

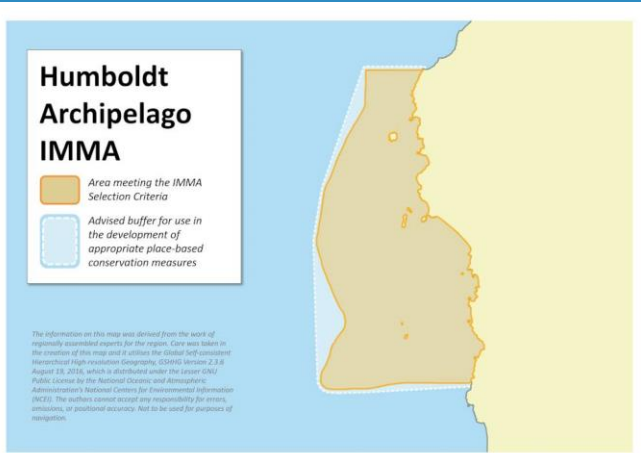
# Humboldt Archipelago IMMA

## Summary

This IMMA represents one of the strongest upwelling zones in the Humboldt Current System. A total of 12 marine mammal species are frequently observed in this area, including nine species of cetaceans, three species of pinnipeds, and the marine otter. Six marine mammals frequently occurring in this area are of conservation concern and are listed under the Chilean Regulation for the Classification of the Wild Species in Conservation categories: a resident population of bottlenose dolphins (*Tursiops truncatus* – Endangered under Chilean law), the fin whale (*Balaenoptera physalus* – Vulnerable on the IUCN Red List, Critically Endangered in Chile), the blue whale (*Balaenoptera musculus* – Endangered on both the IUCN Red List and in Chile), the humpback whale (*Megaptera novaeangliae* – Least Concern globally, but Vulnerable in Chile), the Southern elephant seal (*Mirounga leonina* – Least Concern globally, but Vulnerable in Chile) and the marine otter (*Lontra felina* – Endangered globally and in Chile). This area is a feeding area for most of the marine mammals that use it, and hosts the highest density of marine otters in northern Chile.

## Description:

The Humboldt Archipelago area is a highly dynamic and productive coastal environment located in one of the most important upwelling zones of the Humboldt Current System (HCS, Thiel et al., 2007). The HCS is one of the four major global Eastern Boundary Currents (EBCs), characterised by dominant alongshore wind stress toward the equator, offshore Ekman transport, coastal upwelling of cold, nutrient-



## Area Size

3 301 km<sup>2</sup>

## Qualifying Species and Criteria

Blue whale – *Balaenoptera musculus*

Criterion A; C (2)

Fin whale – *Balaenoptera physalus*

Criterion A; C (2)

Humpback whale – *Megaptera novaeangliae*

Criterion C (2)

Common bottlenose dolphin – *Tursiops truncatus*

Criterion B (1)

South American sea lion – *Otaria byronia*

Criterion C (1)

South American fur seal –

*Arctocephalus australis*

Criterion C (1)

Marine otter – *Lontra felina*

Criterion A; B (1)

Sperm whale – *Physeter macrocephalus*

Criterion A

## Marine Mammal Diversity

Criterion D (2)

*Delphinus delphis*, *Grampus griseus*,

*Lagenorhynchus obscurus*, *Mirounga leonina*

rich subsurface water and highly productive fisheries (Hill et al., 1998). This high productivity supports the presence of a wide variety of marine predators, including mammals and birds (Luna-Jorquera et al., 2003; Pérez et al., 2006). This archipelago is composed of eight small islands, all smaller than 6 km<sup>2</sup> and less than 22 km from the coast. Among the eight islands of the Humboldt Archipelago, only three are protected as part of a national reserve and marine protected area. The other five islands and surrounding waters remain unprotected (Quispe et al., 2020).

## Criterion A: Species or Population Vulnerability

Blue whales (*Balaenoptera musculus*) and sperm whales (*Physeter macrocephalus*) are listed as EN and VU on the IUCN Red List, respectively (Cooke, 2018; Taylor et al., 2019), and both listed as VU by the Chilean Regulation for the Classification of the Wild Species in Conservation categories (clasificacionespecies.mma.gob.cl). Fin whales (*Balaenoptera physalus*) are listed as VU on the IUCN Red List (Cooke, 2018) although they are listed as CR in the Chilean Regulation. For these species, the area is recognized as an important feeding area, particularly for fin and blue whales (Sepúlveda et al., 2020; Buchan et al., 2021). Marine otters (*Lontra felina*) are classified as Endangered according to both listing systems (Valqui & Rheingantz, 2021), and are resident within this IMMA.

## Criterion B: Distribution and Abundance Sub-criterion B1: Small and Resident Populations

A single resident population of common bottlenose dolphins (*Tursiops truncatus*) has been reported in a small area between the Isla Chañaral Marine Reserve and the Choros-Damas Marine Reserve (29°02'-

29°14'S) (Pérez-Alvarez et al., 2018). The population is estimated to contain approximately 45 individuals, although numbers seem to have been drastically reduced according to recent studies (Sepúlveda et al., 2020). Trophic (Santos-Carvalho et al., 2015), genetic (Pérez-Alvarez et al., 2018) and behavioural (Pérez-Alvarez et al., 2018) studies demonstrated that this population is different from the transient or non-resident population of bottlenose dolphins. Group sizes are usually 15-20 individuals, and some resident individuals show long residence (15 years) and strong site fidelity, using the area for feeding, nursing and calving with in a home range of 2-40 km (Gibbons, 1992; Thomas, 2005).

Marine otters are present on Isla Chañaral and Isla Choros, with a density of 6 and 3.7 ind/km<sup>2</sup>, respectively (Sepúlveda et al., 2020). Densities of marine otters estimated for these islands are among the highest documented on the Chilean coast, and the highest of northern Chile (Guido Pavez, unpublished data). The populations are wholly resident within the IMMA, which is critical for the conservation of the species in Central Chile (Medina et al., 2007).

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

Four of the six colonies of the South American sea lions (*Otaria byronia*) in the area are classified as breeding colonies (Oliva et al., 2020). In 2019 a total of 808 newborn pups were documented in these colonies, which represents 31.4% of the total pup production in north-central Chile (Oliva et al., 2020). One of the breeding colonies for this species (Isla Chañaral) has been extensively studied, demonstrating a rapid increase in the number of pups born in this colony, from 109 in 2007 to 760 in 2019 (Sepúlveda et al., 2009; Oliva et al., 2020).

A breeding colony of the South American fur seal (*Arctocephalus australis*) is found in the Isla Chañaral, with an abundance of 1,237 individuals in 2019, of which 269 were classified as pups (Oliva et al., 2020). Interestingly, the abundance of this species in this colony has rapidly increased, from a few individuals in 2009 (Guido Pavez, unpublished data) to more than one thousand in 2019 (Guido Pavez, unpublished data). Pups were first registered in 2018, with a total of three individuals (Guido Pavez, unpublished data). Isla Chañaral is now the southernmost breeding colony of the Peruvian/Chilean population of the South American fur seal in the Pacific coast.

## Sub-criterion C2: Feeding Areas

This IMMA is recognized as an important feeding area for baleen whales, particularly fin, blue and humpback (*Megaptera novaeangliae*) whales (Sepúlveda et al., 2020; Buchan et al., 2021). Diet composition studies (Pérez et al., 2006; Buchan et al., 2021), observational studies (Toro et al., 2016) and tracking studies (Sepúlveda et al., 2018) demonstrate that fin whales feed in the area, particularly preying on krill (*Euphasia mucronate*) (Pérez et al., 2006; Toro et al., 2016; Buchan et al., 2021). For blue and humpback whales, observational studies and diet studies have demonstrated these species also feed on the krill species, *E. superba* in the area (Sepúlveda et al., 2020; Buchan et al., 2021). This keystone euphausiid is the most abundant and endemic krill species of the Humboldt Current System and is associated with coastal upwelling zones (Antezana, 2010; Riquelme et al., 2016), which in turn explain the relevance of the area as a feeding hot spot for these baleen whales (Brediñana-Romano et al., 2022).

## Criterion D: Special Attributes

### Sub-criterion D2: Diversity

A total of 12 marine mammal species are regularly

seen in the Humboldt Archipelago IMMA. Four species or populations are found year-round in the area (South American sea lions, South American fur seals, marine otters, and the resident population of bottlenose dolphins) (Sepúlveda et al., 2016, 2017, 2020). Baleen whales (fin, blue and humpback whales), as well as the Southern elephant seals (*Mirounga leonina*) are regularly seen in austral summer months (Sepúlveda et al., 2007, 2020; Cárcamo et al., 2017). Fin whales remain in the area for several months after the summer with some documented sightings even in winter months. Other species are seasonally unpredictable, but also regularly seen in the area, such as Risso's (*Grampus griseus*), dusky (*Lagenorhynchus obscurus*) and common (*Delphinus delphis*) dolphins, sperm whales, and non-resident common bottlenose dolphins (Sepúlveda et al., 2016, 2017, 2020).

## Supporting Information

Antezana, T. 2010. *Euphausia mucronata*: A keystone herbivore and prey of the Humboldt Current System. Deep Sea Research Part II: Topical Studies in Oceanography, 57(7-8), 652-662.

Brediñana-Romano, L., Zarate, P.M., Hucke-Gaete, R., Vidali, F.A., Buchan, S.J., Cari, I., Clavijo, L., Bello, R. and Zerbini, A.N. 2022. Abundance and distribution patterns of cetaceans and their overlap with vessel traffic in the Humboldt Current Ecosystem, Chile. Scientific Reports, 12(1), 1-15.

Buchan, S.J., Vásquez, P., Olavarría, C. and Castro, L.R. 2021. 'Prey items of baleen whale species off the coast of Chile from fecal plume analysis'. Marine Mammal Science, 37(3), 1116-1127.

Cárcamo, D., Pizarro, M., Orellana, M., Muñoz, L., Pavez, G., Sepúlveda, M., Durán, L.R. and Oliva, D. 2019. New sightings and birth records of the southern

elephant seal *Mirounga leonina* in the southeast Pacific Chilean Coast. *Polar Biology* 42,433-440.

Cooke, J.G. 2018. *Balaenoptera musculus* (errata version published in 2019). The IUCN Red List of Threatened Species 2018: e.T2477A156923585.

Cooke, J.G. 2018. *Balaenoptera physalus*. The IUCN Red List of Threatened Species 2018: e.T2478A50349982.

Gibbons, J. 1992. Estudio sobre conducta y dinámica grupal del tursión, III Región, Chile (Magister). Santiago: Universidad de Chile.

Medina-Vogel, G., Boher, F., Flores, G., Santibañez, A., and Soto-Azat, C. 2007. 'Spacing behavior of marine otters (*Lontra felina*) in relation to land refuges and fishery waste in central Chile'. *Journal of Mammalogy*. 88(2), 487-494.

Oliva, D., Durán, L.R., Sepúlveda, M., Cárcamo, D., Pizarro, M., Anguita, C., Santos-Carvallo, M., Canto, A., Herrera, P., Muñoz, L., Orellana, M. and Vásquez, P. 2020. 'Estimación poblacional de lobos marinos e impacto de la captura incidental'. Informe Final Proyecto FIP 2018-54, 184 pp + Anexos.

Pérez, M.J., Thomas, F., Uribe, F., Sepúlveda, M., Flores, M. and Moraga, R. 2006. 'Fin whales (*Balaenoptera physalus*) feeding on *Euphausia mucronata* in nearshore waters off North-central Chile'. *Aquatic Mammals* 32(1),109-113.

Pérez-Alvarez, M.J., Vásquez, R.A., Moraga, R., Santos-Carvallo, M., Kraft, S., Sabaj, V., Capella, J., Gibbons, J., Vilina, Y. and Poulin, E. 2018. 'Home sweet home: social dynamics and genetic variation of a long-term resident bottlenose dolphin population off the Chilean coast'. *Animal behaviour*, 139, 81-89.

Riquelme-Bugueño, R., Silva-Aburto, J., Escribano, R., Peterson, W.T. and Schneider, W. 2016. Growth of the Humboldt Current krill in the upwelling zone off central Chile. *Journal of Marine Systems*, 163, 1-11.

Santos, M., Pérez-Alvarez, M.J., Muniain, V., Moraga, R., Oliva, D. and Sepúlveda, M. 2015. 'Trophic niche overlap between sympatric resident and transient populations of bottlenose dolphins in the Humboldt current system off North-Central Chile'. *Marine Mammal Science* 31(2),790-799.

Sepúlveda, M., Pérez, M.J., López, P. and Moraga, R. 2007. 'Presence and re-sighting of Southern elephant seal, *Mirounga leonina* (L. 1758), on the central coast of Chile'. *The Latin American Journal of Aquatic Mammals* 6(2),199-202.

Sepúlveda, M., Inostroza, P., Pérez-Alvarez, M.J., Oliva, D. and Moraga, R. 2009. 'Seasonal variation in the abundance of South American sea lions *Otaria flavescens* (Shaw, 1800) in Chañaral Island, Reserva Nacional Pingüino de Humboldt, Chile'. *Revista de Biología Marina y Oceanografía*, 44(3), 685-689.

Sepúlveda, M., Oliva, D., Pavez, G. and Santos-Carvallo, M. 2016. *Caleta Chañaral de Aceituno: Destino turístico de alta calidad para el avistamiento de cetáceos, otros mamíferos y aves marinas*. 124 pp. ISBN 9 78-956-368-261-8.

Sepúlveda, M., Santos-Carvallo, M. and Pavez, G. 2017. *Whale-watching en la Reserva Marina Isla Chañaral: Manejo y planificación para una actividad sustentable*, 84 pp.

Sepúlveda M., Pérez-Álvarez, M.J., Santos-Carvallo, M., Pavez, G., Olavarría, C., Moraga, R. and Zerbini, A. 2018. 'From whaling to whale-watching: identifying fin whale critical foraging habitats off the Chilean coast'. *Aquatic Conservation: Marine and Freshwater*

Sepúlveda, M., Santos-Carvalho, M., Pavez, G., Pérez-Álvarez, M.J., Olavarría, C., Fernández, C., Hernández, C., Ardiles, A., Hernández, P., Barilari, F., López, D., Flores, M. and Luna, G. 2020. Determinación del estado poblacional en las Reservas Marinas isla Chañaral e islas Choros y Damas, de las especies delfín nariz de botella, chungungo, pingüino de Humboldt y cetáceos. Informe Final Proyecto FIPA 2018-43, 343 pp + Anexos.

Taylor, B.L., Baird, R., Barlow, J., Dawson, S.M., Ford, J., Mead, J.G., Notarbartolo di Sciara, G., Wade, P. and Pitman, R.L. 2019. *Physeter macrocephalus* (amended version of 2008 assessment). The IUCN Red List of Threatened Species 2019: e.T41755A160983555.

Thomas, F. 2005. Residencia del delfín nariz de botella *Tursiops truncatus* (Montagu, 1821) en la Reserva Nacional Pingüino de Humboldt, Chile (B.Sc. thesis). Viña del Mar, Chile: Universidad de Valparaíso.

Toro, F., Vilina, Y.A., Capella, J.J. and Gibbons, J. 2016. Novel coastal feeding area for eastern south pacific fin whales (*Balaenoptera physalus*) in mid-latitude humboldt current waters off chile. Aquatic Mammals, 42(1), 47.

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