally, the DCCF of the Social Forestry Wing, there is one Assistant Chief Conservator of Forest under whom there are three Conservators of Forests based in Bogra, Dhaka and Jessore. **Department of Fisheries** is under the administrative control of the Ministry of Fisheries and Livestock. It is headed by a Director General, who is assisted by four Directors (one reserve) and 2 Principal Scientific Officer (equivalent to Director). There are 1553 technical officers of different stairs and supporting staffs in the DoF. There are administrative set-ups at division, district and Upazila (sub-district) levels headed by Deputy Director, District Fisheries Officer and Senior/Upazila Fisheries Officer respectively. Besides these, there are three fish inspection and quality control stations under DoF. Furthermore, DoF also comprises of Marine Fisheries Station, Fisheries Training Academy, Fisheries Training and Extension Centers, and Fish Hatcheries. To cultivate, extract, manufacture, rear, export or import any wild animal or body part, meat, trophy, or any plant mentioned in the WCSA, 2012, a license needs to be issued by the Chief Warden of the Forest Department. Any project including collection of samples or handling of Scheduled species require written permits from the Department of Forest and if it is a		

	CITES species sample collection then it needs to be added in the letter. Permits are also needed to work on protected areas e.g. Sundarbans sanctuaries from the CCF's (Chief Conservator of Forests) and informing the Conservator of Forest in that area. Research in unprotected areas needs ethical permission from academic institutions where the project is being conducted.		
Local expertise and interest	The communities especially the fishers and traders have very good knowledge about the presence and the current steep decline rate of the largetooth sawfish. They often have shown very good knowledge about the habitats, nursery grounds, catch locations, ecology, breeding and other biological information. Within a cell phone generated network the fishers have reported several sawfish landings otherwise unreported in the formal landing sites. The interest to work with sawfish conservation and the recognition as a flagship species is gaining traction. The species being rare and unique in appearance has gained interest amongst the conservation community and researchers. It has also made its way to several media outlets regarding reporting of catch and conservation needs. Department of Forest and Department of Fisheries have the expertise of implementing relevant fisheries and conservation related projects and awareness programs in these areas. Different Universities and research institutes have the expertise to conduct advanced research.	The price of an adult species for its meat, fins and rostrums are much higher than for a fisher to let it go alive.	The knowledge of the local fishers can be used to infer long-term trends and patterns, declines, and regional extinctions. It can help to identify critical habitats, catch locations and trade hotspots. The local knowledge of fishers also assists in capturing a quick temporal snapshot of the past and the plausible future of fisheries and can guide conservation needs and actions. In the development of effective conservation strategies, fishers as key stakeholders can offer essential socio-ecological insights on conservation, legislation and aspects related to better compliance. The expertise from the different departments can create an evidence base for both conservation science and implementation of the projects.

Resources	The resources allocated for shark and ray conservation both nationally and internationally has increased in the recent years. However, due to COVID 19 the funding landscape has shifted towards health and COVID-19 mitigation in low- and middle-income countries. In Bangladesh under the SUFAL project funded by the World Bank and implemented by Department of Forest has some provisions for research and conservation for sharks and rays including sawfish. Some international funds are also available from Save Our Seas Foundation, Shark Conservation Fund, Zoological Society of London and EDGE of Existence program through fellowships for further work focusing on endangered marine animals.	For positive conservation outcomes of a project, it needs long term investments especially where behavioural change is crucial at the community level. For long term resources to be available, the political and in some cases global interests should be persistent which is not the case many times.	Scope of collaborative studies with IUCN shark specialist group, WCS, ZSL, UNDP and other relevant and interested international bodies. There is potential for allocating national funds for research, conservation and community development.

2. ACTION PROGRAMME

Vision (30-50 yrs)	
Restored and thriving largetooth sawfish population in the coastal waters of Bangladesh through rigorous research, effective and evidence-based conservation actions and inclusive policies	
Goal(s) (5-10 yrs)	
Decrease the risk of extinction of the Largetooth sawfish in Bangladesh through effective, participatory and financially sustainable conservation actions, led by local communities in the Bay of Bengal	
Objectives	**Prioritisation** *(low, medium, high or critical)*
Objective 1. Reduce largetooth bycatch mortality through the implementation of a community-led live release program in at least two regions (SW and SC)	Critical
Objective 2. Disincentivise traders and fishers from retaining any caught individual	Critical
Objective 3. Reduce trade through innovative and inclusive monitoring mechanisms in the landing sites, trade hubs and routes	Critical
Objective 4. Increase institutional capacity at the local level to improve enforcement and compliance of legal framework protecting sawfishes	High
Objective 5. Improve the knowledge about sawfish in the coastal communities in all regions to debunk myths and raise awareness about the species and its habitat	Critical
Objective 6. Critical habitat management for enhanced protection	Critical

Activities	Country / region	Priority	Associated costs (USD)	Time scale (yrs)	Responsible stakeholders	Indicators	Risks	Activity type
Objective 1: Reduce largetooth bycatch mortality through the implementation of a community-led live release program in at least two regions (SW and SC).								
Motivating fishing communities to engage in a live release program through engagement programs (multi-year regular meetings, trainings)	SW and SC coastal region	Critical	30,000	2-3	Department of Fisheries, Department of Forest, Fishers, fishing communities, conservation organisations	-Number of communities engaged	-Limited funding -Less interest amongst fishers due to lack of incentives or culturally appropriate conservation programs -losing momentum for a single species conservation due to less funds -Conflict with trades	Education and outreach and Management
Training fishers to release a sawfish alive with enhanced chances of survival and least post-release mortality	SW and SC coastal region	High	25,000	2-3	Department of Fisheries, Department of Forest, Fishers, fishing communities, conservation organisations	-Number of fishers pledged to release sawfish alive/reports that sawfish has been released alive	-Limited funding - Limited to no experienced sawfish handling trainers -Unwillingness to pursue long-term projects	Education and outreach and Management
Ensuring better reporting system through monitoring regimes and digital	SW and SC coastal region	Critical	50,000 (pilot)	3-4	Department of Fisheries, Department of Forest, Fishers, fishing communities,	-Number of log-books/devices installed in boats -number of reported encounters or catch	-Inability to create a central system for better reporting	Management

devices on-board and at landing sites					conservation organisations			
Ensuring culturally appropriate and economically meaningful incentives for live release	SW and SC coastal region	Critical	50,000 (pilot)	3-4	Department of Fisheries, Department of Forest, Fishers, fishing communities	-Acceptance of the fishers -Number of fishers accepted the incentives and adhered to the regulations	-Limited research -Limited outreach to the fishers -Lack of interest among the DoF official to engage in a single species non-commercial species	Management
Ensuring better husbandry practices	SW and SC coastal region	Medium	10,000 (for the protocol to be established)	5	Department of Fisheries, Fishers, fishing communities	-Number of trained fishers -A published protocol for husbandry and handling practices	-Limited research -Limited outreach to the fishers -Lack of interest among the DoF official to engage in a single species non-commercial species	Management and research
Building a self-regulating network of fishers to report any catch through encouraging social good conduct	SW and SC coastal region	High	20,000	2-3	Fishers, Conservation organisations	-Number of fishers/members involved in these networks -Number of reports	-Limited willingness of fishers at scale -Limited incentives to perform social work	Management

Objective 2. Disincentivise traders and fishers from retaining any caught individual								
Ensuring appropriate enforcement of the law	Bangladesh (All coastal region)	Critical	-	2	Department of Fisheries, Department of Forest, Coast guards, Police, Revenue board, Customs, Port Authorities	-Number of seizers -Number of penalties -Number of regular checking of trade hubs	-Limited political will -Limited awareness	Management
Awareness building amongst the fishers and trades about the legality issues	Bangladesh (All coastal region)	Critical	30,000	2	Department of Fisheries, Department of Forest, Practitioners, Conservation organisations	-Number of communities engaged -Number of traders reached	-Limited resources -Limited interest in long-term projects due to lack of continual resources	Education and outreach
Enhancing access to information, fishery and forest officer	Bangladesh (All coastal region)	High	-	2	Department of Fisheries, Department of Forest	-Number of fishery and forest officer involved -Number of times such information is shared on a one-to-one basis	-lack of resources -lack of interest amongst the affiliated bodies -no management body ensure such activities are done	Education and outreach and Management
Enhancing alternative means of income through more effective fishery practices	Bangladesh (All coastal region)	Medium	50,000 (pilot)	5	Department of Fisheries, Department of Forest	-Number of projects for alternative livelihood generation in the area -Number of beneficiaries	-Limited resources -Limited social research	Management

Objective 3. Reduce trade through innovative and inclusive monitoring mechanisms in the landing sites, trade hubs and routes								
Ensuring on-board catch monitoring mechanisms (log-books, digital devices)	Bangladesh (All coastal region)	High	50,000 (pilot)	3	Department of Fisheries, Department of Forest, Research institutes, Technological institutes, Conservation organisations	-Number of log-books/devices installed -Number of fishers engaged	-Limited resources -Limited technological research -Limited collaboration with expert bodies/individuals	Management
Random genetic analysis of fishery or shark products at airports and sea ports	Ports	High	25,000 (pilot)	4	Research institutes, Customs and Port authorities, Department of Fisheries, Department of Forest	-Number of facilities installed in such ports	-Limited genetic research -Limited trained personnel -Limited genetic resources	Management and research
Embedding trade monitoring mechanisms within the national accounting system through standardised processes	Landing sites	High	10,000	3	Department of Fisheries, Department of Forest, BFDC	-Number of BFDC landing sites involved -Number of accounting officers trained	-Limited interest -No precedence of detailed data collection/monitoring at such scale and breadth	Management
Ensuring traceability of marine traded products with individual product codes	Bangladesh (All coastal region)	High	-	5	Department of Fisheries, Department of Forest, revenue board, Customs and Port Authority and Border guards	-Protocol for product codes and its use -Number of BFDC landing sites using it	-No standardised protocol present -No institutions/ body is equipped to deal with trade route traceability	Management and research

Ensuring inclusivity of the fishers and traders in the management plan through workshops and discussions	Bangladesh (All coastal region)	High	20,000	5	Department of Fisheries, Department of Forest, Practitioners	-Number of fishers and traders involved in such meetings	-lack of interested participants from the fishing communities and traders	Education and outreach and Management
Objective 4. Increase institutional capacity at local level to improve enforcement and compliance of legal framework protecting sawfishes								
Creating a national plan of action	Bangladesh (All coastal region)	High	20,000	2	Research institutes, Universities, Department of Fisheries, Department of Forest, Fishers, fishing communities	-Published document of the NPoA	-lack of resources -lack of interest amongst the affiliated bodies -no particular management body/task force to ensure that the NPoA is adhered to	Management
Mobilising all stakeholders (scientists, educators, policymakers, conservationists, practitioners) to adhere to the action plan and take leadership in their respective fields	Bangladesh (All coastal region)	High	20,000	5	Department of Fisheries, Department of Forest, Practitioners	-Number and diversity of institutes and individuals involved	-lack of resources -lack of continual interest	Management

Enhancing education, awareness and interest about sawfish in Bangladesh	Bangladesh (All coastal region)	Critical	20,000 (pilot)	2-3	Department of Fisheries, Department of Forest, Practitioners	-Standardised protocol for such engagement (published) -Number of trainings provided	-lack of continual practitioners' interest to run such information generating and sharing works	Education and outreach
Inter-institutional communication and cooperation building	Bangladesh (All coastal region)	High	20,000 (pilot)	2-3	Department of Fisheries, Department of Forest, Practitioners, research institutions and Conservation organisations	-Number of meetings held -Meeting minutes -Number of actions taken	-lack of interest	Management
Regular training of all affiliated regulatory body field officers to ensure best practices	Bangladesh (All coastal region)	High	20,000 (pilot)	4	Department of Fisheries, Fishery officers, Department of Forest, Forest officers, Coast guards, Police, Revenue board, Customs, Port Authorities	-Number of trainings held	-Limited willingness -Limited resources	Education and outreach
Objective 5. improve the knowledge about sawfish in the coastal communities in all regions to debunk myths and raise awareness about the species and its habitat								
Campaigns for fishing communities	Bangladesh (All coastal region)	Critical	10,000 (pilot)	1-2	Department of Fisheries, Department of Forest, Practitioners, Conservation organisations	-Number of communities engaged	-lack of continual practitioners' interest to run such information generating and sharing works	Education and outreach

Campaigns for younger generations (Schools and colleges, Madrasas)	Bangladesh (All coastal region)	High	10,000 (pilot)	3	Department of Fisheries, Department of Forest, Practitioners, Conservation organisations	-Number of institutions engaged	lack of continual practitioners' interest to run such information generating and sharing works	Education and outreach
Door to door campaigns for at home family members	Bangladesh (All coastal region)	High	10,000 (pilot)	2	Department of Fisheries, Department of Forest, Practitioners, Conservation organisations	-Number of individuals engaged	lack of continual practitioners' interest to run such information generating and sharing works	Education and outreach
Meetings with religious leaders and boat owner's association	Bangladesh (All coastal region)	Critical	10,000 (pilot)	1-2	Department of Fisheries, Department of Forest, Practitioners, Conservation organisations	--Number of leaders engaged	lack of continual practitioners' interest to run such information generating and sharing works	Education and outreach
Designating sawfish as a Flagship species	Sundarbans	High	-	1	Department of Fisheries, Department of Forest	-Acceptance by govt. authorities and locals	-Lack of initiative	Education and outreach and Management
Objective 6. Critical habitat management for enhanced protection								
Research on identifying the critical habitats (participatory mapping, using e-DNA or habitat modelling).		Critical	30,000	2	Research Institutions	-Maps of critical habitats	-Limited resources -Limited advanced research capacity	Research

Ensuring spatial protection through protected areas/no-take zone		High	-	3	Department of Fisheries, Department of Forest, Practitioners, Conservation organisations	-Protected area designation -Published management framework -Number of authorise engaged	-Limited resources for monitoring such initiatives	Management
Ensuring selective gear use in critical habitats		High	30,000	3	Department of Fisheries, Department of Forest, Practitioners, Conservation organisations, research Institutions	-Number of fishers using selected gears	-Limited understanding on what gears are most safe in this context -Unwillingness of fishers to participate -Limited resources	Management and Education and outreach
Enhanced and inclusive monitoring within and adjacent to critical habitats		High	30,000 (pilot)	3	Department of Fisheries, Department of Forest, Practitioners, Conservation organisations	-Number of patrolling per week -Number of petrol officers engaged -Number of seizures	-Unwillingness of fishers to participate -Limited resources -No particulate taskforce to monitor	Management

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