

Blue lines indicate the area meeting the ISRA Criteria; dashed lines indicate the suggested buffer for use in the development of appropriate place-based conservation measures

ZUARI ESTUARY ISRA

Western Indian Ocean Region

SUMMARY

Zuari Estuary is located in the state of Goa on the west coast of India. This dynamic estuarine system is under the influence of the monsoonal wet/dry seasonal cycle. During the dry season, salinity is higher as marine waters of the Arabian Sea penetrate the area while in the wet season, freshwater flow from the Zuari River drives down salinity. The area is characterised by shallow waters, mangroves, and extensive mudflats. Within the area there are: **threatened species** (e.g., Bleeker’s Whipray *Pateobatis bleekeri*); **range restricted species** (e.g., Sharpnose Guitarfish *Glaucostegus granulatus*); and **reproductive areas** (Sharpnose Guitarfish).

CRITERIA

Criterion A - Vulnerability; Criterion B - Range Restricted; Sub-criterion C1 - Reproductive Areas

INDIA

0-14 metres

43.72 km²





DESCRIPTION OF HABITAT

Zuari Estuary is a dynamic estuarine area in Goa on the west coast of India. The Zuari River flows into and heavily influences the estuary which has a mean width of 2.5 km (Giri Bhavan et al. 2023). The area is characterised by shallow waters, with the estuary naturally <7 m deep. A dredged shipping channel at Marmugao Port is maintained at ~14 m depth. Substrate is mostly composed of mud and habitats are dominated by mangroves and extensive mudflats.

The estuary is influenced by the annual monsoon cycle with prominent dry and wet seasons. This results in seasonal fluctuations in salinity, turbidity, temperature, and nutrients (Qasim & Sen Gupta 1981; Ansari et al. 1995; Giri Bhavan et al. 2023). The dry season is characterised by low rainfall and as a consequence, the estuary is more heavily influenced by the intrusion of marine waters from the Arabian Sea (Qasim & Sen Gupta 1981; Ansari et al. 1995). During the wet season, freshwater flow from the Zuari River increases, causing the salinity of the estuary to decrease. In one study, salinity varied from 24.1 ± 4.6 in the wet season to 30.1 ± 2.1 in the dry season (Giri Bhavan et al. 2023). The upper reaches of the estuary have higher turbidity than the lower reaches and the mouth (dry season, 29.4 ± 3.2 ; wet season, 37.9 ± 2.5 ; Giri Bhavan et al. 2023).

This Important Shark and Ray Area is benthic and is delineated from inshore and surface waters (0 m) to a depth of 14 m based on the bathymetry of the area.

ISRA CRITERIA

CRITERION A - VULNERABILITY

Two Qualifying Species considered threatened with extinction according to the IUCN Red List of Threatened Species™ regularly occur in the area. These are the Critically Endangered Sharpnose Guitarfish (Kyne et al. 2022) and Endangered Bleeker's Whipray (Sherman et al. 2020).

CRITERION B - RANGE RESTRICTED

The area holds the regular presence of Sharpnose Guitarfish and Bleeker's Whipray as resident range-restricted species. These species occur during both the wet and dry seasons, although they are more abundant during the dry season (Giri Bhavan et al. 2023). These species have been recorded across multiple years (e.g., surveys in 2018, 2019) demonstrating their regular occurrence in the area (Sreekanth et al. 2020; Giri Bhavan et al. 2023). These two species are often recorded in lower numbers in other areas of western India than in Zuari Estuary (e.g., Johri et al. 2021; Purushottama et al. 2022).

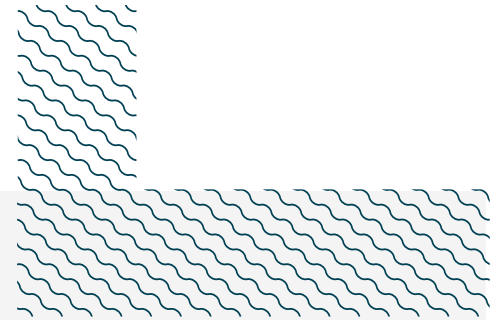
Sharpnose Guitarfish occur in the Red Sea Large Marine Ecosystem (LME) and the Arabian Sea LME and Bleeker's Whipray occurs in the Arabian Sea LME and the Bay of Bengal LME.

SUB-CRITERION C1 - REPRODUCTIVE AREAS

Zuari Estuary is an important reproductive area for one ray species.

Sharpnose Guitarfish neonates and young-of-the-year individuals have been recorded in the area during both the dry and wet season. Forty-eight individuals were recorded during gillnet surveys in January-March 2018 (dry season), August-September 2018 (wet season), January-March 2019 (dry

season), and August-September 2019 (wet season). Of these, 44 (92%) were recorded in the dry season and measured 35.5-60.8 cm total length (TL) and four were recorded in the wet season measuring 54.1-61.5 cm TL (Giri Bhavan et al. 2023). Smaller individuals were therefore recorded in the dry season. The size-at-birth of the species is ~39 cm TL (Moore et al. 2012) indicating that these animals were either neonates or young-of-the-year. All 48 individuals recorded were juvenile.



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Peter M. Kyne (IUCN SSC Shark Specialist Group - ISRA Project), Sreekanth GB (ICAR-Central Coastal Agricultural Research Institute), and Akhilesh KV (Central Marine Fisheries Research Institute) contributed and consolidated information included in this factsheet. We thank all participants of the 2023 ISRA Region 7 - Western Indian Ocean workshop for their contributions to this process.

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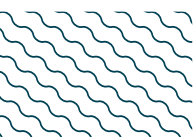
QUALIFYING SPECIES

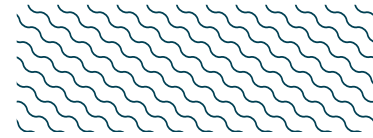
Scientific Name	Common Name	IUCN Red List Category	Global Depth Range (m)	ISRA Criteria/Sub-criteria Met									
				A	B	C1	C2	C3	C4	C5	D1	D2	
RAYS													
<i>Glaucostegus granulatus</i>	Sharpnose Guitarfish	CR	0-120	X	X	X							
<i>Pateobatis bleekeri</i>	Bleeker's Whipray	EN	0-40	X	X								

SUPPORTING SPECIES

Scientific Name	Common Name	IUCN Red List Category
SHARKS		
<i>Carcharhinus leucas</i>	Bull Shark	VU
<i>Chiloscyllium arabicum</i>	Arabian Carpetshark	NT
<i>Rhizoprionodon acutus</i>	Milk Shark	VU
<i>Scoliodon laticaudus</i>	Spadenose Shark	NT
<i>Sphyrna lewini</i>	Scalloped Hammerhead	CR
RAYS		
<i>Aetobatus flagellum</i>	Longhead Eagle Ray	EN
<i>Glaucostegus obtusus</i>	Widenose Guitarfish	CR
<i>Himantura uarnak</i>	Coach Whipray	EN
<i>Maculabatis gerrardi</i>	Whitespotted Whipray	EN
<i>Pastinachus sephen</i>	Cowtail Ray	NT
<i>Rhina ancylostomus</i>	Bowmouth Guitarfish	CR
<i>Urogymnus granulatus</i>	Mangrove Whipray	EN

IUCN Red List of Threatened Species Categories are available by searching species names at www.iucnredlist.org Abbreviations refer to: CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; DD, Data Deficient.

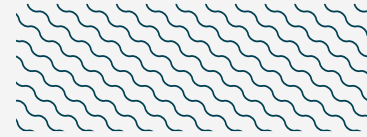




SUPPORTING INFORMATION

There are indications that Zuari Estuary may be an important area for undefined aggregations of three shark and one ray species.

During scientific gillnet surveys in the dry seasons of 2018 and 2019, catches of Arabian Carpetshark (n = 105), Milk Shark (n = 130), Spadenose Shark (n = 167), and Cowtail Ray (n = 60) were documented (Giri Bhavan et al. 2023). These catches were made from 55 gillnet sets (100 m benthic-set nets) with soak times of 100-120 minutes (the study deployed 110 gillnet sets in total, equally distributed between the dry and wet seasons; Giri Bhavan et al. 2023). This suggests that these species are forming aggregations in the area, possibly related to reproduction given that the catches were predominately juveniles (Giri Bhavan et al. 2023). The mean size of each shark species (sexes combined; Giri Bhavan et al. 2023) in the dry season were mostly below their size-at-maturity (Ebert et al. 2021): Arabian Carpetshark (39.1 ± 4.5 cm TL; size-at-maturity, 52-55 cm TL), Milk Shark (54.4 ± 5.1 cm TL; size-at-maturity, 68-81 cm TL), Spadenose Shark (30.5 ± 3.1 cm TL; size-at-maturity, 24-36 cm TL). Sizes recorded were likely to have been influenced by gear selectivity with mesh sizes of 60-80 mm used (Giri Bhavan et al. 2023). Further information is required to document these aggregations and understand their function.



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