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Cetacean Diversity and Mixed-Species Associations off Southern Sri Lanka

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ABSTRACT

Sri Lanka, in the northern Indian Ocean island, has a relatively narrow continental shelf and an abundance of cetacean fauna in her waters. A few vessel surveys have produced data on cetacean occurrence off the east and west coast but no similar data exists for the south. To fill this data gap vessel-based transects were carried out in 2008/2009 off a selected segment of the south coast. A high sighting rate was recorded and nine species were documented: *Balaenoptera musculus*, *Balaenoptera brydei*, *Physeter macrocephalus*, *Stenella longirostris*, *Tursiops truncatus*, *Pseudorca crassidens*, *Feresa attenuata*, *Orcinus orca* and *Globicephala macrorhynchus*. Significantly the first scientifically documented sighting of *O. orca* anywhere in Sri Lanka's waters was recorded. Additionally blue whale feeding aggregations including mother-calf pairs were documented off southern Sri Lanka in the Austral summer. Mixed species associations involving five species of cetaceans were also recorded. The coastal waters off southern Sri Lanka are therefore an important cetacean habitat with high diversity and mixing of coastal and usually pelagic species. The implications of the importance of the area for blue whales also warrants further study and more detailed studies are recommended to generate data that can inform future management and conservation decisions.

Keywords: Cetaceans, sighting frequency, species richness, feeding aggregations, Sri Lanka

INTRODUCTION

Sri Lanka is a 65,000 sq. km. island, located at N 5° 55' - 9° 50'; E 79° 42' - 81° 53', in the northern Indian Ocean (Fig. 1). Like most islands it has a relatively narrow continental shelf (Wijeyananda, 1997) and the surrounding tropical waters are inhabited by a diverse and abundant cetacean fauna (Leatherwood and Reeves, 1989; Ilangakoon, 2002). Dedicated cetacean surveys around the island have however been limited and sporadic due to a lack of resources.

A few cetacean surveys conducted in the last three decades have generated some data on cetacean occurrence off the east coast (Leatherwood *et al.*, 1984; Alling, 1986) and west coast (Ilangakoon *et al.*, 2000a; Ilangakoon, 2006a; Ilangakoon, 2008), but similar data were not available for waters off southern Sri Lanka. While the only information available on live cetaceans in this area is from opportunistic observations since the mid-1980s (Leatherwood and Reeves, 1989; Ilangakoon, 2002; Ocean Alliance, 2003), most of what is known is a result of the study of animals that were occasionally stranded along the coastline (Ilangakoon, 2006b) and studies on fisheries by-catch and direct takes of small cetaceans (Leatherwood and Reeves, 1989; Ilangakoon, 1989, 1997, 2002; Dayaratne and Joseph, 1993; Ilangakoon *et al.*, 2000b).

Opportunistic observations and catch studies indicated that the waters off southern Sri Lanka had both abundance and diversity of cetaceans. However, due to the paucity of dedicated vessel surveys no supporting sightings were available for the area in order to verify this information. In an initial attempt to fill this data gap, vessel-based line-transect surveys were conducted in the 2008/2009 field season (September to April) to record occurrence and species richness of cetaceans off a selected segment off southern Sri Lanka (Fig. 1).

MATERIALS AND METHODS

Boat surveys were conducted during 20 field days evenly spaced out over an 8-month weather-dependent field season starting in September 2008 and ending in April 2009. The selected study area (Fig. 1) off the south coast of Sri Lanka was centered on the fisheries port of Mirissa (N 5° 58'; E 80° 29') where heavy small cetacean by-catch and directed takes are known to occur. The transect lines zigzagged along the 100m depth contour covering both continental shelf waters and deeper waters just beyond the shelf edge. To the south/southeast of the starting port of Mirissa is Dondra head, Sri Lanka's southern most point and off this area a deep submarine canyon is located within the survey area (Fig. 1). Standard line-transect methodology was used from an 11-metre fishing vessel powered by inboard engines

and cruising at an average speed of 8km an hour. A saw-tooth transect design was used in order to maximize coverage of the selected area during the limited time available for each survey (Fig. 1). The survey track covered each survey day was approximately 57km in length and survey effort was confined to appropriate weather conditions when sea-state and visibility were good. If sea-state deteriorated above Beaufort 4 or heavy rain made visibility poor, survey effort was suspended until conditions improved.

Three dedicated cetacean observers were on watch at all times during survey effort. Two observers scanned the water from the beam to approximately 10° past the bow, on the starboard and port sides of the vessel. The third observer played the dual role of observing directly in front of the bow and acting as the recorder for all sightings. At each cetacean sighting the data collected included date and time of sighting, location, species, number of animals, associated organisms, behaviour/activity engaged in at time of observation and basic environmental data such as weather and sea state. All cetaceans/groups encountered were approached to determine species and group size and photographs were obtained opportunistically using a Canon EOS 300D digital camera, with a 70-300mm zoom lens. Nikon 8x40 binoculars were used for identification and counts in more distant sightings where approach was not possible. The position of each sighting was recorded using a hand-held Garmin e-Trex Global Positioning System.

RESULTS

In 153 hours of survey effort, 1,127.7km of track-line was surveyed. Nine species of cetaceans were recorded during the study in 69 sightings (Fig.2). Positive species identification was possible in 67 of the 69 sightings. The identified species include blue whale (*Balaenoptera musculus*), Bryde's whale (*Balaenoptera brydei*), sperm whale (*Physeter macrocephalus*), spinner dolphin (*Stenella longirostris*), common bottlenose dolphin (*Tursiops truncatus*), false killer whale (*Pseudorca crassidens*), pygmy killer whale (*Feresa attenuata*), killer whale (*Orcinus orca*) and short-finned pilot whale (*Globicephala macrorhynchus*) (Fig. 2). Species level identification was not possible on two sightings due to distance and short duration of sighting. One of these was an unidentified species of small cetacean while the other was an unidentified baleen whale but these two sightings are pooled together as unidentified species for purposes of this paper (Fig. 2).

The spinner dolphin was the most frequently sighted species, constituting more than

50% (39 sightings) of total recorded sightings (Fig.2). The blue whale was the second most frequently sighted species in the study area with 16 (23.2%) sightings. These were followed by Bryde's whales with four (5.8%) sightings and bottlenose dolphins with three (4.3%) sightings (Fig.2) respectively. All other identified species had one sighting (1.4%) each (Fig.2).

Three mixed species associations were recorded during the study. One such sighting involved three species (spinner dolphins, bottlenose dolphins and short-finned pilot whale) and the other two involved two species each (blue whale/spinner dolphin and sperm whale/spinner dolphin). Detailed observations of these mixed species associations are as follows:

- A small group of (17-22) spinner dolphins were observed close to a loose feeding aggregation of nine blue whales near the continental shelf-edge. The dolphins were milling at the surface but did not actively interact with the whales.
- A large mixed school of spinner dolphins and bottlenose dolphins numbering 350-400 individuals of which, the majority (approximately 60%), were bottlenose dolphins encountered on the shelf-edge. Both species in this association displayed aerial behaviour and approached the survey vessel to bow-ride. Bow-riding occurred as small sub-groups of either spinner dolphins or bottlenose dolphins, at different times and at no time did individuals of both species bow-ride together. A single short-finned pilot whale was on the periphery of this group and approached the survey vessel several times, 'spyhopping' repeatedly but not attempting to bow-ride. This pilot whale was also interacting with floating debris including a plastic bag into which it inserted its left flipper.
- A school of 50-70 spinner dolphins actively feeding in very close proximity to two sperm whales blowing at the surface on the shelf-edge.

DISCUSSION

An average cetacean sighting frequency of one sighting for every 16.3km surveyed was recorded for the survey area during the study. There is no comparable data set for other areas off Sri Lanka for comparison with this sighting rate. The majority of sightings were clustered on either side of the 100m depth contour beyond which the depth increases rapidly with the 1000m depth contour being less than 5km away on average (Fig. 1). This clustering of sightings along the continental shelf edge was not limited to any particular species, strongly indicating that cetaceans are taking advantage of upwelling related food abundance

occurring in this area (Vinayachandran *et al.*, 2004). This is further substantiated by the fact that blue whales, a usually solitary species, were observed in loosely associated feeding aggregations during two separate surveys.

Previous work based on strandings (Ilangakoon, 2006b), sightings (Alling, 1986; Leatherwood and Reeves, 1989; Ilangakoon *et al.*, 2000a; Ilangakoon, 2006, 2008) and catch records (Leatherwood and Reeves, 1989; Ilangakoon, 1989, 1997; Dayaratna and Joseph, 1993; Ilangakoon *et al.*, 2000a, 2000b) has resulted in 27 species of cetaceans being recorded as occurring in all of Sri Lanka's waters (Ilangakoon, 2002). During the present survey carried out over a single field season, nine species were sighted within the small survey area, constituting a third (33%) of all species recorded for the island. This verifies previously suspected high cetacean diversity off southern Sri Lanka as indicated by studies of catches and opportunistic sightings.

The two species of balaenopterids recorded (blue and Bryde's whales) are both common elsewhere in Sri Lanka's waters (Alling *et al.*, 1991; Ilangakoon, 2002; Branch *et al.*, 2007). Present data however, reveal for the first time that blue whales are feeding near the continental shelf-break off southern Sri Lanka during Austral summer months. This indicates that they may not be moving to temperate waters for summer feeding as would be expected according to the classic migration theory for this species (Branch *et al.*, 2007). In the early 1980's blue whales were recorded feeding off the northeast of Sri Lanka (January-April) and researchers reported that Sri Lanka's north-eastern waters are an important feeding area for the species (Alling *et al.*, 1991). Present data indicates that southern waters may also serve as an important feeding ground for this species and that they are taking advantage of monsoon related upwellings in these areas. The presence of several mother-calf pairs during the present study and also during studies in the 1980's off the northeast (Alling *et al.*, 1991) may indicate that Sri Lankan waters also have a role in the breeding cycle of these blue whales. A similar blue whale feeding and nursing ground has been discovered near Chile in the Pacific Ocean (Hucke-Gaete *et al.*, 2003) within the past decade. These factors need further investigation during future field seasons to determine movement patterns and trends around Sri Lanka for this species.

The Bryde's whales recorded in Sri Lanka's waters are likely to be of the non-edeni type with DNA analysis of one stranded specimen indicated it to be *Balaenoptera brydei* (Herath, 2008). All sightings of this species during the present study are assumed to be of non-edeni type

Bryde's whales although the possibility of more than one type of Bryde's whale occurring in these waters cannot be completely ruled out after the recent splitting of the species (Wada, *et al.*, 2003). Bryde's whale sightings have also previously been opportunistically recorded off southern Sri Lanka (Ilangakoon 2002; Ocean Alliance, 2003) and off the west and east coasts (Alling *et al.*, 1991; Ilangakoon, 2002).

Sightings of false killer whales, pygmy killer whales and short finned pilot whales have previously been recorded from Sri Lankan waters (Alling, 1986; Leatherwood and Reeves, 1989; Ilangakoon, 2002; Ocean Alliance, 2003) although these are usually not considered to be coastal species. The present survey however recorded the first scientifically documented killer whale sighting in Sri Lanka's waters (Ilangakoon *et al.*, 2010). This species was previously known in these tropical waters around Sri Lanka only from unconfirmed reports from fishermen (Leatherwood and Reeves, 1989) and a single bycaught animal from the west coast (Ilangakoon *et al.*, 1992).

Mixed species associations involving delphinids including *Stenella* species, *Tursiops* species and *Globicephala* species are not unusual and they have been recorded in diverse parts of the world's oceans (Querouil *et al.*, 2008; Rossi-Santos *et al.*, 2009) including the tropical Indian Ocean (Anderson, 2005). Associations involving delphinids and large whales are however not so common in the literature although they have been recorded (Rossi-Santos *et al.*, 2009). All three mixed species groups in the present study included spinner dolphins and it was the only species observed associating with large whales. This however is probably due to the fact that spinner dolphins are the most common species in the study area and in Sri Lanka's waters in general. The most likely explanation for the occurrence of these mixed species associations in the area is foraging advantage as suggested for similar associations in the Azores (Querouil *et al.*, 2008). The observed associations in the present study involved both coastal and offshore species and as suggested for similar species groupings off Brazil (Rossi-Santos *et al.*, 2009), the narrow continental shelf off southern Sri Lanka and the presence of a submarine canyon within the study area could result in aggregating both coastal and oceanic species in this area for feeding purposes. This is further substantiated by the fact that all three mixed species associations recorded in the present study were in the vicinity of the continental shelf-break with associated upwelling related food abundance. It is however difficult to be conclusive about these associations at present because the data set is too small for any meaningful statistical analyses.

The study site is clearly an important cetacean habitat with high species richness and encounter rates. Based on these preliminary findings it is clear that the area needs more detailed and in-depth study. This is especially relevant given the implications of the importance of the area to blue whales that appear to use the area even during Austral summer months. Therefore it is recommended that more consistent, long-term studies on cetaceans are initiated in this area as a matter of priority. Such studies are needed in order to generate the necessary scientific data that can inform future management and conservation decisions.

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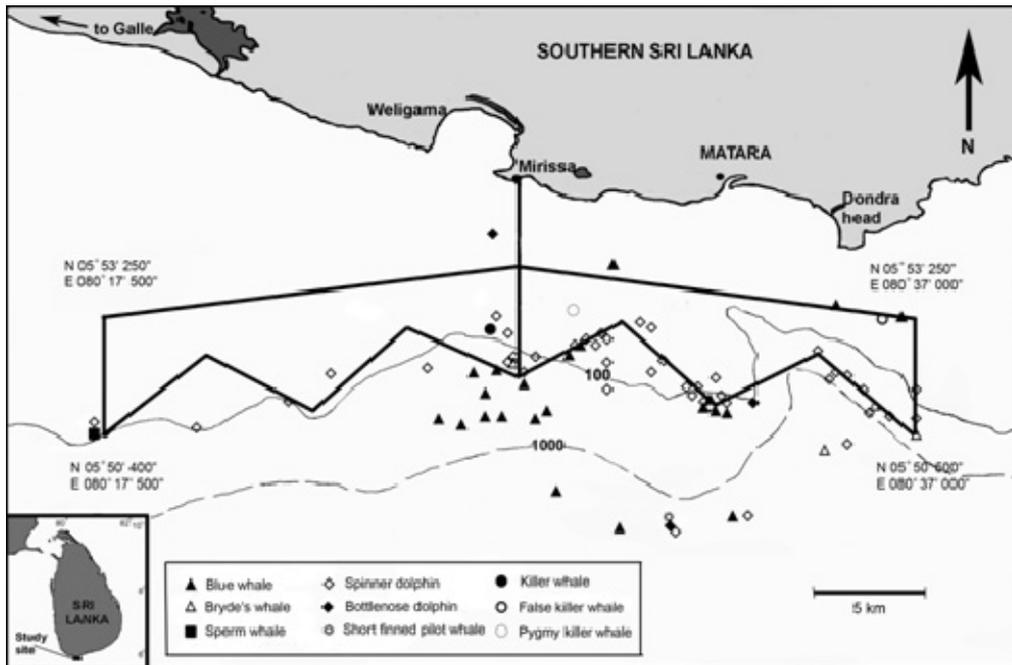


Figure 1. Study site with transect lines and cetacean sightings

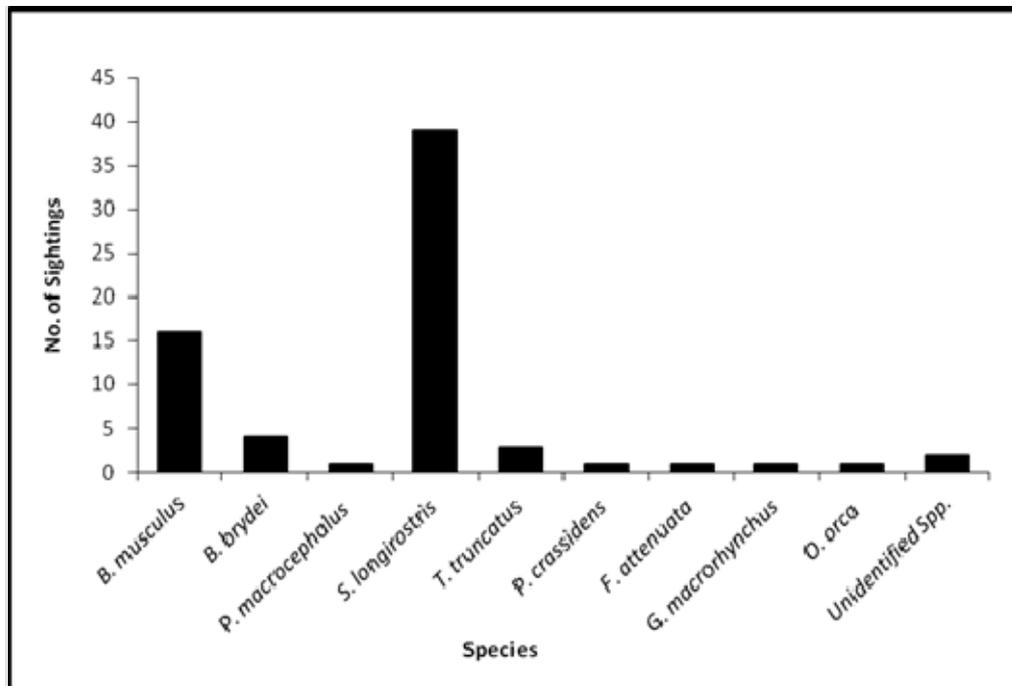


Figure 2. Cetacean species diversity