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Irrawaddy dolphins, Orcaella brevirostris from India

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Irrawaddy dolphins, *Orcaella brevirostris* from India

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ABSTRACT

The largest known population of Irrawaddy dolphins (*Orcaella brevirostris)* in India, is found in Chilika Lagoon, Orissa. The population size in Chilika was estimated to be 107-111 (CV 0.08), with at least 80 individually identifiable adults used in the mark-recapture (MR) analysis (Sutaria and Marsh 2011). We carried out a survey in April 2017 and found that dolphins still used the Outer channel and the South and Central Sectors of the lagoon. Over a period of six days, we re-sighted only 14 individuals from the 2006 catalogue. We also found that there has been an increase in the intensity of dolphin-watching pressure in the Outer Channel, and an observed reduction in compliance with dolphin-watching guidelines. The substrate type and bathymetry in the Outer channel has also changed due to a shift in the location of the mouth to the sea. The dolphins are thus exposed to varying degrees of threats from different kinds of fishing gears, dolphin-watching tourism, and both natural and man-made changes in the habitat. This paper will present the current information regarding Irrawaddy dolphins in Chilika Lagoon and along the coast of Orissa.

KEY WORDS

CHILIKA, INDIAN OCEAN, CONSERVATION, ACOUSTICS, DISTRIBUTION, PHOTO-ID, INCIDENTAL SIGHTINGS, SCHOOL SIZE

INTRODUCTION

Irrawaddy dolphins (*Orcaella brevirostris*) occur in the tropical and subtropical waters of the Indo West Pacific region. The species shows a patchy distribution with geographically isolated populations in rivers, lakes or lagoons. The geographic range of Irrawaddy dolphins in India extends from the coastal waters off Visakhapatnam in southeast India to those of West Bengal (Kumaran 2002), including an isolated population in Chilika Lagoon, in south Orissa (Figure 1).The conservation status of all other lagoon and riverine populations of Irrawaddy dolphins have been recognised as Critically Endangered by the IUCN.

The population in Chilika Lagoon of Orissa, India, was first recorded in 1875 (Stacey & Leatherwood 1997). Thirty years later Annandale (1915) confirmed the continued presence of the species in the lagoon. Annandale (1915) reported that the population was high without providing any quantitative estimate. Much later, in 1997 the population was suggested to be very small - about 20 individuals (Dhandapani 1997). In 2004, a study suggested that there were as few as 50 individuals (Sinha 2004). Based on boat survey results till 2009, dolphins are found in two core areas in the lagoon and use less than 400 km^2 of the available 1000 km^2 of the lake. The total population size of Irrawaddy dolphins in Chilika was estimated to be very small, about 109 to112 individuals (CV=0.07) based on surveys from November 2004 to December 2006 (Sutaria 2009; Sutaria and Marsh 2011). D'Lima (2014) also found that in the Outer channel dolphins foraged from and in the vicinity of a modified traditional fishing gear called *Khonda/Puda jaal* – stake nets for fish and shrimp.

High levels of disturbance, changes in habitat, and unnatural mortality caused by a range of human activities are detrimental to small populations such as the one in Chilika. Temporal information regarding abundance, movement, space use and social interactions and structure is required to better manage and conserve the population, while also monitoring the same. A dedicated monitoring of the population using a standard robust protocol such as Photo ID needs to be incorporated into the management plan for Irrawaddy dolphins in Chilika.

STUDY AREA

Chilika Lagoon along the southeast coast of Orissa, east India, is a kidney shaped wetland of international importance. A RAMSAR site, it has the Nalabana Bird Sanctuary in central Chilika and another migratory bird watching site in north Chilika at Mangaljodi. This lagoon is highly productive with more than 200,000 people depending on its resources for livelihood. Fishing, religion-based tourism and dolphin-watching tourism, and agriculture along its banks are the main occupations of the people of Chilika.

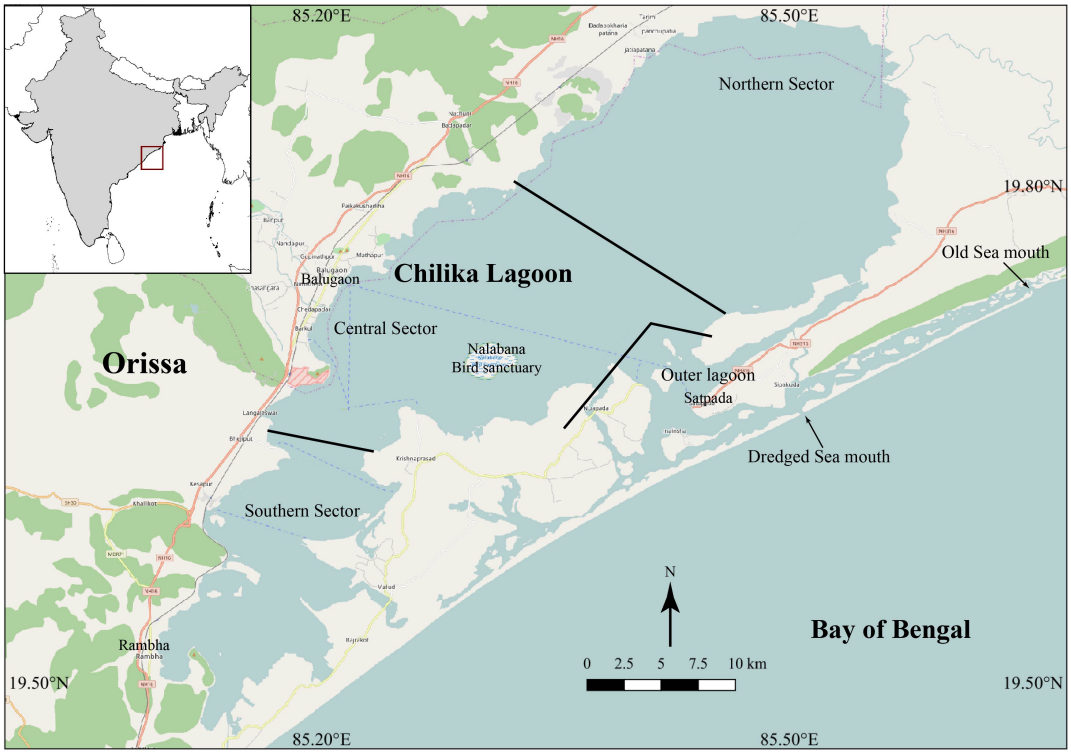

Figure 1. Chilika Lagoon, India showing the different survey sectors of the lagoon showing the position of the opening to the sea in 2006

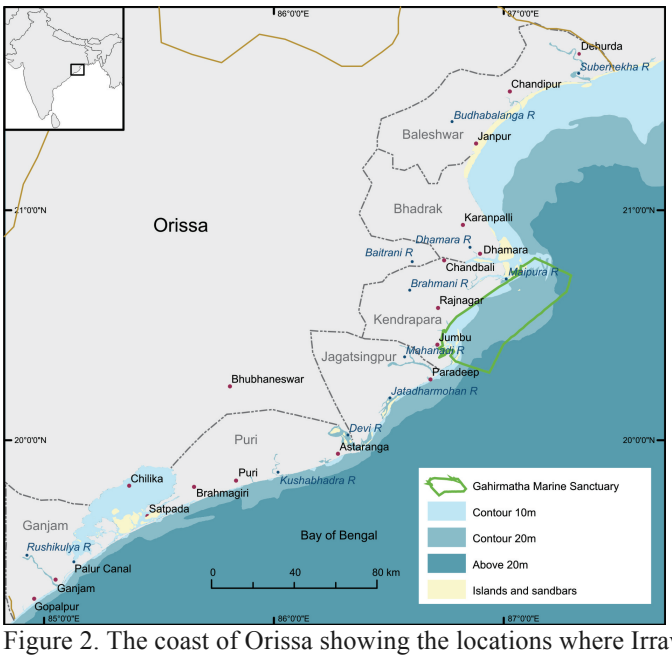

Figure 2. The coast of Orissa showing the locations where Irrawaddy dolphins are reported - Chilika Lagoon and Bhadrak coast.

METHODS

Vessel based surveys

Vessel based surveys were carried out from April 7th to April 12th 2017 from 0600 to 1130 hrs; and from 1530 to 1730 hrs, in Chilika Lagoon to collect information on presence/absence; distribution, space use and to collect photo-identification data. The sampling design used was consistent with Sutaria 2009.

When a dolphin group was sighted, it was approached at slow speed, to minimize disturbance. Location, group size, group composition, predominant group behaviour, and depth were recorded. When the vessel was within 100m of the dolphins, the engine was cut and bamboo poles were used to approach closer, thus increasing the likelihood that all animals would have an equal probability of being photographed. If the animals were traveling, the boat kept parallel to them while moving.

The dorsal fins and flukes of individuals were photographed digitally using a Canon EOS 5D MK4 and Canon EOS 7D digital camera with 100-400mm IS USM and 100-400 mm IS II USM lenses resp. Effort was made to photograph animals from both the right and left sides to avoid backlit fins. A blank shot was taken after each sighting to indicate separate encounters.

We stayed with a group until all animals were photographed or until they moved away and did not resurface for at least 10 minutes. Given the very enclosed study area in the Outer Channel, the chances of the same individuals seen twice during the same survey is high. Only the individual sighted during the first instance during the survey will be considered for all analysis.

Acoustic surveys

Opportunistic acoustic recordings of Irrawaddy dolphin pods were made on the 7th and 8th of April 2017. A Sensor Technology SQ26-08 hydrophone (Ontario, Canada) with a sensitivity of -169 dB re 1V/µPa and a Zoom H1 handy recorder (Zoom Corp, Japan) were used to collect the acoustic data. The hydrophone model had a flat (± 2dB) frequency response in the 20 Hz to 50 kHz range. All recordings were made using a sampling rate of 96 kHz and 24 bits resolution. Files were saved in the standard WAV file format. Vessel engine was turned off during recordings so as to reduce ambient vessel noise. Recordings lasted between 60 s to 3 mins in duration and were monitored live via headphones.

All acoustic recordings were visually and aurally screened in Raven Pro 1.5 (Cornell Lab of Ornithology, Ithaca, NY, USA). The following spectrogram parameters were used to examine the data set for dolphin vocalisation; smoothing window: Hann, fast Fourier transform (FFT): 1024, temporal grid spacing: 5.33 ms with FFT overlap: 50%. Following the method by Van Parijs et al (2000), recorded vocalisations were divided into three categories based on their acoustic properties; clicks, pulsed calls and whistles. Time-frequency features of selected calls displaying moderate to good aural-visual quality were calculated using the selection and measurements tool in Raven Pro.

Review of reports and news articles

We reviewed available published reports and newspaper articles on the species, since 2008, from Orissa.

RESULTS

Vessel surveys

In April 2017 the South and Central Sectors and the Outer channel of the lagoon were surveyed twice. A total survey effort of 65 km (11:49 hours) was carried out in the Outer Channel, and 108 km (15:45 hours) in the South and Central Sectors.

Outer channel: Eight groups were encountered during the first survey and 12 groups on the second survey, with a minimum group size of one individual and a maximum group size of 13 individuals. Individuals were found to be socialising before 0900hrs and after 1700hrs; and were seen mainly mud-plume foraging during the rest of the survey hours. Calves and young individuals were found in tight association with one or two adults. A minimum of 12 individuals from the 2006 ID catalogue (Sutaria 2009) were re-sighted in the Outer channel after 10 years (eg. Figure 5). It was observed that a larger part of this population seemed to be either mother calves or young adults. We also found that many of the key individuals from the Outer Channel commonly encountered from 2004 to 2006, such as A1, A2, A3, A15, A18, A19, A22, A25, A27, were not encountered during the surveys in April 2017.

Central Sector: Only one individual was sighted mud-plume foraging in the Central Sector during both surveys. No dolphins were encountered in the Nalabana Sanctuary region of the Central Sector.

Southern Sector: Seven groups were encountered during both surveys with a minimum group size of 1 and a maximum group size of 6. All the groups were observed to be mud-plume foraging or milling; or traveling in tight groups. Young individuals were found here in associations with one or two adults.

Figure 4. Individuals re-sighted in the South and Central Sectors - Top row: left and right side of the fins of I43. Middle row left: I20. Middle Right: I56. Bottom row left: I42. Bottom row right: new ID

Figure 5. Individuals re-sighted in the Outer Channel - Top row: A77 with A86. Middle row left: A21.Middle row right: A58. Bottom: A12

Groups with young animals or animals in the mother-calf position also showed socialising behaviour. At least six individuals were re-sighted from the 2006 ID catalogue and a few new individuals were also sighted (Figure 4 and 5).

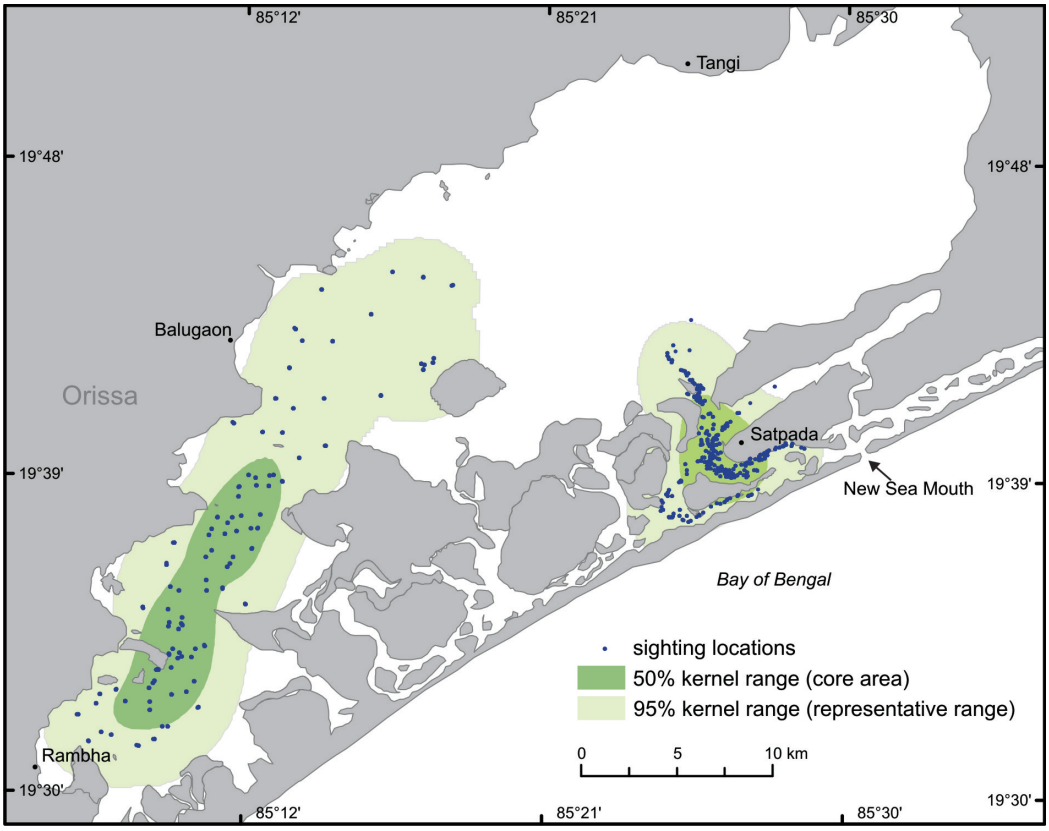

Figure 4. Distribution of dolphins in Chilika Lagoon in 2004-2006

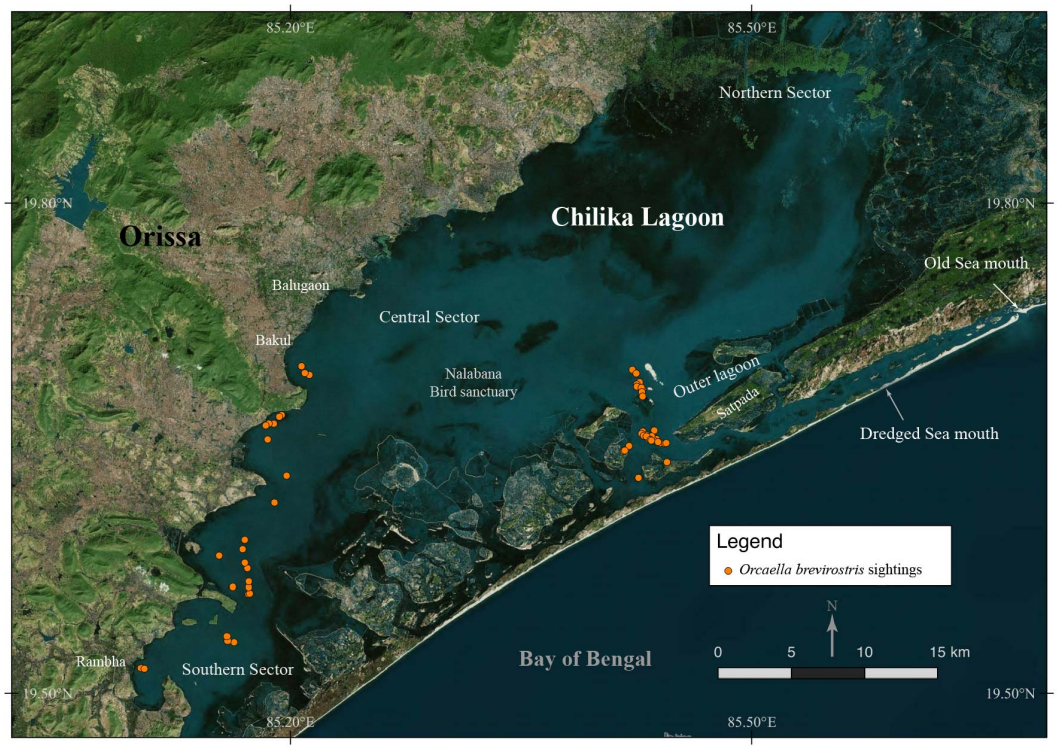

Figure 5. Distribution of dolphins in Chilika Lagoon in April 2017

Acoustic surveys

Fifteen recordings of six group encounters made on 7th and 8th of April 2017 and resulted in approximately 34 mins of dolphin vocalisations. Click trains were observed in all recorded files but could not be effectively analysed for their time-frequency parameters due to limited sampling rate of the equipment. A total of 27 whistles exhibited good aural and visual quality and were analysed for acoustic parameters. Whistles had an average duration of 0.430 ± 0.159s. Mean minimum and maximum frequency was 4.359 ±1.689kHz and 5.737 ± 1.692kHz.

Frequencies ranged from 2.563 to 10.803kHz, although whistles with frequencies about 10kHz were observed they could not be included in the analysis due to their poor aural-visual quality.

Majority of the whistles had a flat contour (48%) and were simple in structure; whistles with a wave contour were also recorded and constituted a small fraction of the dataset (n = 4) (Figure 6). Contour types observed were similar to the ones described by Van Parijs et al (2000) and Hoffman et al (2015).

Based on a previous definition of 'Squeaks' (Van Parijs et al 2000, Kreb 2004), 55 of the pulse calls recorded could be placed into this category (Figure 7). These calls had an average duration of 0.165 ± 0.136s. Durations ranged from 0.010 to 0.537s. The upper frequency range of these pulse calls extended beyond the sampling rate of the recording system, however the minimum frequency observed was as low as 507.9 Hz. Pulsed calls described as "Creaks" and "Buzzes" were also observed in almost all of the recorded files. It was not possible to further analyse these two call types as the recordings contained ambient noise interfering with the frequency range of these sounds and the sampling rate of the recording equipment was limited.

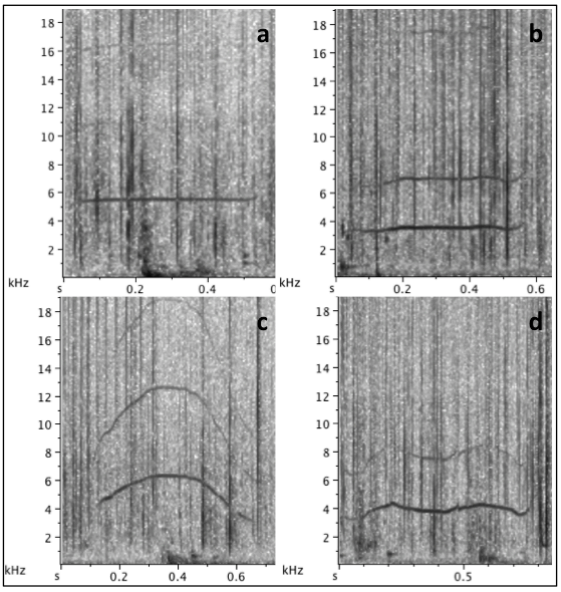

Figure 6: Spectrogram of Irrawaddy dolphin whistle types recorded from Chilika Lagoon, constant (a,b), convex (c) and wave (d)

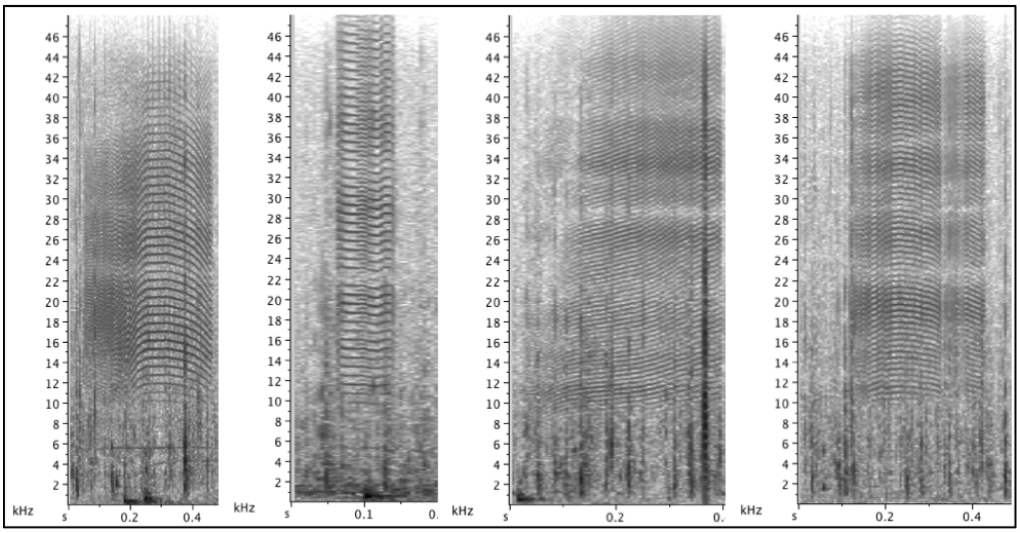

Figure 7: Spectrograms of Irrawaddy dolphin pulse calls recorded from Chilika Lagoon

Review of reports and news articles

Besides the Chilika Lagoon, Irrawaddy dolphins have also been reported from Bhitarkanika and Gahirmatha (Figure 8), approximately 250km north of Chilika (James et al. 1989, CDA 2015, 2017) and two sighted near Hamilton island, in the Sunderbans of India (Pers Obs Elrika D'Souza). A single coastal survey of Orissa by Sutaria et al in 2004-5 did not sight any Irrawaddy dolphins along coastal Orissa. Surveys were recently also carried out by the State Forest Department and the Chilika Development Authority (CDA). These surveys report sighting 58 and 55 Irrawaddy dolphins upstream in the mangrove lined estuaries of Bhitarkanika and Gahirmatha in 2015 and 2017 respectively (CDA 2017). The population in Gahirmatha and further north in the Sunderbans is probably geographically isolated from the population in Chilika, and has not been studied.

The CDA began a comprehensive study of the status of the population in 2002. Instantaneous count method surveys are being carried out every year, involving 18 survey vessels, eight in the outer channel and ten in the main lagoon. All the vessel surveys are conducted on pre-designed tracks at the same time. The total counts have been provided in Table 1. This approach could lead to missing animals that remain underwater or double counting due a 'flushing effect' on animals. This method does not provide any measures of uncertainty to allow the assessment of the power to detect trends in population size over time

Year	Total Count
2006	131
2007	135
2008	138
2009	146
2010	158
2011	-
2012	156
2013	152
2014	-
2015	144
2016	-
2017	134

Table 1: Total counts of Irrawaddy dolphins using instantaneous surveys in Chilika Lagoon from 2006 to 2017.

Mortalities

The mortality figures for Irrawaddy dolphins in Chilika were publicly available only till 2009. Khan (2011) states that 72 dolphin carcasses were found in the lagoon between 2003 and 2009, with a maximum mortality rate of 16.9% in 2003 and last in 2009 at 6.8% as estimated based on the population counts carried out by the CDA shown Table 1.

Evidence of Bull-shark interactions: The new mouth to the sea was dredged in September 2000. The incidents of Bull sharks entering the lagoon had increased after this. Several fishers had been injured while trying to fix their gears in waters exposed directly to the sea. Between 2002 and 2008, 9 carcasses had been found with Bull shark bite evidence, but whether these bites were postmortem or perimortem could not be determined, while there was a single reported case of a dolphin seen being chased by a Bull shark and beaching itself (Khan 2011).

Irrawaddy dolphin carcasses have been reported in three locations outside Chilika in Orissa, namely; near Satabhaya-Ekakula beach in Gahirmatha Marine Sanctuary in Kendrapara district in February 2016; in the Astaranga area, Devi river mouth in 2001; and in the Bhitarkanika region in 1987.

FUTURE RECOMMENDATIONS

Given the very small population size of dolphins in Chilika, it is susceptible to reduction over time and such high rates of mortality are not sustainable. Without a permanent presence of a research team in Chilika, the monitoring of carcasses is not taking place currently. Given the observed changes in the space use in the Outer Channel, an observed reduction in densities and the lack of certain key individual animals from the Outer channel, we suggest that long-term research and conservation of the Irrawaddy dolphin population in Chilika be re-initiated.

The specific activities recommended for 2017 onwards are:

1. Estimate the current population size of Irrawaddy dolphins at Chilika Lagoon and assess trends in population size using the Photo ID data.
2. Map the utilisation distribution, space use and individual home ranges of dolphins in Chilika Lagoon using photo-ID data
3. Assess prey diversity and availability across seasons in the Outer channel and Southern Sector of the lagoon.
4. Map changes in habitat from 2004 to 2018, using satellite imagery
5. Use passive acoustic monitoring (PAM) to study dolphin vocalisations and assess changes in the same, in the presence and absence of tourism vessels
6. To carry out dolphin-watching guideline workshops with all six associations in the Outer channel of the lagoon.
7. To conduct dedicated monitoring surveys in the estuaries of Bhitarkanika and Gahirmatha in Orissa; and in the coastal stretch and the Sunderbans of West Bengal.

The over arching goal of this paper is to provide the impetus to initiate long-term conservation oriented ecological research on Irrawaddy dolphins in Orissa and in West Bengal.

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