



REVIEW

Past and present sawfish (Pristidae) records from India

Zoya Tyabji^{1,*}, Rima W. Jabado^{2,3}, K. V. Akhilesh⁴, Shoba Joe Kizhakudan⁴,
M. Aaron MacNeil^{1,5}

¹Department of Biology, Dalhousie University, Halifax, NS B3H 4R2, Canada

²Elasmo Project, PO Box 29588, Dubai, United Arab Emirates

³College of Science and Engineering, James Cook University, Townsville, QLD 4814, Australia

⁴ICAR-Central Marine Fisheries Research Institute, Kochi, KL 682018, India

⁵Ocean Frontier Institute, Dalhousie University, Halifax, NS B3H 4R2, Canada

ABSTRACT: Overfishing, as well as habitat loss and degradation, has led to major population declines and local extinctions of sawfishes (Pristidae) globally. Four sawfish species reportedly occur in India; however, records have been limited to opportunistic commercial catch and landing reports. Here, we provide the first comprehensive review of published and grey literature on sawfish records from India, including opportunistic observations of sawfish rostra offerings to religious places, highlighting the cultural significance of these species locally. In total, 223 recorded capture events were compiled between 1794 and 2022, with largetooth sawfish *Pristis pristis* (n = 82), followed by narrow sawfish *Anoxypristis cuspidata* (n = 32), being the dominant species reported. In addition to marine fisheries, 8 reports of sawfish were reported from freshwater systems. The wide range of rostra sizes and total lengths recorded also suggests that India's waters harbour various life history stages of sawfish. When caught, sawfish livers were utilised to produce oil, meat was locally consumed, and fins were exported. Despite being legally protected in India since 2001, 63 incidental captures were recorded from landings, suggesting various levels of awareness and enforcement of catch bans across the country. To avoid extinction of these species in India, we emphasise the need to conduct culturally associated awareness programs with coastal communities, encourage safe release and improve handling practices with fishers, identify critical habitats, and strengthen enforcement for mandatory live release.

KEY WORDS: Rhinopristiformes · Culture · Conservation · Threatened species · Fisheries · Awareness

1. INTRODUCTION

Sawfishes (Pristidae) are among the most threatened families of marine fishes in the world (Yan et al. 2021). They are susceptible to fisheries exploitation due their low intrinsic rates of population increase (Harrison & Dulvy 2014) and high catchability in nets

(Dulvy et al. 2016) and are threatened by habitat loss and degradation (Peeverell 2005). Sawfish are also highly valued for their fins, meat, liver oil, and rostra (Hoover 2008, Harrison & Dulvy 2014). Globally, 5 species of sawfish are known: largetooth sawfish *Pristis pristis* (= *P. microdon* and *P. perotteti*), dwarf sawfish *P. clavata*, smalltooth sawfish *P. pectinata*, green

*Corresponding author: zoya.tyabji@gmail.com

sawfish *P. zijsron*, and narrow sawfish *Anoxypristis cuspidata* (Last et al. 2016). According to the IUCN Red List of Threatened Species, all 5 species are assessed as Critically Endangered (Carlson et al. 2022, Espinoza et al. 2022, Grant et al. 2022, Harry et al. 2022, Haque et al. 2023) due to well documented population declines. Historically, all 5 species were found in coastal waters of 90 nations but are now locally extinct in more than half of them (Yan et al. 2021).

Four of the 5 sawfish species (*A. cuspidata*, *P. pristis*, *P. zijsron*, and *P. clavata*) have been reported from Indian waters (Faria et al. 2013, Akhilesh et al. 2014). Of these, *A. cuspidata* was originally described from Kerala (Latham 1794). Historical reports indicate that sawfish were considered a valuable fishery resource in India (Akhilesh et al. 2023). However, steep population declines observed since the 1970s led to their legal protection; under Schedule 1 of the Wild Life (Protection) Act, 1972 (<https://www.indiacode.nic.in/bitstream/123456789/1726/1/a1972-53.pdf>), their fishing, utilisation, and trade are prohibited across India. Further, in the federal system, the state government of Maharashtra, a state in northwestern peninsula India on the northeastern Arabian Sea coast, provides monetary incentives for the onboard release of protected species, including sawfish (Akhilesh et al. 2023). Despite the protection afforded, declines in sawfish numbers are still being reported from India (Akhilesh et al. 2022, Tyabji et al. 2022), where studies focused on these animals remain sparse, with limited understanding of their distribution, interactions with fisheries, and utilisation of their derivative products. To fill these knowledge gaps, here we report results from the first comprehensive literature review of sawfishes in India and opportunistic records of the cultural use of rostra in the region.

2. METHODS

2.1. Literature review

We conducted a review of scientific and grey literature on sawfish in India. Structured searches were first carried out using specific search terms in Web of Science, in Google News, and on social media platforms (Twitter, Facebook, Instagram): (India OR Gujarat OR Maharashtra OR Goa OR Karnataka OR Kerala OR Tamil OR Andhra OR Orissa OR Odisha OR Bengal OR Lakshadweep OR Andaman) AND (sawfish OR saw fish OR elasmobranch OR chon-

drichthyan OR shark OR skates OR ray OR batoid). We also reviewed literature from the Central Marine Fisheries Research Institute (ICAR-CMFRI, <http://eprints.cmfri.org.in>), which consists of one of the oldest and largest fisheries repositories in India; following this, we carried out supplementary searches by reviewing the reference lists of the literature from the structured searches to compile a comprehensive list of published and grey literature. The literature included peer-reviewed papers, reports, dissertations and theses, newsletters, bulletins, media articles, media posts, and conference abstracts.

All literature was read in full and was included if it had any information on sawfish in India. The following information was extracted from the included literature: date and location of the catch or the landing, species, vernacular name reported, information regarding repository if specimen was deposited, number of individuals caught or landed, volume of landings, fishing gear caught in, biology of species including any morphometrics or sex or weight recorded, information on trade and utilisation, and attitudes and perceptions regarding sawfish.

Archeological studies were excluded from the results. Multiple media reports pertaining to the same incident were combined based on the information contained in the report. Where possible, images extracted from the literature and media were identified using Faria et al. (2013) and Last et al. (2016).

2.2. Opportunistic records of rostra

Sawfish rostra were opportunistically recorded from Khanderi during visits to the island from 2017 to 2022. Khanderi, or Kanhoji Angre Island, is an uninhabited island located 5 km off the coast of the Raigad district in Maharashtra. It contains the temple of Vetāl, built in the 17th century; Vetāl was believed to be a guardian deity of the fishing community who offered protection from storms and ghosts of the sea (Harad & Joglekar 2017).

We were informed about the temple through surveys carried out as part of another study on sharks and rays. We were granted permission from the community temple keeper to enter the temple, which is open to the community, where we could access and measure all the rostra in the collection.

Additionally, during the same period, we were informed about rostra located at a university in Maharashtra. A university professor allowed us access to the rostra, where we could measure and photograph all the rostra in their collection.

All rostra were measured to the nearest millimeter according to measurements in Faria et al. (2013). We identified the species that the rostra belonged to using Faria et al. (2013) and Last et al. (2016).

We also received a photograph of a rostrum from a fisher at a dargah (shrine) located in Maharashtra. However, we could not obtain any additional information regarding the rostrum.

2.3. Analysis

When sawfish rostra length was available, either from the literature review or field observations of rostra measurements, we calculated total length (TL) via ratios of standard rostrum length (SRL) to TL. For *Anoxypristis cuspidata*, $TL = SRL/0.2$; for *Pristis pristis*, $TL = SRL/0.23$; and for *P. zijsron*, $TL = SRL/0.24$ (Whitty et al. 2014, Wueringer et al. 2023).

For all records obtained either from the literature review or estimated TL from rostra, where either weight or TL of the sawfish was provided, missing values for weight and TL were calculated using the equation $W = aL^b$, where W is the weight in g, L is the length in cm, and a and b are the length–weight parameters, taken from FishBase (<https://www.fishbase.se/>) for each species (Table S1 in the Supplement at www.int-res.com/articles/suppl/n053p523_supp.pdf). For unidentified individuals, weight was estimated using parameters of *P. pristis*, as these were the same for all species except *A. cuspidata*.

Life history stages for *P. pristis* and *A. cuspidata* were estimated based on the TL of the individual as per the information on maturity published for these species on FishBase and in Last et al. (2016). The maturity length was 264 cm TL for *A. cuspidata* and 300 cm TL for *P. pristis*. We did not estimate the life history stages for *P. zijsron*, *P. pectinata*, and *P. clavata* due to the lack of information on maturity stages for these species.

3. RESULTS

3.1. Records of sawfish rostra

3.1.1. Sawfish rostra offerings to the deity Vetā

We observed 34 rostra offered to the deity Vetā at the Khanderi Island temple (Fig. 1, 2A–C). The term kandere in Marathi, the regional language of Maharashtra, means sawfish (Sorley 1948). Fishers occasionally wrote their names, boat number, and

year of catch on the rostrum, before offering it to Vetā, for prosperity in fishing and safeguarding life at sea. Eight rostra were observed hanging in the temple (Figs. 1 & 2A), 6 of which were contemporary and caught in 1984, 1992, 2000, 2003, 2007, and 2013. Twenty-six additional rostra were found stored in a dilapidated state on the ceiling of the temple (Fig. 2B).

On examining individual rostra, 32 (94.11%) were confirmed as originating from *Pristis pristis*. Identification of 2 rostra (5.88%) could not be confirmed due to their damaged state. Rostrum length ranged from 79 to 130 cm.

3.1.2. Sawfish rostra from a university collection and a dargah

We observed 8 rostra at the university (Fig. 2E). Five originated from *Anoxypristis cuspidata*, with rostrum length ranging from 33.6 to 45.5 cm; 2 rostra originated from *P. pristis*, with lengths of 51.5 and 15.1 cm; and 1 rostrum originated from *P. zijsron*, with a length of 21 cm.

We also received a photograph of a rostrum from a fisher at a dargah (shrine) located in Maharashtra (Fig. 2D). However, we could not obtain any additional information regarding the rostrum.

3.2. Overall trends of sawfish in India from the literature review and rostra records

3.2.1. Distribution and abundance

Between 1794 and 2022, 223 sawfish catch and landing events were reported from India (Fig. 3, Table S1). Of these, 32 (14.34%) were records of *A. cuspidata*, 82 (36.77%) of *P. pristis*, 12 (5.38%) of *P. zijsron*, 1 (0.44%) of *P. clavata*, 8 (3.58%) of *P. pectinata* (likely misidentified *P. zijsron*), and 88 (39.46%) of individuals that could not be identified (Figs. 4 & 5, Table S1).

Various life history stages were recorded for sawfish, with sizes of reported specimens varying between 56 and 762 cm TL. For *A. cuspidata*, 5 mature (15.62%), including 2 gravid females, and 17 immature (53.12%) individuals were recorded. We could not estimate the life history stage for 10 individuals (31.25%). For *P. pristis*, 17 mature (20.73%) and 8 immature (9.75%) individuals were estimated. We could not estimate the life history stage for 57 individuals (69.51%). For *P. zijsron*, 4 mature (33.33%) and 1 neo-



Fig. 1. Temple of Vetala at Khanderi Island, with sawfish rostra hangings. White arrows show 3 sawfish rostra hanging from the ceiling of the temple

nate (8.33%) were recorded from the literature. We did not estimate the life history stage for *P. zijsron* ($n = 7$, 58.33%), *P. pectinata* ($n = 8$), and *P. clavata* ($n = 1$) due to lack of information on maturity stage for these species (Fig. 6, Table S1).

Historical records suggest that sawfishes were abundant along the Indian coast in the northern Arabian Sea (Hefford 1949), southern India (Day 1863, Aiya 1906, James 1973), and Bay of Bengal (Annandale 1909). Based on the literature review, the largest number of reported landings were from northwestern states of peninsular India, in Maharashtra, Gujarat, and Goa ($n = 120$, 53.81%). State-wise, the largest quantities of reported landings were reported from Maharashtra ($n = 63$, 28.25%), followed by Tamil Nadu and Kerala ($n = 12$, 5.38%, Fig. 3). Regional location of catch or landings of sawfish was not available for 25 (11.21%) of the records (Table S1).

Eight records (3.58%) were reported from freshwater systems. These include 2 reports (0.89%) of

P. pectinata (most likely misidentified) from the Ganges River in the Bay of Bengal and Chilika Lake in Odisha (Misra 1947); 4 reports (1.79%) of *P. pristis* from the Mahanadi River in Odisha (Day 1878, Misra 1947), Ganges River in the Bay of Bengal (N. Phillips pers. comm. 2023), and Tapi River in Gujarat (Karbhari 1973); and 2 reports (0.89%) of *Pristis* sp. from the Mahanadi River ending in the Bay of Bengal (Anonymous 1961) (Table S1).

Sawfish were reported to be dominantly caught in fishing nets ($n = 25$, 11.21%). Specifically, according to the literature, they were caught in trawl nets ($n = 16$, 7.17%), with 6 instances (2.69%) of reports from fishing nets, 2 (0.89%) from gillnets, and 1 (0.44%) from a ray fishing net. Information on fishing gears was not available for 198 (88.78%) sawfish records.

Exploratory surveys conducted in Mumbai in the early 1990s reported sawfish as a predominant portion of the catch in trawl surveys and jaal (gillnet) fishing in Mumbai (Sorley 1948), with a recorded

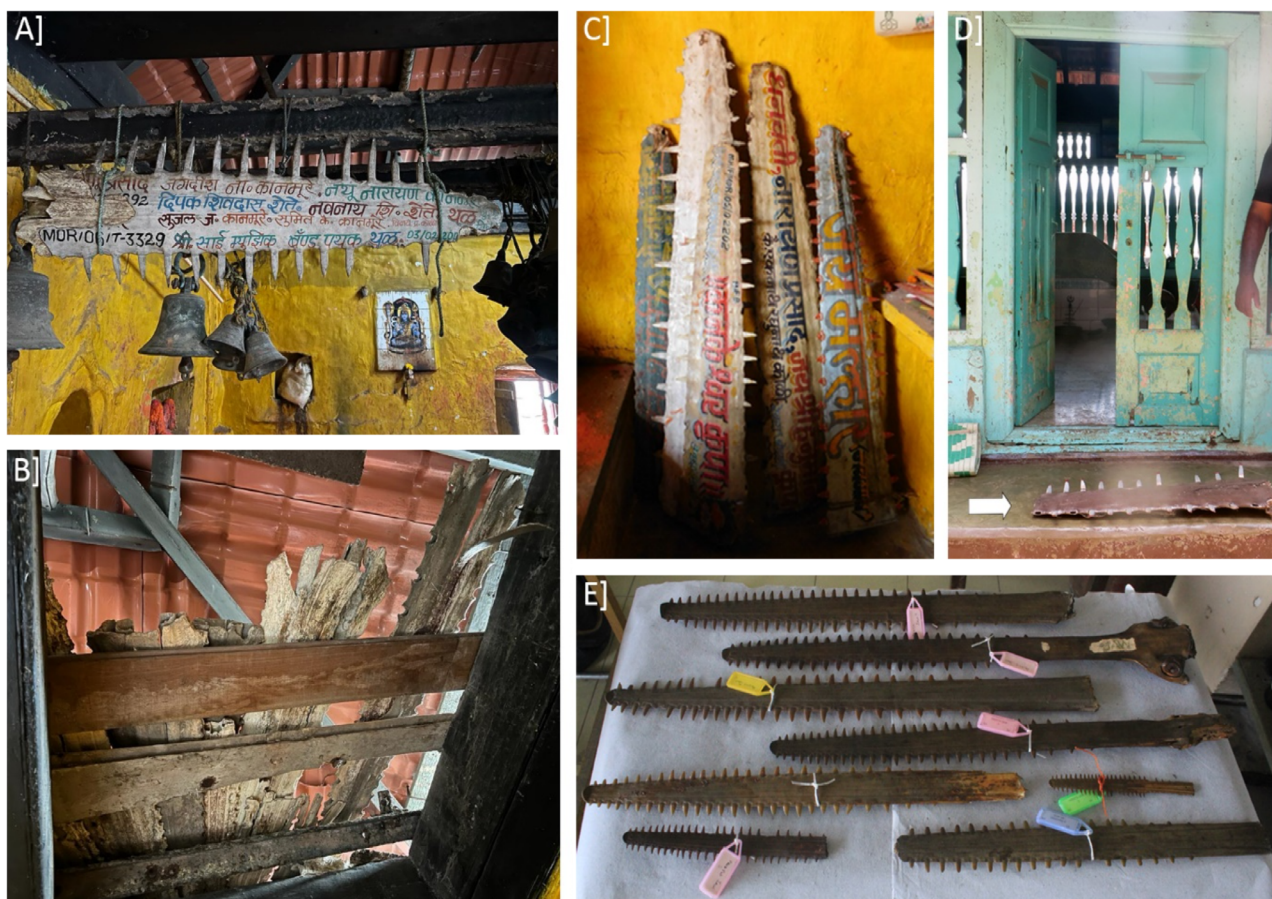


Fig. 2. (A–C) Temple of Vetul at Khanderi. (A) Close-up of a sawfish rostrum hanging from the ceiling. (B) Dilapidated sawfish rostra stored on the ceiling. (C) Sawfish rostra. (D) Sawfish rostrum in a dargah in Jaigad, Maharashtra (image: Swapnil Tandel, P. Khandagale). (E) University collection of sawfish rostra in Maharashtra (image: Sarah Drego)

average catch of 3.14 kg per hour in trawl fishing (Sorley 1948). However, other fish were locally preferred over sawfish, leading to reduced prices for sawfish due to a lack of demand in local markets (Sorley 1948). From 1989 to 2003, major declines in catch of sawfish were recorded (Raje 2006). Between 1989 and 2003, 14.9 t of *Pristis* spp. were landed by trawlers at New Ferry Wharf, Mumbai. An average of 1.68 t yr⁻¹ were landed from 1989 to 1993, 0.74 t yr⁻¹ from 1994 to 1998, and 0.56 t yr⁻¹ from 1999 to 2003. Landings were sporadic, with the highest occurrence recorded during March and April each year (Raje 2006).

Observer data for *A. cuspidata* in India between 1989 and 2011 indicates catches were consistently less than 5 t yr⁻¹, with a peak catch in 2009 of more than 25 t from Okha, Gujarat (Harrison & Dulvy 2014). Catch composition from trawls in Kolkata during 1960 and 1961 included 118 kg of sawfish (Anonymous 1961, James 1973). Two species, *A. cuspidata* and *P. pristis*, were reportedly more common and

commercially important than *P. zijsron* (James 1973). Exploratory trawl surveys conducted in the Bay of Bengal in 1959 caught 595.34 kg of *P. pristis* from West Bengal, with 149 kg caught in the Mahanadi River (James 1973).

3.2.2. Utilization and trade

One of the earliest accounts of utilization was of shark and sawfish livers being used in the medicinal oil industry in Calicut, which existed in 1854 until 1870, with a yearly output of 2268 kg (Kini & Chidambaram 1947). Here, livers under 18 kg weight were not accepted at the factory, as more oil could be extracted from the larger livers. Records indicate that sawfish possessed large livers, with one liver from a sawfish reported to weigh 131.5 kg and another from a female sawfish (4.26 m TL) reported to weigh 83.9 kg (Day 1878).

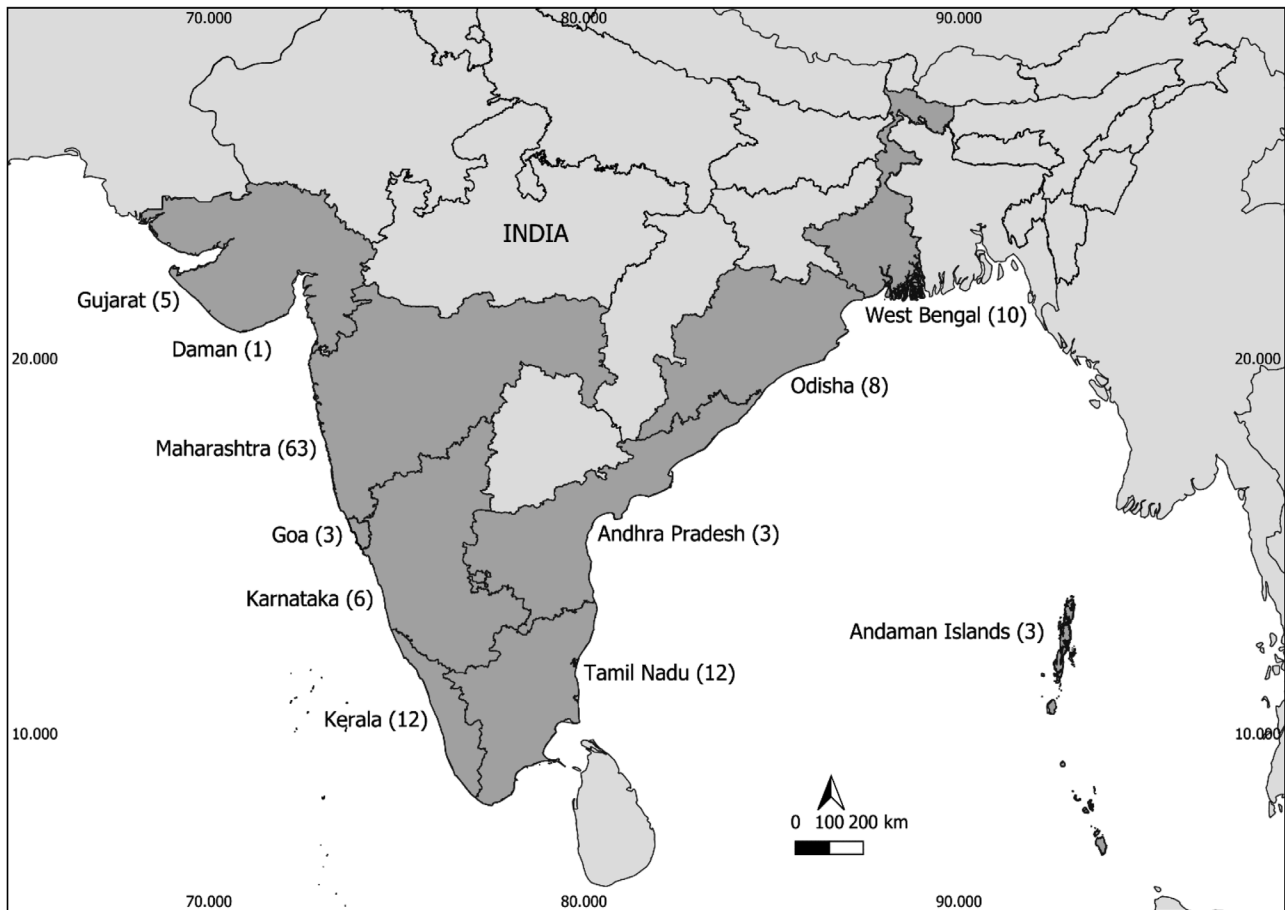


Fig. 3. Number of sawfish reports (in parentheses) in each maritime state

Sawfish were extensively caught and utilised for their oil, reported as Malabar oil, on the Bombay (now Mumbai) and Sind (now Pakistan) coasts (Madras Bulletin 1899). They reportedly possessed large livers, up to 50% of the weight of the fish, which yielded large quantities of oil for vitamin A (Day 1878).

Sawfish fins were exported from India to China (Day 1878). The flesh was sold locally, as it was considered nourishing, and was eaten salted or fresh (Day 1865). In Odisha, *P. pristis* (reported as *P. perotteti*) was consumed only by the poorest communities, whereas the flesh of *A. cuspidata* was believed to be as esteemed as that of a shark (Day 1878). Sawfish skins were also used for sword scabbards and as sandpaper to polish wood on boats (Day 1878).

The auction price for whole sawfish varied from USD 115.86 for 200 kg in 1996 to USD 1219.60 for 500 kg in 2022. The average price was USD 1.4 per kg of sawfish. Fins, including 2 caudal fins and 1 dorsal fin, were sold for USD 67.44 and USD 36.57 in 1996

and 2000, respectively. Meat was sold for USD 0.48 per kg in 2000 and USD 0.76 per kg in 2019 (Table S1).

3.2.3. Attitude towards and perception of sawfish

Mythical perceptions of sawfish were identified in several states. Manasollasa, a 12th century Sanskrit text, mentions a large marine and scaleless fish, chanvilocho, believed to be sawfish, was found frequently in Indian seas including in Mumbai, located along the Arabian Sea (Hora 1951). Fishers were scared of this fish, as it could inflict serious injuries when captured (Sadhale & Nene 2005).

Injuries from sawfish in the Malabar region were reported to be frequent and scary, with stories of large sawfish cutting a bather entirely in two (Day 1878). Sawfish were referred to as the 'carpenters of the sea' to denote that they saw humans and fish in half and attack large fish and whales to eat their skin and entrails (Hanson & Morrison 1991). *P. zisron* was

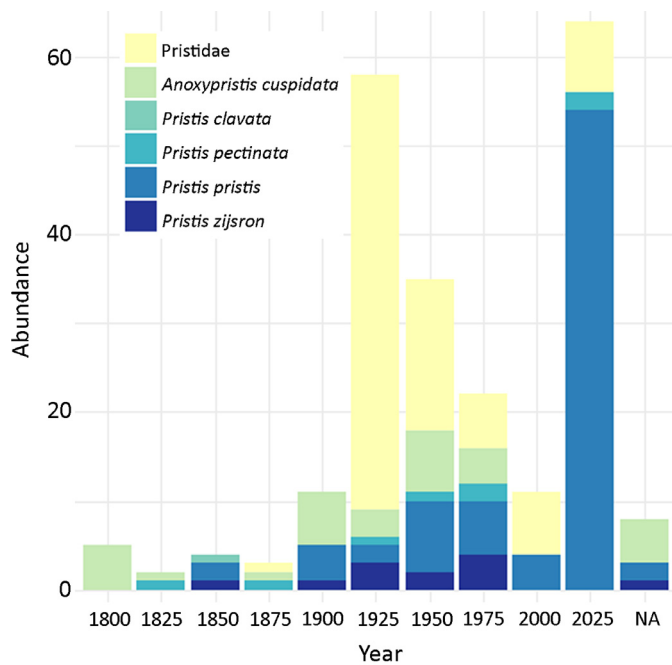


Fig. 4. Abundance of sawfish species catch and landings reported and estimated from literature review and rostra records between 1794 and 2022. Here, *Pristis pectinata* is likely a misidentified *P. zijsron*. NA: unknown year

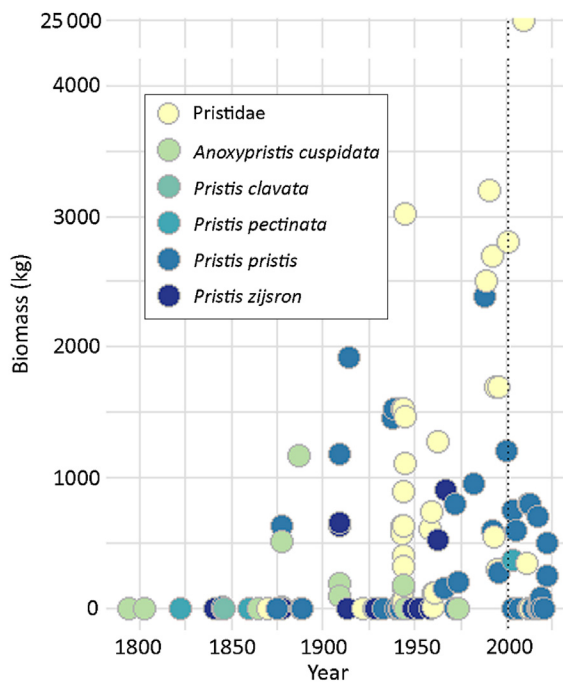


Fig. 5. Total reported and estimated biomass of catch and landings of sawfish species collated from literature review and rostra records between 1794 and 2022. Here, *Pristis pectinata* is likely a misidentified *P. zijsron*. Dashed line at year 2001 represents the year sawfish were protected in India

abundant near the Sind coast (currently Pakistan), where it was feared (Day 1878). At Gwadur, on the Meckran coast (currently Pakistan), fishers of all religions presented rostra to a small temple, where they were hung inside or piled outside. The priest was expected to pray for success and a safe return to shore (Day 1878).

In the Andaman Islands, the Aborigines harpooned a sawfish and gifted the rostrum to their superintendent (Day 1878); sawfish also had cultural significance, as rostra were kept in temples and shrines (Hoover 2008). More recently, records indicate that fishers in Karnataka considered a sawfish as a bad omen, as when caught, it destroyed their nets and took a long time to haul (Table S1).

3.2.4. Vernacular names

Across the literature, there are several vernacular names for sawfish in India. *A. cuspidata* is called vela (=weapon) meen (=fish) in Tamil, yahla in Telegu, and wall tiruke or ween across India (Misra 1969). *P. pristis* is called komben (=big being with horns, derived from komben = big person and kombu = horns) sorah (=shark) in Malayalam, kundah in Odiya, nali or shinshi in Marathi (Misra 1969), and makara (=originating from Sanskrit word which means half animal and half aquatic being) sravu (=shark) in Calicut (Manojkumar et al. 2002). *P. zijsron* is called vella (=weapon) sorrah (=shark) in Tamil (Misra 1969). Currently in Maharashtra, sawfish are also called sondala (=proboscis) and karvat (=saw) maza (=fish), along with kandere. In Tamil, they are called thachchan (=carpenter) sorrah (=shark).

4. DISCUSSION AND CONCLUSION

This review brings together valuable information on sawfish records, including abundance, distribution, interactions with fisheries, and utilisation in India. Records suggest that sawfish were relatively abundant in the past and were used in the oil industry from the 1850s, along with the export of fins and local consumption of meat. This led to the steep population declines that were gradually observed by the 1990s.

Despite the declines in abundance of sawfish along the coast of India, as reported in the literature, we observed an increase in reports of sawfish catches (Fig. 4), which might be attributed to better awareness of the species over time. Additionally, reportings of all sharks, rays, and chimaeras were grouped to-

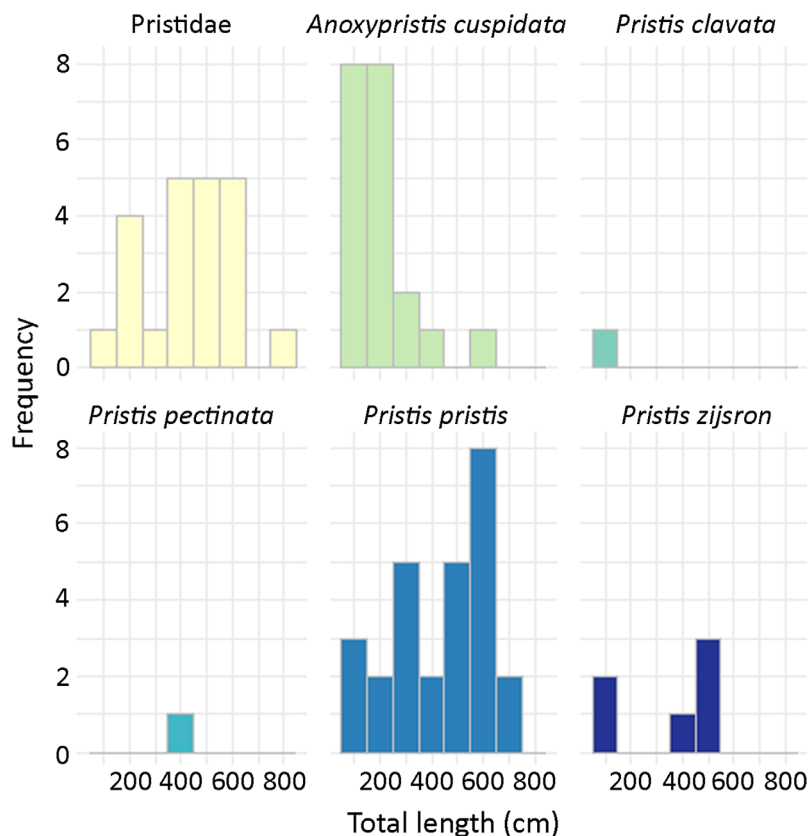


Fig. 6. Reported and estimated total lengths of sawfish individuals collated from literature review and rostra records between 1794 and 2022. Here, *Pristis pectinata* is likely a misidentified *P. zijsron*

gether, with no taxonomic resolution, which could have also led to underreporting of sawfish in the past. It is also likely that as populations of large sawfish decreased, the novelty of their catch increased, leading to an increase in reporting.

Pristis pristis, followed by *Anoxypristis cuspidata*, were reported to be the most abundant species. Our study records a wide range of TLs, indicating that India's waters supported various life history stages. However, we note a shift in species composition throughout the years, with an observed decline in *A. cuspidata* catch between 1794 and 1974 and an increase in reported *P. pristis* catch and landings between 1845 and 2022, highlighting the potential of higher susceptibility of *A. cuspidata* compared to *P. pristis* due to overfishing and habitat change in India. It is also possible that *A. cuspidata* had relatively low populations in waters of India, resulting in its steep decline compared to *P. pristis*.

We also report 8 *P. pectinata*, with 6 of the reports between 1822 and 1958, and 2 in 2013, despite being outside the known range of the species, suggesting they are most likely misidentified *P. zijsron*. We could

not confirm the species in these reports due to the lack of photographs.

Additionally, 4 *P. pristis*, 2 *P. pectinata* (most likely misidentified), and 2 *Pristis* sp. reports are from freshwater systems in India, including the Ganges River, Tapi River, Mahanadi River, and Chilika Lake. Juveniles of *P. pristis* are known to occupy freshwater and estuarine habitats and are known to be philopatric to natal river systems, whereas adults occur in both estuarine and coastal habitats (Feutry et al. 2015, Phillips et al. 2017, Grant et al. 2021). Elasmobranchs that require access to shallow coastal or riverine environments during their life history are reported to be more vulnerable than those in marine systems due to artisanal and commercial fishing pressures, compounded by river engineering, habitat destruction, and pollution (Grant et al. 2019, 2021). These freshwater systems may be important habitats to consider for research and awareness activities in India.

Our results highlight declines in reported catch, which may relate as a proxy to local population collapses of sawfishes in India. For example, trawl

landings from Mumbai reported declines from 1.68 to 0.56 t yr⁻¹ between 1989 and 2003. We also report declines in biomass of total recorded sawfish catches after 2001. Records of sawfish population declines are corroborated by studies from adjacent countries such as Pakistan (Moazzam & Osmany 2014), Bangladesh (Hossain et al. 2015, Haque et al. 2020), the Arabian and Persian gulfs (Moore 2015, Jabado et al. 2017), and Sri Lanka (Tanna et al. 2021).

Sawfish were reported to hold cultural significance, with a large rostra collection observed in Maharashtra. It is likely that there are many other collections in this state and across the country in temples, other religious places of worship, museums, educational institutions, and personal collections (Fig. 3). A collaborative initiative to access information from sawfish rostra across institutions in the country could further strengthen our understanding of past and present sawfish populations and their use in India. Reports were highest from the northern Arabian Sea, which is likely due to the importance of Mumbai in trade and science documentation. This is similar to observations from Pakistan (Moazzam & Osmany 2014).

Despite sawfishes being protected in India, since 2001, 63 landing reports have been recorded. This is likely an underestimation of the total sawfishes caught in the period, as our study was limited to the review of articles published in English, available publicly, and in online forums, and the fact that not all catches along the long Indian coastline are recorded. At certain locations in Karnataka and Tamil Nadu, fishers were unaware of the protection status of these species (Z. Tyabji unpubl. data). These findings indicate that awareness regarding protection varies across the maritime states and likely between communities, with insufficient information provided to fishers and limited enforcement of current management measures. Fishers from Karnataka considered catching sawfish a bad omen, suggesting that awareness activities for the safe release of sawfish could be initiated here, as the fishers are likely to be agreeable with compensation for fishing net damage in return for live releases.

Our results stress the need to conduct species awareness programs with coastal communities, enforce current legislation, and expand incentives for safe release of sawfish to other locations in India. This is likely the only way we can bring the species back from what may be the brink of extinction.

Acknowledgements. We thank the Thal Fishermen's Cooperative Society and Sham Kathe for logistical support during field work at Khanderi Island and Sarah Drego and St. Xaviers University in Mumbai for information shared on sawfish. We also thank Ajay Nakhawa, Ratheesh Kumar, Swapnil Tandel, Bala Mhadgut, and Thakurdas (ICAR-CMFRI) for their support in sawfish research in Maharashtra and Nicole Phillips and museum curators for information shared on sawfish. We thank Akshay Tanna and Christopher Mull for help with the manuscript figures and Rajaswaminathan Vairavan for help with translating the vernacular names. The visit by Z.T. was funded by a grant from the Shark Conservation Fund awarded to M.A.M.

LITERATURE CITED

- Aiya VN (1906) The Travancore state manual, Vol 2. Travancore Government Press, Trivandrum
- ✦ Akhilesh KV, Bineesh KK, Gopalakrishnan A, Jena JK, Basheer VS, Pillai NGK (2014) Checklist of chondrichthyans in Indian waters. *J Mar Biol Assoc India* 56: 109–120
- Akhilesh KV, Menon M, Sen S, Sajina AM and others (2022) Status of sawfishes (Pristidae: Rhinopristiformes) in Indian waters. *Book of Abstracts, 12th Indian Fisheries and Aquaculture Forum, Chennai, India, 5–7 May 2022*. Dr G Sugumar, Chennai, p 670
- Akhilesh KV, Kizhakudan SJ, Muktha M, Najmudeen TM and others (2023) Elasmobranch conservation, challenges and management strategy in India: recommendations from a national consultative meeting. *Curr Sci* 124: 292–303
- Annandale N (1909) Report on the fishes taken by the Bengal fisheries steamer 'Golden Crown'. I. Batoidei. *Mem Indian Mus* 2:1–60
- Anonymous (1961) *Indian Fisheries Bulletin* Vol. 8, No. 4
- Carlson JK, Blanco-Parra MP, Bonfil-Sanders R, Charles Rand others (2023) *Pristis pectinata*. The IUCN Red List of Threatened Species 2022: e.T18175A58298676. <https://dx.doi.org/10.2305/IUCN.UK.2022-2.RLTS.T18175A58298676.en>
- Day F (1863) *The land of the Permauls. Or Cochin, its past and its present*. Gantz Bros, Madras
- Day F (1865) *The fishes of Malabar*. Quaritch, London
- Day F (1878) *The fishes of India*. Dawson & Sons, London
- ✦ Dulvy NK, Davidson LN, Kyne PM, Simpfendorfer CA, Harrison LR, Carlson JK, Fordham SV (2016) Ghosts of the coast: global extinction risk and conservation of sawfishes. *Aquat Conserv* 26:134–153
- ✦ Espinoza M, Bonfil-Sanders R, Carlson J, Charvet P and others (2022) *Pristis pristis*. The IUCN Red List of Threatened Species 2022: e.T18584848A58336780. <https://dx.doi.org/10.2305/IUCN.UK.2022-2.RLTS.T18584848A58336780.en> (accessed 16 Aug 2023)
- ✦ Faria VV, McDavitt MT, Charvet P, Wiley TR, Simpfendorfer CA, Naylor GJ (2013) Species delineation and global population structure of Critically Endangered sawfishes (Pristidae). *Zool J Linn Soc* 167:136–164
- ✦ Feutry P, Kyne PM, Pillans RD, Chen X, Marthick J, Morgan DL, Grewe PM (2015) Whole mitogenome sequencing refines population structure of the Critically Endangered sawfish *Pristis pristis*. *Mar Ecol Prog Ser* 533:237–244
- ✦ Grant MI, Kyne PM, Simpfendorfer CA, White WT, Chin A (2019) Categorising use patterns of non-marine environments by elasmobranchs and a review of their extinction risk. *Rev Fish Biol Fish* 29:689–710
- ✦ Grant MI, White WT, Amepou Y, Appleyard SA and others (2021) Papua New Guinea: a potential refuge for threatened Indo-Pacific river sharks and sawfishes. *Front Conserv Sci* 2:719981
- ✦ Grant MI, Charles R, Fordham S, Harry AV and others (2022) *Pristis clavata*. The IUCN Red List of Threatened Species 2022: e.T39390A68641215. <https://dx.doi.org/10.2305/IUCN.UK.2022-2.RLTS.T39390A68641215.en> (accessed 16 Aug 2023)
- Hanson JK, Morrison D (1991) *Of kinkajous, capybaras, horned beetles, seladangs, and the oddest and most wonderful mammals, insects, birds, and plants of our world*. HarperCollins, New York, NY
- ✦ Haque AB, Leeney RH, Biswas AR (2020) Publish, then perish? Five years on, sawfishes are still at risk in Bangladesh. *Aquat Conserv* 30:2370–2383
- ✦ Haque AB, Charles R, D'Anastasi B, Dulvy NK and others (2023) *Anoxypristis cuspidata*. The IUCN Red List of Threatened Species 2023: e.T39389A58304073. <https://dx.doi.org/10.2305/IUCN.UK.2023-1.RLTS.T39389A58304073.en> (accessed 14 Dec 2023)
- Harad PA, Joglekar PP (2017) A study of fish symbolism in the life on the Son Koli community of Mumbai. *Bull Decan Coll Postgrad Res Inst* 77:121–130
- Harrison LR, Dulvy NK (eds) (2014) *Sawfish: a global strategy for conservation*. IUCN Species Survival Commission's Shark Specialist Group, Vancouver
- ✦ Harry AV, Everett B, Faria V, Fordham S and others (2022) *Pristis zijsron*. The IUCN Red List of Threatened Spe-

- cies 2022: e.T39393A58304631. <https://dx.doi.org/10.2305/IUCN.UK.2022-2.RLTS.T39393A58304631.en> (accessed 16 Aug 2023)
- Hefford AE (1949) Report on the work of 'William Carrick'. Government Press, Bombay
- Hoover JJ (2008) Searching for sawfish: a history of the hunt. *Am Curr* 34:1–15
- Hora SL (1951) Knowledge of the ancient Hindus concerning fish and fisheries of India. *J Asiat Soc Lett* 17:145–169
- ✦ Hossain MA, Thompson BS, Chowdhury GW, Mohsanin S, Fahad ZH, Koldewey HJ, Islam MA (2015) Sawfish exploitation and status in Bangladesh. *Aquat Conserv* 25:781–799
- ✦ Jabado RW, Al Baharna RA, Al Ali SR, Al Suwaidi KO, Al Blooshi AY, Al Dhaheri SS (2017) Is this the last stand of the Critically Endangered green sawfish *Pristis zijsron* in the Arabian Gulf? *Endang Species Res* 32:265–275
- James PSBR (1973) Sharks, rays and skates as a potential fishery resource off the east coast of India. In: *Proc Symp Living Resour Seas Around India*. CMFRI Spec Publ, Cochin, p 483–494
- Karbhari JP (2011) Giant saw fish, *Pristis microdon* Latham from the river Tapti at Surat. *Indian J Fish* 20:677–678
- ✦ Kini US, Chidambaram K (1947) The liver oils of elasmobranch/fish of south Indian waters. *J Soc Chem Ind* 66: 233–238
- ✦ Last P, Naylor G, Séret B, White W, de Carvalho M, Stehmann M (eds) (2016) Rays of the world. CSIRO, <http://dx.doi.org/10.1071/9780643109148>
- Latham J (1794) An essay on the various species of sawfish. *Trans Linn Soc Lond* 2:273–282
- ✦ Madras Fisheries Bureau (1899) Papers from 1899. Vol 1, Bull 1. https://ia601600.us.archive.org/11/items/madras_fisheriesb01madr/madrasfisheriesb01madr.pdf
- Manojkumar PP, Nasser AKV, Chandran K (2002) A rare landing of a large sawfish at Thikkodi, Calicut. *Mar Fish Inf Serv Tech Ext Ser* 172:7–8
- ✦ Misra KS (1947) A check list of the fishes of India, Burma and Ceylon. Part I. Elasmobranchii and Holocephali. *Rec Zool Surv India* 45:1–46
- Misra KS (1969) Pisces: Elasmobranchii and Holocephali. In: Roonwal ML (ed) *The fauna of India and the adjacent countries*, Vol. 1. Manager of Publications, Delhi
- Moazzam M, Osmany HB (2014) Occurrence of sawfish (family: Pristidae) in Pakistan. *Int J Biol Biotechnol* 11: 97–102
- ✦ Moore AB (2015) A review of sawfishes (Pristidae) in the Arabian region: diversity, distribution, and functional extinction of large and historically abundant marine vertebrates. *Aquat Conserv* 25:656–677
- ✦ Peverell SC (2005) Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on sawfish ecology. *Environ Biol Fishes* 73:391–402
- ✦ Phillips NM, Chaplin JA, Peverell SC, Morgan DL (2017) Contrasting population structures of three *Pristis* sawfishes with different patterns of habitat use. *Mar Freshw Res* 68:452–460
- Raje SG (2006) Skate fishery and some biological aspects of five species of skates off Mumbai. *Indian J Fish* 53: 431–439
- Sadhale N, Nene YL (2005) On fish in Manassollasa (c. 1131 AD). *Asian Agrihist* 9:177–199
- Sorley HT (1948) The marine fisheries of the Bombay Presidency. KH Mohamed, Poona
- ✦ Tanna A, Fernando D, Gobiraj R, Pathirana BM, Thilakarathna S, Jabado RW (2021) Where have all the sawfishes gone? Perspectives on declines of these Critically Endangered species in Sri Lanka. *Aquat Conserv* 31:2149–2163
- ✦ Tyabji Z, Jabado RW, Sutaria D (2022) Utilization and trade of sharks and rays in the Andaman Islands, India. *Mar Policy* 146:105295
- ✦ Whitty JM, Phillips NM, Thorburn DC, Simpfendorfer CA, Field I, Peverell SC, Morgan DL (2014) Utility of rostra in the identification of Australian sawfishes (Chondrichthyes: Pristidae). *Aquat Conserv* 24:791–804
- ✦ Wueringer BE, Biskis VN, Pinkus GA (2023) Impacts of trophy collection and commercial fisheries on sawfishes in Queensland, Australia. *Endang Species Res* 50:133–150
- ✦ Yan HF, Kyne PM, Jabado RW, Leeney RH and others (2021) Overfishing and habitat loss drive range contraction of iconic marine fishes to near extinction. *Sci Adv* 7:eabb6026

*Editorial responsibility: Charlie Huveneers,
Adelaide, South Australia, Australia
Reviewed by: 2 anonymous referees*

*Submitted: September 9, 2023
Accepted: February 2, 2024
Proofs received from author(s): April 12, 2024*