

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

SOUTHERN INHAMBANE PROVINCE ISRA

Western Indian Ocean Region

SUMMARY

Southern Inhambane Province is located in the southwest of the Mozambique Channel and spans ~100 km of the Mozambican coastline. This area encompasses a range of coastal and benthic habitats, including subtropical rocky reefs, sandy substrates, estuarine and mangrove ecosystems, seagrass beds, a kelp bed, and pelagic waters. Within this area there are: **threatened species** (e.g., Bowmouth Guitarfish *Rhina ancylostomus*); **range-restricted species** (e.g., Shorttail Nurse Shark *Pseudoginglymostoma brevicaudatum*); **reproductive areas** (e.g., Reef Manta Ray *Mobula alfredi*); **feeding areas** (Whale Shark *Rhincodon typus*); **resting areas** (e.g., Whitetip Reef Shark *Triaenodon obesus*); **undefined aggregations** (e.g., Oman Cownose Ray *Rhinoptera jayakari*); **areas with distinctive attributes** (e.g., Smalleye Stingray *Megatrygon microps*); and the area sustains a **high diversity** of sharks (24 species).

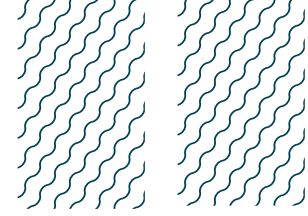
CRITERIA

Criterion A - Vulnerability; Criterion B - Range Restricted;
Sub-criterion C1 - Reproductive Areas; Sub-criterion C2 - Feeding Areas;
Sub-criterion C3 - Resting Areas; Sub-criterion C5 - Undefined Aggregations;
Sub-criterion D1 - Distinctiveness; Sub-criterion D2 - Diversity

— —
MOZAMBIQUE

— —
0-100 metres

— —
1,612.87 km²



DESCRIPTION OF HABITAT

Southern Inhambane Province is located along the southern coast of Mozambique, within the Agulhas Current Large Marine Ecosystem (LME). The area is characterised by subtropical rocky reefs in shallow water (5–25 m) and a deep reef system (25–40 m) running parallel to shore, with a predominant sand depression between these two reef systems. The continental shelf in the north of the area is narrow with a steep slope, widening south of Praia do Tofo. Southward propagating mesoscale eddies interact with the shelf edge creating frequent and pronounced upwelling throughout the year (Roberts et al. 2014). These intermittent upwelling events increase plankton biomass in shelf waters (Rohner et al. 2014, 2018; Vinayachandran et al. 2021). Shelf-edge upwelling occurs in the northern part along the narrow shelf, while the south of the area is influenced by divergent upwelling off Zavora, and vortex-driven upwelling in the Delagoa Bight (Rohner et al. 2014, 2018).

While the primary habitat along the coastline is rocky reef on sandy substrate, the region also hosts a diverse range of other habitats, such as mangroves, seagrass beds, estuaries, and an extensive kelp bed in Zavora. These diverse habitats, along with frequent coastal upwelling, have led to this area being considered one of the most productive and biodiverse ecosystems in the region (Pereira et al. 2014).

The area overlaps with the Morrumbene to Zavora Bay and the Mozambique Channel Ecologically or Biologically Significant Marine Areas (EBSAs; CBD 2023a, 2023b). It also overlaps with the Tofo Key Biodiversity Area (KBA 2023).

This Important Shark and Ray Area is benthopelagic and extends from inshore and surface waters (0 m) to 100 m, based on the bathymetry of the area.

ISRA CRITERIA

CRITERION A – VULNERABILITY

Twenty-two Qualifying Species considered threatened with extinction according to the IUCN Red List of Threatened Species™ regularly occur in the area. Threatened sharks comprise two Critically Endangered species, three Endangered species, and four Vulnerable species; threatened rays comprise three Critically Endangered species, seven Endangered species, and three Vulnerable species (IUCN 2023).

CRITERION B – RANGE RESTRICTED

This area holds the regular presence of the Shorttail Nurse Shark and Greyspot Guitarfish as resident range-restricted species.

Shorttail Nurse Shark is a rare species that only occurs in the Agulhas Current and neighbouring Somali Coastal Current LMEs. Baited Remote Underwater Video (BRUV) surveys recorded two individuals during surveys in 2019, both solitary individuals on a rocky reef in the area (Bennett et al. 2021). Their occurrence here represented a significant range extension for the species that was previously only known from Tanzania and Madagascar (Bennett et al. 2021). Additionally, a mating event (two individuals) was observed in 2021 (F Trotman pers. comm. 2023) in close proximity to the previous BRUV records in 2019, confirming the continued use of this area by this species. Despite the low number of observations, these are globally significant given the rarity of the species. The

only other contemporary records in the region are from Chidenguele ~150 km away and Maputaland ~300 km away.

Greyspot Guitarfish occur in the Agulhas Current LME and has been recorded in all months of the year. In-water sightings of this species in the Inhambane Province are almost exclusively recorded within the area, with dive surveys recording a total of 245 sightings (four opportunistic records from 2011, and 241 sightings recorded in 2017–2023). This species is highly philopatric, with almost half of all sightings (112 sightings) occurring at a single inshore rocky reef (Marine Megafauna Foundation unpubl. data 2023; All Out Africa unpubl. data 2023). BRUV surveys in 2019 and 2021 recorded an additional nine sightings at rocky reefs throughout the area and within an estuary (Wildlife Conservation Society unpubl. data 2023; Instituto Oceanografico de Mocambique unpubl. data 2023).

SUB-CRITERION C1 – REPRODUCTIVE AREAS

Southern Inhambane Province is an important reproductive area for two ray species.

Pregnant female Reef Manta Rays have been observed during dive surveys every year between 2003–2023, except 2015 and 2016 (Marine Megafauna Foundation unpubl. data 2023). Pregnancies were visually identified by the heavily extended abdomen, and they were observed in all months of the year, with increased numbers in the austral summer (November to February). One hundred and twenty females have been observed pregnant (19% of all females identified in the area) and 244 (39%) had reproductive scars; individuals were seen pregnant on up to five occasions and across multiple years. Courtship and mating events were also reported from the area each year from 2003–2008 (Marshall & Bennett 2010). Reproductive scars were observed on 43% of females and 69 pregnancy events were recorded (in 62 individuals).

Courtship in Blotched Fantail Rays has been observed during dive surveys on 17 occasions at rocky reefs, with 14 of these courtship events occurring since 2020 (Marine Megafauna Foundation unpubl. data 2023; All Out Africa unpubl. data 2023). Courtship events involved groups of 3–17 individuals, usually a single female with multiple males forming a mating train (N Cullain pers. obs. 2023; J Keeping pers. obs. 2023). Courtship events predominantly occur in autumn (March–May), coinciding with the peak in seasonal sightings for this species (Keeping et al. 2021). Additionally, three presumed pregnant females were observed in May and June, and at least 18 individuals of ~50 cm disc width (DW) have been recorded at one rocky reef site (Marine Megafauna Foundation unpubl. data 2023; All Out Africa unpubl. data 2023). These were likely to be young-of-the-year considering the size-at-birth of 30–35 cm DW (Last & Stevens 2009).

SUB-CRITERION C2 – FEEDING AREAS

Southern Inhambane Province is an important feeding area for one shark species.

Southern Inhambane Province supports one of the largest identified aggregations of Whale Sharks globally. Researchers and citizen scientists have photographically identified 793 individuals and logged >3,200 encounters during surface surveys since 2005 (C Prebble unpubl. data 2023). Whale Sharks were feeding in 46% of all encounters (n = 873) between 2011–2023, with feeding observed every year (Marine Megafauna Foundation unpubl. data 2023). Previous work in 2008–2010 also noted feeding in ~20% of encounters (n = 689), although shark behaviour was not consistently recorded (Haskell et al. 2014). Large feeding aggregations have been reported including 51 individuals in March 2005 (Rohner et al. 2018), 25 individuals in January and in February 2010 (Rohner et al.

2013), and 14 individuals in July 2017 (Marine Megafauna Foundation unpubl. data 2023). Although Whale Sharks likely feed in various locations throughout their range, observations suggest that coastal aggregation sites are important feeding hotspots. Fifteen satellite-tracked Whale Sharks in 2010–2012 spent much of their time in coastal areas of southern Mozambique, and selected areas with higher chlorophyll- α than randomised model sharks, further highlighting the importance of this area for feeding (Rohner et al. 2018). Biochemical analysis of Whale Shark tissues showed evidence of long-term site fidelity (within a few hundred kilometres of the region) for feeding (Prebble et al. 2018). Photo-identification data support the long-term philopatry of these sharks, showing low connectivity to other known feeding sites, highlighting the importance of this region to their dietary ecology (Prebble et al. 2018).

SUB-CRITERION C3 – RESTING AREAS

Southern Inhambane Province is an important resting area for two shark and one ray species.

Indo-Pacific Leopard Shark sightings are concentrated in the area, with 82% of sightings from the Inhambane Province reported from rocky reefs in this area (Marine Megafauna Foundation unpubl. data 2023). This species is relatively rare in the Western Indian Ocean, and this area is the main identified hotspot along the East African coast (Pottie et al. 2021). Dive surveys between 2010–2023 recorded sightings every year ($n = 336$, mean = 24, range = 4–58 sightings per year). Sightings occurred year-round, with a peak in summer/autumn (January–April). Individuals were resting in 71% of sightings for which behaviour was recorded ($n = 286$), in groups of up to four individuals on sandy substrate adjacent to rocky reefs, in caves or under reef ledges during the day, which is typical for this nocturnal forager (Dudgeon et al. 2008). Indo-Pacific Leopard Sharks were seen in groups on 53 occasions (mean group size = 2.4 individuals).

Whitetip Reef Sharks are sighted at rocky reefs throughout the Inhambane Province, but 89% of all sightings are from within this area (Marine Megafauna Foundation unpubl. data 2023). Dive surveys recorded 1,036 sightings, with the species seen every year from 2010–2023 (mean = 74, range = 16–177 sightings per year). Sightings occurred year-round and groups of up to eight individuals resting together were recorded. Resting was the most frequently observed behaviour for this species and was observed during the day (07:00–14:00), which is typical of this primarily nocturnal hunter (Randall 1977).

Aggregations of resting Bluespotted Maskrays are regularly observed in the area. Dive surveys recorded 178 aggregations of up to 20 individuals between 2011–2023 (mean = 3.6 individuals, range = 2–20 individuals per survey) with these aggregations sighted year-round (Marine Megafauna Foundation unpubl. data 2023; All Out Africa unpubl. data 2023). Photo-identification indicates that the same individuals are re-sighted throughout the year at rocky reefs (5–18 m depth) in the area (All Out Africa unpubl. data 2023), indicating site preference to certain habitats.

SUB-CRITERION C5 – UNDEFINED AGGREGATIONS

Southern Inhambane Province is an important area for undefined aggregations of four ray species.

Dive surveys conducted between 2003–2023 have recorded 7,799 sightings of Reef Manta Rays of 969 individuals from the area (90% of total sightings across the Inhambane Province). Multiple individuals were often seen cleaning together in groups. High numbers are observed at these sites, for example up to 61 individuals were identified on a cleaning station, during which cleaning, courtship, and social interactions were observed (N Cullain unpubl. data 2023). Sightings were

recorded year-round every year throughout the area, but with a peak in winter (July–September) at sites in Zavora (Marine Megafauna Foundation unpubl. data 2023). This species is predominantly observed at rocky reef cleaning stations, where cleaner fishes remove parasites and dead skin (Marshall et al. 2011). This is an important behaviour in the species, with 10 of 36 individuals tracked with passive acoustic telemetry spending >3 consecutive hours on a cleaning station (mean visit duration of 25 min, maximum visit duration = 8 hr; Venables et al. 2020). Apart from the physical/health benefit, cleaning stations are also important locations for social interactions and courtship of Reef Manta Rays (Marshall & Bennett 2010; Perryman et al. 2019).

Oceanic Manta Rays are observed actively cleaning at rocky reef cleaning stations (15–30 m deep) within this area, or near the surface when they are feeding. Dive surveys recorded 867 sightings of 293 individuals, with sightings recorded every year from 2003–2023 (mean = 41 sightings per year, range = 7–79 sightings per year; Marine Megafauna Foundation unpubl. data 2023). Oceanic Manta Rays were seen in groups of up to 13 individuals, with multiple individuals cleaning together (mean group size = 2.75). Cleaning aggregations were recorded on 178 occasions. Sightings occur year-round, with higher numbers in autumn (March–May). Sightings are more common in this area compared to surrounding coastal waters, with 99% of the total sightings of the species in the Inhambane Province recorded from the area. Satellite tagged Oceanic Manta Rays (n = 7) moved between Praia do Tofo and Zavora, and 10 individuals have been identified at cleaning stations in both locations, demonstrating connectivity between the sites (Marine Megafauna Foundation unpubl. data 2023). While the main importance of the area to Oceanic Manta Rays is cleaning, there is also some evidence of feeding, with groups of up to 15 individuals seen feeding during half of surface-based sightings (n = 478) from 2011–2023, and reproduction (three pregnant females observed) (Marine Megafauna Foundation unpubl. data 2023).

Shorthorned Pygmy Devil Rays are sighted throughout the Inhambane Province, however, 97% of sightings have been recorded in this area. Sightings occurred year-round with Shorthorned Pygmy Devil Rays swimming mid-water in groups of up to ~200 individuals. The mean number of individuals in a group was 14 (range 2–200), and single individuals were recorded on 229 occasions (Marine Megafauna Foundation unpubl. data 2023). Dive surveys recorded 5,647 sightings in the area, with the species seen every year from 2003–2023 (mean = 269 sightings per year, range = 21–891).

Dive and boat-based surface surveys have recorded groups of up to 200 individuals of Oman Cownose Rays (five groups of 80–100 individuals, three groups of ~200 individuals) swimming mid-water or at the surface on 14 occasions throughout 2012–2014 and 2017–2019 (mean group size = 82 individuals, range = 3–200). Observations occurred in all months except February, May, and June, and solitary individuals were recorded on only two occasions (Marine Megafauna Foundation unpubl. data 2023; All Out Africa unpubl. data 2023).

SUB-CRITERION D1 – DISTINCTIVENESS

Southern Inhambane Province contains areas with distinctive attributes for two ray species.

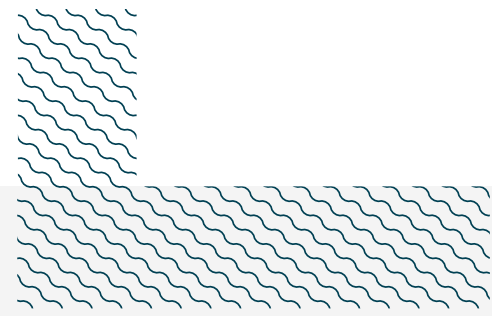
The area includes important cleaning habitats for Smalleye Stingrays at rocky reef cleaning stations. The Inhambane Province is the only documented region globally where Smalleye Stingrays regularly visit cleaning stations (Boggio-Pasqua et al. 2019), and 91% of sightings from the whole province have been recorded in Southern Inhambane Province, making it the main site globally where this species is regularly observed. Dive surveys recorded 371 sightings of 97 photo-identified individuals between 2005–2023 (mean = 15 sightings per year, range = 1–49; Marine Megafauna Foundation unpubl. data 2023; All Out Africa unpubl. data 2023). Remote cameras recorded 43 individuals actively cleaning for an accumulated time of ~2 hours between 2021–2023 (All Out Africa unpubl. data 2023), plus a

single BRUV record in 2019 (Wildlife Conservation Society unpubl. data 2023; Instituto Oceanografico de Mocambique unpubl. data 2023). Sightings occur year-round, with a peak in winter (July-September; Keeping et al. 2021). Active cleaning was observed in 32% of sightings for which behaviour was recorded (n = 187) and the species showed preference to certain sites (e.g., 91 sightings at one reef).

This area is an important cleaning area for the Bowmouth Guitarfish, with 96% of all sightings throughout the Inhambane Province recorded in this area. Southern Inhambane Province represents one of the few locations in the Western Indian Ocean region where this species is regularly encountered and to our knowledge the most common reports of cleaning behaviour in the species globally. While there are limited observations of active cleaning during dive surveys (n = 9), remote camera deployments recorded cleaning behaviour on 22 occasions (All Out Africa unpubl. data 2023). This suggests Bowmouth Guitarfish are actively cleaning but are easily disturbed by divers during cleaning events. They have been recorded 166 times on dive surveys, and five times on remote camera deployments. Sightings were recorded every year between 2004–2023, year-round with a slight increase during autumn (March-June; Marine Megafauna Foundation unpubl. data 2023; All Out Africa unpubl. data 2023).

SUB-CRITERION D2 – DIVERSITY

This area sustains a high diversity of Qualifying Species (24 species). The regular and predictable occurrence of these species was based on extensive dive surveys in the area, in addition to relevant publications (Marshall et al. 2011; Rohner et al. 2013, 2018; Boggio-Pasqua et al. 2019; Bennett et al. 2021; Keeping et al. 2021; O'Connor & Cullain 2021; Pottie et al. 2021; Burian et al. 2023).



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QUALIFYING SPECIES

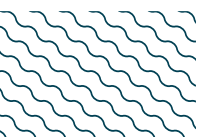
| Scientific Name | Common Name | IUCN Red List Category | Global Depth Range (m) | ISRA Criteria/Sub-criteria Met | | | | | | | | | |
|------------------------------------------|----------------------------|------------------------|------------------------|--------------------------------|---|----|----|----|----|----|----|----|--|
| | | | | A | B | C1 | C2 | C3 | C4 | C5 | D1 | D2 | |
| SHARKS | | | | | | | | | | | X | | |
| <i>Carcharhinus amblyrhynchos</i> | Grey Reef Shark | EN | 0-280 | X | | | | | | | | | |
| <i>Carcharhinus leucas</i> | Bull Shark | VU | 0-256 | X | | | | | | | | | |
| <i>Carcharhinus limbatus</i> | Blacktip Shark | VU | 1-140 | X | | | | | | | | | |
| <i>Nebrius ferrugineus</i> | Tawny Nurse Shark | VU | 0-70 | X | | | | | | | | | |
| <i>Pseudoginglymostoma brevicaudatum</i> | Shorttail Nurse Shark | CR | 0-20 | X | X | | | | | | | | |
| <i>Rhincodon typus</i> | Whale Shark | EN | 0-1,928 | X | | | X | | | | | | |
| <i>Sphyrna lewini</i> | Scalloped Hammerhead | CR | 0-1,043 | X | | | | | | | | | |
| <i>Stegostoma tigrinum</i> | Indo-Pacific Leopard Shark | EN | 0-62 | X | | | | X | | | | | |
| <i>Triaenodon obesus</i> | Whitetip Reef Shark | VU | 0-330 | X | | | | X | | | | | |
| RAYS | | | | | | | | | | | | | |
| <i>Acroteriobatus leucospilus</i> | Greyspot Guitarfish | EN | 0-100 | X | X | | | | | | | | |
| <i>Aetobatus ocellatus</i> | Spotted Eagle Ray | EN | 0-40 | X | | | | | | | | | |

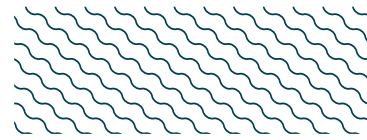
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|-----------------------------------|-----------------------------|------------------------|------------------------|--------------------------------|---|----|----|----|----|----|----|----|---|--|
| | | | | A | B | C1 | C2 | C3 | C4 | C5 | D1 | D2 | | |
| <i>Himantura uarnak</i> | Coach Whipray | EN | 0-50 | X | | | | | | | | | | |
| <i>Megatrygon microps</i> | Smalleye Stingray | DD | 0-200 | | | | | | | | | | X | |
| <i>Mobula alfredi</i> | Reef Manta Ray | VU | 0-711 | X | | X | | | | | | X | | |
| <i>Mobula birostris</i> | Oceanic Manta Ray | EN | 0-1,246 | X | | | | | | | | X | | |
| <i>Mobula kuhlii</i> | Shorthorned Pygmy Devil Ray | EN | 0-50 | X | | | | | | | | X | | |
| <i>Neotrygon caeruleopunctata</i> | Bluespotted Maskray | LC | 0-100 | | | | | X | | | | | | |
| <i>Pateobatis fai</i> | Pink Whipray | VU | 0-200 | X | | | | | | | | | | |
| <i>Pateobatis jenkinsii</i> | Jenkins' Whipray | EN | 0-90 | X | | | | | | | | | | |
| <i>Rhina ancylostomus</i> | Bowmouth Guitarfish | CR | 0-70 | X | | | | | | | | | X | |
| <i>Rhinoptera jayakari</i> | Oman Cownose Ray | EN | 0-50 | X | | | | | | | | X | | |
| <i>Rhynchobatus australiae</i> | Bottlenose Wedgefish | CR | 0-60 | X | | | | | | | | | | |
| <i>Rhynchobatus djiddensis</i> | Whitespotted Wedgefish | CR | 0-70 | X | | | | | | | | | | |
| <i>Taeniurops meyeri</i> | Blotched Fantail Ray | VU | 0-439 | X | | X | | | | | | | | |

SUPPORTING SPECIES

| Scientific Name | Common Name | IUCN Red List Category |
|-------------------------------|------------------------|------------------------|
| SHARKS | | |
| <i>Carcharhinus obscurus</i> | Dusky Shark | EN |
| <i>Carcharodon carcharias</i> | White Shark | VU |
| RAYS | | |
| <i>Himantura leoparda</i> | Leopard Whipray | EN |
| <i>Taeniura lymma</i> | Bluespotted Lagoon Ray | LC |
| <i>Torpedo sinuspersici</i> | Gulf Torpedo | DD |

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 Southern Inhambane Province is an important reproductive area for two shark and one ray species. Sightings data were recorded during dive surveys (n = 7,686) conducted by researchers and trained observers with *in-situ* identification and photographic sightings confirmed using species ID guides (Marine Megafauna Foundation and All Out Africa datasets). For most species, data were collected on SCUBA. The methodology is similar to an underwater visual census (UVC) whereby an observer records species during a dive, without following a particular transect or staying stationary. A 'sighting' is of a single individual. Some species were also recorded from a boat or on snorkel (referred to as 'surface sightings' i.e., Whale Sharks). Survey effort varied slightly throughout the area among locations, with most effort in Praia do Tofo (2003–2023, although some species were logged only after 2010) and Zavora (2009–2011, 2017–2023).

Photo-ID has identified 102 Indo-Pacific Leopard Shark individuals throughout the Inhambane Province (88 of these in the area), with 38% re-sighted on more than one occasion, and one individual encountered 14 times. Individuals demonstrated site fidelity, returning to the same reefs year after year, with one individual sighted in eight consecutive years and a maximum re-sighting period of 11 years (Pottie et al. 2021). Photo-ID detected movements between sites within this area. Other than resting behaviour (71%), cleaning behaviour was observed in 3% of sightings (Marine Megafauna Foundation unpubl. data 2023). Courtship/attempted mating has been observed on three occasions (twice at a rocky reef off Praia doTofo, in January 2020 and October 2022, and once at a rocky reef off Zavora; Marine Megafauna Foundation and All Out Africa unpubl. data 2023), and evidence of fresh mating scars on females has been recorded. Juveniles (<100 cm total length [TL]) have also been observed swimming at the surface, suggesting a potential breeding area.

Courtship has also been observed for the Whitetip Reef Shark on four occasions.

Evidence from tagging studies indicates that Smalleye Stingrays may be more abundant in the area than diver observations suggest. A satellite-tracked mature male spent 66% of its time below 30 m, in depths where visual observers would not record them (Marine Megafauna Foundation unpubl. data 2023). Acoustic tagging data (n = 12) further support this, with ~80% of acoustic detections recorded between midnight and 6 am, when observers are not present on the reefs (Marine Megafauna Foundation unpubl. data 2023). Photo-ID has identified 120 individuals to date throughout the whole province, 20% of which have been re-sighted (up to five times). Of these individuals, 97 have been identified in Southern Inhambane Province. Twelve pregnant females have been observed over multiple years (2012, 2017, 2018, 2021, and 2022) and courtship was observed on a single occasion in 2019 (Marine Megafauna Foundation unpubl. data 2023). One female, sighted in Praia do Tofo in January 2017, was resighted ~200 km north in San Sebastian in May 2017 (visibly pregnant), and sighted again in July 2018 in Praia do Tofo (not visibly pregnant), showing movement between regions and the potential of pupping in surrounding waters. More data are needed to determine whether this is also an important reproductive area for the species.

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