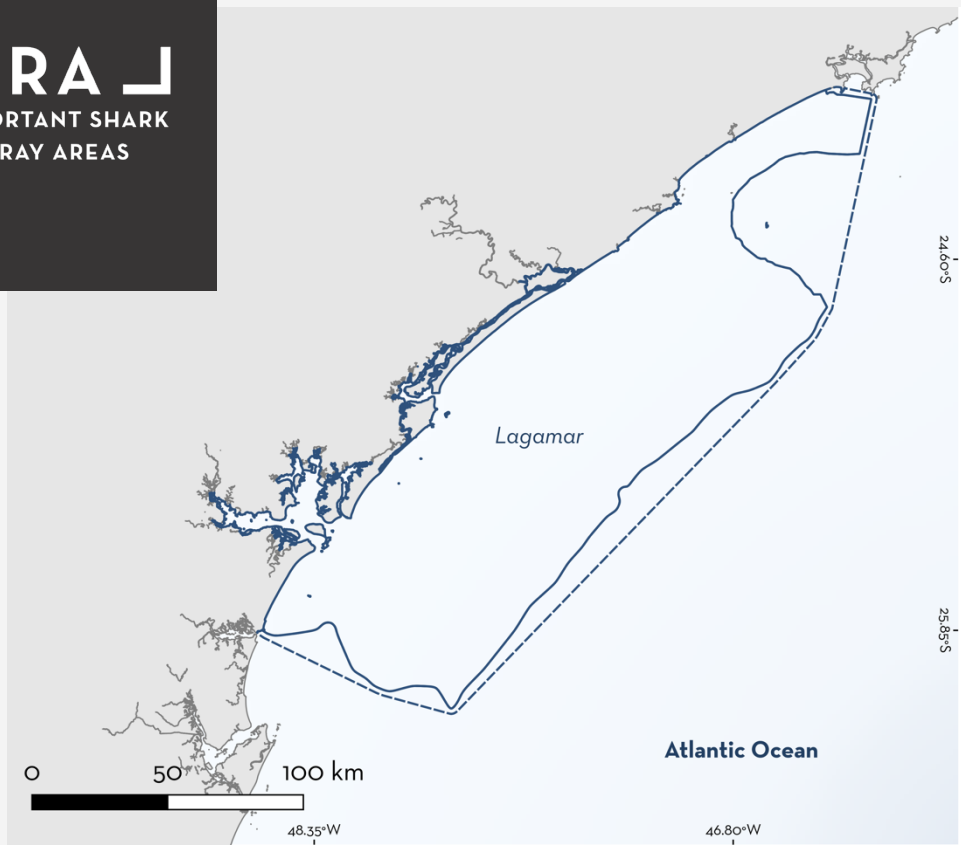
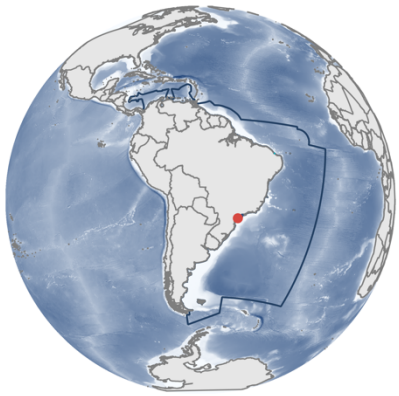
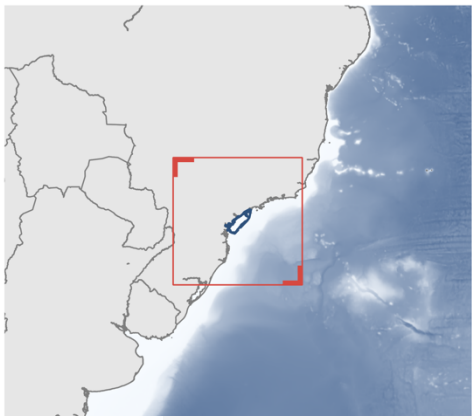
ISRA
IMPORTANT SHARK AND RAY AREAS







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

LAGAMAR ISRA

South American Atlantic Region

BRAZIL

0–55 metres

18,284 km²

SUMMARY

Lagamar is located along the southern coast of São Paulo and the northern coast of Paraná, Brazil. This region is characterised by a dynamic estuarine-lagoonal system where freshwater and marine environments interact. This system has high primary productivity, driven by nutrient input from mangroves, river discharges, and seasonal upwelling events. The area partially overlaps with seven protected areas and the Environmental Protection Area of the Cananéia-Iguape-Peruíbe Ramsar Site. Within this area there are: **threatened species** (e.g., Sandtiger Shark *Carcharias taurus*); **range-restricted species** (Lesser Numbfish *Narcine brasiliensis*); **reproductive areas** (e.g., Spinner Shark *Carcharhinus brevipinna*); **feeding areas** (e.g., Oceanic Manta Ray *Mobula birostris*); and the area sustains a **high diversity** of sharks (32 species).

CRITERIA

Criterion A – Vulnerability; Criterion B – Range Restricted;
Sub-criterion C1 – Reproductive Areas; Sub-criterion C2 – Feeding Areas;
Sub-criterion D2 – Diversity

DESCRIPTION OF HABITAT

Lagamar is located on the continental shelf along the southern coast of São Paulo and the northern coast of Paraná, Brazil. This region is characterised by a dynamic estuarine-lagoonal system where freshwater and marine environments interact, creating unique oceanographic conditions influenced by tides, freshwater inflow, and coastal currents (Tramonte et al. 2018). High sediment loads from riverine inflows contribute significantly to coastal and estuarine sedimentation, shaping features such as sand banks and influencing coastal morphology. The system boasts high primary productivity, driven by nutrient input from mangroves and river discharges. These nutrient-rich waters sustain diverse marine and estuarine food webs, while seasonal upwelling events during the austral summer further enhance nutrient availability, supporting biological activity (Knoppers et al. 1999; Nagata et al. 2015).

Freshwater from the Ribeira de Iguape River establishes a seasonal salinity gradient. During the rainy summer months, freshwater dominates, reducing salinity, while in the drier winter, saltwater intrusion becomes more pronounced due to tidal action. Water temperatures range from 18°C in winter to 28°C in summer, with estuarine waters generally warmer because of their shallow depths (Tramonte et al. 2018; Bastos & Braga 2023).

The area overlaps with the Mel Island Ecological Station, Tupiniquins Ecological Station, Currais Island National Park, Mel Island State Park, Cardoso Island State Park, Itinguçu State Park, Superagui National Park (UNEP-WCMC & IUCN 2024), and the Environmental Protection Area of Cananéia-Iguape-Peruíbe Wetland of International Importance Ramsar Site (Ramsar 2025).

This Important Shark and Ray Area is benthic and pelagic and is delineated from surface waters (0 m) to a depth of 55 m based on the bathymetry of the area.

ISRA CRITERIA

CRITERION A – VULNERABILITY

Thirty-two Qualifying Species considered threatened with extinction according to the IUCN Red List of Threatened Species regularly occur in the area. Threatened sharks comprise four Critically Endangered species, four Endangered species, and nine Vulnerable species; threatened rays comprise one Critically Endangered species, eight Endangered species, and six Vulnerable species (IUCN 2024).

CRITERION B – RANGE RESTRICTED

This area holds the regular presence of the Lesser Numbfish as a range-restricted species. This species occurs year-round across multiple life stages (neonate, juvenile, and adult) within the area. It is regularly captured by trawl and bottom gillnet fleets operating in this area (Rolim 2012; Santos 2022). This is one of the only known areas with regular catches of Lesser Numbfish in Brazil (Rolim 2012). Between 2009–2010, 35 individuals were recorded from artisanal landings (Chaves et al. 2019). Between November 2010–March 2012, 105 individuals, including pregnant females, were accidentally caught in 34 pair trawl operations monitored on the coast of São Paulo (seven were within this area) (Rolim 2012). From 2013–2020, 12 individuals were reported across eight fishing occasions (Santos 2022). Lesser Numbfish only occurs in the Patagonian Shelf Large Marine Ecosystem (LME) and South Brazil Shelf LME.

SUB-CRITERION C1 – REPRODUCTIVE AREAS

Lagamar is an important reproductive area for nine shark and one ray species.

Between 1996–2002, 210 artisanal fisheries landings were monitored, and 12,406 sharks were sampled (Motta 2006). Landing data from artisanal gillnet and trawl fishery operations, concentrated in a small southwestern portion within this area, were collected from June 2009–May 2010 over 14 days per month. These were divided into two consecutive seven-day sampling periods, except in December and February, when only one seven-day sampling was undertaken (Chaves et al. 2019). Fieldwork totalled 154 days over 12 months, covering all active vessels and extending from early morning to late afternoon. All landed sharks and rays were recorded, with fishers providing capture locations. A total of 4,941 individuals were recorded, consisting of 2,508 sharks (50.7%) and 2,432 rays (49.3%). Between December 2013–December 2020, 339 fisheries landings events (artisanal = 243; industrial = 62; recreational = 39) from captures from this area were monitored. Bottom gillnets represented 84.6% and 96.1% of the artisanal and industrial fishery gear used, respectively, while pole handling was the only type used by recreational fishers (Santos 2022). Sharks were identified and measured, and neonates were determined based on the presence of an umbilical scar (PRS Santos unpubl. data 2024).

Between 1996–2002, 488 Spinner Sharks (55–195 cm TL) were captured, of which 455 were neonates (96.6%; Motta 2006). Between December 2013–December 2020, 348 Spinner Sharks were recorded (males = 181, females = 167). The highest catch rates were observed between October–March. Of these, 76 Spinner Sharks (21.84%) were neonates measuring 65–77 cm TL. Pregnant females were also recorded (PRS Santos unpubl. data 2024).

Between 1996–2002, 32 Silky Sharks (71.5–98 cm TL) were captured in the eastern part of the area, of which 84.4% were neonates and 15.6% were young-of-the-year (YOY) (Motta 2006). Between 2009–2010, 38 Silky Sharks (27 neonates and YOY based on total length) were captured in the western portion of the area, of which 22 were in December 2009 (Chaves et al. 2019). Between December 2013–December 2020, Silky Sharks were regularly caught. Of 604 individuals (ranging 80–120 cm TL) reported on 103 occasions (~6 individuals per fishing trip) from the recreational, artisanal and industrial fishery, ~211 were from pole and line fishing, and the remaining were captured in bottom and surface gillnets from the artisanal and industrial fishery. Of 130 measured individuals, ~120 were <115 cm TL. The size-at-birth for this species (~56–87 cm TL) and the known segregation by size (Ebert et al. 2021), suggest this area is used for reproductive aggregations of Silky Sharks. Although two aggregations (250–300 individuals) of Silky Sharks (80–200 cm TL) were opportunistically reported in the Alcatrazes Archipelago (~50 km of this area) in June 2024, with smaller animals being more numerous (Corrêa et al. 2024), Lagamar was the only area in São Paulo with regular occurrence of smaller individuals for a longer time frame.

Between December 2013–December 2020, 103 Bull Sharks were recorded (males = 41, females = 62). The highest catch rates were observed between October–December. Of these, 39 Bull Sharks were neonates (37.9%) measuring 78–89 cm TL. Pregnant females were also recorded (PRS Santos unpubl. data 2024).

Between 1996–2002, 455 Blacktip Sharks (96.2% out of 488 landed [59–93.5 cm TL]) were neonates and the remaining YOY (Motta 2006). Between December 2013–December 2020, 158 Blacktip Sharks were reported on 58 occasions (813.1 kg [~5.14 per individual]) (Santos 2022). Size-at-birth for Blacktip Sharks is 37–72 cm TL (Ebert et al. 2021). According to the length-weight relationship, YOY individuals (~96 cm TL) would weigh ~5.6 kg (Froese et al. 2013; Froese & Pauly 2024) supporting the regular contemporary occurrence of neonates/YOY within this area.

Between 1987–2024, artisanal fishers reported the occurrence of Sandtiger Sharks in a slightly broader monitored area (P Charvet unpubl. data 1987–2024). From 563 individuals (378 pregnant females, 103 females, 82 males) reported, 523 were within this area (92.9%). Since 2009, 36 Sandtiger Sharks have been reported, of which 32 were from this area, including 17 pregnant females (P Charvet unpubl. data 1987–2024). This is the only known area in Brazil where pregnant females are still regularly observed (P Charvet unpubl. data 2024).

Between 1996–2002, 2,058 Brazilian Sharpnose Sharks (27.7% out of 7,438 landed [30–75 cm TL]) were neonates (Motta 2006). Pregnant females with full term embryos and postpartum females were landed between June to August. Neonates were landed between July and September (Motta 2006). Between 2009–2010, 1,173 Brazilian Sharpnose Sharks were recorded, mainly between October–March. Of these, 277 (23.61%) were considered neonates and YOY based on the TL of individuals (Chaves et al. 2019). Between December 2013–December 2020, 2,423 Brazilian Sharpnose Sharks were recorded (males = 1,301, females = 1122). The highest catch rates were observed between May–September, pregnant females increased in August (PRS Santos unpubl. data 2024). Of these, 375 (15.5%) were neonates measuring 35–42 cm TL. Pregnant females were also recorded (PRS Santos unpubl. data 2024).

Between 1996–2002, 553 Caribbean Sharpnose Sharks (28.5% out of 1,943 captured [33.5–113 cm TL]) were neonates landed mainly between August and November (Motta 2006). Between 2009–2010, 168 Caribbean Sharpnose Sharks were landed, mainly October–March, of which 80 were neonates (Chaves et al. 2019). Between 2013–2020, 1,320 individuals were captured and reported on 124 occasions, indicating an average of 10.6 individuals per catch (Santos 2022). Of 206 measured, ~170 (82.5%) were 35–55 cm TL and considered neonates/ YOY. Size-at-birth is 31–39 cm TL (Ebert et al. 2021).

Between 1996–2002, 897 Scalloped Hammerheads (83.8% out of 1,070 captured [39–111 cm TL]) were neonates and landed mainly between October to December (Motta 2006). The remaining individuals were all YOY and juveniles except for a pregnant female with full term embryos captured in December 2001 (Motta 2006). Between May 2012–May 2014, 253 individuals were collected on the coast of São Paulo for stomach analysis and of these, 135 were neonates. Because 44 had empty stomachs, only 209 were sampled. Of these 209, 119 were captured within this area (Dolphine 2014). Between 2013–2020, 2,419 Scalloped Hammerheads were captured mainly in spring and summer, and reported on 167 occasions, indicating an average of 14.5 individuals per trip (Santos 2022). Of 312 individuals measured, ~180 measured ~60 cm TL (57.7%). Size-at-birth is 31–57 cm TL indicating those were neonates (Ebert et al. 2021). During the summer, catches are mostly composed of neonates (45–55 cm TL) and sporadically captures of adults (280–330 cm TL); autumn is mostly composed of juveniles (75–105 cm TL); winter of larger juveniles (120–150 cm TL); and spring mostly adults (280–370 cm TL) (Santos 2022). During a one-month monitoring of artisanal fishery landings in the region in 2013, over 500 juveniles (100–160 cm TL) were recorded, of which 150 were captured by a single canoe in one day (N Wosnick unpubl. data 2023). The capture of this species predominantly occurs during the warmer months (December–February), a pattern that has persisted for at least 40 years (N Wosnick pers. obs. 2023). In November and December 2019, 26.5% of ~70 sharks (~410 kg) landed were Scalloped Hammerheads ranging in size from 60.5–119 cm TL (~68 kg) (N Wosnick unpubl. data 2023).

Between 1996–2002, 217 Smooth Hammerheads (66–140.5 cm TL [94% between 65–100 cm TL]) were captured between June–December (mainly July–September) in the western portion of the area (Motta 2006). Between 2009–2010, 853 Smooth Hammerheads were captured in the west portion of the area, mainly May–December, of which 106 (12.4%) were classified as neonates and YOY based on TL (Chaves et al. 2019). In 2019, two landings (1.5–2 ton) of Smooth Hammerheads (86–166 cm TL) were recorded in May (R Leite unpubl. data 2020). Between 2013–2020, 1,464 individuals were

captured within the core area, mainly in autumn and winter, and reported on 83 occasions, indicating an average of 17.6 animals per fishing trip (Santos 2022). Of 216 individuals measured, ~30 (13.88%) measured 80–85 cm TL. Size-at-birth is 49–63 cm TL indicating those were YOY (Ebert et al. 2021).

Between 2009–2010, 1,799 Shortnose Guitarfishes were captured, of which 1,699 (94.4%) were captured between May–November suggesting seasonality in their area use (Chaves et al. 2019). Captures of Shortnose Guitarfish were monitored from landings of bottom gillnets operating in two fishing points within this area between 2021–2024, from which landings were monitored (N Wosnick unpubl. data 2023). In general, sexually active males (evidenced by semen in the seminal vesicles) were predominant from May–August, with fewer females present. By mid-season (September to November), the trend shifted, with females becoming predominant. These females were in vitellogenesis and exhibited various stages of embryonic development monitored (N Wosnick unpubl. data 2023). From December–February, if fleets continued operating in the area (a rare occurrence), nearly all captured females were in advanced stages of pregnancy, with males rarely observed (N Wosnick unpubl. data 2023). This shift in sex ratios suggests that mating occurs from May–August, during which males dominate the area. After this period, males appear to leave the region while females remain (N Wosnick unpubl. data 2023). Considering the numbers from one fishing point, ~500–600 Shortnose Guitarfishes are captured annually in this area. Peak capture occurs in winter, but individuals are captured year-round. Of these, ~50% are sexually active based on the observation of pregnant females (assessed by necropsy), and semen in the males' seminal vesicles. This highlights the importance of this area for the reproductive purposes of this species (N Wosnick unpubl. data 2016).

SUB-CRITERION C2 – FEEDING AREAS

Lagamar is an important feeding area for one ray species.

Land-based observations of Oceanic Manta Rays somersaults were made by one observer, from December 2011–May 2012, and between January–May 2013, comprising 257 and 181 h of observations, from two points of observation during 2011–2012 and one point in 2013 (Medeiros et al. 2015). There were 99 sightings in 2011–2012 and 147 in 2013. The sightings per unit of observation effort peaked in March during 2011–2012 and in February 2013, forming a gradual bell-shaped pattern of increase and decline in both years. Most sightings involved backwards somersaults; only three sightings were forward somersaults with a drop in the belly-down position (Medeiros et al. 2015). Backwards somersaults have been recorded as feeding strategy for solitary Oceanic Manta Rays (Stevens 2016). On two occasions on 19 February 2013, however, three individuals breached at the same time, indicating that more than one individual was in the area at the time (Medeiros et al. 2015). Such surface orientated, aggregative behaviour in *Mobula* rays is generally associated with foraging behaviour (Stevens 2016). The water inside the estuary is turbid, precluding underwater observations, however, reports from fishers, including records of incidental catch, damage to fishing gear and sightings, support a seasonal occurrence inside the estuary. The freshwater input is significantly higher during the summer, increasing to up to 170% of the annual mean value (Marone et al. 2005). Spatial and temporal dynamics of zooplankton assemblages were studied in the Paranaguá Estuarine System in March and August of 2012 and in February and June of 2013 (Salvador & Bersano 2017). Total zooplankton abundance varied considerably within sampling periods, and a seasonal tendency was apparent. Mean densities were higher over summer surveys and were dominated by holoplanktonic organisms (Salvador & Bersano 2017). The seasonal abundance of zooplankton aligns with the seasonal records of Oceanic Manta Rays' somersaults supporting the use of the area for feeding purposes. Additionally, seven occurrences of breaching Oceanic Manta Rays displacing schools of teleosts subsequently preyed upon by Guiana Dolphins *Sotalia guianensis*

were observed within this area. It is suggested that Guiana Dolphins has learned to recognise such breaches as a signal to the presence of teleosts (probably Clupeidae and Engraulidae) and apparently to improve their predation success rate (Domit et al. 2017).

SUB-CRITERION D2 – DIVERSITY

Lagamar sustains a high diversity of Qualifying Species (33 species). This exceeds the regional diversity threshold (25 species) for the South American Atlantic region. The regular presence of Qualifying Species has been documented through fisheries landings and catches from artisanal industrial and recreational fisheries operating within this area between 1996–2020 (Motta et al. 2006; Chaves et al. 2019; Santos et al. 2022).

Acknowledgments

Paulo Roberto S Santos (Santa Catarina State University), Eloisa Pinheiro Giareta (Associação MarBrasil), Rodrigo Domingues (São Paulo State University, UNESP, Campus do Litoral Paulista), Renata Daldin Leite (Associação MarBrasil), Domingos Garrone-Neto (São Paulo State University), Natascha Wosnick (Universidade Federal do Paraná; Associação MarBrasil), Patricia Charvet (PPGSis, Universidade Federal do Ceará; Projeto Trygon), Leonardo de Paula Rios (Associação MarBrasil), Ryan Charles (IUCN SSC Shark Specialist Group – ISRA Project), and Vanessa Bettcher Brito (IUCN SSC Shark Specialist Group – ISRA Project) contributed and consolidated information included in this factsheet. We thank all participants of the 2025 ISRA Region 05 – South American Atlantic workshop for their contributions to this process.

This factsheet has undergone review by the ISRA Independent Review Panel prior to its publication.

This project was funded by the Shark Conservation Fund, a philanthropic collaborative pooling expertise and resources to meet the threats facing the world's sharks and rays. The Shark Conservation Fund is a project of Rockefeller Philanthropy Advisors.

Suggested citation

IUCN SSC Shark Specialist Group. 2025. Lagamar ISRA Factsheet. Dubai: IUCN SSC Shark Specialist Group.

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
SHARKS												
Carcharhinus acronotus	Blacknose Shark	EN	3–100	X								
Carcharhinus brevipinna	Spinner Shark	VU	0–200	X		X						
Carcharhinus falciformis	Silky Shark	VU	0–1,112	X		X						
Carcharhinus leucas	Bull Shark	VU	0–256	X		X						
Carcharhinus limbatus	Blacktip Shark	VU	0–140	X		X						
Carcharhinus obscurus	Dusky Shark	EN	0–500	X								
Carcharias taurus	Sandtiger Shark	CR	0–232	X		X						
Ginglymostoma cirratum	Atlantic Nurse Shark	VU	0–130	X								
Isurus oxyrinchus	Shortfin Mako	EN	0–1,888	X								
Mustelus schmitti	Narrownose Smoothhound	CR	2–195	X								
Notorynchus cepedianus	Broadnose Sevengill Shark	VU	0–570	X								
Rhizoprionodon lalandii	Brazilian Sharpnose Shark	VU	0–149	X		X						
Rhizoprionodon porosus	Caribbean Sharpnose Shark	VU	0–500	X		X						
Sphyrna lewini	Scalloped Hammerhead	CR	0–1,043	X		X						

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
SHARKS												
Sphyrna zygaena	Smooth Hammerhead	VU	0–500	X		X						
Squatina guggenheim	Angular Angel Shark	EN	7–150	X								
Squatina occulta	Hidden Angel Shark	CR	10–350	X								
RAYS												
Aetobatus narinari	Whitespotted Eagle Ray	EN	0–60	X								
Dasyatis hypostigma	Groovebelly Stingray	EN	5–80	X								
Gymnura altavela	Spiny Butterfly Ray	EN	0–150	X								
Hypanus berthalutzae	Lut'z Stingray	VU	0–100	X								
Mobula birostris	Oceanic Manta Ray	EN	0–1,246	X			X					
Mobula hypostoma	Atlantic Pygmy Devil Ray	EN	0–100	X								X
Mobula thurstoni	Bentfin Devil Ray	EN	0–100	X								
Myliobatis freminvillei	Bullnose Eagle Ray	VU	0–122	X								
Myliobatis goodei	Southern Eagle Ray	VU	0–181	X								
Narcine brasiliensis	Lesser Numbfish	NT	6–60		X							
Pseudobatos horkelii	Brazilian Guitarfish	CR	0–150	X								

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												
Pseudobatos percellens	Chola Guitarfish	EN	0–110	X								
Rhinoptera bonasus	Cownose Ray	VU	0–60	X								
Rhinoptera brasiliensis	Brazilian Cownose Ray	VU	0–20	X								X
Rioraja agassizi	Rio Skate	VU	5–600	X								
Zapteryx brevirostris	Shortnose Guitarfish	EN	0–140	X		X						

SUPPORTING SPECIES

Scientific Name	Common Name	IUCN Red List Category
SHARKS		
Galeocerdo cuvier	Tiger Shark	NT
Heptranchias perlo	Sharpnose Sevengill Shark	NT
Mustelus canis	Dusky Smoothhound	NT
Scyliorhinus haeckeli	Freckled Catshark	DD
Squalus albicaudus	Brazilian Whitetail Shark	DD
RAYS		
Hypanus guttatus	Longnose Stingray	NT
Psammobatis extenta	Zipper Sandskate	LC
Psammobatis rutrum	Spade Sandskate	LC
Sympterygia bonapartii	Smallnose Fanskate	NT

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 additional indications that Lagamar is an important reproductive area for two shark species.

Between 2013–2020, Shortfin Makos were mostly captured between October–December. A total of 466 individuals (71–145 cm TL) were reported on 54 occasions, indicating an average of 8.7 individuals per catch (Santos 2022). Size-at-birth is 60–70 cm TL and size-at-maturity varies regionally, with males maturing at ~165–215 cm TL and females at 265–312 cm TL (Ebert et al. 2021).

Neonate and small juvenile Tiger Sharks (~100 cm TL) were landed in the autumn of 2022. Size-at-birth is 51–71 cm TL (Ebert et al. 2021). In summer, catches comprised large juveniles and adults (150–340 cm TL) (Santos 2022).

However, more information is required to determine the reproductive importance of this area for these species.

REFERENCES

Bastos TCC, Braga ES. 2023. Anthropogenic influence on silicon behavior in an estuary member of the Biosphere Reserve in Southeastern Brazil. *Ocean and Costal Research* 71: e23035. https://doi.org/10.1590/2675-2824071.22120atccb

Chaves PDTDC, Almeida MPD, Platner M. 2019. Tubarões e raias como captura incidental na pesca artesanal do litoral do Paraná: condição reprodutiva e variações sazonais em composição e abundância. *Arquivos de Ciências do Mar* 52(2): 7–23. https://doi.org/10.32360/acmar.v52i2.39966

Corrêa ALT, Mello TJ, Candido CF. 2024. Opportunistic sighting of a silky shark (*Carcharhinus falciformis*) aggregation in the subtropical southwest Atlantic. *Journal of Fish Biology* 106(2): 654–659. https://doi.org/10.1111/jfb.15979

Dolphine PM. 2014. Hábitos alimentares de jovens de tubarão-martelo *Sphyrna lewini* (Griffith & Smith, 1834) (Chondrichthyes, Sphyrnidae) no litoral do estado de São Paulo. Unpublished PhD Thesis, Universidade Estadual Paulista, Rio Claro.

Domit C, Broadhurst MK, Bornatowski H. 2017. Interactions between *Manta birostris* and *Sotalia guianensis* in a World Heritage listed Brazilian estuary. *Journal of Fish Biology* 91: 1236–1240. https://doi.org/10.1111/jfb.13399

Ebert DA, Dando M, Fowler S. 2021. *Sharks of the world: A complete guide.* Princeton: Princeton University Press.

Froese R, Thorson JT, Reyes RB. 2013. A Bayesian approach for estimating length-weight relationships in fishes. *Journal of Applied Ichthyology* 30: 78–85. https://doi.org/10.1111/jai.12299

Froese R & Pauly D. 2024. FishBase. World Wide Web electronic publication. www.fishbase.org, version (02/2024).

IUCN. 2024. The IUCN Red List of Threatened Species. Version 2024-2. Available at: https://www.iucnredlist.org Accessed February 2025.

Knoppers B, Kjerfve B, Carmouze JP. 1999. The hydrochemistry and biogeochemistry of coastal lagoons of South America. In: Perillo GM, Piccolo MC, Iribarne MO, eds. *Coastal Lagoon Processes*. Verlag: Springer, 111–154. http://dx.doi.org/10.1029/2008GM000771

Marone E, Machado EC, Lopes RM, Da Silva ET. 2005. Land-ocean fluxes in the Paranaguá Bay estuarine system, southern Brazil. *Brazilian Journal of Oceanography* 53: 169–181. https://doi.org/10.1590/s1679-87592005000200007

Medeiros AM, Luiz OJ, Domit C. 2015. Occurrence and use of an estuarine habitat by giant manta ray *Manta birostris*. *Journal of Fish Biology* 86: 1830–1838. https://doi.org/10.1111/jfb.12667

Motta FS. 2006. Ecologia e pesca artesanal de tubarões costeiros no litoral centro-sul de São Paulo. Unpublished PhD Thesis, Universidade Estadual Paulista, Rio Claro.

Nagata RM, Moreira MZ, Pimentel CR, Morandini AC. 2015. Food web characterization based on δ15N and δ13C reveals isotopic niche partitioning between fish and jellyfish in a relatively pristine ecosystem. *Marine Ecology Progress Series* 519:13-27. http://dx.doi.org/10.3354/meps11071

Ramsar Convention on Wetlands of International Importance (Ramsar). 2025. Ramsar site: Environmental Protection Area of Cananéia-Iguape-Peruíbe. Available at: https://rsis.ramsar.org/ris/2310 Accessed March 2025.

Rolim FA. 2012. Ocorrência, morfometria e crescimento relativo da raia treme-treme Narcine brasiliensis (Olfers, 1831) (Elasmobranchii: Narcinidae) no litoral do Estado de São Paulo. Unpublished Undergratuate Thesis, Universidade Estadual Paulista, Rio Claro.

Salvador B, Bersano JGF. 2017. Zooplankton variability in the subtropical estuarine system of Paranaguá Bay, Brazil, in 2012 and 2013. Estuarine Coastal and Shelf Science 199: 1–13. https://doi.org/10.1016/j.ecss.2017.09.019

Santos PRS. 2022. Avaliação e aprimoramento dos dados pesqueiros de elasmobrânquios no litoral sul de São Paulo, sudeste do Brasil. Unpublished PhD Thesis, Universidade Estadual Paulista, Rio Claro.

Santos PRS, Balanin S, Gadig OBF, Garrone-Neto D. 2022. The historical and contemporary knowledge on the elasmobranchs of Cananeia and adjacent waters, a coastal marine hotspot of southeastern Brazil. *Regional Studies of Marine Science* 51: 102224. http://dx.doi.org/10.1016/j.rsma.2022.102224

Stevens GMW. 2016. Conservation and population ecology of manta rays in the Maldives. Unpublished PhD Thesis, University of York, York.

Tramonte KM, Figueira RCL, Majera AP, Ferreira PAL, Batista MF, Ribeiro AP, Mahiques MM. 2018. Geochemical behavior, environmental availability, and reconstruction of historical trends of Cu, Pb, and Zn in sediment cores of the Cananéia-Iguape coastal system, Southeastern Brazil. *Marine Pollution Bulletin* 127: 1–9. http://dx.doi.org/10.1016/j.marpolbul.2017.11.016

UNEP-WCMC & IUCN. 2024. Protected Planet: The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM) [Online], January 2025, Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net Accessed January 2025.