Area Size

202 062 km²

Qualifying Species and Criteria

Sperm whale – *Physeter macrocephalus*
Criterion A; B (2); C (1,2)
Blue whale – *Balaenoptera musculus*
Criterion A; C (2)
Fin whale – *Balaenoptera physalus*
Criterion A; C (2)
Sei whale – *Balaenoptera borealis*
Criterion A; C (2)
Risso's dolphin – *Grampus griseus*
Criterion B (1); D (1)
Sowerby's beaked whale – *Mesoplodon bidens*
Criterion B (2)

Marine Mammal Diversity

Criterion D (2)

Balaenoptera acutorostrata, Balaenoptera borealis, Balaenoptera edeni, Balaenoptera musculus, Balaenoptera physalus, Delphinus delphis, Grampus griseus, Hyperoodon ampullatus, Megaptera novaeangliae, Mesoplodon bidens, Mesoplodon densirostris, Orcinus orca, Physeter macrocephalus, Pseudorca crassidens, Stenella coeruleoalba, Stenella frontalis, Tursiops truncatus, Ziphius cavirostris

Azores Archipelago IMMA

Summary

The remote archipelago of the Azores is characterised by dynamic oceanography and complex bathymetry, providing an exceptional habitat for cetaceans. It benefits from a sustainable development model based on artisanal fisheries with limited cetacean bycatch, and one of the largest MPA networks in the Atlantic covering coastal, oceanic and deep-sea habitats. The area hosts a small, resident population of Risso's dolphins (*Grampus griseus*), and important aggregations of Vulnerable sperm whales (*Physeter macrocephalus*) and Sowerby's beaked whales (*Mesoplodon bidens*). Additionally, it serves as foraging, calving and possibly mating ground for sperm whales, and as a mid-latitude foraging area for migratory Endangered blue (*Balaenoptera musculus*) and sei (*B. borealis*) whales, and Vulnerable fin whales (*B. physalus*). It hosts a high cetacean diversity with 19 species regularly sighted, including six baleen whale species, eight delphinid species, four beaked whale species, and sperm whales.

Description:

The Azores is the most remote archipelago in the North Atlantic, located about 1,000 nm from continental Europe and 3,000 nm from North America. It consists of nine volcanic islands divided into three groups. The IMMA of the Azores Archipelago covers an area of just over 200,000 km² and encompasses vast expansions of deep ocean, narrow island shelves, steep slopes, numerous seamounts and a portion of the Mid-Atlantic Ridge. The region is characterized by strong seasonality and
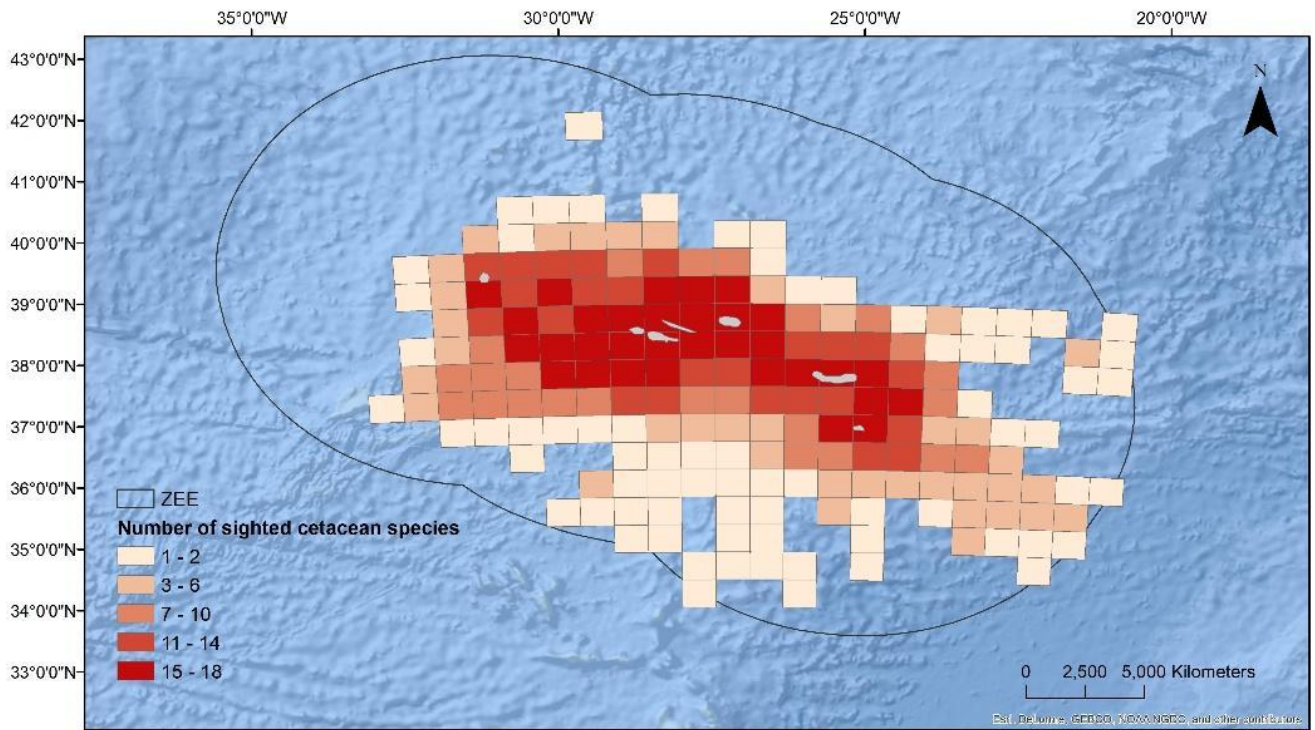
Figure 1: Cetacean diversity (number of species sighted) per 50 km x 50 km grid cell, based on sighting data collected by the Azorean Fisheries Observer Program (POPA) from 1998 and 2022. Excerpt from Mónica A. Silva, unpublished data.
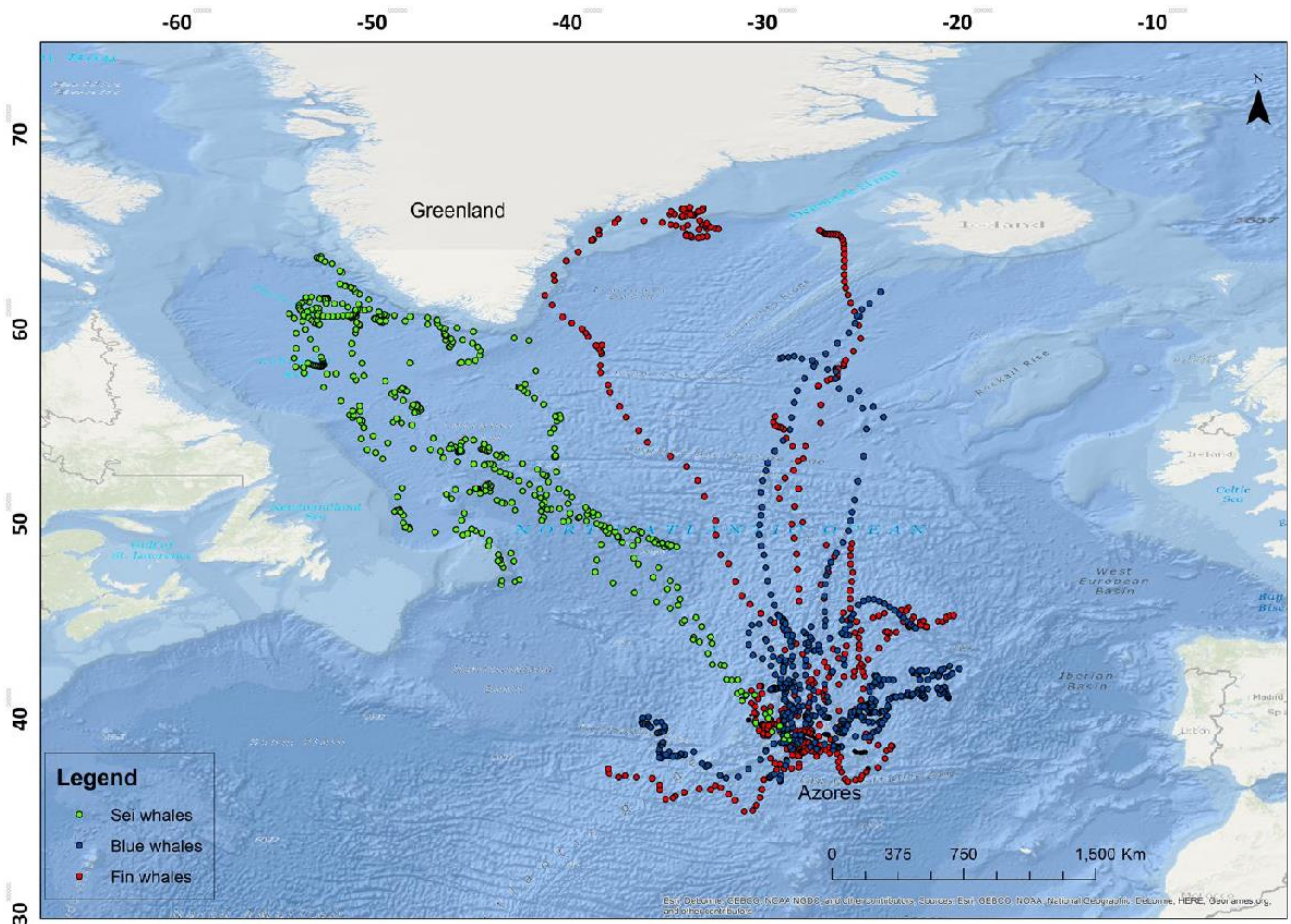

Figure 2: Map showing the Argos-derived positions of sei (green dots), blue (blue dots) and fin (red dots) whales instrumented with satellite transmitters in the Azores between 2008 and 2016. Excerpt from Pérez-Jorge et al. (2020).

complex ocean circulation patterns resulting from the interaction of the North Atlantic Current (in the North) and the Azores Current (in the south) with many unstable eddies and meanders (Afonso et al., 2020; González García, 2019; and references therein). This unique blend of a dynamic oceanography interacting with high seafloor complexity in the middle of the North Atlantic basin is thought to provide the particular conditions which attract cetaceans (Silva et al., 2014; Tobeña et al., 2016; Prieto et al., 2017; Pérez-Jorge et al., 2020). The Azores has one of the largest and most diverse networks of marine protected areas (MPAs) in Europe and the Atlantic, covering a mix of coastal, oceanic and deep-sea habitats (including several seamounts and pelagic seabird foraging areas) (Afonso et al., 2020), but no MPA has been specifically designated to protect cetaceans.

Criterion A: Species or Population Vulnerability

Blue whales (*Balaenoptera musculus*) and sei whales (*Balaenoptera borealis*) are currently listed as Endangered on the IUCN Red List of Threatened Species (Cooke, 2018a, b), and fin whales (*Balaenoptera physalus*) (Cooke, 2018c) and sperm whales (*Physeter macrocephalus*) as Vulnerable (Taylor et al., 2019). The European regional Red List considers sperm whales as Vulnerable, while blue, sei and fin whales are considered Endangered (Cabral et al., 2005). The region is a well-known feeding and calving ground for sperm whales, and evidence suggests it serves as mid-latitude foraging habitat for fin, blue and sei whales during spring migration (Clarke, 1993; Prieto et al., 2014; Silva et al., 2013, 2014, 2019; González García et al., 2018, 2022; Pérez-Jorge et al., 2020). Additionally, these last three species have been acoustically detected around the archipelago in autumn and winter (Romagosa et al., 2020).

Figure 3: Blue whale (*Balaenoptera musculus*) blows. Photo credit: Laura González García

Figure 4: Sperm whale (*Physeter macrocephalus*) breaching. Photo credit: Laura González García

Figure 5: Fin whale (*Balaenoptera physalus*) surfacing near shore of Pico Island, Azores. Photo credit: MónicaSilva@AzoresWhaleLab

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

Risso's dolphins (*Grampus griseus*) are listed as Least Concern globally (Kiszka & Braulik, 2018) and Least Concern within European waters (Genov, 2023). Sightings of Risso's dolphins have been reported to occur throughout the entire Azorean archipelago (Silva et al., 2014; Tobeña et al., 2016) but there are indications of a resident population around one of the islands.

Out of 1,626 individuals identified south of Pico in 2004-2021, 223 were resighted more than 25 times, and 130 were resighted over 50 times, indicating strong site fidelity to the area (K.L. Hartman,

unpublished data). This corroborates a previous study based on data collected over 35 consecutive months (May 2004 – November 2007) that showed that this population was resident year-round in the area (Hartman et al., 2015). Home range analysis of frequently sighted individuals revealed core habitat areas within 4-nautical miles south of Pico Island (Hartman et al., 2014, 2015). Within this area, females with neonates and nursing calves appear to use coastal waters most frequently, often less than 100 m from the shore, whereas sub-adult and adult groups (mixed sex or males only) occupy slightly more offshore waters (Hartman et al., 2015). During the nursing period, between June and August, sub-adults, pregnant females, and females with neonates and older calves often cluster together in nurseries, occupying restricted core areas (Hartman et al., 2014).

Figure 6: Risso's dolphins (*Grampus griseus*) breaching. Photo credit: Karin L. Hartman

Figure 7: Sperm whale (*Physeter macrocephalus*) fluke seen in the Azores IMMA. Photo credit: Laura González García

Figure 8: Aerial view of sperm whales (*Physeter macrocephalus*) in the Azores IMMA. Photo credit: RuiPrieto@AzoresWhaleLab

Figure 9: Sperm whales (*Physeter macrocephalus*) in the Azores. Photo credit: Laura González García

Sub-criterion B2: Aggregations

The global population of sperm whales in 2022 was estimated at 844,761 (SE = 171,206; CV = 0.209; 95% CI 481,901–1,153,459) individuals, which represents a 57% (95% CI 28.43–75.56) decline from the pre-whaling (reference year of 1711) population size (Whitehead & Shin, 2022). The same authors provide an estimate of 92,085 (CV=0.38) sperm whales for the North Atlantic in 1993, representing 12.5% of the global population of this species. Sperm whales are frequently sighted around all the islands of the Azores, as well as in more offshore waters (encounter rates of 0.44/100 km in habitats <20 km from the islands, and of 0.22/100 km in habitats <100 km from the islands) (Silva et al., 2014; Tobeña, 2022). Whales of both sexes and all age classes use the area year-round, but the majority (76%) of observations consist of social groups, and sighting rates are higher in late spring and summer (Silva et al., 2014). Sperm whale social groups are nomadic (Whitehead et al., 2008), and although a few social groups use the area nearly every year, none resides in the area permanently (Boys et al., 2019). There are no estimates of abundance of sperm whales for the entire Azores region. Capture-recapture models applied to photo-identification data collected during the summer (July-early September) 2009-2015 around only two islands (~8,500 km², ~6% of the IMMA), estimated that a total population of 1468 (95% CI: 1203–1791) adult and juvenile sperm whales used the area in those years as part of their summer range (Boys et al., 2019). However, not all whales from this super-population visited the area every summer, and annual abundance ranged between 275 (95% CI: 188–404) in 2014 and 367 (95% CI: 248–543) in 2012 (Boys et al., 2019). A ship-based line transect survey conducted in the summer of 2018 around the central group of islands of the Azores (32,804 km²) yielded an estimate of 212 sperm whales (95% CI: 134–334) (Freitas et al., 2019), although this estimate was not corrected for perception or availability bias, and therefore it is likely underestimated. The uncorrected average density of 0.006 whales/km² is 1.5 to 3 times higher than the density estimated in the Northeast Atlantic (Rogan et al., 2017).

Figure 10: Sowerby's beaked whales (*Mesoplodon bidens*) in the Azores. Photo credit: Laura González García

Figure 11: Sowerby's beaked whales (*Mesoplodon bidens*) observed surfacing off Pico Island. Photo credit: K L Hartman, Nova Atlantis Foundation

Beaked whales (Ziphiidae) are frequently sighted around the Azores islands as well as in more offshore waters (Silva et al., 2014; Tobeña et al., 2016). Although no population estimates are available for the whole archipelago, estimates of beaked whale density from the ship line-transect survey around the central islands of the Azores were considerably higher than those in neighbouring regions (archipelagos of Madeira and Canary Islands) (Freitas et al., 2019), suggesting that the Azores hosts important aggregations of multiple beaked whale species. This is especially the case for Sowerby's beaked whale (*Mesoplodon bidens*), with an estimated abundance of 605 whales (CV=28%, 95%CI: 355-1,032) in the 32,804 km² survey area (<24% of the IMMA) (Freitas et al., 2019), giving an estimated density of 0.018 whales/km². These estimates were not corrected for availability or perception bias and therefore are very likely underestimates.

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

The IMMA is used as a calving, and possibly mating, ground by sperm whales (Clarke, 1981; Silva et al., 2014). About 76% of sperm whale sightings in the area are of social groups, 8% of adult males, observed singly or in aggregations, and the remaining 16% of adult males interacting with social units (Silva et al., 2014). Calves are frequently sighted (38% of the sightings include at least one calf) throughout the year, although the proportion of sightings with calves is higher in summer (Silva et al., 2014). Newborns (<5 m, with foetal folds) are also frequently observed, with a clear peak in August (Silva et al., 2014), agreeing with historical whaling data that showed an increasing rate of large foetuses and lactating female sperm whales in summer, supporting their birth during July and August (Clarke, 1956). Parturition and sperm whale placentas have been reported occasionally by whale-watch operators.

Sub-criterion C2: Feeding Areas

Analysis of stomach contents from sperm whales hunted in the Azores showed that whales foraged in the area (Clarke, 1956; Clarke, 1983). Consistent with this, most whales encountered in the Azores are foraging (Silva et al., 2014) and individual whales have been documented to spend 75-80% of their time foraging (Gordon & Steiner, 1992). Diving profiles of sperm whales instrumented with Dtags showed that whales spent about 76% of the time in foraging dives to the lower mesopelagic layer (bottom phase diving depth of 750 m), producing an average of 0.53 (±0.19) buzzes per minute, suggesting high rates of prey capture attempts (Oliveira et al., 2022). The predicted relative density of sperm whales in the region is higher over deep waters (1,000-2,200 m depth) and is significantly associated with micronekton production in mesopelagic layers, which probably attracts squid species that sperm whales feed on (Tobeña, 2022).

Blue, fin and sei whales are observed every year in the Azores region, mostly between March and July, with occasional sightings in autumn and winter (Silva et al., 2014; Visser et al., 2011; González García et al., 2018, 2022). These species use the area as mid-latitude foraging habitat during spring migration (Silva et al., 2013). Satellite tracking data showed that blue and fin whales suspended their spring migration and remained within the wider Azores region for periods ranging from days to a few months, spending a substantial proportion of their time in area-restricted search behaviour, assumed to represent foraging (Silva et al., 2013). This is supported by recent studies of the diving behaviour and activity budgets of fin whales (Fonseca et al., 2022). Conversely, tracking data and at-sea observations suggested that sei whales had shorter residency times in the area and rarely engaged in foraging activity (Prieto et al., 2014). However, in recent years, sei whales have been observed in the area for months foraging on small fish (especially snipe fish *Macroramphosus* sp.). Modelling of tracking data showed that movement patterns of blue, fin and sei whales within the Azores and at higher latitudes were closely linked to prey biomass and production within the epipelagic layer, consistent with their known diets (Pérez-Jorge et al., 2020).

Criterion D: Special Attributes
Sub-criterion D1: Distinctiveness

The existence of genetically distinct populations of Risso's dolphins in the northern North Atlantic (United Kingdom, UK) and Mediterranean waters has been reported by Gaspari et al. (2007). More recently, analysis of mitochondrial DNA showed that, despite a lack of complete lineage sorting, Risso's dolphins inhabiting the waters of the Azores were genetically differentiated from those sampled in the UK, Mediterranean and Pacific Ocean (Chen et al., 2018). In fact, no haplotype was shared between the Azores (15 unique haplotypes, 35 samples) and the UK (3 haplotypes, 18 samples) or Pacific Ocean (55 haplotypes, 136 samples), and only one haplotype was shared with the Mediterranean (13 haplotypes, 24 samples). In addition, morphological differences have been reported for Risso's dolphins from different regions (e.g., Japan and Taiwan, Chen et al., 2011; Yu et al., 2019; Faroe Islands, Bloch et al., 2012; South Africa, Plön et al., 2020; Azores, Hartman et al., 2016, 2023), reflecting restricted gene flow and genetic divergence between populations, and/or adaptation to local ecological conditions through phenotypic plasticity.

Risso's dolphins in the Azores maintain a sexually stratified community with males forming stable clusters, whereas females tend to associate in temporally stable units when calving and nursing (Hartman et al., 2008). In addition, the mating system of this species reveals complex patterns and layered

intra-group male-male collaborations (Hartman et al., 2020). Male Risso's dolphins have been frequently observed to conduct consortships, which is considered to be a driver of the rare existence of non-kin but stable associated multi-male groups in the research area (Hartman et al., 2023).

Figure 12: Risso's dolphins (*Grampus griseus*) aerial view in the Azores. Photo credit: Karin L. Hartman

Sub-criterion D2: Diversity

The Azores hosts some of the highest cetacean biodiversity in the world, with 19 species of toothed and baleen whales occurring regularly in the region (Silva et al., 2014; Azevedo & Barreiros, 2019; Azevedo et al., 2023). This includes a mix of resident common bottlenose (*Tursiops truncatus*) and Risso's dolphin populations, species that are present year-round (e.g. sperm whales, common (*Delphinus delphis*) and striped dolphins (*Stenella coeruleoalba*), Cuvier's (*Ziphius cavirostris*), Sowerby's and Blainville's (*Mesoplodon densirostris*) beaked whales, and seasonal visitors, such as blue, fin and sei whales, Bryde's whales (*Balaenoptera edeni*), Atlantic spotted dolphins (*Stenella frontalis*) and northern bottlenose whales (*Hyperoodon ampullatus*). There are also regular visitors with no clear seasonality, such as short-finned pilot whales (*Globicephala*

macrorhynchus), false killer whales (*Pseudorca crassidens*), common minke whales (*Balaenoptera acutorostrata*), humpback whales (*Megaptera novaeangliae*), and killer whales (*Orcinus orca*) (Silva et al., 2014).

Sightings of dwarf (*Kogia sima*) and pygmy sperm whales (*Kogia breviceps*), Gervais' (*Mesoplodon europaeus*) and True's beaked whales (*Mesoplodon mirus*) are rare but strandings suggest that these taxa are present year-round and possibly in higher numbers than revealed by sighting information (Silva et al., 2014). In addition, long-finned pilot whales (*Globicephala melas*) and rough-toothed dolphins (*Steno bredanensis*) are occasionally recorded in the area.

Figure 13: Common bottlenose dolphins (*Tursiops truncatus*) leaping in the Azores. Photo credit: Laura González García

Figure 14: Common dolphins (*Delphinus delphis*) in the Azores. Photo credit: Laura González García

Figure 15: Striped dolphins (*Stenella coeruleoalba*) in the Azores.
Photo credit: RuiPrieto@AzoresWhaleLab

Figure 18: A pair of northern bottlenose whales (*Hyperoodon ampullatus*) surfacing off Pico Island.
Photo credit: K L Hartman, Nova Atlantis Foundation

Figure 16: Atlantic spotted dolphins (*Stenella frontalis*).
Photo credit: Laura González García

Figure 17: False killer whales (*Pseudorca crassidens*).
Photo credit: K L Hartman, Nova Atlantis Foundation

Supporting Information

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