

Oman Arabian Sea IMMA

Summary (continued)

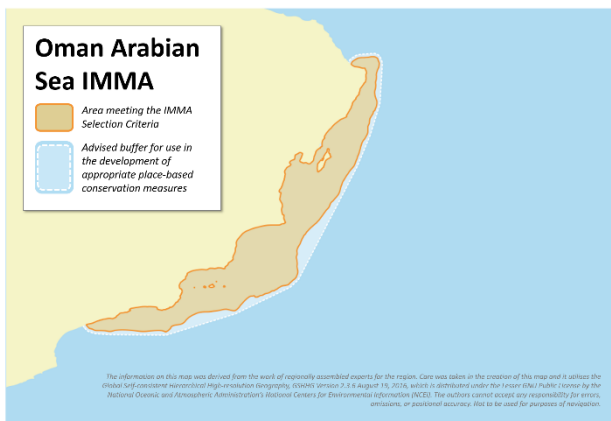
IMMA more strongly associated with reproduction. This larger IMMA encompasses these two smaller IMMAs as well as the wider corridor connecting them. It also includes the zone to the north of Masirah Island that has not been well surveyed, but where numerous anecdotal reports and some strandings of humpback whales have been documented.

Description

This IMMA is situated at the heart of one of the five largest upwelling areas of the world, which occurs both coastally and offshore out to 300 to 400 km and influences the water column to a depth of about 250 m. The high primary productivity associated with the monsoon-driven upwelling in the Arabian Sea fuels the ecosystem of the wider region. It also creates favorable feeding conditions for at least 20 species of cetaceans, including the world's most isolated whale, the endangered Arabian Sea humpback whale. Satellite tracking reveals preferred habitats of these whales within the Ecologically or Biologically Significant Area (EBSA), which also hosts other significant taxa, such as endangered and critically endangered sea turtles. Up to 20 species of cetaceans can be found in this IMMA and are described in the assessments of the two smaller IMMAs of Dhofar and the Gulf of Masirah. This larger IMMA encompasses the Dhofar and the Gulf of Masirah IMMAs, reflecting the area's importance as a corridor containing prime habitat for the distinct subpopulation of the Arabian Sea humpback whale.

Criterion A: Species or Population Vulnerability

The Arabian Sea humpback whale sub-population is listed as 'Endangered' on the IUCN Red List based on a mark-recapture population estimate of 82 individuals (95% CI 60-111; Minton et al., 2008), as well as the sub-population's documented genetic distinctiveness and isolation from other neighbouring sub-populations in the Indian Ocean (Pomilla et al., 2014). While the Dhofar region (Hallaniyats Bay) and Gulf of Masirah (GOM) have been identified as core



Area Size
96,146 km²

Qualifying Species and Criteria

Humpback whale - *Megaptera novaeangliae*
Criteria A, B2, C3

Marine Mammal Diversity

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

Summary

The Arabian Sea humpback whale subpopulation is the only known population of humpback whales (*Megaptera novaeangliae*) that does not migrate between low-latitude breeding grounds and high-latitude feeding grounds. Dedicated cetacean surveys of Oman's Arabian Sea coastline conducted from 2000 onward have confirmed that these whales are genetically distinct and geographically isolated, and thus represent a highly distinct sub-population which is designated as Endangered on the IUCN Red List. Boat-based surveys, acoustic surveys, satellite telemetry and photo-identification indicate that this IMMA encompasses the most important habitat for Oman's Arabian Sea humpback whales. Whales mate, calve, feed and travel in this general area, with the Gulf of Masirah IMMA more strongly associated with feeding animals and the Dhofar

hotspots for feeding and reproduction (Fig. 1). Arabian Sea humpback whales have been documented using almost the full range of this humpback highway through direct observation during dedicated cetacean surveys, satellite tracking and passive acoustic monitoring (Minton et al., 2011; Baldwin et al., 2011; Willson et al., 2012; 2013; 2014; 2015; ESO, 2019; Cerchio et al., 2016, Cerchio et al., 2018)

Criterion B: Distribution and Abundance

Sub-criterion B2: Aggregations

The Arabian Sea humpback whale subpopulation is the only known population of humpback whales that does not engage in a large-scale migration between low-latitude breeding grounds and high latitude feeding grounds. It is genetically distinct and geographically isolated, and thus represents a highly distinct sub-population. Boat-based surveys coupled with acoustic surveys, satellite telemetry and photo-identification studies indicate that the Oman Arabian Sea Coast EBSA, with slightly expanded boundaries, encompasses the most important habitat for Oman's Arabian Sea humpback whales. While two of 14 tagged whales left the boundaries of the area, the majority stayed within these boundaries throughout

the duration of their tag transmission (Willson et al. 2016; 2018). Furthermore, a high rate of photo-identification re-sightings between the Gulf of Masirah and Dhofar both within years and between years indicates that while some whales may engage in longer-range movements to Yemen and/or India, at least a portion of the sub-population seems to remain on the Arabian Sea coast of Oman year-round and in multiple years (Minton et al., 2011; Willson et al. 2016; 2018). Additionally, mark-recapture estimates based on the same photo-identification data collected off the coast of Oman between 2000 and 2004 indicate that fewer than 100 individuals were using the habitats encompassed in the area (Minton et al. 2008; Minton et al., 2011.). 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 and Gulf of Masirah areas a reflection of their behaviour and not only survey effort (Corkeron et al., 2011; Willson et al., 2016; 2017; 2018). 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). While densities of whales in these areas may be lower than those on other humpback whale breeding and feeding grounds, the densities recorded here are higher than any other area in the Arabian Sea humpback whales' range to date, and the areas clearly serve the same purpose as feeding and breeding grounds do for the species elsewhere.

Criterion C: Key Life Cycle Activities

Sub-criterion C3: Migration Routes

Location and track data derived from the satellite telemetry revealed a predominance of localized behaviour and transits between the Hallaniyats Bay area and the Gulf of Masirah. Transitory movements of humpback whales through the Dhofar area have been revealed by behaviour mode index of static space-state modelling of satellite telemetry data. These records are noted from five of 14 Arabian Sea humpback whales instrumented with tags in the Dhofar and Gulf of Masirah areas between 2014 and 2015 (Willson et al., 2016). Habitat utilization kernel density estimates indicate high site fidelity for the

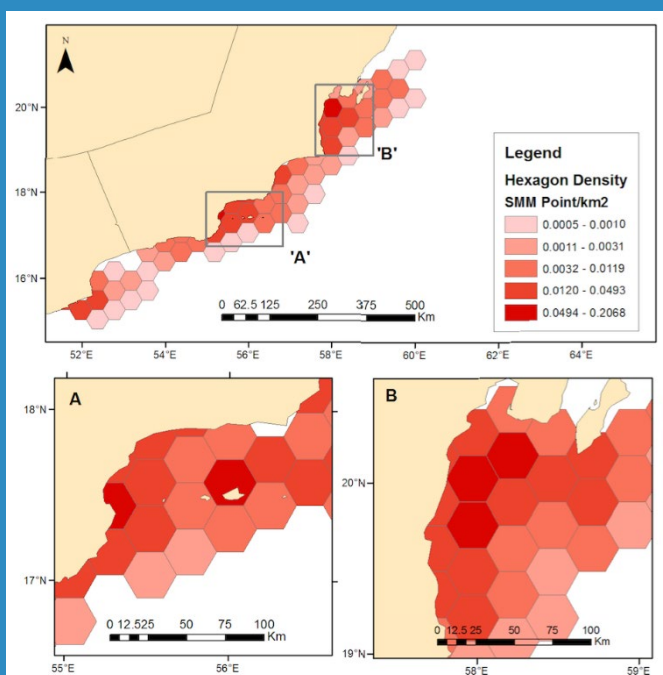


Figure 1: Habitat utilization derived from counts of modeled telemetry locations within a hexagon grid network. Full extent of the study area defined by whale movement (upper panel; this should be A; cell size 25 km min. radius) and selected high-use areas (bottom plots 'B' and 'C'; cell size 15 km min. radius). Density classification consistent across all figure parts. From: Willson et al., 2016.

majority of tagged individuals (Willson et al., 2015; 2016; 2018). Only two of the 14 tagged individuals moved outside of Omani waters and the area bounded by this area. Of these two, one male, remained mostly within the boundaries of the area but moved further southwest into Yemeni waters. The other, a female, crossed the Arabian Sea to the southern tip of India, but then returned to the Gulf of Masirah where she was originally tagged (Willson et al., 2016; 2018). The documented movement between Oman and India, coupled with an increasing number of sightings and recordings of song documented from the coasts of Pakistan and India, provides evidence that some proportion of the Arabian Sea humpback whale population is using the eastern portion of the Arabian Sea as well as Oman's coast. The Oman Arabian Sea area encompasses the most heavily used habitat for whales that are present, year-around, off of Oman's coast.

Supporting Information

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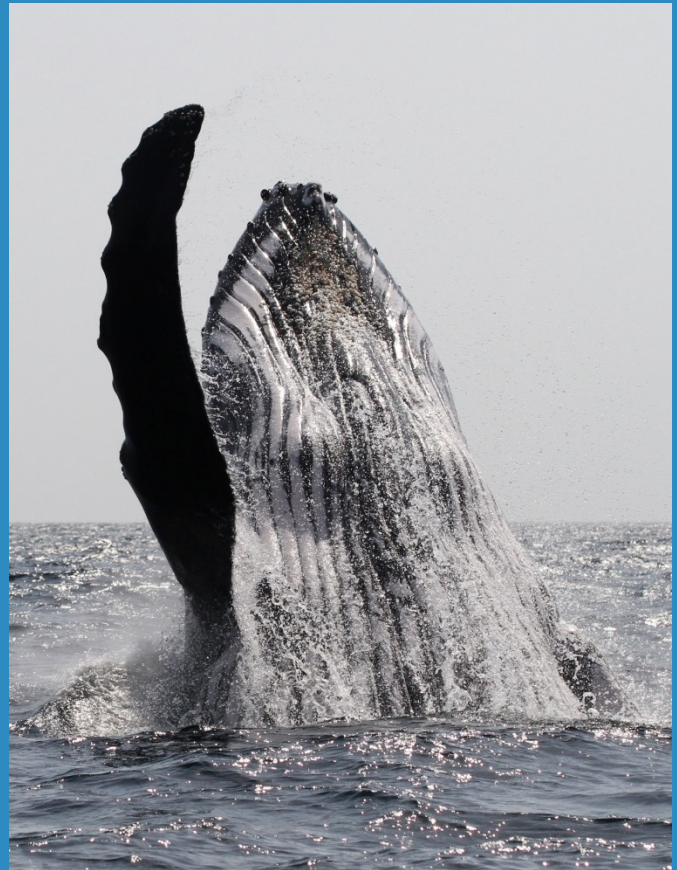


Figure 2: An Arabian Sea humpback whale surfaces off the coast of Oman. Photo: Ken Findlay for the Environment Society of Oman.

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MARINE MAMMAL PROTECTED AREAS TASK FORCE

IUCN SSC WCPA IMMA

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GOBI

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