

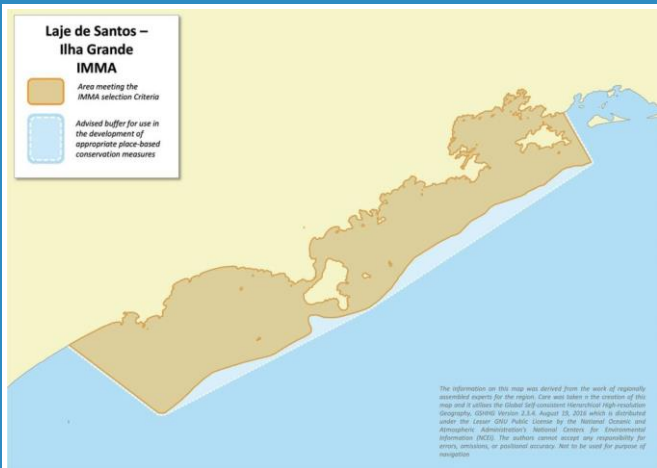
# Laje de Santos – Ilha Grande IMMA

## Summary:

The Laje de Santos – Ilha Grande IMMA is located on southeastern coast of Brazil and extends from the shore to the 50 m isobath. Its boundaries extend from the city of Itanhaem in the southeast to Ilha Grande in the northwest. The coastline is heterogeneous with long beaches punctuated by estuaries south of ~24°S, and the presence of small bays, coves, mangroves and islands in the northern part of the area. More than 30 species of cetaceans have been recorded in the IMMA, and at least eight species are consistently reported, highlighting the importance of the area for cetacean diversity. The most frequently documented species include humpback whales (*Megaptera novaeangliae*), Bryde's whales (*Balaenoptera edeni*) and southern right whales (*Eubalaena australis*), as well as Guiana dolphins (*Sotalia guianensis*), bottlenose dolphins (*Tursiops truncatus*), Atlantic spotted dolphins (*Stenella frontalis*), rough-toothed dolphins (*Steno bredanensis*) and franciscanas (*Pontoporia blainvillei*).

## Description:

The Laje de Santos - Ilha Grande IMMA is located on the southeastern coast of Brazil. The IMMA runs from the city of Itanhaem in the southeast to Ilha Grande in the northwest, a distance of approximately 290 km, and extends from the shoreline to the 50 m isobath. The coastline is heterogeneous with long beaches and the presence of estuaries from the southern limit of the area (~24°30'S) until ~24°S, followed by a transition area of islands and beaches until the 23°48'S and from there, the presence of small bays, coves and islands until the northern section (23°08'S)



## Area Size

10 606 km<sup>2</sup>

## Qualifying Species and Criteria

Humpback whale – *Megaptera novaeangliae*

Criterion C (1)

Franciscana dolphin – *Pontoporia blainvillei*

Criterion A; C (2)

Guiana dolphin – *Sotalia guianensis*

Criterion A; B (2); C (2)

Atlantic spotted dolphin – *Stenella frontalis*

Criterion B (2); C (2)

Rough-toothed dolphin – *Steno bredanensis*

Criterion C (2)

Bryde's whale – *Balaenoptera edeni*

Criterion B (2); C (2)

Southern right whale – *Eubalaena australis*

Criterion C (3)

## Marine Mammal Diversity

Criterion D (2)

*Megaptera novaeangliae*,

*Pontoporia blainvillei*, *Sotalia guianensis*,

*Tursiops truncatus*, *Stenella frontalis*,

*Steno bredanensis*, *Balaenoptera edeni*,

*Eubalaena australis*

(Tessler et al., 2006). The oceanographic conditions of this area are influenced mainly by three different water masses: Coastal Water (CW), Tropical Water (TW) and South Atlantic Central Water (SACW). The latter consists of seasonally wind-driven upwelled nutrient-enriched waters, which enhance primary productivity (Campos, 1995; Castro & Miranda, 1998; Nogueira et al., 1999; Kjærfve et al., 2021).

Within the IMMA several different MPAs have been established. Three Sao Paulo state MPAs known as: i) Área de Proteção Ambiental Marinha (APA) Sul, ii) APA Central, and iii) APA Norte"; three state units: i) "Parque Estadual Marinho da Laje de Santos", ii) "Parque Estadual Marinho da Ilha Anchieta" and iii) Reserva de Desenvolvimento Sustentável do Aventureiro and one municipality protected areas: i) Área de Proteção Ambiental Municipal de Paraty and four Brazilian federal protected areas: i) "Estação Ecológica Tupiniquins", ii) "Estação Ecológica Tupinambás" iii) REVIS Arquipélago de Alcatrazes and iv) "Estação Ecológica de Tamoios". Ilha Grande Bay was also inscribed on the Cultural and Biodiversity World Heritage List by UNESCO.

The IMMA boundaries were defined after considering the oceanographic conditions coupled with the marine mammal sightings.

## Criterion A: Species or Population Vulnerability

The franciscana (*Pontoporia blainvillei*) is classified as "Vulnerable" on the IUCN Red List (Zerbini et al., 2017) and "Critically Endangered" on the Brazilian Endangered Species National List (MMA/ICMBio, 2022). Due to their coastal and estuarine habits, franciscanas suffer from high levels of fisheries bycatch (Crespo et al., 1994; Praderi, 1997; Secchi et al., 1997; Bertozzi & Zerbini, 2002; Di Benedetto, 2002; Secchi et al., 2004) as well as from habitat loss and

degradation (Kajiwara et al., 2004; Lailson-Brito et al., 2007; Lailson-Brito et al., 2011; Alonso et al., 2012; Gago-Ferrero et al., 2013).



Figure 1: Franciscana dolphins (*Pontoporia blainvillei*) in Ilhabela. Photo credit: Projeto Baleia à Vista / Julio Cardoso

Guiana dolphins (*Sotalia guianensis*) are classified as "near threatened" by IUCN (Secchi et al., 2019). However, their reliance on nearshore habitats, restricted home ranges, and susceptibility to bycatch and other human activities put them at risk at local and national levels, and they are considered "vulnerable" on the Brazilian Endangered Species National List (MMA/ICMBio, 2022).



Figure 2: : Guiana dolphins (*Sotalia guianensis*) in Ilhabela. Photo credit: Projeto Baleia à Vista / Julio Cardoso

## Criterion B: Distribution and Abundance

### Sub-criterion B2: Aggregations

Systematic surveys in the area by Figueredo et al. (2020), as well as data from opportunistic surveys, have documented the presence of Atlantic spotted dolphins (*Stenella frontalis*) in the IMMA year-round. Different studies have shown that the highest number of sightings of the species occurs in the area surrounding the Laje de Santos Marine Park (Santos et al., 2017; Figueredo et al., 2020). The species is very common in the area (Santos et al., 2019; Figueredo et al., 2020). Moreover, the IMMA corresponds to the centroid of the potential distribution area estimated using niche modeling for this species (Figueredo et al., 2020). Mark-recapture efforts using photo-identification from 2017 to 2020 yielded an estimate of 397 dolphins in Ilha Grande Bay (95% CI 389 – 406) (Pereira et al., 2021). The same

authors reported large groups of more than 100 individuals in 34% of the time devoted to focal-group observations.

Guiana dolphins seem to be the most common species in the area (Santos et al., 2010; Lailson-Brito et al., 2020). The Ilha Grande Bay sustains aggregations of around 500 individuals (Ribeiro-Campos et al., 2021). Systematic mark-recapture photo-identification studies in Ilha Grande Bay from 2017 to 2020 yielded an abundance estimate of 2,432 (95% CI 2,182 – 2,734) individuals (Quintana, 2020).

Studies based on photo-ID demonstrated that Bryde's whales (*Balaenoptera edeni*) were present in the IMMA throughout the year, with higher concentrations between spring and summer (Gonçalves et al., 2015; Athayde et al., 2020).



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Figure 3: : Bryde's whale (*Balaenoptera edeni*) skim feeding north of Ilhabela. Photo credit: Projeto Baleia à Vista / Julio Cardoso



## Criterion C: Key Life Cycle Activities

### Sub-criterion C1: Reproductive Areas

The majority of humpback whales (*Megaptera novaeangliae*) that have been documented in this IMMA have only short residency times in the area. However, some individuals remain in the IMMA area around Ilhabela where competitive groups, mating, at least one newborn calf and nursing/mother-calf pairs have been reported since 2018 (Morete et al., 2022).

### Sub-criterion C2: Feeding Areas

Trophic ecology studies conducted in the IMMA demonstrated that franciscanas are strongly associated with shallow waters and estuarine regions, where they feed mainly on small pelagic and demersal neritic prey, including the American coastal pellona (*Pellona haroweri*) and the bigtooth corvina (*Isopisthus parvipinnis*) (Di Benedetto et al., 2009; Campos et al., 2020). Based on the isotopic niche of the species together with data from strandings and sightings, Paschoalini et al. (2021) concluded that franciscana populations in the IMMA are also feeding in the area.

Ribeiro-Campo et al. (2020) reported that at least 52.2% of all observed activities during Guiana dolphin encounters involved feeding. Stable isotope studies also demonstrated that Guiana dolphins' sampled in the IMMA are also feeding in the area (Bisi et al., 2013; Pascoalini et al., 2021). Ecological niche analysis further demonstrates that the IMMA has the ideal characteristics for the species (Figuereido et al., 2020).

Atlantic spotted dolphins were observed feeding in all seasons during systematic survey efforts reported by Pereira et al. (2022), and feeding was the most frequently observed behavior during the summer

season. Stomach content analysis of stranded animals in the IMMA identified prey such as the tropical arrow squid (*Dorytheuthis plei*), the knobby (*Argonauta nodosa*) and the rough-scad (*Trachurus lathamii*) (Melo et al., 2010; Lopes et al., 2012).

Rough-toothed dolphins (*Steno bredanensis*) are mainly sighted in the IMMA's shallow coastal waters and inside Ilha Grande Bay (Carvalho et al., 2010; Santos et al., 2019; Figueiredo et al., 2020). These areas are known to host teleost species such as mullet (*Mugil* sp. and *Mugil curema*), cutlass fish (*Trichiurus leprurus*) and balao (*Hemirhamphus brasiliensis*) that are also the prey during rough-toothed dolphin encounters (Lodi & Hetzel, 1999). Furthermore, carbon and nitrogen isotopes have shown that rough-toothed dolphins in Rio de Janeiro state feed in the inner continental shelf environment and are thus pooled together with the more strictly coastal Guiana dolphins that also inhabit Ilha Grande Bay (Bisi et al., 2013) and the southern part of this IMMA.



Figure 4: : Rough-toothed dolphins (*Steno bredanensis*) sighted in south of Ilhabela. Photo credit: Projeto Baleia à Vista / Julio Cardoso

Bryde's whales have been reported year-round in the IMMA, with a higher number of sightings during spring and summer months when they are in search of prey in shallower waters (Zerbini et al., 1997; Siciliano et al., 2004; Santos et al., 2010; Gonçalves et al., 2016; Santos et al., 2019). Areas around São

Sebastião Island (Ilhabela) and the Alcatrazes archipelago are highly productive and thus able to support Bryde's whale feeding aggregations. The species has been observed feeding mainly on schools of small epipelagic fish (probably *Sardinella* sp.) (Athayde et al., 2020). Tardin et al. (2019) demonstrated a positive correlation between *B. edeni* and high concentrations of Chlorophyll-a in depths between 30 and 60 m in southeast Brazil.

### Sub-Criterion C3: Migration Routes

The number of Southern right whale (*Eubalaena australis*) sightings in the IMMA has been increasing year after year (Santos et al., 2001; Figueredo et al., 2020; Paschoalini et al., 2021; Morete et al., 2022). Several of these sightings have been of mothers with calves. However, it is not known if these calves were born in the area or are migrating to waters further north of the proposed area or heading south to the known breeding area of Santa Catarina, Brazil. The area is most likely part of a migratory corridor towards areas that were previously occupied by the species for reproduction (Santos et al., 2001).

### Criterion D: Special Attributes Sub-criterion D2: Diversity

Systematic surveys and studies have reported more than 30 species of cetaceans in the area encompassed by the IMMA (Santos et al., 2010; Santos & Figueiredo, 2016; Lailson-Brito et al., 2020). However, this high number of species includes some which are documented only sporadically through strandings and/or very low encounter rates during systematic. Of all the species documented least 8 species have been consistently observed in the IMMA, all of which, with the exception of common bottlenose dolphins (*Tursiops truncatus*) meet at least one other criterion and are thus described in the preceding text.

### Supporting Information

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