

Arabian Sea humpback whale research update for 2012/13

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Abstract

Previous research and historical records have confirmed the presence of a discrete and non-migratory population of humpback whales in the Arabian Sea. A small vessel survey was conducted in Oman from October through to November 2012 from base camps at Hasik and Masirah Island. The survey covered a total of almost 3000km (1250km of survey effort) and resulted in 3 humpback whale sightings totaling just 5 individuals, of which 3 had been photographed during previous surveys off the coast of Oman. All of these five sightings were located within the Gulf of Masirah, previously identified through habitat modeling as a critical area for the population in Oman. These findings support the decision to locate bottom-mounted passive acoustic units in waters adjacent to the new facility of Duqm Port, and consideration of additional remote sensing techniques to further inform fine scale habitat use and broader scale movements of Arabian Sea humpback whales. On-going coastal development in the Gulf of Masirah and increasing vessel traffic continue to pose a threat to this endangered population of whales. Efforts to mitigate these threats are being addressed through engaging stakeholders (from local industry to range state governments) to consider management options. A series of workshops in Oman is also being delivered to help develop national whale watching and stranding response guidelines.

Introduction

Historic whaling data and recent scientific research confirm the presence of a resident and discreet sub-population of humpback whales in the Arabian Sea (Reeves *et al.* 1991; Mikhalev, 2000; Minton *et al.* 2008, Minton *et al.* 2011). Historical and incidental records indicate a distribution that includes Oman, Yemen, Iran, Pakistan and India and potentially other states of the NIO region (Brown, 1957; Mikhalev, 2000; Minton *et al.* 2008; Reeves *et al.*, 1991; Slijper *et al.* 1964; Wray and Martin, 1983; Yukhov, 1969). The population is currently listed as Endangered by the IUCN (Minton *et al.* 2008) and is considered extremely vulnerable to escalating threats (Baldwin *et al.* 1999, Minton *et al.* 2008; Baldwin *et al.* 2010).

Studies conducted in Oman since 2000 have used observational, acoustic and genetic survey techniques to assess population size, behavioral characteristics and habitat use of this species within discrete areas of the coastline (accessible using small boats). This work has further affirmed the non-migratory nature of the population and provided some initial measures of its isolation. Genetic studies have, for example, revealed that three of eight MtDNA haplotypes recorded from humpbacks sampled off Oman are unique to the population (Pomilla *et al.* 2010; Rosenbaum *et al.* 2009). Analyses of photo-identification images reveal a relatively high incidence of re-sightings of individuals off the coast of Oman. These provide the basis for a 2004 population estimate of 82 (95% CI=60-111) individuals (Minton *et al.* 2008, Minton *et al.* 2011). A lack of matches to photo-ID catalogues from Madagascar, Mozambique and Zanzibar (Minton *et al.* 2010b), as well as sightings of calves, feeding and initial analyses of song provide further supporting evidence for a discrete and regionally resident Arabian Sea sub-population.

The following report presents highlights of new data collected during field surveys and opportunistic encounters in the second half of 2012 and first half of 2013. We discuss emerging threats, conservation initiatives and a new research approach for the Arabian Sea humpback whale (ASHW), to satisfy identified requirements.

Methodology and Results

Boat and Shore Observations

One humpback whale dedicated field survey has been completed since the last IWC report in June 2012. This survey effort in Oman is a continuation of surveys initiated in 2000. The survey ran between the 20th October and 23rd November, in the Arabian Sea, in coastal waters off Masirah Island, the Gulf of Masirah and the Halaniyat Bay, (see Figure 1 below). The survey was conducted aboard a 6.5m research vessel with 2 or more observers, tasked with maximizing photo-identification and biopsy opportunities within areas previously noted as hotspots for Arabian Sea humpback whales. Planned line transect surveys were restricted to within 10km of shore due to piracy related security concerns.

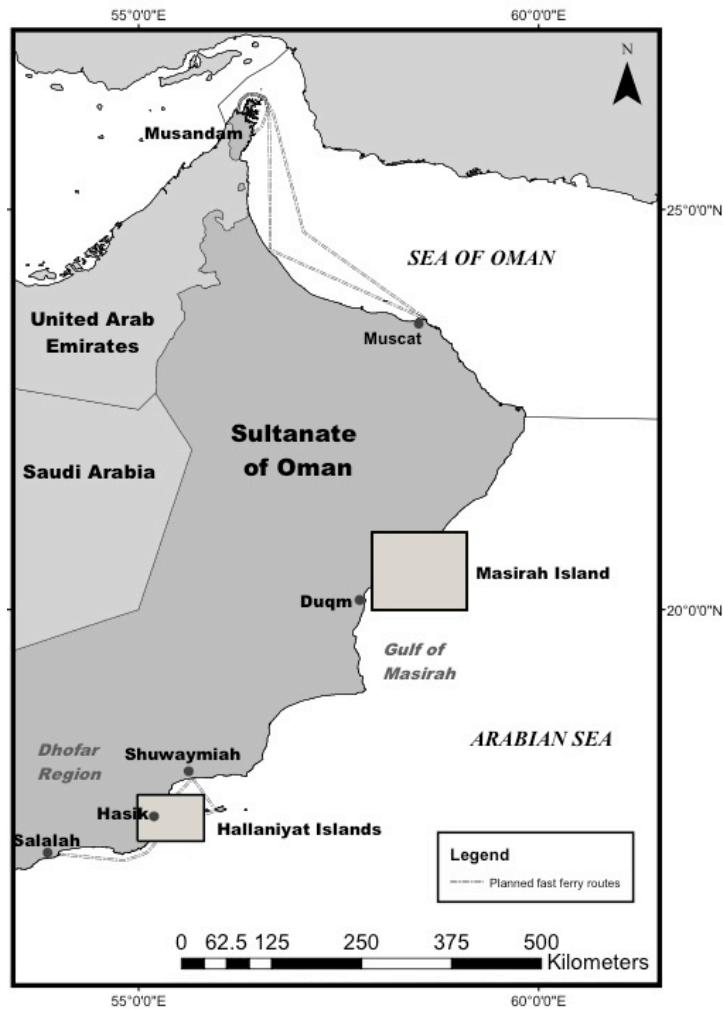


Figure 1. Survey areas within boxes visited in October/ November 2013.

Humpback sightings and other cetacean biodiversity

The survey accounted for approximately 172 hours and 1,250km of 'on-effort' observation.. In total 3 sightings of 5 individual humpback whales (*Megaptera novaeangliae*) were recorded (Table 1), all within the Gulf of Masirah, with one of these occurring off effort. As such, the humpback whale encounter rate for this survey was only 0.003 sightings/ hour. Common dolphins (*Delphinus capensis tropicalis*) and bottlenose dolphins (*Tursiops* sp.) were occasionally encountered in the Hasik area, although no baleen whales were sighted. Additional notable sightings within the same survey area included one group of up to 30 sperm whales (*Physeter macrocephalus*) comprised of females, juveniles and one male escort, and the first confirmed sighting of short finned pilot whales (*Globicephala macrorhyncus*) in Omani waters.

A separate survey dedicated to sampling of *Tursiops* sp. was also undertaken by small vessel in 2012 within the

fjords of the Musandam peninsula bordering the Straits of Hormuz at the eastern end of the Arabian Gulf. Tasked to collect genetic samples from dolphins as part of PhD genetic study from Durham University, over 300 survey hours resulted in no baleen whale encounters but did amass data on distribution of *Tursiops aduncus* and *Sousa chinensis* around the peninsula. Genetic samples from here and other sites in Oman are expected to define the taxonomy and population structure of bottlenose dolphins as part of this study.

Table 1. Summary of effort and sightings of all cetaceans recorded during vessel survey in 2012.

Location	Hasik	Gulf of Masirah	Total
Species			
<i>Megaptera novaeangliae</i>	0	3	3
<i>Balaenoptera sp.</i>	0	1	1
<i>Balaenoptera edeni</i>	0	1	1
<i>Physeter macrocephalus</i>	1	0	1
<i>Tursiops sp.</i>	3	2	5
<i>Stenella sp.</i>	0	1	1
<i>Delphinus capensis tropicalis</i>	3	1	4
<i>Globicephala macrorhynchus</i>	1	0	1
<i>Pseudorca crassidens</i>	1	0	1
Unidentified whale	1	0	0
Total	10	9	19
Total Survey Time (Hours)			
	70	103	173
On-Effort (Hours)			
	24	37	61

Incidental sightings of note made outside of the survey time include two humpback whales in the Hasik area in February 2013 which were found feeding and using bubble netting in the same manner as reported from the 2011 spring survey, and another 2 humpbacks found within 5km of the port at Duqm. Video and photographic evidence has also been provided of two sightings of Cuviers beaked whale (*Ziphius cavirostris*) off capital city of Muscat in May 2013. One of these encounters reported 3 animals together, one of which was a calf.

Acoustic Research

Vessel based acoustic monitoring was incorporated into vessel based surveys. Hydrophone stations (44kHz, High Tech Inc-96) were deployed at regular intervals during transects and transiting. Initial review of the recordings revealed complete absence of humpback whale song across all study areas for the October to November survey period. Suspected vocalisations of other baleen whales are still to be reviewed and confirmed. The data has been archived for analysis along with past recordings.

Table 2. Summary of effort and cetacean encounters detected by hydrophone (HTI-96) deployed during the October/ November 2012 survey period.

Location	Listening Effort		Encounters per Survey				
	No of Primary Stations*	Duration Total Time (hh:mm)	Delphinid Vocalisation	Sperm Whale Clicks	Suspected Baleen Whale Vocalisation	Humpback Song	Unknown Vocalisations
Gulf of Masirah	45	3:52	7	1	5	0	2
Hasik	70	3:36	8	0	12	0	6

*Primary stations do not include locations that are derived from acoustic grid search efforts when song is encountered.

As an additional component of the monitoring programme, bottom mounted passive acoustic monitoring units (Wildlife Acoustics SM2M), are in commission to detect the presence and behavioral traits of baleen whales within previously identified high density critical habitat. Having completed almost a year of service at a site off Hasik the units were removed in October 2012, and relocated to the north within the Gulf of Masirah. Aside from the

established importance of this habitat for humpback whales (Minton et al. 2011), the strategy to relocate the equipment was also influenced by the need to further understand the presence of humpback whales adjacent to the new port of Duqm (referred to later in this paper under ‘threats’). A field intervention on 14th April 2013 successfully obtained 5 months of data from this array, with the units subsequently redeployed and due for recovery again in November 2013. The sampling rate and duty cycle of the units has been adjusted between 16 to 32kHz and 33 to 50% respectively during the course of deployment according to constraints of field interventions coupled with memory capacity and battery endurance. Efforts are underway between ESO and the Wildlife Conservation Society to initiate processing of this data starting 3rd quarter of 2013.

Photo-identification

Analysis of photographs of incidental and survey encounters of humpback whales between October 2012 and May 2013 has revealed a total of 5 new humpback whales out of a total of 9 individuals photographed. The Oman catalogue as of April 2013 holds 95 individuals. It is likely this catalogue contains duplicates of unrecognized individuals due to poor quality photos or incomplete representation. A total of 73 individuals are represented by ‘fair’ or ‘good’ quality tail fluke photographs.

Previously published estimates from mark-recapture studies drawing on survey data up through 2004, (Minton *et al.* 2008; Minton *et al.* 2011) indicated a population of 82 individuals (95% CI=60-111). Given the constrained geographical range of surveys in recent years, further revision of this population estimate has been deemed redundant until broader scale surveys can be adopted within Oman and the rest of the range states. However, re-sight rates in previously identified “hotspots” of restricted geographical range remain high, indicating high levels of site fidelity and/or consistently low population numbers.

To further understand the constraints of existing survey strategy and associated datasets, unfiltered sighting history data from the photo catalogue up until April 2012 has been summarized into a sighting frequency assessment documented in Table 3 below.

Table 3. Summarised sighting frequency statistics of identified individuals derived from data between January 2000 and March 2012.

Sighting Frequency Bin	Number of Identified Individuals	Percentage of Identified Individuals	Number of Sightings	Percentage of Sighting Frequency
1	55	61.8	55	27.2
2	17	19.1	34	16.8
3	4	4.5	12	5.9
4	4	4.5	16	7.9
5	3	3.4	15	7.4
6	1	1.1	6	3.0
7	1	1.1	7	3.5
8	0	0.0	0	0.0
9	1	1.1	9	4.5
10	0	0.0	0	0.0
11	0	0.0	0	0.0
12	0	0.0	0	0.0
13	0	0.0	0	0.0
14	0	0.0	0	0.0
15	0	0.0	0	0.0
16	3	3.4	48	23.8
Total	89	100	202	100

Considering the shortfalls of dealing with raw data, the table shows a distinct bimodal distribution of sighting frequency, with less than 4% of known animals accounting for almost a quarter of all sightings (n=202). It is likely this is a facet of high site fidelity, as reported in the previous IWC report (Willson et. al. 2012), coupled with

restricted and repetitive surveys over the same ground from year to year. Further inspection of summary data reveals the 3 individuals that were sighted on 16 separate occasions to all be male. The table also implies that 60% of individuals within the catalogue have been sighted just once, representing 27% of all sightings. In addition to being influenced by the geographic restrictions to survey bias these trends are also indicative of possible duplicates of unrecognized individuals. The demonstrated constraints within the dataset reflect the decision not to formally revise population estimates, until a more robust survey approach can be attained.

Behaviour and appraisal of encounters

The October and November 2012 surveys revealed no sightings of humpback whales off the east coasts of Masirah Island and Hasik in comparison to the same areas surveyed in 2011 where 0.12 sightings/ hour and 0.13 sightings/ hour in 2011 from each location respectively (Willson et. al. 2012). Sightings were only made during survey time in 2012 during unscheduled excursions further west into the Gulf of Masirah adjacent to Duqm Port and elevate the encounter rate for the entire survey to 0.003 sightings/ hour. Given the continuous high concentration of fishing activity observed by the authors in this area, one hypothesis to explain this could be that the shallow waters (15-30m) close to Duqm provide a rich feeding ground for much of the year with distribution related to feeding further afield driven by seasonal pulsing and spatial shifts in prey items from year to year (Willson et. al. 2012). The sighting of humpbacks feeding off Hasik in 2010, 2011 and 2013 but with an absence of the activity in 2012, and the feeding activity observed east of Masirah island in 2011 and not in 2012 partially supports this theory.

Threats

Two strandings of Bryde's whales were reported from the Oman coastline for 2012/13. The most significant stranding event was that of 12 false killer whales that live-stranded at As-Sawadi some 80km north of the capital Muscat. Of the 6 animals returned to the sea before professional help arrived, only one was found not to have re-stranded. Partial necropsy on three of the animals revealed stomachs devoid of food except for remnants of decayed otoliths and squid beaks. The causes behind the stranding remain unestablished.

Vessel traffic numbers continue to increase throughout Oman's other ports, including a 29% increase at Sohar in 2012 (Oman Observer 2013d) and 660% increase between 1998 and 2012 in Sohar, (Times of Oman 2012). A new port in Duqm became operational in March 2013. The 2011/2012 IWC Oman report highlighted the near completion of this multi-purpose port and dry dock area situated on the west of the Gulf of Masirah (Willson et al. 2012). Previous research associated the location with a high incidence of humpback whale sightings (Corkeron *et al.* 2011, Minton *et al.* 2010a, Minton *et al.* 2011), information that has been presented to senior port management. The response of the operations has been to introduce preliminary mitigation measures. This includes an advisory notice to mariners on new admiralty charts detailing; the importance of the area for whales, the need for extra vigilance for those on watch on their approach through the Gulf of Masirah, reduced vessel speeds and adherence to taking an approach route of least distance through the critical habitat. Further consultation with specialists has been proposed to ensure additional mitigation measures are applied to reduce conflict between whales and port operational activities.

The coastal hinterland surrounding the Gulf of Masirah continues to be a focus for industrial and infrastructure development within the next five years that will provide management challenges into the future. To the north side of the gulf feasibility assessments are currently underway for construction of a 40km bridge, linking the island of Masirah to the mainland. The proposed development comes with the strategy to boost fishing and other economic activities in the governorate, (Oman Observer 2013c). Oman Oil Company will construct a 200 billion barrel tank farm to the south of Duqm port at Ras Makaz with reception facilities for VLCC vessels (Oman Observer, 2013b). This facility will also feed a 230,000 barrel/day refinery with associated 'liquid terminal' to export the refined product. Reception facilities for transfer of liquid petroleum gas (5MM sm³/day) are included in these developments being supported by the 'Special Economic Zone Authority of Duqm' (SEZAD). Within the SEZAD area, the Ministry of Agriculture and Fisheries Wealth is tendering a USD 120 million project to make the area the center of Oman's fish capture, processing and farming industry. This project includes an additional dedicated harbor anticipated to take advantage of rich fisheries resources within the Gulf of Masirah (Oman Observer 2013a).

From the fisheries sector, tangle or gill-nets represent the greatest threat to the ASHW. Analysis of scarring on the caudal peduncle region of photographically identified humpback whales in Oman indicates that as of 2004 between 30-40% showed signs of having been involved in entanglements with fishing gear (Minton *et al.* 2011). Review of national fisheries statistics shows a 27% (n=18731 in 2011) increase in the number of licensed vessels throughout

Oman between 2007 and 2011. Of these, 74% (n=704) of the larger artisanal vessels (dhows) and are dedicated to handling gill nets alone and are registered in the area surrounding the Governorates surrounding the Gulf of Masirah, (Fisheries Statistic and Information Department, 2012). As such, the risk of further entanglements is likely to have increased considerably.

Developments in Outreach, Capacity and Regional Initiatives

National stranding response guidelines and a series of workshops have been delivered to government and NGO field staff by the authors as part of renewed efforts to increase capacity in this discipline within Oman. A locally trained field team of ESO employees on Masirah Island is now successfully conducting monthly beach stranding monitoring surveys along 150km of coastline. Given additional resources there is the potential to role this programme out to other parts of the coastline thereby increasing effectiveness of response to incidental strandings. The network of stranding responders has identified that further training is required for advanced physiological examinations, necropsies, live stranding response and net-disentanglement. Negotiations are on-going to secure experts and funding to meet these needs.

A project to develop national whale watching guidelines has also been ongoing, including consultation with the Ministry of Tourism, Fisheries and industry stakeholders. Workshops with operators are due for delivery in the 3rd and 4th quarter of 2013 as financially supported by the IWC Whale Watching Working Group.

International media attention has recently been drawn to the ASHW through broadcast of a recent BBC series 'Wild Arabia' (March 2013). Internet coverage of the production has also further stimulated interest and discussion. ESO also continues to drive outreach programmes through social media.

Efforts to establish a regional initiative to coordinate conservation efforts for the ASHW have continued amongst scientists associated conservation work in Oman and the wider region. Preliminary discussions have been held between WWF International, WWF Pakistan, WWF India, EWS/WWF UAE, the Wildlife Conservation Society and ESO. The associated organisations and consultants are currently seeking a means to support the IWC Conservation Management Plan (CMP) process.

Appraisal of Research Priorities

Since 2010 the existing research team has focused field efforts towards surveying areas identified as critical humpback whale habitat in order to support dedicated spatial planning and management initiatives. On-going limitations in funding and personnel necessitate a continuation of surveys with limited geographical range focused in those areas where threats are considered greatest. The results of the sighting frequency evaluation demonstrate the incompatibility between these objectives and the long term monitoring needs of refining and updating population assessments. Given that there are plans on the horizon to formalize work within a regional context through a CMP, it is suggested that the population assessment requirements are incorporated within a broader regional research strategy. This should also account for concerns that previous population estimates might have been biased due to data having been collected only off the coast of Oman and not in other parts of the populations' suspected range.

The high percentage of photo-identified individuals, only observed once off the coast of Oman (reviewed in Table 3), is perhaps also suggestive of a wider distribution of the population outside of the focused study sites. Given the large area covered by all range states, satellite telemetry may be one of the best available tools to understand broad scale distribution and movements and potentially identify new hotspot areas. The potential health risks associated with telemetry require careful assessment given the small size of the population.

Satellite telemetry could also help to refine knowledge of critical habitat at target study sites, as these areas of previous high sighting density are likely to be the most practical sites for tag application. Data from this and ongoing acoustic and boat surveys will also contribute to a vulnerability mapping exercise planned over the next two years. A component of the vulnerability mapping includes further assessment of data relating to habitat use, a theme that should also consider dynamics of prey availability, given the link inferred between encounter rates and feeding events.

Conclusion

Given the paucity in humpback whale encounters in the last year, the ongoing vessel based survey strategy has been of limited value in its contribution to our understanding of whale habitat use. Although currently limited in its scope, future processing of acoustic data is expected to fill this gap, whilst alternative remote sensing techniques and development of regional research capacity are being sought to define broader scale knowledge of the population's ecology. To achieve this and meet the management challenges presented by rapid intensification of primary threats in critical habitat, a matching shift in commitment and capacity development is required for conservation measures to be effective in guarding this sub-population from collapse.

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