

# Golfo Dulce IMMA

## Summary, continued.

*graffmani*) foraging in the deeper waters of the middle of the gulf. Two populations of humpback whales (*Megaptera novaeangliae*) from both the Northern (*M. n. kuzira*) and Southern Hemispheres (*M. n. australis*) use the Golfo Dulce as critical calving and reproductive habitat, evidenced by observations of mother-calf pairs engaged in nursing behaviour and singing males. False killer whales (*Pseudorca crassidens*) are also commonly seen in the Golfo Dulce IMMA, adding to the abundance of marine life that marks the inlet as a biodiversity hotspot.

## Description:

Golfo Dulce, Costa Rica, is considered a rare tropical fiord (Svendsen et al., 2006). The semi-closed embayment is positioned in the tropical zone between 8° 22' N and 8° 45' N and 83° 06' W and 83° 29' W (Hebbeln et al., 1996). Measuring approximately 50 km long and 10–15 km wide, it has a surface area of about 750 km<sup>2</sup> (Wolff et al., 1996). A steeply sloped inner basin > 200 m deep dominates the bathymetry of the upper gulf bound by an effective sill and a shallow outer basin extending south toward the mouth. The sill is a key topographic feature because it effectively limits free exchange between the deeper northern waters and those of the broader Eastern Tropical Pacific (ETP), producing a calm interior with anoxic conditions in the deeper realms (Quiros-Alvarez, 2003; Svendsen et al., 2006). The embayment can be divided into three areas defined by the bathymetry and oceanographic conditions (Oviedo et al., 2015): (1) the inner basin, which encompasses 65% of the embayment (ca. 450 km<sup>2</sup>) with currents below 5 cm/s (Morales-Ramírez et al., 2015); (2) the sill area (ca. 200 km<sup>2</sup>), starting



## Area Size

910 km<sup>2</sup>

## Qualifying Species and Criteria

Common bottlenose dolphin – *Tursiops truncatus*

Criterion B (1)

Pantropical spotted dolphin – *Stenella attenuata*

[Coastal – *S. a. graffmani*]

Criterion B (1)

Humpback whale – *Megaptera novaeangliae*

[North Pacific – *M. n. kuzira*]

Criterion C (1)

[Southern – *M. n. australis*]

Criterion C (1)

## Marine Mammal Diversity

*Pseudorca crassidens*, *Steno bredanensis*

## Summary

Golfo Dulce is a rare 'tropical fjord' in southwestern Costa Rica that provides several critical habitats for cetaceans. North of the mouth of the gulf (500-m), two resident populations of coastal dolphins show year-round site fidelity for foraging and calving. They exhibit habitat partitioning, with common bottlenose dolphins (*Tursiops truncatus*) occurring primarily close to shore, especially near river mouths, and inshore pantropical spotted dolphins (*Stenella attenuata*

approximately 20 km from the mouth of Golfo Dulce, which is characterized by shallow depths (~60 m) and strong currents associated with tidal cycles (Quiros-Alvarez, 2003); and (3) the transitional oceanic zone at the mouth of Golfo Dulce, where depths decline to > 500 m (GEBCO, 2014).

The regional climate is bimodal with a rainy season from May to November, during which monthly precipitation averages 500 mm/mo (Acuña-González et al., 2006; Morales-Ramírez et al., 2015). Golfo Dulce is fed by four major rivers, Tigre, Rincón, Esquinas, and Coto Colorado, and many smaller waterways,

leading to a reduced (< 32 ppt) surface salinity and relatively warm sea surface temperatures (Rincón-Alejos & Ballestero-Sakson, 2015). Mangroves are common to the riparian zones, while skerries, coral reefs, sandy beaches, montane rainforest, and deforested slopes are featured along the coastal periphery (Wolff et al., 1996).

Because Golfo Dulce is a vital environment for myriad marine species (Quesada & Cortés, 2006; Morales-Ramírez et al., 2015; Vargas-Zamora et al., 2021), it provides a major source of food and recreation for the people residing near its shores. Golfo Dulce

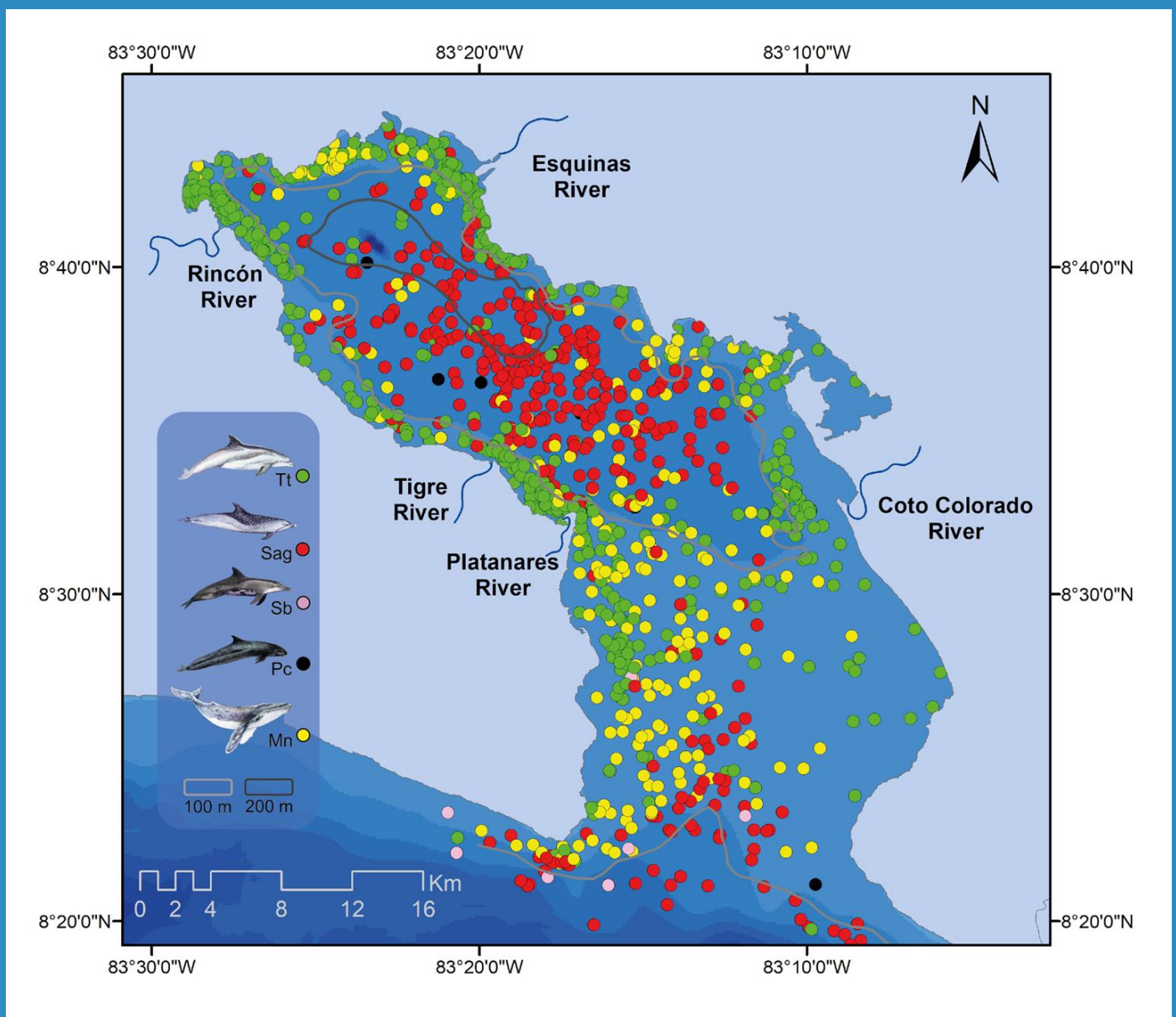


Figure 1: Mapped cetacean sightings (2005-2022) within the Golfo Dulce IMMA modified from Oviedo et al. (2015): Inshore bottlenose dolphins (Tt), coastal pantropical spotted dolphins (Sag), false killer whales (Pc), rough toothed dolphin (Sb) and humpback whales (Mn).

comprises part of the 'Corredor Marino del Pacífico Oriental tropical', an Ecologically or Biologically Significant Area (EBSA; CBD 2022). Since 1991 a marine area of 13,2 km<sup>2</sup> along the shores of Piedras Blancas National Park has been listed as protected (Alvarado et al., 2012). In 2010, local fishing associations declared Golfo Dulce a Marine Area of Responsible Fishing (Fargier et al., 2014), and in 2019 it was named as a sanctuary for juvenile scalloped hammerhead sharks, *Sphyrna lewini* (Mission Blue, 2019). To avoid the likelihood of collision with humpback whale calves due to traffic, the Costa Rican government established a formal ship routing system in 2018 (Area to Be Avoided, ATBA; MAG, 2018). Still considered a relatively pristine marine environment, the region is rapidly developing and negative anthropogenic impacts including chemical contaminants have already been reported (Spongberg et al., 2011; Fournier et al., 2019).

## Criterion B: Distribution and Abundance

### Sub-criterion B1: Small and Resident Populations

Sympatric common bottlenose dolphins (*Tursiops truncatus*) and coastal pantropical spotted dolphins (*Stenella attenuata graffmani*) are considered year-round residents (Acevedo-Gutiérrez & Burkhart, 1998; Cubero-Pardo, 2007; Oviedo, 2007) with a significant level of photographic recaptures and site fidelity (Pacheco-Polanco, 2016; Oviedo, 2018; Oviedo et al., 2018; Oviedo et al., in press). Calving areas for bottlenose dolphins have been identified in coastal areas near river mouths, where resident females form nursing groups (CEIC, unpubl. data). River mouths also serve as key foraging habitat for that species (Oviedo, 2007; Herra-Miranda et al., 2016; Pacheco-Polanco, 2016; Oviedo et al., 2018, 2019). Pantropical spotted dolphin nursing groups have been recorded



Figure 2: Cruising along the north shore of Golfo Dulce, a young inshore bottlenose dolphin calf, *Tursiops truncatus*, stays within its protective nursery group. Photo credit: David Herra-Miranda, CEIC.

in the species' core foraging habitat (CEIC, unpubl. data), which covers a sizeable area of the deep inner basin, where the dolphins follow the movement of preferred prey species, such as ballyhoo (*Hemiramphidae*) and flying fish (*Exocoetidae*) (Oviedo 2007; Oviedo et al., 2018). Modelled photo-identification data indicate relatively small populations of 119 (95% CI: 108.55–130.35) bottlenose dolphins and 368 (95% CI: 341.51–396.31) spotted dolphins (Oviedo, 2018; Oviedo et al., in press).

## **Criterion C: Key Life Cycle Activities**

### **Sub-criterion C1: Reproductive Areas**

North Pacific humpback whales (*Megaptera novaeangliae kuzira*) belong to the Central America Distinct Population Segment, designated under the United States Endangered Species Act (Bettridge, 2015). Southern Hemisphere humpback whales (*Megaptera novaeangliae australis*) belong to the population designated by the International Whaling Commission as Breeding Stock G. Both these populations seasonally migrate to the Eastern Tropical Pacific, and use Golfo Dulce for reproduction during their respective wintering seasons (Acevedo-Gutierrez & Smultea 1995; Oviedo et al.; 2009, 2015). This unusual geographical overlap allows potential trans-equatorial genetic exchange (Medrano-González et al., 2001). The whales spend time in both the inner basin and sill area (Oviedo et al., 2015; Herra-Miranda et al., 2016; Pelayo-González et al., 2022a). Neonates have been documented (Bessesen, 2015), and mothers with nursing calves have been demonstrated to prefer the coastal areas, especially along western portion of the sill area, while singing males and competitive groups remain in the deep waters (Herra-Miranda et al., 2016; Pelayo-González et al., 2022a).

The Southeast Pacific humpback whale carries out long seasonal migrations from feeding grounds off

the coasts of southern Chile and Antarctica to winter calving grounds in tropical waters. Humpback whales from the Southern Hemisphere have multiple wintering areas comprising a large breeding habitat in Central America including Golfo Dulce, Costa Rica. The region is utilized between July and November with high numbers of documented observations of mother-calf pairs and mature males (Acevedo-Gutierrez & Smultea, 1995). By contrast, the number of observations of the Central American humpback whales in both Golfo Dulce and Osa Peninsula IMMAs, recorded between December and April, have declined in recent years (Pelayo-Gonzalez et al., 2022b), and sightings of this subpopulation are not as frequent as those whales migrating from the Southern Hemisphere. Calves from the Northern Hemisphere are commonly observed (Bessesen, 2015) but behaviours related to reproduction such as competitive groups have yet to be documented during the Northern Hemisphere breeding season.

According to historical data in Golfo Dulce (July–October 2010–2019), humpback whales primarily occur in the channel that communicates the inner basin with the Pacific within 100 m isobaths. Single adults concentrate in the central part of the mouth while mothers with calves are found nearer the coast, primarily in the western portion between Puerto Jimenez and Cabo Matapalo. Two additional areas are identified by a spatial usage trend: the coastline from the entrance of Golfito towards Punta Gallardo; and along the northern coast of Golfo Dulce from the western side of Punta Estrella towards the Esquinas River. These aggregation areas could result from calving females moving away from the sill area where they are most likely to encounter males. Competitive groups and singing males are mainly observed in the sill area (Herra-Miranda et al., 2016; Pelayo-González et al., 2022a).



Figure 3: A mother humpback whale, *Megaptera novaeangliae*, leads her calf through the calm sanctuary waters of Golfo Dulce, passing quiet beaches and rich rainforest. Photo credit: David Herra-Miranda, CEIC.

## Supporting Information

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