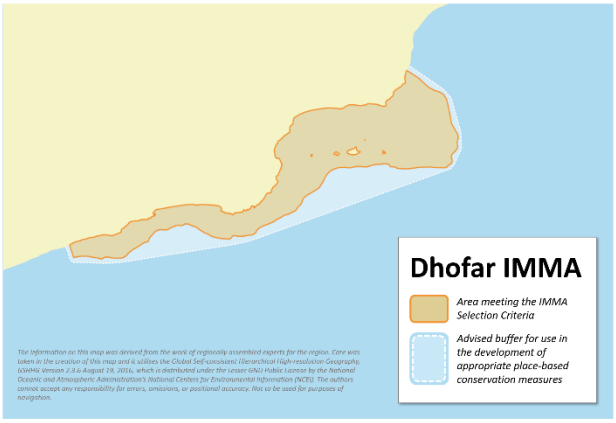
Dhofar IMMA



Area Size

19,168 km²

Qualifying Species and Criteria

Indian Ocean blue whale – *Balaenoptera musculus indica*
Criteria A, C2

Bryde's whale - *Balaenoptera edeni*
Criteria A, C2

Humpback whale – *Megaptera novaeangliae*
Criteria A, B2, C1, C2

Sperm whale – *Physeter macrocephalus*
Criteria C1, C2

False killer whale – *Pseudorca crassidens*
Criterion C1

Indian Ocean humpback dolphin – *Sousa plumbea*
Criterion A

Marine Mammal Diversity (D2)

Balaenoptera edeni, Balaenoptera musculus indica, Delphinus delphis tropicalis, Globicephala macrorhynchus, Grampus griseus, Kogia sima, Megaptera novaeangliae, Orcinus orca, Peponocephala electra, Physeter macrocephalus, Pseudorca crassidens, Sousa plumbea, Stenella longirostris, Steno bredanensis, Tursiops aduncus, Tursiops truncatus, Ziphius cavirostris

Summary

The waters off the coast of the Dhofar region of southern Oman are characterized by dynamic oceanographic conditions strongly influenced by summer and winter monsoons. The summer monsoon creates strong upwelling conditions and high levels of primary productivity between the months of May and September. Highly variable bathymetry in the IMMA comprises wide protected bays and islands on the edge of the continental shelf as well as steep slopes that plummet to great depths. This variety provides a range of highly productive habitats for a diverse array of cetacean species. The area has been documented as a 'hotspot' for Endangered Arabian Sea humpback whales (*Megaptera novaeangliae*). This sub-population is the only known non-migratory humpback whale population in the world, as the animals remain in the Arabian Sea year-round to both feed and breed. Individually identified humpback whales in the Dhofar IMMA demonstrate a high degree of site fidelity, as well as behaviours associated with both feeding and reproduction (singing males (Fig. 1) and mothers with calves). In total, 17 cetacean species have been observed in the region thus far, ranging from resident nearshore communities of Endangered Indian Ocean humpback dolphins (*Sousa plumbea*) and Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) to deep-diving species such as Risso's dolphins (*Grampus griseus*), rough toothed dolphins (*Steno bredanensis*) and Cuvier's beaked whales (*Ziphius cavirostris*). Recent sightings and acoustic data suggest the area is also likely to be important for Northern Indian Ocean blue whales (*Balaenoptera musculus indica*).

Description

'Dhofar' is the name of the southernmost Governorate of the Sultanate of Oman. The coastal extent of the Dhofar IMMA is defined by the boundaries of the Governorate. The seaward extent is defined by the 1000 m isobath. The area is characterised by diverse bathymetric and oceanographic features, a key aspect of which is very high productivity. Despite being in the tropics, nutrient-rich temperate

conditions are generated by upwelling driven by the southwest monsoon in the summer (peak between July and August) which drives sea surface temperatures down to as low as 16-17 ˚c. Phytoplankton (chlorophyll) levels on the Arabian Sea coast can increase from 0.1g C m–2 d–1 during the inter monsoonal period to above 1.1g C m–2 d–1 during the summer season (Brock and McClain, 1992; Kindle and Arnone, 2001; Sheppard et al., 2018). These conditions support an abundance of prey for cetaceans (Papastavrou and Van Waerebeek, 1997). Indicators incorporated within Oman's National Spatial Strategy (SCP, 2019) to support the high value of this region include species richness, clusters of satellite-telemetry location points (for humpback whales), and vessel-based sightings records of Endangered Arabian Sea humpback whales and Indian Ocean humpback dolphins.

The westernmost portion of the IMMA is dominated by a narrow continental shelf that borders steep drop-offs. The inshore area there is a patchwork of sandy substrates and small sandy beaches interspersed with extensive rocky headlands and cliffs. This area provides important habitat for inshore Indo-Pacific bottlenose and humpback dolphins (Minton et al., 2011) and is a transiting area for Arabian Sea humpback whales (Willson et al., 2016b). Between Mughsayl and Mirbat the pattern of beaches and headlands continues but the continental shelf widens and beaches tend to be longer, including some that extend tens of kilometres between Salalah and Mirbat. From Mirbat to Hasik the coast is predominantly rocky and is punctuated with small sandy bays and a very narrow continental shelf. The headland at Hasik marks the transition between steeply shelving bathymetry and the broad continental shelf of the Hallaniyats Bay (known to be an important area for humpback whales). The transition between the steep shelving area and the continental shelf is considered influential in supporting a high diversity of species.

Criterion A: Species or Population Variability

The Arabian Sea humpback whale (ASHW) population is the only known population of humpback whales not to undertake long-range migrations between low-latitude breeding grounds and high-latitude feeding grounds (Mikhalev, 1997, Minton et al., 2011). The population is genetically isolated and distinct (Pomilla et al., 2014), and mark-recapture estimates generated from photo-identification studies off the coast of Oman are fewer than 100 individuals (82 individuals 95% CI 60-111), providing the rationale for an IUCN Red list status of Endangered (Minton et al., 2008). Dedicated field surveys, satellite tracking and passive acoustic monitoring have confirmed that the Dhofar area is one of the most important habitats in Oman's waters for this population. Within the Dhofar area, the highest density of sightings, vocalizations and occupancy (as evidenced by satellite tracks and localized behaviour) is concentrated in the Hallaniyats Bay (Minton et al., 2011; Baldwin et al. 2011; Willson et al., 2012; Willson et al., 2013; Willson et al., 2014; Willson et al., 2015; ESO, 2019; Supreme Council, 2019; Cerchio et al., 2018). Indian Ocean humpback dolphins (*Sousa plumbea*) are also observed in the Dhofar area and wider Arabian Sea Coast with a

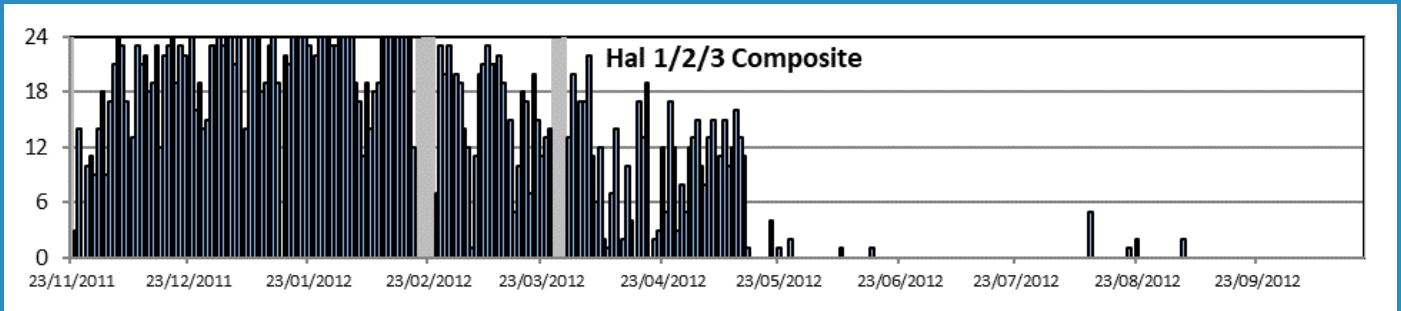


Figure 1: Daily occurrence of humpback whale vocalizations as shown by composite histograms for all acoustically monitored sites in Hallaniyats Bay (Hal 1, 2 and 3), showing the number of hours in a given day in which humpback whales were detected during complete days for which recordings were available. Since these sites within each region were not close enough to record the same whales, the composite histogram combining the data from all sites represents a general indication of presence in the region as a whole. Grey indicates no data. From: Cerchio et al., 2016.

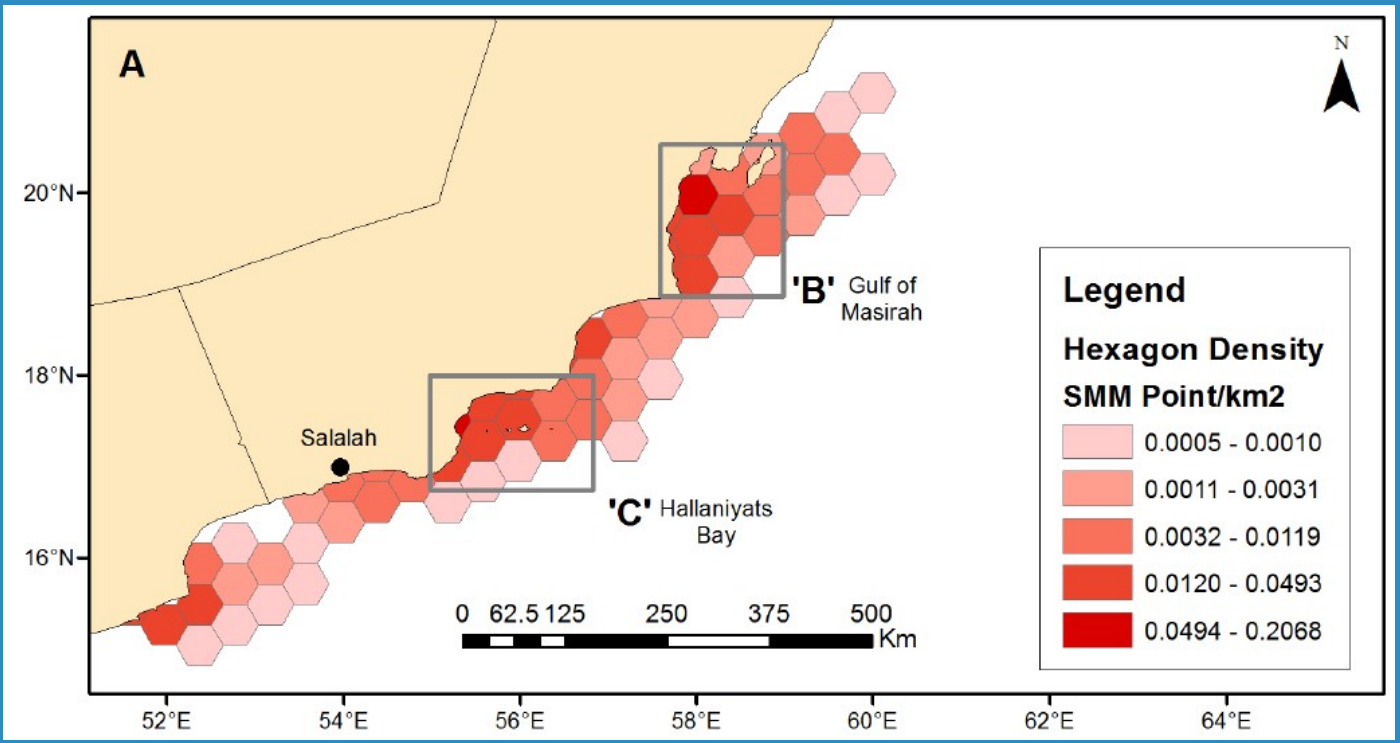


Figure 2: Arabian Sea humpback whale (*Megaptera novaeangliae*) habitat utilization derived from counts of modeled telemetry locations within a hexagon grid network. Cell size: 25 km min. radius. From: Willson et al., 2016.

strong preference for near-shore shallow coastal habitat. Encounters were made around Hasik Bay and southwest of Salalah (Minton et al., 2011) although sightings have also been documented in intervening areas. The species is listed as Endangered on the IUCN Red List (Braulik et al., 2017).

Criterion B: Distribution and Abundance Sub-criterion B2: Aggregations

Modelling of humpback whale sightings data in relation to survey effort using spatial eigenvector filtering to account for spatial autocorrelation, as well as results of satellite telemetry studies, confirm that the higher relative densities of whales in the Dhofar area are a reflection of their behaviour and not only survey effort (Corkeron et al., 2011; Willson et al., 2016a; Willson et al., 2017) (Fig. 2). The aggregations have been associated with feeding and breeding behaviour and in one survey period these activities were observed concurrently (Baldwin et al., 2011; Willson et al., 2011).

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

Passive acoustic monitoring has documented the presence of ASHW song between November and the end of May (Cerchio et al., 2016; Cerchio et al. 2018).

Further breeding-related behaviour has been observed in the form of competitive groups off Ras Hasik (Baldwin et al., 2011). Mother and calf pairs have been observed in the Dhofar area on 7 occasions between 2000 and 2014 (ESO, 2019).

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

Bubble-net feeding by ASHWs has been documented within the Hasik/Hallaniyats Bay (Baldwin et al. 2011) along with 17 other feeding events recorded in the area between 2001 and 2017 (ESO, 2019). Feeding records also exist for other species including Bryde's whales, false killer whales, common dolphins, both common and Indo-Pacific bottlenose dolphins and Indian Ocean humpback dolphins (ESO, 2019).

Criterion D: Special Attributes Sub-criterion D2: Diversity

The diversity in this area includes a range of species exhibiting different ecological preferences, with some species exploiting near shore shallow habitats (e.g. humpback dolphins) and others offshore habitats (e.g. Cuvier's beaked whales). The range of species also represents species feeding at different trophic levels, from baleen whales to top predators, such as killer

whales and false killer whales. Review of sightings data suggests that Ras Nus marks the westernmost extent of humpback dolphin records with a lack of sightings between this point westwards to Mirbat (ESO, 2018). A minimum of 17 cetacean species have been confirmed to occur in the Dhofar area, and dwarf sperm whales are suspected to occur. The list of confirmed species includes: Indo-Pacific common dolphin (*Delphinus delphis tropicalis*), Common bottlenose dolphin (*Tursiops truncatus*), spinner dolphin (*Stenella longirostris*), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), rough-toothed dolphin (*Steno bredanensis*), Indian Ocean humpback dolphin (*Sousa plumbea*), Risso's dolphin (*Grampus griseus*), false killer whale (*Pseudorca crassidens*), killer whale (*Orcinus orca*), dwarf sperm whale (*Kogia sima*), melon-headed whale (*Peponocephala electra*), short-finned pilot whale (*Globicephala macrorhynchus*), Cuvier's beaked whale (*Ziphius cavirostris*), sperm whale (*Physeter macrocephalus*), Bryde's whale (*Balaenoptera edeni*), humpback whale (*Megaptera novaeangliae*) and Northern Indian Ocean blue whale (*Balaenoptera musculus indica*). This diverse assemblage of 18 species has been recorded between 'Ras Nus' and Ras Hasik (Minton et al., 2011; Baldwin et al., 2011; Willson et al. 2012; Willson et al., 2013; Willson et al., 2014; Willson et al., 2015; ESO, 2018; Supreme Council, 2019).

Figure 3: Indian Ocean humpback dolphin (*Sousa plumbea*) in the Dhofar region of Oman. Photo: Gianna Minton for the Environment Society of Oman.

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