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Occurrence of threatened cetacean species and its conservation strategy along Ganjam coast, Odisha

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Abstract
Cetaceans are an important component of marine biodiversity, as apex predators, cetacean abundance and distribution are key indicators of environmental status, such as food web integrity. Five species of cetacean have been recorded in recent history within the North Bay of Bengal of Ganjam coast. Many are widely dispersed oceanic species that are rarely seen and very difficult to monitor. As a result, this indicator is restricted to assessing species for which more robust data are available. The information originates primarily from opportunistic sightings and few washed ashore marine mammals have being reported. Several of these appear to be poorly documented in this area. In this study, four marine mammals, common Bottle nose dolphin (*Tursiops aduncus*), Hump back dolphins (*Sousa chinensis*), Porpoise (*Neophocaena phocaenoides*) Spinner dolphins (*Stenella longirostris*) were counted and found in the shallow water areas of the coast during high tides to collect food. Bottle nose dolphin had relatively good population in the southern part of the coast. But other two species-Porpoise and Spinner dolphin were very rare. This assessment considers information on abundance and distribution and, where possible, assesses the status of the following species: bottle nose dolphin, Humpback dolphin, harbour porpoise, spinner dolphin.
Some human activities affect the abundance and distribution of cetaceans. Historically, no direct evidence has being found for removal of individuals by hunting that could severe effects on populations. Today, by-catch in fisheries is one of the major causes of mortality for small cetaceans. Other pressures such as chemical and noise pollution are known to affect individual animals, but the effects of these on populations are not yet well understood.

Keywords: Marine mammals, distribution, porpoise, spinner dolphin, Bryde's whale

1. Introduction
Indian subcontinent has vast coastline which is coupled with both artisanal and mechanized fishery (NRC, 1992) [13]. This is a cause and concern to marine biodiversity. There are literature on incidental catch of cetaceans reported in India is vast (Lal Mohan, 1994; Satya Rao & Chandrasekar, 1994; Thiagarajan *et al*., 2000) [9, 12, 15]. Study by Lal Mohan (1994) [9], estimated the annual cetacean mortality to be about 1000–1500 due to the exploitation of fishery. This study is aimed to prepare a comprehensive ecological status of the marine mammals along the coast of the Ganjam and it's offshore, including abundance and distribution of marine mammals. Most of the marine mammals effort has being made from Chilika mouth to Subarnarekha River Mouth, North of Odisha, but no extensive work has being done in southern coast of odisha, Ganjam coast and its offshore water except two studies. Sutaria; 2009 [10], and John, *et al*; 2012. Both of these studies were restricted to one portion of the coast, Rushikulya River mouth only.
Survey of marine mammals was done in and around the continental self of the Ganjam coast and the world's second largest marine Turtle rookery, Rushikulya. A survey on marine mammals was done in and around the entire coastline of 56 km for three consecutive years from April 2012-13, 2013-14 and 2014- April15 respectively. Sighting of marine mammals in and around the Ganjam coast is normally possible during high tide. Frequency of visit was high from September to March and it was not possible to sight during summer and monsoon due to the disturbance in the sea so the line transects data of summer and monsoon was not take to consideration.
A total 14 cetacean species of which Ganges River Dolphin (*Platanista gangetica gangetica*), Irrawaddy Dolphin (*Orcaella brevirostris*), Bottlenose Dolphin (*Tursiops aduncus / trancatus*), Indo-Pacific Humpback Dolphin (*Sousa chinensis*), Spinner Dolphin (*Stenella longirostris*), Finless Porpoise (*Neophocaena phocaenoides phocaenoides*) (James *et al*. 1989; Jayaprakash *et al*. 1995; Sutaria; 2009) [4, 5, 10], Striped Dolphin (*Stenella coeruleoalba*), Risso's Dolphin (*Grampus griseus)*, Bryde's Whale (*Balanoptera edeni / brydei*) (John *et al*. 2012) [6], Common Dolphin (*Delphinus delphis*) (Jayaprakash 1995) [5] are sighted live in offshore water of Odisha. Minke Whale (*Balaenoptera acutorostrata)*, Sei Whale (*Balaenoptera borealis*), Sperm Whale (*Physeter macrocephalus*), False Killer Whale (*Pseudorca crassidens*), have been recorded from the coastal and inland waters of Odisha (M. Khan pers. comm. 2010).
All marine mammals are specified for protection under "Schedule I" of the Indian Wildlife (Protection) Act, 1972 (Anon 2003) [1]. There are no targeted fisheries for marine cetaceans in coastal waters of Odisha. Possible threats to marine mammals are from ongoing and proposed off-shore/onshore developmental activities. In the near future, major hydrocarbon exploration is planned for the offshore waters of Odisha (Behera *et al*. 2010). Oil exploration

activities and nearby Gopalpur all-weather Port may impact pelagic and coastal marine mammal's habitats. However offshore and onshore development activities consequential set off marine pollution which will affect the cetaceans along the Odisha coast needs further investigation and management interventions.

2. Study Area

The total coastline length of Odisha is 480 km of which the south most district, Ganjam is having a coastline length of 56 km. The Ganjam coast has sandy surf beaches (Ayyeppan & Jena 2000) [3]. The continental shelf is ~4km at Gopalpur (Figure 1)

Odisha has a maritime coast with 589 marine fishing villages and 3678 villages involved in inland fisheries. Miscellaneous varieties of marine products contribute as much as 53% of the total production (Ayyeppan & Jena 2000) [3]. Marine catches are diverse comprising sciaenids (12.23%), followed by elasmobranchs (7%), catfish, hilsa, pomfrets, other clupeids, polynemids and prawns. The coast has one major shipping harbour at Gopalpur, two major fishing jetties, (Gopalpur and Sunapur fishing jetty) and at least 12 marine fish landing centres.

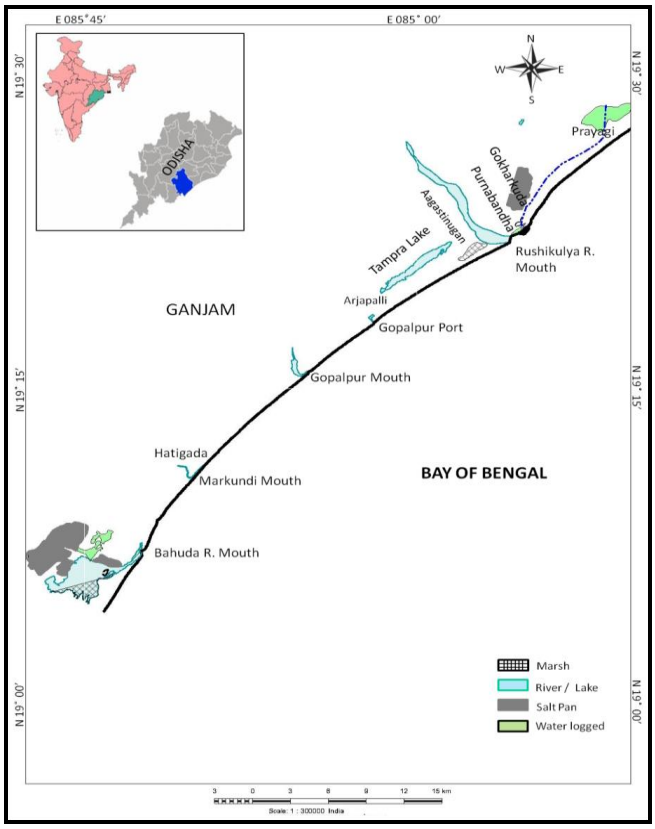

Fig 1: Map showing the entire study area and points of the four sectors along the Ganjam coast Odisha

3. Methods

The south coast of Odisha was monitored from 2012-15 and we surveyed both offshore as well as onshore. Offshore transect was primed for sighting of cetaceans. Onshore monitoring was ascertained for the mortality if any on the beach. We intended three different methods which were employed to carry out observations on the marine mammals.

3.1 Offshore survey: The boat transects were considered for observation during high tides. The entire coast line was divided into four sectors with transect length of 14 km. Five transect line were surveyed in each sectors on monthly basis and each transect line were equidistance. The distance between each transect lines was 1km i.e. the area of 5km from the coast toward sea was totally scanned to get the distribution status of cetaceans.

Sector I- Prayagi to Rushikulya Mouth.
Sector II- Rushikulya Mouth to Gopalpur Mouth.
Sector III- Gopalpur Mouth to Markundi Mouth.
Sector IV- Markundi Mouth to Bahuda Mouth.

The visible distance from both sides of boat was covered and the sightings were recorded with the help of binocular. The characteristics and morphology were observed, once it was located. The numbers of each group were also recorded.

3.2 Island/sand bar coastal survey: The high tidal area of each island near the Rushikulya river mouth and the entire coast was surveyed on daily basis to find out dead body, skeleton or skull that had come over there by floating with waves. The dead body part observed carefully and in these cases, the measurements were done for parts of body. In case of skeleton parts, careful observations were done to identify the exact species from its skull or fins.

3.3 Interview with local community: Local fishermen were interviewed to record their individual observations about the recent history related to the abundance of marine mammal's population. This observation is often cross-checked with the observation of the other fishermen in the same area.

4 Results

4.1 Offshore Survey

During 2012 to 2015 we carried out the marine mammal's survey for 167 days and the overall effort was 1461 hrs (Table-1). During boat surveys the highest concentrations of marine mammals were sighted in the Sector III (Gopalpur mouth to Markundi Mouth). In a total 1,219 No. of (*Tursiops aduncus*) and 5 No. of *(Sousa chinensis)* and the mean encounter was 6.19± 2.17, 2.5± 1.21 respectively followed by the sector IV (Markundi Mouth to Bahuda Mouth) of the Ganjam coast (Table 2). These two areas are not affected by the near shore developmental activities as in the sector II (Rushikulya Mouth to Gopalpur Mouth) which foil the marine mammals from using potential habitat of the coast and Gopalpur Port is situated in this sector. Dolphins have been recorded in the offshore at depths of 10 – 30m, temperatures of 21.7°-34.5°C, salinities of 21-37.5 ppt, turbidities of 3-9 NTUs. The sector III wires about 26.93% of Bottle Nose Dolphins (*Tursiops aduncus*), and sector III had a population of 24.32%. The sector III & IV (Gopalpur Mouth to Bahuda Mouth) has been identified as a primary habitat for focal conservation attention based on the relatively high density of marine mammals found there throughout the year, followed by the Sector I. Sutaria (2009) [10] conducted a coastal survey for

dolphins along the Odisha coast during 2005. During her surveys, cetaceans were documented, which including three groups of Indo-Pacific humpback dolphins, one group of spinner dolphins *Stenella longirostris*, one group of bottlenose dolphins *Tursiops aduncus* or *T. truncatus*, and one group of finless porpoises *Neophocaena phocaenoides.* But this survey was restricted to the Rushikulya mouth.

4.2 Coastline Survey

A total of 12 mortalities were recorded along the coast of which (eleven) *Tursiops aduncus* and one *N. phocaenoides* (Figure 2). The mortality of marine mammals was recorded in the two sectors of the four sectors, Prayagi to Rushikulya Mouth and Gopalpur Mouth to Markundi. Among the two sectors the mortality was observed highest in sector I with a number of 9 *Tursiops aduncus* washed ashore in a total. All animals recorded were adults and it was difficult to assess the cause of death as we did not carry out a necropsy (lack of infrastructure and required permissions were not available).

Table 1: The survey effort for dedicated cetacean surveys conducted between Octobers to May 2012 to 2015 inclusive

Sector	Year	No. of Survey Days	Survey Effort Hours	Total No. of Encounters
I	2012	12	105	35
	2013	10	87.5	29
	2014	14	122.5	37
	2015	12	105	42
II	2012	10	87.5	5
	2013	9	78.75	7
	2014	10	87.5	1
	2015	11	96.25	4
III	2012	5	43.75	29
	2013	10	87.5	61
	2014	9	78.75	54
	2015	12	105	59
IV	2012	10	87.5	41
	2013	9	78.75	39
	2014	12	105	47
	2015	12	105	52
Total				542

Fig 2: Showing the number of washed ashore dead Bottle nose Dolphin (*Tursiops aduncus)* along the Ganjam coast Odisha during 2012 to 2015

Table 2: The encounter rates, cumulative frequencies and group sizes of cetacean species recorded in the four sectors of study area from 2012 to 2015

Sector	Species	No. of Encounters	Cumulative no. of animals encountered	Group Size		
				Mean± S.D	Max	Min
I	*Tursiops aduncus*	137	279	2.04±1.94	7	1
	Sousa chinensis	10	12	1.20±2.01	1	1
	Neophocaena phocaenoides	0	0	0.00	0	0
	Stenella longirostris	0	0	0.00	0	0
II	*Tursiops aduncus*	16	18	1.13±0.98	3	1
	Sousa chinensis	1	1	1.00±0.0	1	1
	Neophocaena phocaenoides	0	0	0.00	0	0
	Stenella longirostris	0	0	0.00	0	0

III	*Tursiops aduncus*	197	1219	6.19±2.17	12	4
	Sousa chinensis	2	5	2.50±1.21	3	2
	Neophocaena phocaenoides	0	0	0.00	0	0
	Stenella longirostris	1	1	1.00±0.0	0	0
IV	*Tursiops aduncus*	175	978	5.59±4.32	10	3
	Sousa chinensis	3	7	2.33±1.01	4	2
	Neophocaena phocaenoides	0	0	0.00	0	0
	Stenella longirostris	0	0	0.00	0	0

4.3 Porpoise (*Neophocaena phocaenoides* (Cuvier)

During the present study at one instance, one freshly dead porpoise was recorded near Golabandha (Fishing village) in Sector III of present study. It was about 1.2 m in length and its body color was black. It could have been possibly dead because of badly entangling with fishermen nets

4.4 Community Response

In a total all 25 individuals from 28 fishermen villages along the Ganjam coast were interviewed about species sightings or carcasses found along the coast. About 78 percent of the respondents have sighted the four types of dolphins 30 percent of the fishermen responded to the mortality of the marine mammals sighted along the coast. 12 percent of the fishermen have sighted the whale in the offshore water but no specific identification could not being made due to lack of proper information about the identification.

Table 3: Lists both published and unpublished reports of Cetaceans found along the coast of Ganjam till September 2015

Species	Year /Type	Region (number of individuals)	References/pictures-pers. Comm
Sousa chinensis	2004; Dead	Ganjam-Rushikulya River mouth (2)	D. Sutaria
Tursiops aduncus	1992; Dead	Ganjam-Gopalpur (1)	Chandrashekhar 1993
	2012; Dead	Rushikulya Coast (Prayagi) (1)	Recent study
	2012; Dead	Gopalpur (1)	Recent study
	2013; Dead	Rushikulya Coast (1)Rushikulya Coast (Praygi) (2)	Recent study
	2014; Dead	Rushikulya Coast (Praygi) (3)	Recent study
	2015; Dead	Rushikulya Coast (Prayagi) (2)	Recent study
	2015; Dead	Gopalpur (1)	Recent study
Stenella longirostris	2014; live	Gopalpur- Markundi (1)	Recent study
Neophocaena phoceanoides	2013; Dead	Gopalpur- Garmpeta (1)	Recent study
Balanoptera edeni / brydei	2007; Dead	Near Gopalpur River, Odisha,	M. Khan pers. obs. April 2009
	2009; Live	Rushikulya River (3)	S. John *et al*. August 2012
	2010; Dead	Near Gopalpur South of Rushikulya River Mouth. Speciemen preserved in RMNH Bhubaneswar, Odisha	Dr. Siba Prasad Parida pers. obs. July 2010

(*D. Sutaria)

In addition to these individuals fishermen of all villages value the presence of dolphins indicates presence of fish schools. They also said we never catch dolphins rather we rescue the dolphins if entangled in the nets. Most of the fishermen of this cost are dependent on the out board engine boats and very minimal trawling is found in this part of the coast (Behera, 2013) [2] and most of the fishermen use the monofilament nets in which dolphins are where rarely to be entangled (Tripathy, 2009) [16].

5. Discussion

The coastal waters of the south coast of Odisha support fascinating diversity of marine mammal's species. In addition to the seasonal occurrence of bottlenose dolphins, Humpback dolphin, and an abundance of finless porpoises, all of which show a seasonal peak in numbers from one year to next. Most of the sightings were found during December to March. In present study, a single encounter with Spinner dolphins was made in December 2013. Spinner dolphin was first time reported by (Sutaria; 2009) [10] at Devi Mouth, Puri coast of Odisha. However live species (three) of Brydei whales reported by John 2012 from this coastal water.

The distribution of marine mammals observed in the present study can be allow to focus conservation measures in relation to human activities in this area, such as disturbance by shipping and tourism.

Fig 3: Finless porpoise dead washed ashore near Golabandha North of Bahuda River Mouth, Ganjam, Odisha

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