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Introduction

The Indian coastline is approximately 7,516 km long and is distributed among nine coastal states and one union territory. Currently 13-15 species of marine mammals have been reported (or putatively reported) from the west coast of India, of which three are baleen whale species confirmed through sightings and the assessment of carcasses or carcass images over the last fifteen years (2000 to 2015); blue whale (*Balaenoptera musculus*), humpback whale *Megaptera novaeangliae* and Bryde's whales (*Balaenoptera edeni*¹). Of these, Bryde's whales were found to be the most commonly reported on both coasts and most records are based on carcasses that are washed ashore or reported as bycatch. Few baleen whale sightings records prior to the year 2000 exist, but misidentifications are common and published records of other baleen whales, specifically fin whales (*B. physalus*), sei whales (*B. borealis*) and minke whales (*B. acutorostrata*) are considered spurious (e.g. James & Lal Mohan. 1987; Kumaran 2002). Research on large whales in Indian waters has otherwise been extremely limited (reviewed by Kumarran, 2012).

Efforts to conduct dedicated baleen whale surveys using visual and acoustic methods off the west coast were recently initiated with the aim of filling this knowledge gap and improving the availability of data for conservation management. This is considered particularly important in light of the current status of Arabian Sea humpback whales and the alarming number of recent strandings observed. Baleen whales in Indian waters are protected to the highest level under the Wildlife Protection Act (1972), which includes a blanket ban on the hunting, trade or capture of cetaceans.

In this note we present details of confirmed sightings of baleen whales, a compilation of available data of baleen whales over the last fifteen years and information retrieved from fishing communities along three states of the west coast – Gujarat, Maharashtra and Kerala. All records of baleen whales from the west coast of India, based on available newspaper articles, CMFRI publications and sightings by authors, are listed in Table 1 and displayed in Figure 7.

Methods and observations

Our marine mammal research teams are working from three locations off the west coast of India; Gujarat, Maharashtra and Kerala. We have initiated interview surveys in Gujarat and Maharashtra (Figure 1, 3, 7). Boat based hydrophone surveys (using dipping hydrophones) were started in Maharashtra in May 2015 with surveys supported through collaboration with the Indian Coast Guard, captains and crews of fishing boats, and captains of native shipping vessels (dhows) for this project.

¹ Recent genetic work by Kershaw *et al.* (2013) confirms the presence of at least two forms of Bryde's whales in the Arabian Sea – we do not attempt to distinguish them here.

Gujarat

The coast of Gujarat is ~1,600 km long, accounting for almost 19.79% of the total coastline in India. Its continental shelf is vast enough to make up 34.07% of the country's shelf area. With such an immense coastline, Gujarat is one of the foremost fish producing states in the country with 851 fishing villages recorded in the late 1990s (Gujarat FAO, 2000). Blue whales, Bryde's whales and humpback whales have been reported from the Gujarat coast (Kumaran *et al.* 2002).

The waters off Gujarat are known to provide habitats for humpback whales. Mikhalev (1997) reported the catch of 164 humpback whales in waters off the northern coast of Gujarat by Soviet whalers in November 1966, by far the largest proportion of the 238 whales killed in the Arabian Sea that year. The region is highly productive and biologically diverse, supporting shrimp, squid, lobster and elasmobranch fisheries; fishermen from all over India go there to fish. The continental shelf slopes gently and extends in some places to 300 km from shore. Productivity is driven by both the southwest monsoon and the outflow of the Indus River, which empties into the Arabian Sea at the border between India and Pakistan. Whale sightings are commonly reported by fishermen throughout the year, and with increased frequency between October and April. Baleen whales are locally called 'Maccha Raja' (King of all fish), and sighting a whale on a fishing expedition is considered a good omen. The region is thus important not only for whales but also for biological diversity and richness.

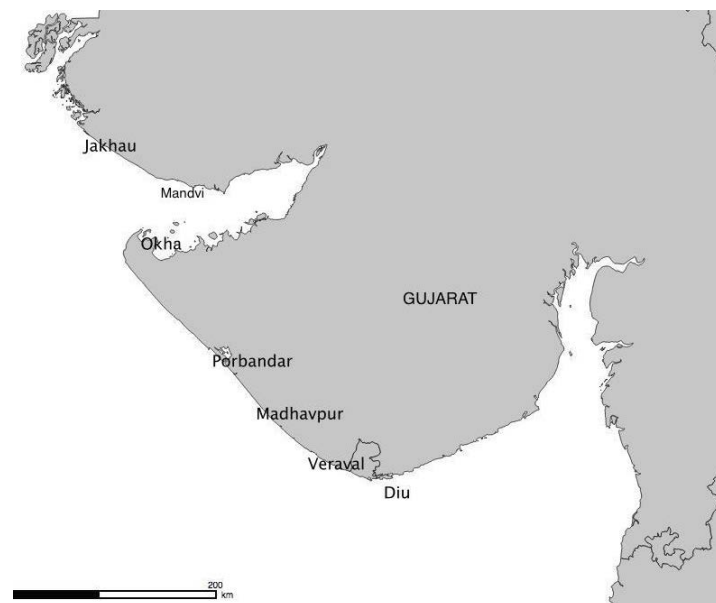


Figure 1. The coast of Gujarat, in northwest India showing interview and boat survey locations.



Figure 2. Three Arabian Sea Humpback whales were sighted by the Indian Coast Guard in October 2005.

Coastguard meetings

In 2014, we met with the regional head for the North West region of the Indian Coast Guard, Gandhinagar. In May 2014 we visited Jakhau and Mandvi Indian Coast Guard Stations in Gujarat and informed them about the project and plans for follow-up workshops. Between June–October 2015, we shall be holding training workshops to collect photographic evidence and location of any new Baleen whale sightings for the Coast Guard staff at Jakhau, Mandvi, Okha, Porbandar, Diu and Veraval.. The Indian Coast Guard has provided us with pictures of rescue operations for baleen whales and of sightings along the coast till 2013 (Figure 2).

Dhow captain meetings

In Mandvi, Gujarat we met with three Dhow captains. We showed them pictures of different baleen whales and were excited to see them pointing to the humpback whales which they said

were common near Muscat and sometimes seen on their way to Indian waters as well. They said that these whales were common mostly in the winter months. Meetings will be held with the leader of the Dhow Association and then with Dhow staff for collecting sighting data of humpback whales in 2015-2016.

Interviews with fishermen

We interviewed ten fishermen in April 2015; three gillnet boat captains and seven trawler captains. All of the trawler captains and two of the gillnet captains had encountered baleen whales in their 17-30 years of fishing, and all of them had seen baleen whales between November 2014 and March 2015. They said that the whales are found all through the year but are more commonly sighted in the winter months, all along the coast from Jakhau as far as Diu in south Gujarat. The whales are usually sighted in depths of 50-200 m, and sometimes in even shallower waters in north Gujarat. The last reported sighting is from March 12th 2015, in waters approximately 200 m deep west of Dwarka, Gujarat. Fishermen sometimes described the whales as having very long wing-like flippers and bulbous structures on their head (suggesting these could be humpback whales). All of these interviewees considered whales to be a sign of good luck and either burn incense or break a coconut to pay their respects to the whale after it has been sighted. In 2008, fishers off the coast of Veraval rescued a humpback whale from a gill net (Figure 3).



Figure 3. Humpback whale rescued from a gillnet off the coast of Gujarat, India in 2008

Maharashtra

The Sindhudurg coastline is 121 km long and has shallow productive waters interspersed with offshore islands and rock formations. The continental shelf ranges from 120 to 150 km from the coastline. Interview surveys, boat-based surveys and monitoring of cetacean carcasses and strandings were initiated in 2013 by the Konkan Cetacean Research Team. The team use interview surveys to study the perceptions of fishermen towards two coastal cetaceans species: humpback dolphins (*S. plumbea*) and finless porpoise (*N. phocaenoides*) along with collecting anecdotal data on other cetacean species. The majority of fishers have sighted baleen whales in their lifetime, with older fishermen describing a decline in whale sightings over the past 30 years, and some attributing this to the decline of fisheries in the area. Exact identifications of these animals could not be confirmed given the descriptions provided by fishermen. Our monitoring of cetacean strandings/mortalities in the study areas also included unidentified baleen whales. Finally, boat-based transect surveys conducted as part of the ongoing study gave us confirmation of baleen whale presence and the confirmation of two baleen whale species in the study area.

On 28th March 2015, a blue whale mother/calf pair was sighted off Kunkeshwar, Sindhudurg at 13:00 hrs at a depth of 16 m, 2.7 km offshore. One of the individuals appeared to be considerably smaller than the other. The calf was observed on its side with its flipper raised out of the water, probably nursing/playing. The animals were observed for about 25 minutes, from 150 - 500 m away heading northwards. Humpback dolphins and finless porpoises are also frequently encountered in the same area but during this sighting no other cetaceans were observed in the area. Two set gillnets were present near the animals.



Figure 4. Coast of south Maharashtra, northwest India showing locations of acoustic and boat surveys.



Figure 5: Bryde's whale sighted off the coast of Sindhudurg, Maharashtra (Konkan Cetacean research team 2015).

Bryde's whales were observed on several occasions during small boat survey effort on the 11th, 16th and 30th of April and May 6th 2015. Accounts for each sighting are provided below:

Sighting 1: On the 11th of April, three individuals were first sighted off the Talashil coast (N16 07.165 E73 26.547), in 12.2 m of water approximately 600 m from the coast, covering a distance of 8.6 km within a 1.0 km² area. The individuals observed included a pair of adults and a sub-adult. An adult was closely associated with the sub-adult. The whales appeared to be milling in the area and were probably foraging. Shoals of sardines and small fish were recorded. The pair surfaced often, with short dives, with an average dive time of 1min 4secs. The lone individual was observed to be taking deeper dives (average dive time 2 mins 3 secs). The three individuals seemed to be associated and eventually travelled southwards together. These animals were observed in habitats associated with humpback dolphins and finless porpoises. During this sighting a small pod (two to three individuals) of finless porpoises was also observed in the same area.

Sighting 2: On 16th April 2015 the same three individuals were spotted again approximately 1.5 km from the shore near Tarkarli (N15 59.051 E73 26.780). The resightings were

confirmed by the presence of distinct cookie cutter marks on the dorsal fins. The whales were observed over a distance of 5.4 km within an area of 0.3 km², in water depths of ~17.5 m. The sub-adult and adult pair was later seen swimming southwest towards deeper waters (20 m). They were probably foraging and defecation was observed.

Sighting 3: On 30th of April four individuals were spotted off the Nivati coast Sindhudurg district (N15 59.345 E73 26.869) in 17.3 m of water, approximately 1.5 km from shore. They appeared to be swimming/travelling very fast, in no particular direction. One of the individuals appeared to be a calf being significantly smaller.

Sighting 4: Four individuals were sighted on the 6th of May 2015, first at 09:05 and then at 14:06 hrs, off Achra lighthouse, Sindhudurg (N16 10.890 E73 25.151, N16 09.869 E73 25.151). The initial depth and distance from shore were recorded as 15.2 m and 2.34 km respectively. At 14:06 hrs the recorded depth was 15.2 m and distance from shore 2.6 km. One mother-calf pair and possibly two adults were sighted. During this observation, the mother-calf pair was swimming in a tightly knit sub-group. One adult individual was observed swimming about a 100 m from the mother-calf pair, taking long dives; spending a considerable amount of time underwater between resurfacings. The mother calf pair also appeared to be engaged in long dives. All the individuals showed active avoidance of our survey vessel during both occasions, possibly due to the presence of a young animal in the group. A small pod of 3-4 finless porpoises was also present in the area during this observation.

Kerala

The Kerala coast is the southernmost state on the Indian west coast and has a long coastline with a narrow continental shelf, strong upwelling, heavy surf; long continuous rocky and sandy shores interspersed with small creeks and remnant mangroves and greatly exploited and polluted internal lagoon systems protected by seaward sandbars (Pernetta 1993). The coastal plains of Kerala are well watered with rivers from the Western Ghats flowing into the Arabian Sea. There are 41 west flowing rivers that flow into 30 estuaries (Devaraj *et al.* 1999). In the state, there is one major port at Kochi, consisting of an international container transshipment terminal, a cruise berth, an LPG terminal and two fishing harbours. This area attracts heavy vessel traffic from tankers and large cargo ships to smaller mechanised fishing boats. There has been one confirmed live sighting of a baleen whale from these waters and several records of stranded baleen whales.

During a project on humpback dolphins, four boat based sightings surveys were conducted in order to improve our understanding of the distribution of marine mammals in the coastal areas off Kochi and Munambam (Panicker & Sutaria 2013). A pair of Bryde's whales, an adult and calf, was spotted on these surveys, 12.8 km off the Kochi harbour and at a depth of 20.1 m. The whales were identified by the presence of three ridges on the rostrum. The blow was variable and one of the dorsal fins was falcate. They kept a distance of 200-400 m from us at all times. The water temperature was 29.3°C with a salinity of 36ppt. Turbidity in the water was recorded as 0.5 NTU.

Fishermen were interviewed during the course of the above study (2012-2013) from this region. Almost all fishermen have sighted whales and reported seasonality in sightings with some fishermen stating March- May to be the peak. However we could not ascertain the exact seasonality or the species identification. Fishermen found that a higher number of whale sightings were correlated to the rise in large sardine shoals in near shore areas. Whales are locally known as 'Kadal aana' (meaning Sea Elephant) or 'Thimingalam' (all whales) and are respected and perceived as good fortune for fishing.

Mahanty *et al.* (2015) reported the presence of vocalising *M.novaeangliae* in southwest (Kerala) waters using autonomous acoustic platforms between January and March 2011 with a peak in detections during February 2011 (thus consistent with records off Oman; Minton *et al.* 2011). The sea surface temperature during this period was recorded approximately 28°C. Although recordings were collected till May 2011 using the same methodology, no humpback whales were detected after mid-March. Whether these whales are part of the southeast Bay of Bengal population (see Figure 5) or from the northern Arabian Sea requires further research.

Figure 6. A stranded humpback whale reported from the southeast coast of India and misidentified as a Blue whale



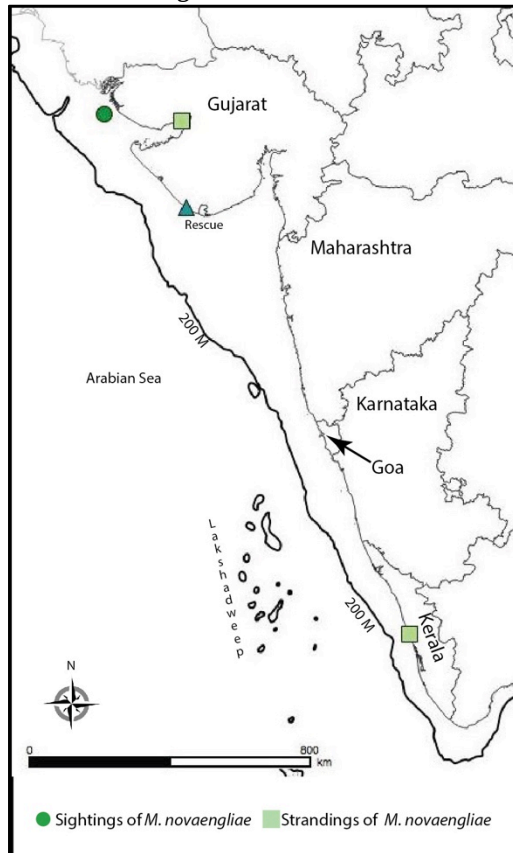
Discussion and future work

On the west coast, it seems that the presence of Arabian Sea humpback whales is most probable along the Saurashtra and Kachchh coasts of northern Gujarat. The majority of carcass reports are from Maharashtra and the species most commonly reported is the Bryde's whale, with at least five strandings reported in 2015 alone. Sightings of Baleen whales in northern Gujarat are mainly reported in the winter months of November to March. In Maharashtra the sightings of fishermen are correlated with the presence of sardine shoals. From June 2015 till December 2016, we shall be carrying out interview surveys, acoustic surveys and training fishers and Dhow captains to collect sighting data for our work.

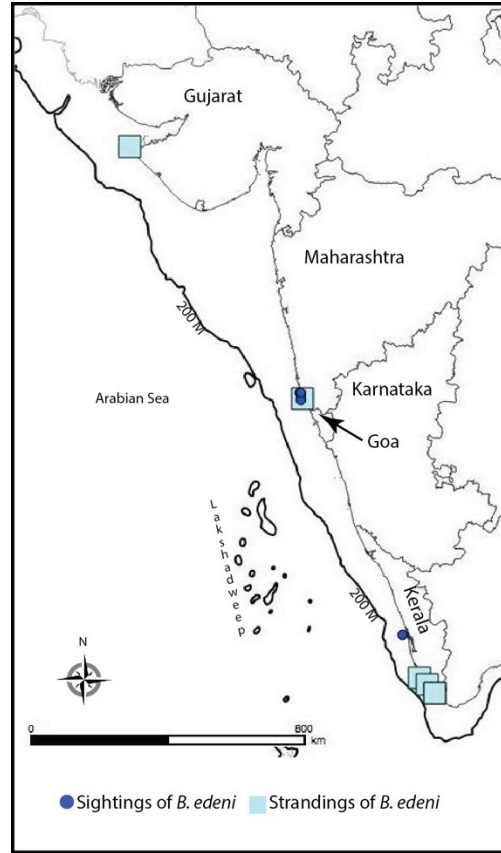
Dedicated baleen whale surveys using visual and acoustic methods would significantly aid us to fill the large gaps of knowledge on baleen whales and cetaceans in offshore waters of India. A serious and concentrated effort with an in-depth analysis of baleen whale carcasses is required to understand the causes and seasonality of mortalities. This requires the collaboration of local administrative authorities along with the forest department and trained veterinarians licenced to carry out necropsies or deal with live strandings. Moreover an organised database of all records in a shared standard format needs to be used to make the data available to range countries of these baleen whales. The current prohibition on the collection of samples for further analyses, particularly for genetics should also be rectified as soon as possible.

Figure 7: Sightings and strandings records along the west coast of India

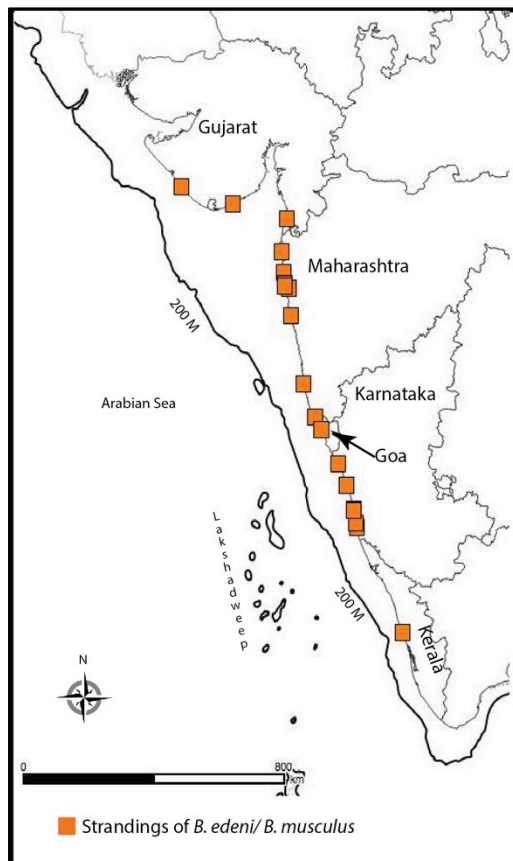
A: *M. novaeangliae*



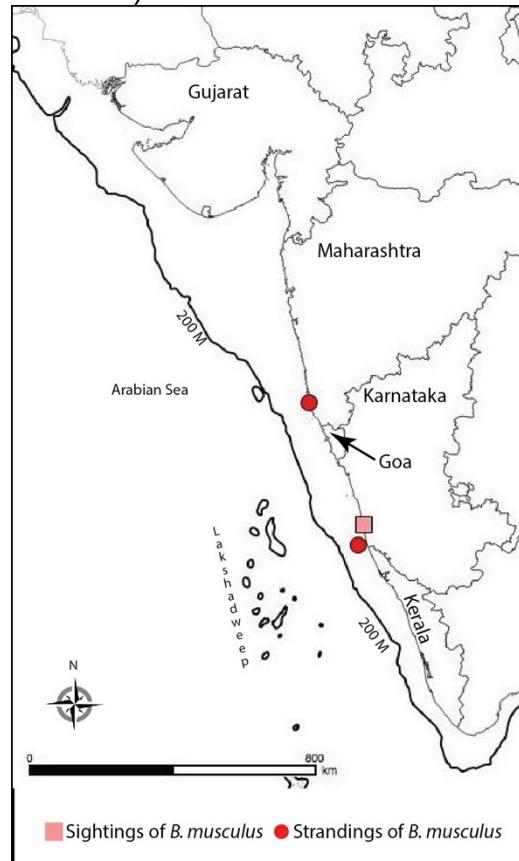
B: *B. edeni*



C: *B. musculus*



D: *B. edeni*/*B. musculus*



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