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THE PROTECTION OF ELASMOBRANCH BIODIVERSITY IN THE SUNDARBANS, BANGLADESH IN RELATION TO SEASONAL ABUNDANCE

Md. Enamul Hoq[1*], Saha Pran[2], Swaran Chowhan[2], Masood Siddique[2] and Md. Mukhlesur Rahman[2]

Arannayk Foundation, 572/K Matikata ECB Chattar, Dhaka-1206, Bangladesh

ABSTRACT: The Sundarbans mangrove forest in south-western Bangladesh provides a unique habitat for coastal fisheries and estuarine nurseries, which in turn sustain thousands of local people. However, little is known about the biology, ecology, and composition of elasmobranch i.e. sharks and rays because there is a lack of species-specific research in this region. This study aims to evaluate local catch trends by analyzing landing data from small-scale fisheries in the north-west Sundarbans. In a one-year research, 20 species of sharks and rays were recorded in the mesohaline and saline zone of the Sundarbans: six sharks– *Carcharhinus leucas, Carcharhinus limbatus, Chaenogaleus macrostoma, Glyphis gangeticus, Scoliodon laticaudus, Pristis pristis,* and fourteen rays– *Brevitrygon imbricata, Brevitrygon walga, Himantura leoparda, Himantura uarnak, Himantura undulata, Pastinachus gracillicaudus, Pastinachus sephen, Pateobatis bleekeri, Pateobatis uarnacoides, Urogymnus asperrimus, Urogymnus granulatus, Urogymnus lobistoma, Urogymnus polylepis, Glaucostegus granulatus* etc. With the exception of the Critically Endangered large-tooth sawfish and granulated sharp-nose guitarfish (*P. pristis* and *G. granulatus*), the honeycomb stingray (*H. uarnak*) was the most frequently landed ray species in the region in terms of weight and quantity, with post-monsoon (September–November) catch having the highest abundance. Since the majority of coastal communities appear to be ignorant of biodiversity protection, the working fishermen should be made aware of the detrimental effects of illegal shark and ray harvesting and trade. The number and presence of sharks and rays are indicators of the overall health of the Sundarbans' ecosystem, and overfishing has a detrimental ecological effect on these species.

Key words: Elasmobranch, Sundarbans, Shark, Ray, Biodiversity

INTRODUCTION

Mangroves are vital habitats in tropical and subtropical region because they support a diverse range of organisms including aquatic fauna.

**Author for correspondence: <hoq_me@yahoo.com>, [2]Center for Natural Resource Studies (CNRS), House #13, Road #17, Block-D, Banani, Dhaka-1213, Bangladesh*

Furthermore, it is stated that mangrove ecosystems provide elasmobranchs i.e. shark and rays with food sources, spawning and nursery ground and protection from predators (Kanno *et al.* 2023, Leurs *et al.* 2023, Saha *et al.* 2022). For many marine animals, including sharks and rays, estuarine waters close to the Sundarbans mangrove forest offer spawning and nursing habitat. The Sundarbans mangrove roots provide oviparous or egg-laying species (i.e. grey bamboo shark, *Chiloscyllium griseum*) with attachment sites and nurseries for viviparous sharks (i.e. blacktip shark, *Carcharhinus limbatus*, and hammerhead shark, *Sphyrna* spp.) that give birth to live pups that hide among the mangrove roots to avoid predators (WCS 2021). Moreover, rays were more frequently seen hiding beneath or near mangrove roots in mangrove areas than in open beach areas (Davy *et al.* 2015).

The ecological importance of shark and rays in mangrove habitats is little understood. Because it is difficult to examine their behavior in complex mangroves, little is known about their feeding ecology and the trophic linkages to other ecosystems (Davy *et al.* 2015). Despite national and international laws that forbid the landing, retention, and fining of several shark and ray species, other socioeconomic factors, such as the need to find alternative fisheries resources and the increasing demand and price of elasmobranchs' fins and meat, contribute significantly to unreported catches (Dulvy *et al.* 2014). Shark fishing in the Sundarbans, however, is a by-catch rather than a targeted or regular fishery (Joshi *et al.* 2008, Hoq *et al.* 2011). Despite conservation efforts on the ground (Haque *et al.* 2021b), shark fins, liver oil, cartilage, and skin are traded for their high demand (Gupta *et al.* 2012, Fofandi Durga *et al.* 2020). The benefits of the mangrove habitat for elasmobranchs have received less attention than those for teleost fishes and other species. The purpose of this study is to collect data on the current distribution and composition of shark and ray catch in Sundarbans rivers.

MATERIAL AND METHODS

Study sites: This study took place on the north-western Sundarbans with a saline and mesohaline ecosystem from April 2024 to March 2025 (Fig. 1). The coast of the Sundarbans is topographically heterogeneous, with habitats that include coasts containing estuaries, mangroves swamps and mudflats, pocket beaches, and long sand beaches (BFD-IUCN-GIZ 2023). There were two all-inclusive trips from covering Sundarbans East (Mongla to Dubla) and West (Mongla to Mandarbaria) Divisions to assess the aquatic resources of the Sundarbans. Monthly landing surveys of key market places, such as Dewlia and

Chadali bazars at Koyra, as well as Kolabari landing site, Nowabaki and Sonarmor bazar under Shyamnagar were conducted.

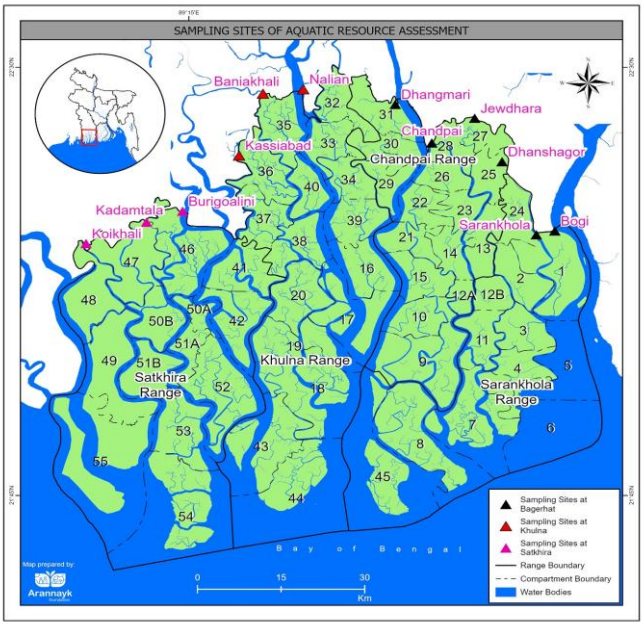

Fig. 1. Sampling sites in the Sundarbans west division.

Data collection methods: Fisher's knowledge, which is essential for making better decisions, is the firsthand understanding about Sundarbans habitats that fishermen gain from their fishing activities. Data was collected through structured and unstructured interviews and visual documentation. To record local fisher's awareness on shark and ray species, and their distributions, we conducted side-interviews with the fishers and traders in the market place or fishing villages during fortnightly fish landing survey to assess the Sundarbans catch. The community voluntary participated in the interviews. The interview questionnaire comprised questions on fishers' demographics, fishing activities, fishing gears, targeted species, occurrences (commonly available, available, moderately available, occasional, and rare) of captured sharks and rays, fishers' perception of the shark/ray and utilization of shark and rays including trade.

Face-to-face interviews were also conducted with 42 participants, including local knowledge holders like the *arotders* (commission agent) and traders and dry fish workers at the Dublar *char*. Monthly data was collected, 6 days in each lunar cycle (full or new moon), 12 days in a month basis. In Dublar *char*, shark and rays were observed being caught and landed by fishermen and fishing boats, which later one dried. In order to measure local catch trends and the significance of sharks and rays in small-scale fisheries catches, we also

examined preserved landings data from *arotder* of markets, where available. During data collection, only complete specimens or those with distinct diagnostic features were included, morphological identification was done using the catalogs and references of Ahmad and Lim (2012), Ahmad *et al.* (2013), Haque *et al.* (2021a), and BFD & WCS (2022). Due to their similar appearances, many shark and ray species are difficult to differentiate from one another using only physical traits.

RESULTS AND DISCUSSION

Monthly abundance of species-wise sharks and rays in the Sundarbans are presented in Table 1. At least 20 species of sharks and rays were recorded during one-year study in the north-west Sundarbans: six shark species, i.e. *Carcharhinus leucas, Carcharhinus limbatus, Chaenogaleus macrostoma, Glyphis gangeticus, Scoliodon laticaudus, Pristis pristis,* and fourteen rays, i.e. *Brevitrygon imbricata, Brevitrygon walga, Himantura leoparda, Himantura uarnak, Himantura undulata, Pastinachus gracillicaudus, Pastinachus sephen, Pateobatis bleekeri, Pateobatis uarnacoides, Urogymnus asperrimus, Urogymnus granulatus, Urogymnus lobistoma, Urogymnus polylepis,* and *Glaucostegus granulatus*. Most of the shark and rays were abundant in the winter months. Ray species abundant round the year, whereas, sharks were mostly available from July to March. Bull shark and Spade-nose shark were the most abundant shark species, whereas, Bengal whip-ray and Honey-comb sting-ray were most abundant ray species during study period. Among 20 species, 3 species are critically endangered and 9 ray species are endangered as per IUCN (International Union for Conservation of Nature) Red List of 2021 (Table 1, Fig. 2). WCS (2021) documented approximately 11 shark species in the SoNG (Swatch of No Ground) MPA (Marine Protected Area) along the Dubla coast of Sundarbans. While deep waters in the SoNG support pelagic rays like devil rays (*Mobula* spp.) and eagle rays (*Aetobatus* spp.), mangrove channels and shallow estuarine waters adjacent to the SoNG MPA are ideal habitat types for bottom dwelling rays, such as giant freshwater whip-ray (*Urogymnus polylepis*) and mangrove whip-ray (*Urogymnus granulata*) (WCS 2021). Additionally, at least five large-tooth sawfish were recorded in fish landing sites in a single year in sea close to the Sundarbans at the northern border of the SoNG MPA (Chowdhury *et al.* 2018).

It was evident from the field survey that sharks and small sized rays are occasionally caught in fishing nets and in angling in the rivers of Kopothoko and Shankbaria under Koyra upazila of Khulna. Fig. 3 shows the month-wise weight of the shark and rays caught in the fishing boats and landed. Most of the rays landed in the markets of Koyra and Shyamnagar Upzilas after being captured in

fishermen's nets from the Malancha River at Mandarbaria, Arpangasia and Sibsha rivers. Shark and rays were frequently landed and sold at Koyra's

Table 1. Monthly abundance of species-wise shark and rays in the north-west Sundarbans

Elasmobranchs with IUCN status	Months											
Sharks	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Carcharhinus leucas (VU) Bull shark		√(1)		√(2)	√(1)	√(3)	√(1)	√(2)	√(3)	√(3)	√(1)	√(1)
Carcharhinus limbatus (VU) Blacktip shark					√(1)			√(2)	√(1)			
Chaenogaleus macrostoma (VU) Hook-tooth shark				√(1)	√(1)		√(1)			√(1)		
Glyphis gangeticus (CR) Ganges shark							√(1)	√(1)				
Scoliodon laticaudus (NT) Spade-nose shark			√(1)	√(1)	√(1)	√(3)	√(4)	√(5)	√(8)	√(6)	√(3)	
Pristis pristis (CR) Large-tooth sawfish							√(2)	√(1)		√(1)		
Rays												
Brevitrygon imbricata (VU) Bengal whip-ray		√(2)		√(3)	√(2)	√(2)	√(3)	√(2)		√(3)	√(2)	√(4)
Brevitrygon walga (NT) Scaly whip-ray			√(1)	√(1)		√(1)	√(2)	√(1)	√(2)		√(2)	√(1)
Himantura leoparda (VU) Leopard whip-ray				√(1)		√(1)		√(2)	√(2)			√(2)
Himantura uarnak (EN) Honeycomb sting ray	√(1)		√(1)	√(2)		√(2)	√(3)	√(1)		√(2)	√(1)	√(3)
Himantura undulata (EN) Leopard whip-ray		√(1)		√(1)		√(1)					√(1)	√(2)
Pastinachus gracillicaudus (EN) Narrow tail sting-ray			√(1)		√(1)				√(1)			
Pastinachus sephen (NT) Cow-tail ray						√(1)						√(1)
Pateobatis bleekeri (EN) Bleeker's whip-ray				√(2)	√(1)	√(1)	√(1)	√(1)	√(1)	√(2)		√(2)
Pateobatis uarnacoides (EN) White-nose whip-ray			√(1)	√(1)		√(1)	√(2)	√(1)		√(1)		√(2)
Urogymnus asperrimus (EN) Porcupine ray						√(1)	√(1)					√(2)
Urogymnus granulatus (EN) Mangrove whip-ray	√(1)	√(1)			√(1)		√(1)				√(1)	
Urogymnus lobistoma (EN) Tube-mouth whip-ray		√(1)				√(1)			√(1)		√(1)	
Urogymnus polylepis (EN) Giant freshwater whip-ray	√(1)					√(1)	√(4)		√(2)	√(4)	√(1)	√(3)
Glaucostegus granulatus (CR) Sharp-nose guitarfish							√(1)		√(1)	√(1)		

*Nos. are in parenthesis

Fig. 2 (a–c). Critically endangered (a) *Pristis pristis*, 4 kg & 98 cm landed on 30 October 2024, (b) *P. pristis* without rostra, 4 kg & 76.5 cm landed on 28 November 2024 and (c) *Glaucostegus granulatus*, 1.5 kg & 83.8 cm landed on 30 October 2024 during 7-8 am at the Dawlia bazar, Koyra Bangladesh.

marketplace due to its remote location, after which they were sold in Khulna or Dhaka. Large-tooth sawfish continue to be landed in Bangladeshi waters with some regularity. Between October 2016 and December 2017, Haque *et al.* (2020b) recorded 17 large-tooth sawfish (*P. pristis*) from Bangladesh coast and we recorded 4 of them in 4 months' period only from Sundarbans coast. Sting ray with lowest 200 g and frequently 1-3 kg sizes observed in fishing nets and landing centers. Juveniles rays were mostly observed in the month of May. Large size rays were visible during winter with highest weight of 30 kg, whereas most of the rays were between 2-12 kg. In contrast most shark species were 1-3 kg sizes and critical endangered saw shark observed between 4-6 kg. Rays are occasionally targeted by fishermen, and sharks have been captured in gill nets as bycatch alongside other teleost fisheries in the Sundarbans. Fishers employed a multi-species and multi-gear strategy (such as long lines, set bag nets, seine nets, and submerged or floating gill nets) in the rivers and on all kinds of vessels operated in the Sundarbans. Sea conditions and the target species' seasonality are the main factors that influence gear selection. Large specimens (>150 cm) were typically captured in the winter, spring, and summer, whereas smaller specimens (<70 cm) were quite prevalent throughout the year (WCS 2021). Artisanal fisheries in Bangladesh are supported by the highly productive and shallow coastal waters inhabited by shark and rays (DoF 2016). In Dublar *char* of Sundarbans, fishers observed a sharp decline in diversity, individual size, and catch size of shark and rays during their fishing careers. All fishers reported decline in ray populations also, especially after the tropical cyclone–Sidr on 2007. Bangladesh's Wildlife (Conservation and Security) Act,

2012 (WCSA) is currently the only regulatory tool providing limited national protection against elasmobranch fishery. The catch and trade of 23 species,

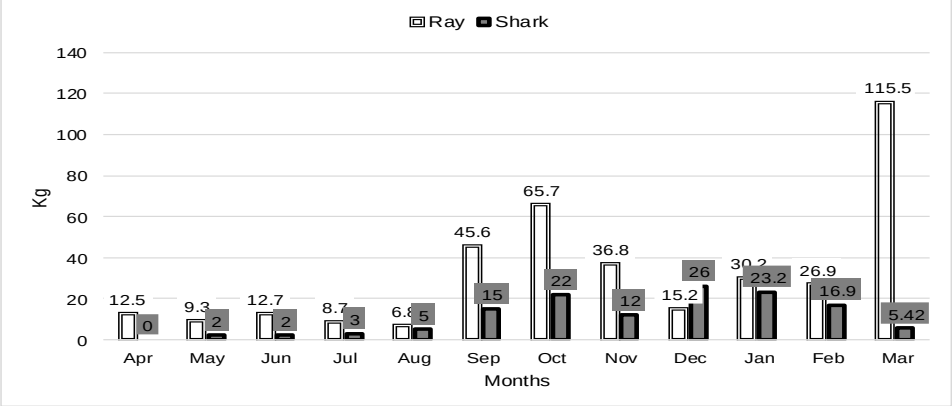

Fig. 3. Month-wise distribution pattern of shark and rays in the north-west Sundarbans.

including hammerhead sharks, guitarfish, and sawfish, are strictly prohibited by the WCSA. As long as their capture is proven to be non-detrimental to wild populations, it allows the utilization of additional 29 shark and ray species with Non-Detriment Findings (NDFs). However, elasmobranch catch is unrestricted by the Fisheries Law, which regulates the Bangladeshi coast's neritic water. There is insufficient enforcement of Bangladeshi law, knowledge of these rules, and involvement of stakeholders in conservation decision-making for effective management (Haque *et al.* 2020a). Due to life-history characteristics including restricted fecundity, slow growth, and late maturation, sharks and rays are particularly susceptible to fishing pressure. The majority of species depend on coastal habitats for food and for their early and reproductive life phases, despite the fact that some are migratory (Heupel *et al.* 2007). Based on the use of productive nursery grounds and site-attached coastal movements by neonates and juveniles, there is strong evidence that sharks depend on habitat close to the continental shelf (Kinney and Simpfendorfer 2009).

The findings of our study demonstrate that shark and rays frequently use the nearshore waters of the north-west Sundarbans, and mapping these areas as a starting point for further research and the setting of priorities for Sundarbans fisheries management. It is now widely known that mangroves are important for fisheries biomass, and both catch record and interviews showed a correlation between the existence of mangrove forests and the landings of juvenile elasmobranchs (Carrasquilla-Henao and Juanes 2017). Although many euryhaline and obligate freshwater elasmobranch species use estuaries, little is known about their ecology, especially their reliance on mangroves (Martin 2005).

A wide range of interrelated factors, including temperature, salinity, depth, substrate type, prey distribution and variability, predator distribution, social structure, and reproductive activity, affect the habitat choices made by shark and rays.

Mangrove and estuary habitats provide many elasmobranchs species with safe havens where they may feed, mate, give birth, and protect away from predators. The loss of habitat is probably going to have a greater impact on shark and rays that spend all or a portion of their life in mangrove areas than on shark and rays that reside in the open sea. In order to prioritize research on endangered species and identify crucial habitats, this study emphasizes the significance of fisher's knowledge. Shark and rays' conservation and fisheries management policies at local levels generally focus on restrictions of trade, fishing gear or fishing area. As long as local communities are included, small-scale fisheries in the Sundarbans may adopt conservation management more widely since it is necessary to support the recovery of coastal fish stocks. Elasmobranch behavior in mangrove ecosystems must be directly observed in order to have a better knowledge of the relationship between mangroves and elasmobranchs. Understanding the impact of mangrove degradation on shark and rays' populations would necessitate long-term research, especially in the Sundarbans, given the widespread concern about this issue.

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