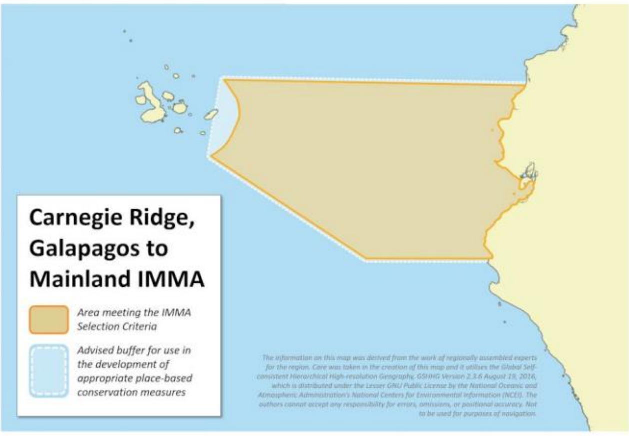

Area Size

459 869 km²

Qualifying Species and Criteria

Blue whale – *Balaenoptera musculus*

Criterion A; C (2, 3)

Sperm Whale – *Physeter macrocephalus*

Criterion A; C (2, 3)

Marine Mammal Diversity

Balaenoptera edeni, Delphinus delphis, Megaptera novaeangliae, Orcinus orca, Pseudorca crassidens, Stenella attenuata

Summary

The Carnegie Ridge forms a natural seaway between the eastern Galapagos Archipelago and the coasts of Ecuador (0°) and Peru (5°S), including the Gulf of Guayaquil. Geologically, the Carnegie Ridge structure comprises an area approximately 1,350 km long and 300 km wide. It was created by the passage of the Nazca Continental Plate over the Galapagos hotspot subducted beneath the Ecuador Andes. This area is permanently influenced by the Equatorial Front between the equator and 5°S, an oceanographic feature that fluctuates seasonally due to winds, that increase regional productivity between the Galapagos and the mainland. The Carnegie Ridge

Carnegie Ridge, Galapagos to Mainland IMMA

Summary, continued.

serves as a migratory route between feeding and calving areas for sperm whales. Most notably by Endangered blue whales (*Balaenoptera musculus*) and Vulnerable sperm whales (*Physeter macrocephalus*). The IMMA encompasses highly productive coastal and oceanic upwelling areas adjacent to the Galapagos archipelago and the Gulf of Guayaquil. These productive waters comprise important feeding habitat for blue, sperm, Bryde's (*Balaenoptera edeni*), and humpback whales (*Megaptera novaeangliae*). There are at least three different ecotypes: offshore, coastal and estuarine common bottlenose dolphins (*Tursiops truncatus*), as well as the pygmy beaked whale (*Mesoplodon peruvianus)*.

Description:

The Carnegie Ridge (CR) is an aseismic volcanic ridge forming a natural seaway between the eastern Galapagos archipelago and the coasts of Ecuador (0°) and Peru (5°S), including the Gulf of Guayaquil. The CR is an oceanic plateau rising 1,500 m above the seafloor (Bentley, 1974), that meets the Ecuadorian trench between 0.5°N and 2.2°S (Graindorge et al., 2004). The undersea mountain range comprises an area approximately 1,350 km long by 300 km wide (De La Torre et al., 2005) produced by the passage of the Nazca Plate over the Galapagos hotspot subducted beneath the Ecuador Andes (Bourgois, 2013; Witt & Bourgois, 2010; Lynner et al., 2020). The mountain range has the shallowest portion of approximately 25,900 km² with depths ranging from 1,829 m to 1,370 m (Shumway, 1954).

This mountain range is permanently and seasonally affected by the wind-driven Equatorial Front (EF) between the equator and parallel 5°S, which affects only the upper 100 m of the water column between Galapagos and mainland (Wyrtki, 1965; Wooster, 1969; Pak & Zaneveld, 1974). The ECF ear is a dynamic system separating warm water from the north from cool waters from the south creating prime conditions for high biological productivity (e.g., iron and nitrate nutrients, chlorophyll) in the area (Palacios, 2004). This IMMA also encompasses highly productive oceanic upwelling areas from the Galapagos to the Gulf of Guayaquil (Reilly & Thayer, 1990; Redfern et al., 2017).

Two Ecologically or Biologically Significant Marine Areas (EBSA) exist within the IMMA, the Carnegie Ridge – Equatorial Front and the Gulf of Guayaquil, both adding some level of protection to the area. Additionally, the western side of the CR borders the Galapagos Archipelago and Marine Reserve, (CPPS/PNUD, 2012). Along the northeastern coastal shore of Ecuador, between the Gulf of Guayaquil and the equator, the CR IMMA encompasses a network of over thirteen small marine protected areas (Acuerdo Ministerial, 2017), including the Machalilla National Park. The IMMA includes the jurisdictional waters of the Republic of Ecuador and as well as a significant portion of international waters or high seas.

Figure 1: Blue whale around la Plata Island, central coast of Ecuador. Photo: Fernando Félix.

Criterion A: Species or Population Vulnerability

Blue whales are currently listed as Endangered on the IUCN Red List of Threatened Species (Cooke, 2018). Blue whales were once abundant in the Southern Hemisphere but were intensely exploited by industrial whaling that began in 1904 (Branch et al., 2004). In the South Pacific there were widespread catches along the west coast of South America north of 44°S off Chile, Peru, and Ecuador, and from Peru to the Galapagos Islands but no other catches north of 59°S in the waters stretching west to 180° (Branch et al., 2007). Pre-whaling abundance of southeast Pacific blue whales has been estimated at 1,500-5,000 individuals but the abundance in 1998 was estimated to be only 12% of pre-whaling levels, based on minimum abundance estimates (Williams et al., 2011, 2017). Recent abundance estimates for Chilean blue whales in Chile and for the northern Chilean Patagonia feeding ground, provide remarkably similar results: 303 whales (95% CI 176–625) (Williams et al., 2011) and 373 whales (95% CI 191–652) (Bedriñana-Romano et al., 2018), respectively. A third study based on different photo-id data sets yielded higher estimates, ranging between 569 (95% CI = 455-683), and 761 (95% CI = 614-908) (Galletti-Vernazzani et al., 2017). Uncertainty envelopes overlap across all recent studies and are indicative of a population ranging from low to mid hundreds. Due to the low population size of this blue whale subspecies/population, for which estimated potential biological removal (PBR) should not exceed 0.548 individuals per year, or one human-caused death in every 1.8 years (Bedriñana-Romano et al., 2018).

Sperm whales are currently listed as Vulnerable on the IUCN Red List of Threatened Species (Taylor et al., 2019).The current global estimated abundance of 360,000 individual whales represents an estimated 67% reduction from the initial pre-whaling population

Figure 2: Humpback whale breaching forward off Salinas, Ecuador. Photo: Fernando Félix.

size (Whitehead, 2002). Historic whaling in the 19th century in the southeast Pacific including within the coastal waters of Peru and Ecuador caused severe declines of sperm whales in the region (Eguiguren et al., 2020). The eastern Pacific population was estimated to include 22,666-26,053 individuals (Wade & Gerrodette, 1993; Whitehead, 2002). There is no evidence that the population has increased in recent years (Taylor et al., 2019). Sperm whales have been regularly documented in the Carnegie Ridge area, and from the Galapagos Archipelago to the Gulf of Guayaquil (Whitehead et al., 1997; Hamilton et al., 2008; Whitehead, 2011).

Criterion C: Key Life Cycle Activities
Sub-criterion C2: Feeding Areas

Although blue whales typically migrate between tropical breeding grounds and high latitude feeding grounds, some individuals may reside year-round in habitats of high productivity feeding on zooplankton, while others may stop to feed in areas of high productivity on route (Cooke, 2018). Multiple sightings of blue whales in this IMMA (Hamilton et al., 2008; CPPS/PNUD, 2012; Guzman pers. obs.) indicate that the area is used by blue whales, and data on productivity and whale behaviour during the time of observations indicate that the Carnegie Ridge IMMA encompasses feeding areas off the coast of mainland Ecuador (Gulf of Guayaquil) as well as around the eastern Galapagos islands (CPPS/PNUD, 2012). In particular, Southern Hemisphere blue whales that occur off Ecuador and the Galapagos Islands, mostly during the austral winter, seem to be foraging in the area (Palacios, 1999; Busquete-Vass et al., 2021). Similarly to blue whales, sperm whales have been reported feeding along the Carnegie Ridge, from the Galapagos Islands and mainland Ecuador (Whitehead, 1989; Whitehead, 2011; CPPS/PNUD, 2012; Eguiguren et al., 2021).

Sub-criterion C3: Migration Routes

At the global level there is evidence that most blue whales migrate between separate wintering and summering areas (Hucke-Gaete et al., 2004; Cooke, 2018; Torres et al., 2015). Blue whale populations in the northeast Pacific and the eastern tropical pacific seem to be largely spatially and temporally separated (Reilly & Thayer, 1990; Ballance et al., 2006; Hamilton et al., 2009; Busquets-Vass et al., 2021). There is evidence that blue whales that use the eastern tropical pacific further migrate north from Chile to the Galapagos and close to the mainland in and around the Gulf of Guayaquil (CPPS/PNUD, 2012; Hucke-Gaete et al., 2018).

Recent data on sperm whale distribution and habitat use around the Galapagos suggest that whales use the Carnegie Ridge IMMA as a migratory corridor from offshore areas to mainland areas between Northern Peru to Panama (CPPS/PNUD, 2012; Whitehead et al., 2008; Eguiguren et al., 2021). Movements determined by focal follows and re-sightings of photo-identified individuals indicate that movement patterns vary with gender and age, ranging from 2,000 to 5,000 km, with no reports of transoceanic movements between the eastern and western Pacific (Whitehead et al., 2008).

Figure 3: Bottlenose dolphins, estuarine ecotype, in the inner estuary of the Gulf of Guayaquil. Photo: Fernando Félix.

Supporting Information

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