

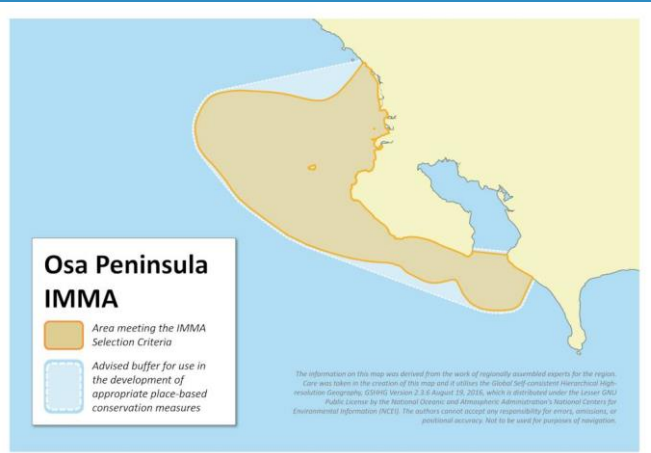
Osa Peninsula IMMA

Summary

The Osa Peninsula IMMA is a hot spot for cetacean diversity, providing habitat for over 17 cetacean species. The inshore waters of the IMMA serve as a critical reproductive and calving habitat for both southern and northern hemisphere populations of humpback whales (*Megaptera novaeangliae*). Semi-resident populations of false killer whales (*Pseudorca crassidens*) and killer whales (*Orcinus orca*) have been documented in the area. Photographic recaptures of these species demonstrates in other parts of Costa Rica, as well as Panamá and Nicaragua, demonstrates their connectivity, social stability and site-fidelity for over 10 years. Likewise, a semi-resident population of rough-toothed dolphins (*Steno bredanensis*) has been assessed through mark-recapture methods, showing individual dolphins with a high level of site-fidelity along with foraging habitats within nearby shelf waters. The IMMA includes important cetacean habitat of three main categories: 1) continental shelf habitat for humpback whales, coastal pantropical spotted dolphins (*Stenella attenuata graffmani*), false killer whales, killer whales, common bottlenose dolphins (*Tursiops truncatus*), spinner dolphins (*Stenella longirostris*) and rough-toothed dolphins; 2) oceanic depths for sperm whales (*Physeter macrocephalus*), pilot whales (*Globicephala macrorhynchus*), and other deep divers; and transitional habitat at the edge of the shelf-break, which is particularly important for offshore pantropical spotted dolphins (*Stenella attenuata attenuata*).

Description:

The IMMA area is over 140 km long and 72 km wide at the furthest distance from the coast (approximately



Area Size

5 001 km²

Qualifying Species and Criteria

Humpback whale – *Megaptera novaeangliae*

[North Pacific – *M. n. kuzira*]

Criterion A; C (1)

[Southern Pacific – *M. n. australis*]

Criterion C (1)

Pantropical spotted dolphin – *Stenella attenuata*

[Coastal – *S. a. graffmani*]

Criterion C (2)

Common bottlenose dolphin – *Tursiops truncatus*

Criterion C (2)

Spinner dolphin – *Stenella longirostris*

[Central America – *S. l. centroamericana*]

Criterion C (2)

Common dolphin – *Delphinus delphis*

Criterion C (2)

Marine Mammal Diversity

Criterion D (2)

Orcinus orca, *Steno bredanensis*,

Grampus griseus, *Globicephala macrorhynchus*,

Lagenodelphis hosei, *Physeter macrocephalus*,

Kogia sima, *Ziphius cavirostris*,

Balaenoptera edeni, *Balaenoptera acutorostrata*

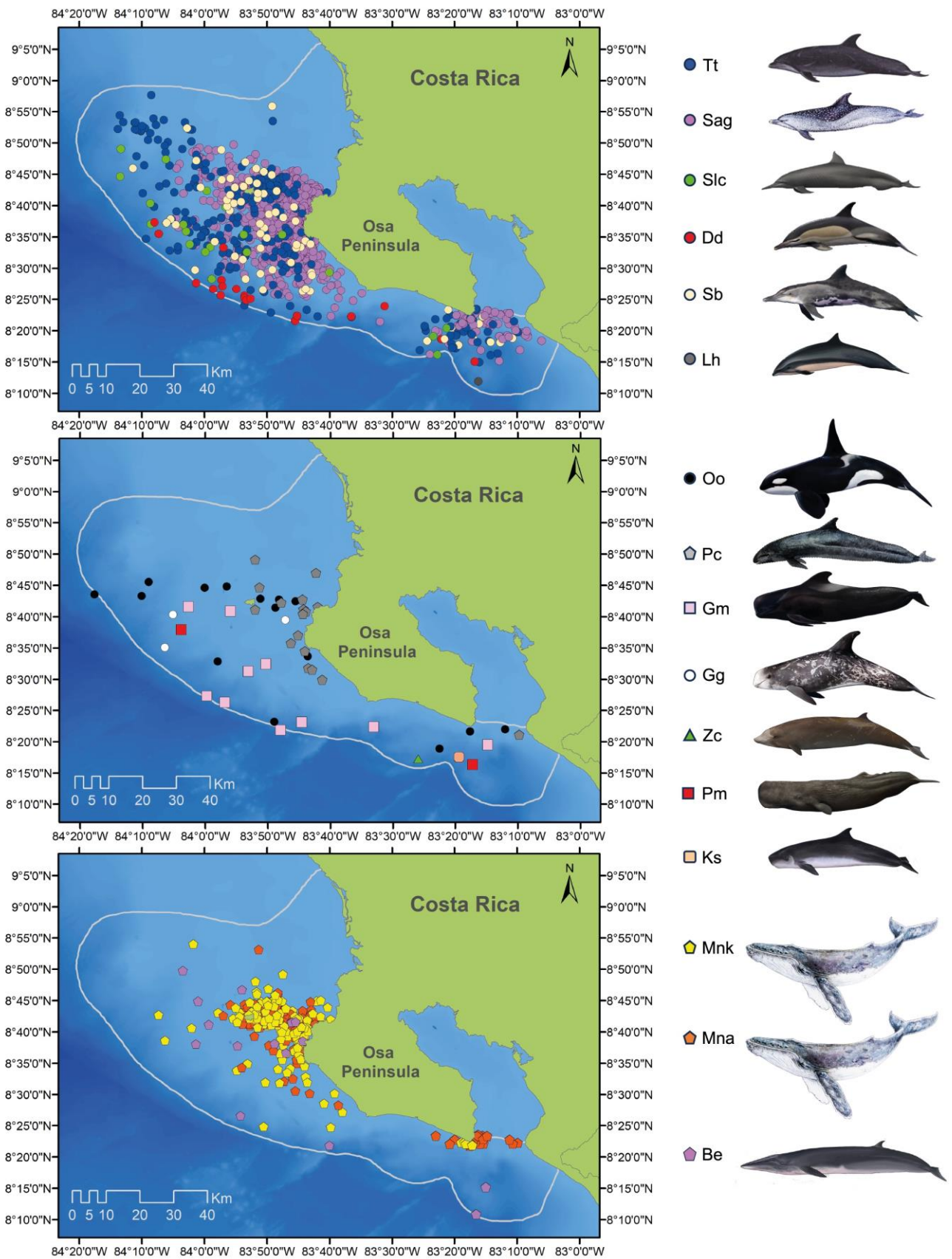


Figure 1: Cetacean diversity within the boundaries of the Osa Peninsula IMMA: Offshore ecotype bottlenose dolphin (Tt), coastal pantropical spotted dolphin (Sag), Central American spinner dolphin (Slc), common dolphin (Dd), rough-toothed dolphin (Sb), Fraser's dolphin (Lh), orca (Oo), false killer whale (Pc), short-finned pilot whale (Gm), Risso's dolphin (Gg), Cuvier's beaked whale (Zc), sperm whale (Pm), dwarf sperm whale (Ks), northeast Pacific humpback whale (Mnk), southeast Pacific humpback whale (Mna), Bryde's whale (Be).
Map source: Fundación Vida Marina/CEIC.

4,260 km²). This IMMA is bordered by the shorelines of the Térraba-Sierpe National Wetland (RAMSAR site No. 782), Drake Bay and Corcovado National Park to Punta Salsipuedes, continuing south to Punta Banco at the entrance of Golfo Dulce. The area includes waters on the continental shelf, where Caño Island Biological Reserve is located (8°42'13"/83°52'28"). The shelf becomes progressively more narrower southward along the western coast of the Peninsula at the edge of The Coco's Ridge, which acts as a barrier influencing the local hydrography promoting stability (Lizano, 2008). Climatic conditions are characterized by a bimodal regime of precipitation. During the rainy season (June–October), salinity levels in the water column fluctuate by the increased flow of rivers and creeks along a coast lined by humid tropical rainforest (Morales-Ramírez et al., 2015). Depths range from less than 4 m at Cabo Matapalo to the 1,500-meter isobaths acting as the bathymetric limit of this IMMA.

The local economy relies on the significant marine diversity, particularly cetaceans. Osa Peninsula is regarded as a hot spot for whale-watching in Costa Rica. Humpback whales and coastal dolphins are the focal species of local marine-oriented ecotourism. Since February 2018 the Costa Rica government has implemented a protective routing system, Area To Be Avoided (ATBA), to mitigate the likelihood of collision between maritime traffic and calving humpback whales (Executive Decree N° 41003-MOPT-SP-MINAE/N° 41086-MAG).

Criterion A: Species or Population Vulnerability

North Pacific Humpback whales (*Megaptera novaeangliae kuzira*) that use the IMMA are part of the Central America distinct population segment (DPS), which is classified as 'Endangered' by the United States Endangered Species Act (81 FR 62260,

September 8, 2016). The Central America DPS is one of fourteen humpback whale DPS classifications around the world, and one of only four DPS listed as 'Endangered' (Bettridge et al., 2015). A DPS is made up of whales that share the same latitude breeding area but migrate seasonally to specific mid-to-high latitude feeding grounds that may differ among individuals (Bettridge, 2019). The Central America DPS is composed of whales that breed along the Pacific coast of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama (Bettridge et al., 2015; Curtis et al., 2022). This DPS wintering area is understood to extend into southern Mexico (Wade, 2016; Curtis et al., 2022). The population estimate for the Central America DPS varies between 500–700 individuals depending on the mark-recapture method used (Calambokidis et al., 2008; Barlow et al., 2011; Wade, 2016). In comparison, the abundance of humpback whales off the United States West Coast, which includes some of the Central America DPS whales, is estimated to be approximately 5,000 individuals (Calambokidis & Barlow, 2020). Humpback whales from this DPS use this IMMA as a breeding ground during the Northern Hemisphere winter months, while Southern Hemisphere humpback whales (*Megaptera novaeangliae australis*) breed in the IMMA during the austral winter months (Felix et al., 2021; Palacios-Alfaro et al., 2012; Chereskin et al., 2019; Rasmussen et al., 2011; Pelayo-González et al., 2022).

Criterion C: Key Life Cycle Activities Sub-criterion C1: Reproductive Areas

Humpback whales from both the southeast Pacific (Felix et al., 2021; Palacios-Alfaro et al., 2012; Chereskin et al., 2019) and northeast Pacific (Rasmussen et al., 2011; Pelayo-González et al., 2022) use this IMMA as a calving and reproductive habitat. The continental shelf areas of this IMMA provide habitat that is typical of humpback whale breeding

habitat, with depths of less than 100 m and a slope less than 10% (Oviedo & Solis, 2008). Within this preferred habitat, behaviour associated with humpback whale breeding, such as singing (Chereskin et al., 2019) and competition involving groups of males are regularly documented. A significant proportion of documented humpback whale encounters in the Osa Peninsula during the

austral breeding season between 2001 and 2006 were of mother-calf pairs (149 /208 total encounters) (CEIC, unpublished data). Mother-calf pairs also comprised over 50% of encounters with endangered northeast Pacific humpback whales (N=115) during the boreal breeding seasons between 2001 and 2006 (CEIC, unpublished data; Rasmussen et al., 2011).



Figure 2: Breaching humpback whale (*Megaptera novaeangliae australis*) in the reproductive/calving critical habitat in Osa Peninsula IMMA. Photo Credit: Sierra Goodman-Fundación Vida Marina.

Sub-criterion C2: Feeding Areas

The waters of the Osa Peninsula IMMA host critical foraging habitats for coastal pantropical spotted dolphins (*Stenella attenuata graffmani*), Central American spinner dolphins (*Stenella longirostris centroamericana*), common dolphins (*Delphinus delphis*), and deep diving teuthophagous odontocetes (CEIC, unpublished data). Coastal pantropical spotted dolphins were most commonly observed in neritic waters, without any significant seasonal variations due to seasonality. The most common behaviours observed were foraging and traveling (dry season 2001-2006: foraging=34%, traveling=42%, out of 653 encounters; rainy season 2001-2006: foraging=43%, traveling=41%, out of 515 encounters). Central American spinner dolphins were the third most abundant species off Osa Peninsula waters during surveys in 2001-2006. This subspecies is one of the two endemic forms occurring in the Eastern Tropical Pacific, *S. l. centroamericana* and *S. l. orientalis* (Perrin 1990, 2008b), with the former being more coastal and the latter highly pelagic (Perrin, 2008a). Habitat suitability modelling shows that coastal habits of *S. l. centroamericana* are concentrated in depths close to 200 m. Central

American spinner dolphins favour the upper limit of the neritic habitat in oligotrophic waters, where mesopelagic prey (lanternfish belonging to the family Myctophidae) would be encountered in considerable density. Common dolphins (*Delphinus delphis*) in the IMMA correspond with the central Eastern Tropical Pacific Stock, specifically to the "C" subpopulation. According to Fernandez & Oviedo (2009) and Daniel & Chivers (2006), this is the subpopulation that occurs closer to shore, in contrast to units "A" and "B" that occur in offshore waters of the central Eastern Tropical Pacific. Common dolphins in the IMMA are believed to focus on mesopelagic prey (lanternfish belonging to the family Myctophidae) off the continental shelf, where small-scale micro-upwelling linked to the shelf edge topography, would promote a stronger vertical migration of the Deep Scattering Layer to shallower waters. The coastal waters over the continental platform are also important feeding areas for false killer whales (*Pseudorca crassidens*), which have been documented to spend more than 37% of their time during observations in the IMMA engaged in feeding behaviour (n=1952 sightings), consuming over 11 species of pelagic and demersal bony fishes (Palacios-Alfaro et al., 2022).



Figure 3: Central American spinner dolphin (*Stenella longirostris centroamericana*) sighted off the shelf habitat in Osa Peninsula IMMA. Photo Credit: David Herra-Miranda-CEIC.

Criterion D: Special Attributes

Sub-criterion D2: Diversity

The diversity of cetacean species in this area includes more than 17 types, including coastal pantropical spotted dolphins, common bottlenose dolphins (*Tursiops truncatus*), Central American spinner dolphins, common dolphins, rough-toothed dolphins, false killer whales, killer whales (*Orcinus orca*), Risso's dolphins (*Grampus griseus*), short-finned pilot whales (*Globicephala macrorhynchus*), Fraser's dolphins (*Lagenodelphis hosei*), sperm whales (*Physeter macrocephalus*), dwarf sperm whales (*Kogia sima*), Cuvier's beaked whales (*Ziphius cavirostris*) and unidentified beaked whales (*Mesoplodon* spp.). In addition to the toothed whales mentioned above, the IMMA hosts balaenopterids such as migratory humpback whales from both the Southern and Northern Hemispheres, and rorqual whales like Bryde's - (*Balaenoptera edeni*) and Minke (*Balaenoptera acutorostrata*) whales (Palacios-Alfaro, unpublished data). False killer whales are considered transient in the IMMA. However, a high proportion of photographic recaptures within the IMMA over a period of 10 years shows the intensive use of this area as critical habitat. Their population size is small $N=92$; 95% CI: 954.76 with an estimated survival of 0.99 (Sánchez-Robledo et al., 2020). Re-sighting of highly distinctive individuals on different capture occasions are concentrated in the Osa Peninsula and Golfo Dulce. The lack of recaptures between false killer whales identified in Nicaragua vs Costa Rica (Pouplard et al., 2019), or southwestern Costa Rica vs Isla del Coco (Douglas et al., 2011), suggests that there may be discrete population units along a wider range extending through the whole eastern tropical Pacific, among these, a population unit ranging over the Nicoya and Panama (CEIC, unpublished data).

Pacheco-Polanco et al. (2011) documented the occurrence of the inshore and offshore ecotypes of *T.*

truncatus in Osa Peninsula and Golfo Dulce respectively. Oviedo et al. (2015) described the distribution of each ecotype. The distribution of offshore bottlenose dolphins in Osa Peninsula is primarily associated with depth; during the dry season bottlenose dolphin distribution is better predicted by depths close to the 200m bathymetric contour. During the rainy season this shifts to depths of less than 200m. Distance to the 200m isobaths is the second-best predictor of the ecological niche of *T. truncatus* in the IMMA (Oviedo et al., 2019). A semi-resident population of rough-toothed dolphins in the IMMA has been assessed through mark-recapture methods, showing individual dolphins with a high level of site fidelity along foraging habitat centered within shelf waters (CEIC, unpublished data). Short-finned pilot whales, Risso's dolphins, Cuvier's beaked whales, sperm whales and dwarf sperm whales constitute a community of teuthophagous odontocetes in the IMMA. Sperm whales have also recently been documented through both acoustic and observational evidence along the shelf edge off Osa Peninsula. Beaked whales, including Cuvier's beaked whales, unidentified members Mesoplodon family, are also associated with depths beyond 1500 m in the IMMA (May Collado et al., 2005).

Finally, behavioural observations of pilot and dwarf sperm whales in the IMMA include resting episodes after foraging dives, while most of the encounters of Cuvier's beaked whales involve travelling from one foraging spot to another. The latter observations support the incidence of an important foraging ground along the shelf edge off the Osa Peninsula, which would explain the habitat use of these deep diver species beyond neritic waters (CEIC, unpublished data).

Supporting Information

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