

RESEARCH ARTICLE

## Cetacean occurrence and distribution around the Bar Reef Marine Sanctuary, North-West Sri Lanka

A. D. Ilangakoon

Cetacean Specialist Group of IUCN Species Survival Commission, 215, Grandburg Place, Maharagama.

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**Abstract:** The Bar Reef Marine Sanctuary (BRMS) off North-Western Sri Lanka and adjacent waters were suspected to be important cetacean habitat but a dedicated survey had never been undertaken in this area. This survey was done over a period of one year in 2004/2005 to fill the knowledge gaps on cetacean occurrence and distribution in the area and gather baseline data for management and conservation. Boat surveys were carried out each month following a pre-planned transect line and all cetacean sightings in the Sanctuary, the adjacent Puttalam lagoon and deeper waters beyond the Sanctuary were recorded. During the study, a total of 33 sightings of eight cetacean species were documented. Cetaceans were present within the BRMS throughout the year and the northern and central parts of the Sanctuary could be termed a "cetacean hotspot" due to high species richness and year-round abundance. Live sightings of *Sousa chinensis*, the only species to be recorded within the Puttalam lagoon, were documented for the first time in Sri Lanka's waters. This species needs special consideration as this newly discovered population appears to be heavily dependent on the lagoon which is under intense human use, making these dolphins vulnerable to a multiplicity of anthropogenic threats. Baseline data from this survey can be used immediately for management purposes while further studies to obtain detailed information on these species and their habitats are recommended.

**Key words:** Bar Reef Marine Sanctuary, cetacean hotspot, cetaceans, *Sousa chinensis*, Sri Lanka.

### INTRODUCTION

The Bar Reef Marine Sanctuary (BRMS) is one of the few marine protected areas in the waters off the island of Sri Lanka. This Sanctuary is 306.7 km<sup>2</sup> in extent, and is located between latitude 08° 16'00" N – 08° 32'00" N and longitude 79° 44'00" E – 79° 46'70" E off the Kalpitiya peninsula on the North-Western coast of Sri Lanka. It was designated under the Sri Lanka Fauna and Flora Protection Ordinance in 1992 and is divided into a buffer zone and core area within which varying degrees of human activity may take place.<sup>1</sup>

The BRMS and its surrounding waters were suspected to be important for cetaceans based on opportunistic observations and sporadic sightings<sup>1-4</sup> in the area. A single stranding of a sperm whale (*Physeter macrocephalus*) has been documented<sup>4</sup> from the Kalpitiya coastline in 1946 and cetacean bycatch studies in the 1980's and early 1990's have reported a few specimens of small cetaceans from the landing site of Kandakkuliya<sup>4</sup> within the study area. Despite some information being available for the area, a dedicated cetacean survey had never been carried out in this marine Sanctuary or its immediate surroundings. Therefore the waters within the BRMS, the Puttalam lagoon immediately adjacent and landward of it and the deeper waters immediately seaward of it were selected as the study area for the present survey. The shallow Puttalam lagoon varies in depth from 1-5 meters, while depths within the BRMS are shallow to moderate, straddling the 20 meter depth contour towards its western boundary. Beyond the western boundary of the Sanctuary water depth increases rapidly with the 20 meter contour and 100 meter contour being located in close proximity to each other. Sri Lanka's continental shelf is also at its narrowest off the Kalpitiya peninsula, being approximately 2.8 km in width.

The present survey was undertaken in order to fill the knowledge gaps that existed on the temporal and spatial distribution of cetacean fauna in and around the BRMS and was designed with the primary objective of gathering baseline data on occurrence and distribution of cetaceans in the area. This was deemed necessary in order to make informed management decisions based on scientific data in relation to the BRMS which would lead to long-term conservation and rational management of this important marine living resource.

\* Corresponding author

## METHODS AND MATERIALS

Vessel based cetacean sighting surveys were carried out over a period of twelve consecutive months from April 2004 to March 2005. Two days of survey effort were undertaken each month with one survey within the Sanctuary using a 25-hp outboard-engine powered fibreglass vessel and one offshore survey seaward of the Sanctuary boundary using a larger 3.5 ton motorised fishing boat. A pre-planned saw-tooth patterned transect line was run each month in order to maximize coverage of the area with the available time and resources.

Three dedicated cetacean observers were looking out for cetaceans at all times while rotating through the three positions of port observer, bow observer and starboard observer at 30 min intervals. The port and starboard observers searched from the beam of the vessel to approximately 10° past the bow while the bow observer searched directly ahead of the vessel in a 20° cone in front of the bow and also acted as the data recorder. Survey effort was carried out during appropriate weather when sea-state was below Beaufort 4 and visibility was good. When sea state deteriorated beyond Beaufort 4 or heavy rain made visibility very poor effort was suspended.

Cetaceans or cetacean groups encountered were approached to a distance where species identification and group size estimates were possible. A pair of hand-held Nikon 7x50 binoculars was used to verify distant sightings and determine species. Species identification was done through careful observation of a combination of distinguishing morphological features and behavioural characteristics and the aid of several marine mammal identification guides (Guide to Marine Mammals of the World by Reeves *et al.*, 2002; The Sierra Club Handbook of Whales and Dolphins by Leatherwood and Reeves, 1983 and Whales and Dolphins Sri Lanka by Ilangakoon, 2002). The data on cetaceans encountered was recorded on a standard data sheet with particular attention to

position at sighting, species identification, group size, presence of calves and associated organisms. Other parameters such as general behaviour and environmental conditions were also recorded. The position at sighting was recorded using a hand held GARMIN Global Positioning System and when cetaceans were approached photographs were taken using a Nikon F70 camera with a 70-300 mm zoom lens. The resultant data form the basis of the findings of this paper.

## RESULTS

A total of 33 sightings and eight species of cetaceans were recorded during the survey. The species sighted include the blue whale (*Balaenoptera musculus*), minke whale (*Balaenoptera acutorostrata*), sperm whale (*P. macrocephalus*), dwarf sperm whale (*Kogia sima*), melon-headed whale (*Peponocephala electra*), Indo-Pacific humpback dolphin (*Sousa chinensis*), long-snouted spinner dolphin (*Stenella longirostris*) and common bottlenose dolphin (*Tursiops truncatus*) (Figure 1). The most common species was *S. longirostris* accounting for 33.3% of all sightings, followed by *S. chinensis* accounting for a further 30.0% of sightings. *B. acutorostrata*, *P. macrocephalus* and *T. truncatus* accounted for 9.1% each of the total recorded sightings (Figure 1). Meanwhile, *B. musculus*, *K. sima* and *P. electra* were recorded with only one sighting (3.0%) each (Figure 1).

### Temporal distribution

Cetacean sightings were recorded in all months of the year except June when survey effort was minimized due to the prevailing South-West monsoon resulting in adverse sighting conditions (Figure 2). The largest number of sightings was recorded in the month of April. This was followed by high sighting frequencies in the months of August, September, November, December and February. Species richness was highest in August when four different species were sighted (Figure 2)

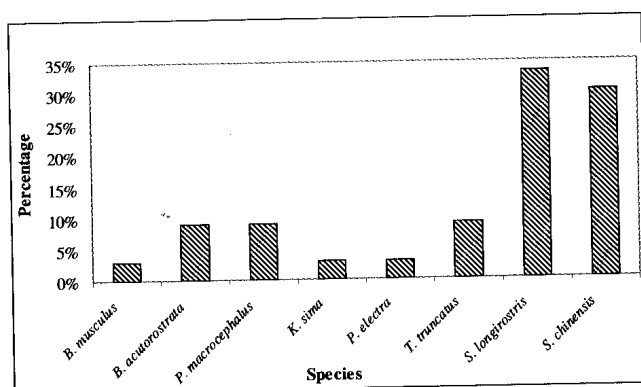


Figure 1: Cetacean species and relative abundance

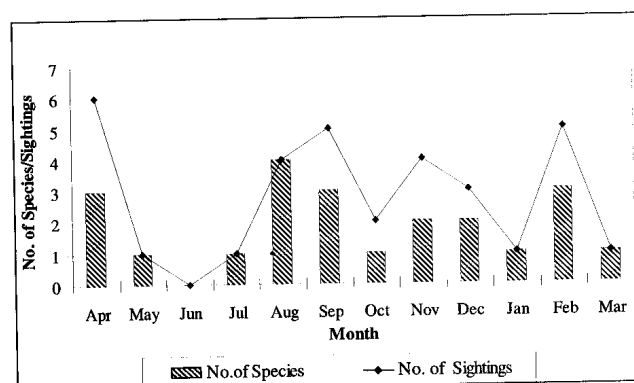


Figure 2: Cetacean sightings and species richness by month

followed by the months of April, September and February with three species being recorded in each. Two species were sighted in November and December while only one species was seen in all other months of the year except June when there were no sightings.

Temporal variation in the occurrence of the different species was also observed (Table 1) with *B. musculus* and *P. macrocephalus* being sighted only during the inter-monsoonal period of August-September. In contrast *B. acutorostrata* was recorded sporadically throughout the year with sightings in April, August and December (Table 1).

The most common species *S. longirostris* was sighted in all months from September to February but there were no sightings from March to August (Table 1). Large schools of *S. longirostris* consisting of 500-1000 individuals, including many juveniles were seen in the area during the yellow-fin tuna (*Thunnus albacares*) fishing season in September/October and in the majority of sightings they were in association with species of tuna. *S. chinensis* was sighted regularly in the three consecutive months of July to September, not sighted at all in the next five months and again sighted in the three consecutive months of February, March and April (Table 1). The species was sighted in marine waters of the

Sanctuary only in the month of April while all other sightings were in the Puttalam lagoon or near the lagoon mouth (Figure 4).

### Spatial distribution

Approximately 50% of cetacean sightings during the survey were recorded within the BRMS while species richness was also greatest within the Sanctuary with six of the total eight species being sighted at least once (Figure 3). The majority of cetacean sightings were clustered around the northern and central parts of the Sanctuary with no sightings towards the southern boundary. Likewise sightings were more frequent along the western, seaward boundary of the BRMS where there is a change in water depth.

In terms of spatial distribution of species, *S. longirostris* had the widest distribution being recorded throughout the central part of the BRMS and also in deeper waters seaward of the Sanctuary boundary. In contrast, *S. chinensis* sightings were restricted in area and limited to the Puttalam lagoon and the north-western extremity of the Sanctuary (Figure 4). All *B. acutorostrata* sightings were clustered in a small area within the north-central part of the BRMS (Figure 4). *T. truncatus* sightings were recorded from north to south along the seaward

**Table 1:** Monthly sightings of cetacean species in and around the Bar Reef Marine Sanctuary

| Month        | Species and number of sightings |              |              |              |              |              |              |              | Total     |
|--------------|---------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------|
|              | <i>B.mus</i>                    | <i>B.acu</i> | <i>P.mac</i> | <i>K.sim</i> | <i>P.ele</i> | <i>T.tru</i> | <i>S.lon</i> | <i>S.chi</i> |           |
| April        | -                               | 1            | -            | -            | -            | 2            | -            | 3            | 6         |
| May          | -                               | -            | -            | 1            | -            | -            | -            | -            | 1         |
| June         | -                               | -            | -            | -            | -            | -            | -            | -            | 0         |
| July         | -                               | -            | -            | -            | -            | -            | -            | 1            | 1         |
| August       | 1                               | 1            | 1            | -            | -            | -            | -            | 1            | 4         |
| September    | -                               | -            | 2            | -            | -            | -            | 1            | 2            | 5         |
| October      | -                               | -            | -            | -            | -            | -            | 2            | -            | 2         |
| November     | -                               | -            | -            | -            | -            | 1            | 3            | -            | 4         |
| December     | -                               | 1            | -            | -            | -            | -            | 2            | -            | 3         |
| January      | -                               | -            | -            | -            | -            | -            | 1            | -            | 1         |
| February     | -                               | -            | -            | -            | 1            | -            | 2            | 2            | 5         |
| March        | -                               | -            | -            | -            | -            | -            | -            | 1            | 1         |
| <b>Total</b> | <b>1</b>                        | <b>3</b>     | <b>4</b>     | <b>1</b>     | <b>1</b>     | <b>3</b>     | <b>11</b>    | <b>10</b>    | <b>33</b> |

\* Species names in column headings of the above Table are abbreviated as follows:

*B.mus* = *Balaenoptera musculus*

*P.mac* = *Physeter macrocephalus*

*P.ele* = *Peponocephala electra*

*S.lon* = *Stenella longirostris*

*B.acu* = *Balaenoptera acutorostrata*

*K.sim* = *Kogia sima*

*T.tru* = *Tursiops truncatus*

*S.chi* = *Sousa chinensis*

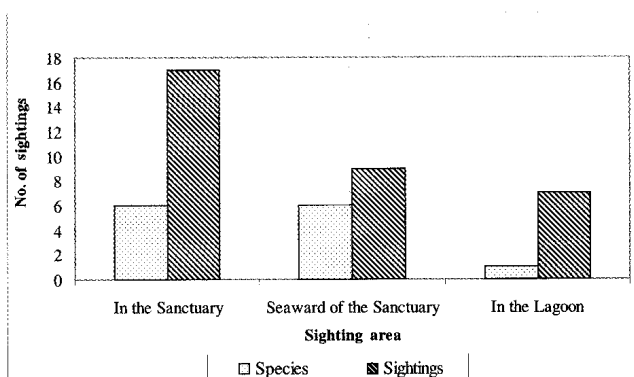


Figure 3: Cetacean sightings by area of occurrence

(western) boundary of the Sanctuary and *P. macrocephalus*, sightings were limited to deep offshore areas beyond the seaward boundary of the Sanctuary (Figure 4). *K. sima* and *P. electra* were also sighted in deep offshore waters while the single *B. musculus* sighting was within the BRMS where water depths were shallow to moderate (Figure 4).

## DISCUSSION

A significant finding of this survey was that *Sousa chinensis* was the second most common cetacean species in the study area. This is of importance because live sightings of the species have never before been scientifically documented anywhere in Sri Lanka's waters although its presence was known from two museum specimens obtained from strandings<sup>4,6</sup> and a possible unconfirmed sighting<sup>2</sup> off an aerial survey for dugongs in this same area. Likewise, *Kogia sima* and *Peponocephala electra* were sighted off the west coast for the very first time although both species have been previously recorded in fisheries bycatch<sup>4,7,8,9</sup> from all around the island.

### Temporal distribution

Despite the fact that sighting effort was not consistent in all months of the year, the data collected in the present survey can be used to draw certain inferences about temporal variation in the occurrence of cetacean species in these waters. Although this analysis is based on data from a single year, there is strong indication that cetaceans are present in these waters throughout the year. This hypothesis is further strengthened by the fact that cetaceans were sighted even in the months of May and July when the South-West monsoon was prevalent in the area resulting in less than ideal sighting conditions and only offshore surveys being carried out. There are however no data from previous studies in this area to compare the present data with and even for other parts

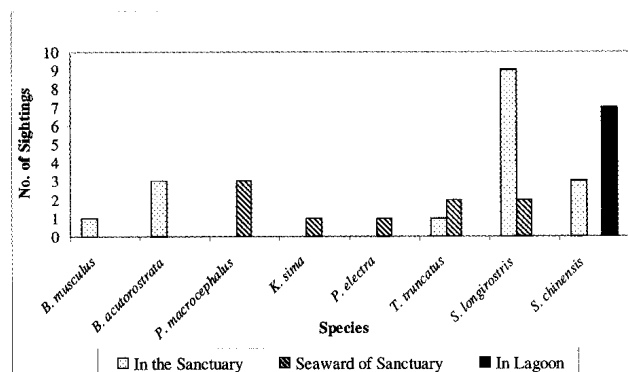


Figure 4: Cetacean species distribution

of Sri Lanka's west coast there is very little<sup>9</sup> comparable sightings data for the South-West monsoon period.

High species richness was noted during inter-monsoonal periods such as August-September and again in February and April. These results are in agreement with previously reported<sup>9</sup> high cetacean species diversity in the fisheries bycatch in the months of September and October based on a 1994 study on the west coast.

A temporal trend was seen in the occurrence of the most common species *S. longirostris* in this area, with continuous sightings from September to February and no sightings from March to August. The present results also indicate a very strong association between *S. longirostris* and yellow-fin tuna, with tuna fishermen in the area being aware of this and actually looking for dolphins in order to find the tuna. While *S. longirostris* has been documented in tuna-dolphin associations in other parts of the world such as the Eastern Tropical Pacific the association with yellow-fin tuna in the northern Indian Ocean has not been extensively documented<sup>4</sup>. However the possibility of such an association has been previously suggested<sup>9</sup> based on some sightings during a study in 1994 off the west coast. During the present survey *S. longirostris* was not only seen in frequent association with yellow-fin tuna but the largest schools were also observed during the tuna fishing season. Of the total of 11 sightings of this species during the entire study, only two sightings were of schools consisting of over 500 individuals and these were in the months of September and October. This gives an indication that both the dolphins and the tuna were probably following or aggregating around the same food source.

Temporal variation in sightings of *S. chinensis* was interesting in that they were seen in consecutive months after which they disappeared for several months and then returned for another consecutive period. The three month periods when they were seen coincided with the inter-

monsoonal periods of August-October and February-April when the sea was calm. It should be noted here that this species is somewhat subdued in its surface behaviour and therefore the likelihood of sighting them was higher during calm periods. This hypothesis is further supported by the fact that they were sighted in marine waters of the BRMS only in the month of April when the sea was extremely calm and visibility was excellent. The majority of sightings in the lagoon also coincided with prawn fishing activity among lagoon fishermen and the dolphins were often seen in close proximity to their boats. In the waters off Hong Kong where *S. chinensis* has been extensively studied, it has been reported that they feed mainly on a variety of fishes but may sometimes ingest cephalopods and crustaceans which do not make up a major portion of their diet.<sup>10</sup> Therefore, it is interesting that sightings of this species in the Puttalam lagoon during the present survey coincided with prawn fishing. This seasonal occurrence of *S. chinensis* needs to be investigated further before any definitive conclusions can be drawn, especially because there is no previous data for comparison.

*P. macrocephalus* was sighted only during the inter-monsoonal period of August-September, possibly due to the presence of seasonal food sources in the area. This also coincided with the period when fishermen in the study area were getting a good catch of squid and *P. macrocephalus* is known to prefer a diet rich in cephalopods. The single sighting of *B. musculus* was also in the inter-monsoonal period and was again possibly due to the presence of food in the area. Large aggregations of seabirds, especially mixed species flocks of terns, were also observed at this time of the year feeding on small organisms on the sea surface indicating food abundance. A previous study off the west coast in 1994 has reported<sup>4</sup> that this species was frequently sighted during the south-west monsoon and the following inter-monsoonal period. *B. acutorostrata* sightings on the other hand were spread throughout the year indicating that individuals may migrate but the species is present in this area during most parts of the year.

### Spatial distribution

With respect to spatial distribution it is noteworthy that approximately 50% of cetacean sightings were within the BRMS, despite the fact that more surveys were carried out beyond the Sanctuary than within it. Six of the total eight species recorded during the survey were sighted within the BRMS at least once indicating that the waters of the Sanctuary not only support large numbers of cetaceans but are also rich in species diversity.

More than 80% of sightings for *S. longirostris*, the most common species with the widest distribution, were within the BRMS strengthening further the indication that the waters of the Sanctuary are important as cetacean habitat. Spatial distribution of *S. chinensis* appears to be confined to shallow regions in the area and the species seems heavily dependent on the brackish water habitat within the Puttalam lagoon. Even within the lagoon they were often sighted in the shallows in close proximity to the shoreline making them highly vulnerable to anthropogenic threats in this ecosystem which is heavily used by humans. Therefore it is important to take these specialized habitat needs of this species into consideration when planning for management of the area.

It is also of interest that the single *B. musculus* sighting was within the BRMS in moderately shallow waters and not in deeper waters beyond as would be expected. However, sightings of the species have previously been reported<sup>4</sup> in near-shore continental shelf waters in other areas off the west coast of Sri Lanka. Meanwhile, *B. acutorostrata* sightings being clustered in a small area in the north-central part of the BRMS indicates that the species may have a specific area it inhabits on a regular basis within these waters. The possibility that this area may provide important habitat for the species was suspected earlier<sup>4</sup> based on a previous sighting at Thalawila, just south of the present study area and several documented strandings<sup>4,7</sup> to the north of the present study area. The present findings clearly indicate that the waters around the BRMS are important for this species which is not common around Sri Lanka and has not been recorded to occur frequently in other parts of the islands coastal waters.

*T. truncatus* sightings being recorded along the seaward boundary of the BRMS where there is a change in water depth indicates that this may be a preferred feeding area for the species. However the present data is not sufficient to make a definitive statement regarding this, especially as the species has been commonly seen in both coastal and offshore waters<sup>4,9,11</sup> in other parts of Sri Lanka. *P. macrocephalus* sightings being confined to deep offshore waters is in accordance with the deep diving, feeding habits of the species. The present data on the distribution of this species is also in agreement with a previous study where large numbers were reported in the deeper waters of the Gulf of Mannar<sup>12</sup> off North-Western Sri Lanka. Sightings of *K. sima* and *P. electra* in deeper waters is in accordance with the normal oceanic habits of these species but no specific conclusions can be drawn due to the fact that there was

only a single sighting of each of these species during the survey.

## CONCLUSION

The survey succeeded in filling many of the existing information gaps on cetaceans in this area while adding new knowledge on cetacean distribution in Sri Lanka's waters as a whole. This was achieved by documenting sightings of *S. chinensis*, a species never sighted in Sri Lanka's waters before as well as *K. sima* and *P. electra* that had not been previously sighted off the west coast of the island.

While the entire study area is rich in cetacean fauna with at least some species occurring year-round, the area from the northern boundary of the BRMS to its central section is important as cetacean habitat. Therefore it is suggested that the area be considered a "cetacean hotspot" off Sri Lanka, and that more long-term studies to gather more extensive data be initiated in order to substantiate the present findings based on one year's data. With high species richness and frequent sightings this is the most interesting and important part of the entire survey area in relation to cetacean occurrence and distribution throughout the year. This should be taken into consideration when planning future conservation and management strategies for the BRMS and it is suggested that the core area of the Sanctuary be extended to cover this entire section or declare the area as a 'cetacean sanctuary' and provide more protection to these cetaceans. The role of the Puttalam lagoon in providing essential habitat to the newly discovered population of *S. chinensis* should be further investigated as should this population itself. It is important that this population is studied in more detail in order to ensure its long-term survival particularly because the Puttalam lagoon is under intensive human use and these dolphins already face a multiplicity of anthropogenic threats.

Data from this survey has only provided a baseline upon which further studies should be undertaken on the cetacean fauna of the area. While this baseline data can be used immediately for management purposes more detailed studies on the ecological needs of the different species are recommended in order to make long-term conservation and management decisions based on sound scientific data.

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