

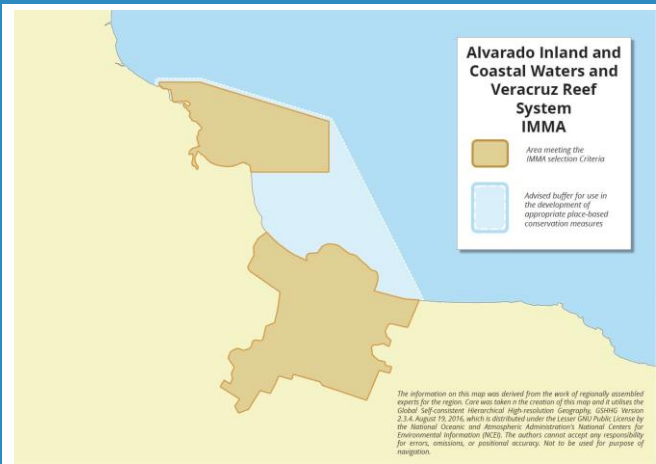
Alvarado Inland and Coastal Waters and Veracruz Reef System IMMA

Summary, continued.

dolphins (*Tursiops truncatus*) in this area form a small resident community with high site fidelity and multi-year residency, particularly females. The area is contiguous to two "Priority Marine Regions for Biodiversity Conservation in Mexico", named the Alvarado Lagoon System-Ramsar Site, and the Veracruz Reef System, which is a National Protected Area.

Description:

This IMMA is situated along the southern coast of the Gulf of Mexico and encompasses estuarine and shelf habitats (up to 20 m depth) with permanent freshwater input with typical of eutrophic regions that receive high nutrient inputs from rivers (Muller-Karger et al., 2015), as the Papaloapan river which has the highest annual runoff ($\sim 44,929 \text{ hm}^3 \text{ y}^{-1}$; Bello et al., 2009), Blanco, Limón, and Acula rivers (Portilla-Ochoa, 2003), and the third largest coastal lagoon in Mexico all provide inputs to the waters of this IMMA (Alvarado Lagoon). In addition, a seasonal upwelling promotes high primary production and high marine biodiversity (Muller-Karger et al., 2015; Salas-Pérez et al., 2023). It is influenced by the La Antigua, Cotaxtla, Jamapa and Papaloapan rivers (Fuentes-Mariles et al., 2014), as well as the largest coastal city and commercial port in Mexico. The area is considered a "Priority Marine Region for Biodiversity Conservation in Mexico", the Veracruz Reef System, which is a National Protected Area. Furthermore, the area is contiguous to two "Priority Marine Regions for Biodiversity Conservation in Mexico", named the



Area Size

2,080 km²

Qualifying Species and Criteria

Greater Caribbean manatee –

Trichechus manatus manatus

Criterion A; B (1)

Common Bottlenose dolphin – *Tursiops truncatus*

Criterion B (1)

Other Marine Mammal Species Documented

Stenella frontalis, *Steno bredanensis*

Summary

The Alvarado Inland and Coastal Waters and Veracruz Reef System IMMA is located in the Southern Gulf of Mexico. The boundaries of the IMMA extend 10 km on both sides of the Alvarado lagoon mouth, and approximately 4 km from shore towards the 20 m isobath, and receives high nutrient inputs from river discharges. It extends over more than 6550 km² and it is comprised of 23 reefs separated into two main areas by the Jamapa river. This IMMA contains a small (<100 individuals) resident population of Greater Caribbean manatees (*Trichechus manatus manatus*), which are concentrated in the riverine and lagoon systems of the inland portions of the IMMA. Common bottlenose

Alvarado Lagoon System-Ramsar Site, and the Veracruz Reef System, which is a National Protected Area.

Criterion A: Species or Population Vulnerability

The Greater Caribbean manatee (*Trichechus manatus manatus*) inhabits coastal areas along the Mexican states of Tamaulipas, Veracruz, Tabasco, and the Bay of Campeche (Morales-Vela, 2010; Olivera-Gómez et al., 2022). It is considered Endangered (EN) on the IUCN Red List of Threatened Species (Deutsch et al., 2008). This species is on the Mexican Official Norm under the Endangered category (NOM-059-SEMARNAT-2010; SEMARNAT, 2010), with documented local extinctions in the northern Gulf of Mexico, possibly attributed to the increase of anthropogenic activities (Serrano et al., 2007).

Criterion B: Distribution and Abundance

Sub-criterion B1: Small and Resident Populations

Bottlenose dolphins (*Tursiops truncatus*) across these areas form small open resident population and exhibit high site fidelity based in the association, particularly among females (Morteo et al., 2014, 2017; Bolaños-Jiménez et al., 2021). Long-term mark-recapture data from 2002-2016 indicates a small but open population of approximately 120 individuals (Morteo et al., 2017; Bolaños-Jiménez et al., 2021). There are seasonal fluctuations in total abundance due to the presence of prey, but the habitat supports a resident core community comprising about 30% of all individuals, most of which are females (Morteo, 2011; Morteo et al., 2014, 2015, 2017). This region is a well-known nursing and breeding ground for this species (year-round relative abundance averages 0.31 and 0.14 individuals for young and calves, respectively) (Hernández-Candelario et al., 2015;

Escobar-Lazcano, 2019). Demographic parameters such as low abundance, high calf mortality (13-20%) and short nursing time when the calf are separating from their mothers (2.6 y) distinguish this population (or community) from others along the Gulf of Mexico and the Caribbean (Martínez-Serrano et al., 2011; Vázquez-Castán et al., 2013; Bazúa & Delgado-Estrella, 2014; García-Vital et al., 2015; Hernández-Candelario et al., 2015; Morales Rincón, 2016; Morteo et al., 2017, 2019; Aguilar-Badillo, 2019; Escobar-Lazcano, 2019; García-Aguilar, 2020; Ojeda-Sánchez, 2020; Bolaños-Jiménez et al., 2021). This area is influenced by the productive mangrove and constitutes a year-round nursing and breeding ground for coastal bottlenose dolphins (Aguilar-Badillo, 2019). High prey abundance also supports this as an extensive feeding area for common bottlenose dolphins, but also promotes intensive interactions with artisanal fisheries (Morteo, 2011; Morteo et al., 2012, 2017; Hernández-Candelario et al., 2015; Rechimont et al., 2018; Ojeda-Sánchez, 2020; García-Aguilar, 2020; Chávez-Martínez et al., 2022; Hernández-García, 2022).

This IMMA contains a small (<100 individuals) resident population of Greater Caribbean manatees, which are concentrated in the riverine and lagoon systems of the inland portions of the IMMA, with abundant and diverse flora, including submerged, emergent, floating, and riverbank vegetation (Pablo-Rodríguez et al., 2015). Riverine manatees are opportunistic herbivorous mammals adapted to the seasonal dynamic of the region, including major fluctuations of water levels between dry and wet seasons (Pablo-Rodríguez et al., 2016). Individuals from inland populations may move across the coast from one area to other (Olivera-Gómez et al., 2022). However, there is no evidence that manatees from this area travel to the north of the Gulf of Mexico or towards the Caribbean (Deutsch et al., 2022).



Figure 1: A pair of common bottlenose dolphin (*Tursiops truncatus*) surfacing in this IMMA. Photo credit: M. Rafael Ramirez.



Figure 2: Common bottlenose dolphins (*Tursiops truncatus*) surfacing in this IMMA. Photo credit: LabMMar.



Figure 3: Greater Caribbean manatee (*Trichechus manatus manatus*) approaching boat in Alvarado, Veracruz.
Photo credit: Alfred Junier Pastelin Sánchez.



Figure 4: Greater Caribbean manatee (*Trichechus manatus manatus*) surfacing in Alvarado, Veracruz.
Photo credit: Alfred Junier Pastelin Sánchez.



Figure 5: Sperm whales (*Physeter macrocephalus*) observed in this IMMA. Photo credit: Manuel Fernández, Pelagic Life.



Figure 6: Rough-toothed dolphins (*Steno bredanensis*) seen underwater in this IMMA. Photo credit: Manuel Fernández, Pelagic Life.

Supporting Information

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