THE IRRAWADDY DOLPHINS *ORCAELLA BREVIROSTRIS* OF CHILIKA LAGOON, INDIA[1]

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The Irrawaddy Dolphin *Orcaella brevirostris*, known as 'Khera' in local parlance in Chilika, is a facultative cetacean species found both in fresh as well as coastal waters. It is also found in two lagoons – Chilika in India and Songkhla in Thailand. It is distributed in southeast Asia, extending to northern Australia. It was first described by Owen based on a specimen found in 1852, in the harbour of Vishakhapatnam on the east coast of India.

The status of the Irrawaddy Dolphin in its entire distribution range is not well known; however, the population is expected to be less than a thousand. Its population in Chilika is not more than 50. A maximum number of 31 dolphins were sighted during three surveys conducted in July, September and December, 2000. Except in the northern zone, which receives a heavy load of sediments through several tributaries of the River Mahanadi, these dolphins are found throughout Chilika lake. Deliberate killings of dolphins in Chilika have not been reported, but the species is under threat from intensive and extensive fishing, unorganised tourism using mechanised boats, and habitat degradation. At least 15 dolphins were found dead in the lagoon during 1999 and 2001. Immediate attention is required to protect the dolphins from being hit by mechanised boats and from drowning in fishing nets. Besides the habitat improvement programme being undertaken by the Chilika Development Authority, which will help in conserving the Chilika lagoon in general and the dolphins in particular, education and awareness among the masses and tourists is warranted. However, a Dolphin Conservation Programme would focus on the specific requirements and help in conserving the rare Irrawaddy Dolphins of Chilika.

Key words: Irrawaddy Dolphins, *Orcaella brevirostris*, Chilika Lagoon, status, threats, conservation

INTRODUCTION

Irrawaddy Dolphins *Orcaella brevirostris* primarily occur in the tropical-subtropical Indo-west Pacific, from northwest Bay of Bengal to northeastern Australia. The Irrawaddy Dolphin was first described by Owen (in Gray 1866) based on a specimen found in 1852, in the harbour of Vizagapatnam (now Vishakhapatnam) along the east coast of India. Unlike many cetaceans, it is a coastal species, also found in several major river systems of southeast Asia. Only two lagoon populations of Irrawaddy Dolphins are known in the world: Chilika in Orissa State, India and Songkhla in Thailand. Records are relatively few, though there are some areas of local abundance (Stacey and Arnold 1999).

DISTRIBUTION

In India, the Irrawaddy Dolphin has been recorded from Vishakhapatnam to the deltas of the Brahmaputra and Ganges (= Ganga) rivers (Anderson 1879; James *et al.* 1989). The brackish Chilika lagoon was an important habitat (Annandale 1915), but Irrawaddy Dolphins are now considered rare there (Dhandapani 1992). The species has been recorded in relatively small numbers in the coastal waters of Bangladesh (Kasuya and Haque 1972, Haque 1982), Myanmar (Smith *et al.* 1997b), peninsular Malaysia (Morzer Bruyns 1966; Stacey and Leatherwood 1997), Singapore (Pilleri and Gihr 1974), Thailand (Chantrapornsyl *et al.* 1996; Stacey and Leatherwood 1997), Sarawak (Gibson-Hill 1950; Pilleri and Gihr 1974), Sabah (Dolar *et al.* 1997), Brunei (Gibson-Hill 1949, 1950; Pilleri and Gihr 1974), and the Gulf of Papua (Dawbin 1972). The population status is unknown in all these areas, but numbers appear to be declining in the Gulf of Thailand where they are concentrated in the Thale Sap (= Songkhla Lake) region (Perrin *et al.* 1996) and the Laem Sing area (Stacey and Leatherwood 1997). Records from Sumatra, Java, Sulawesi, Kalimantan, and Irian Jaya are more numerous (Morzer Bruyns 1966; Stacey and Leatherwood 1997). Major concentrations are said to occur in the coastal areas of Cilacap on the southern coast of Java and Kalimantan (Perrin *et al.* 1996). Recently it has been recorded from Malampaya Sound in the Philippines. Records from northern Australia are numerous, extending from Broome, Western Australia to the east coast of Queensland as far south as the Brisbane river, Queensland (Paterson *et al.* 1998).

Orcaella brevirostris has been recorded in the Irrawaddy (= Ayeyarwady) river, from near Prome to about 50 km above Bhamo, about 1,300 km upstream (Anderson 1879; Thein 1977; Leatherwood *et al.* 1984; Smith *et al.* 1997b). There are records of the species from River Mekong in Vietnam and Cambodia, and a short distance into the Lao Peoples'

Democratic Republic (Baird *et al.* 1994; Baird and Mounsouphom 1994; Lloze 1973; Perrin *et al.* 1996; Smith *et al.* 1997a; Stacey and Leatherwood 1997). Recent information suggests that numbers throughout the Mekong river, as well as in the Sekong river in Laos, have been declining. The species has been recorded in the Mahakam river and Semayang Lake-Pela river of east Kalimantan, as well as the Kumay river of central Kalimantan (Tas'an and Leatherwood 1984; Perrin *et al.* 1996). There is no fossil record.

The Irrawaddy dolphin is locally known as '*Khera*' in the Chilika Lagoon area, and also '*Bashiyya Magar*' (oil yielding dolphin) in the Oriya language. It is known as *Pa kha* in Lao PDR and *Pesut Mahakam* or *Ikan pesut* in Indonesia; it is the provincial symbol of East Kalimantan (Perrin *et al.* 1996). The Malaysian name is *Lumba lumba* (Watson 1981). In Thailand, one of its names is *Pla loma hooa baht*, because its rounded head is thought to resemble the shape of a monk's bowl, a *hooa baht* (Baird and Mounsouphom, 1994).

STUDY AREA

Chilika Lagoon, commonly known as Chilika Lake, is the largest brackish waterbody in Asia. The pear-shaped lake is situated on the east coast of Orissa, India between 19° 28' and 19° 54' N and between 85° 05' and 85° 38' E (Fig. 1). The maximum north-south length is 63 km. The average width is 17.8 km (Satellite Imagery, October 2000) and total surface area is *c.* 845-sq. km (May, 2000) (IRS-IC, IRSS-III). The maximum depth of the lagoon varies between 3-4.5 m in the Central Sector near Kalijai Temple (Fig. 1). The catchment area of the lake is 3212 sq. km, not including the drainage of the Mahanadi. Altogether, 35 rivers and rivulets drain into the lake. There are several islands covering a total area of 223 sq. km. Chilika Lagoon runs parallel to the Bay of Bengal, separated by a 0.1-1.5 km narrow and 39 km long sand spit.

On September 23, 2000, a new mouth was opened opposite the village Sipakuda, 8 km from Satpada (Fig. 1), by desilting to restore the lagoon ecosystem. This increased salinity to 14 ppt in December 2000 at Satpada against the average salinity of 3-4 ppt in the same period for the last decade, resulting in an overall increase in fish, prawn and crab landings by 131%, 534% and 449% respectively, in 2000-2001 compared to the previous year.

The lake can be divided into four major ecological divisions: Outer Channel, Northern, Central and Southern Sectors. The Northern Sector is shallow as it receives silt from the rivers, whereas the Central and Southern Sectors are relatively deep.

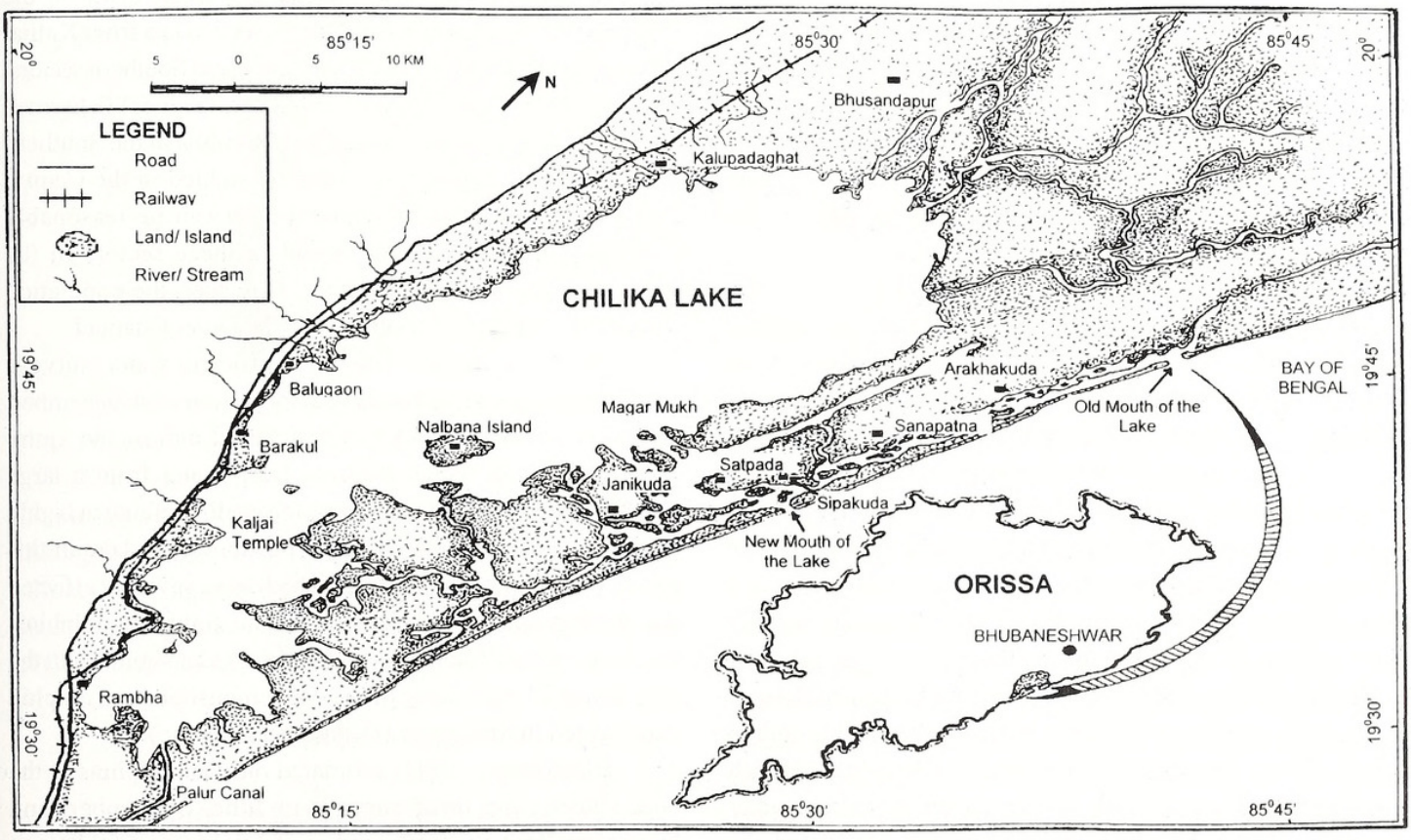

Fig. 1: Map of Chilika Lagoon

The lake is highly productive, with rich fishery resources (Chilika = fish in local parlance, which probably gave the lake its name). It sustains about 1.5 lakh fisherfolk of 12,363 families in 132 villages in its environs. The total number of active fishermen is estimated at 30,000.

METHODS

On the initiative and support of the Chilika Development Authority, rapid surveys were conducted in June, September and December 2000 to determine the current status and distribution of the Irrawaddy Dolphins in the lake.

During the surveys, we interviewed fishermen whom we met at the lake to obtain information regarding the occurrence, distribution, threats, conservation, and cultural attitudes regarding protection of dolphins. Repeating questions to different fishermen increased the reliability of information provided by the informants. The fishermen associated with the Dolphin Motorboat Association, and Mr. Shial, the Assistant Tourist Officer of Orissa Tourism Department at Satpada were interviewed to collect information on the number of tourists visiting Chilika for dolphin watch.

RESULTS AND DISCUSSION

Dolphin Population in different Ecological Zones of the lake

Surveys were conducted for nine days between June and December, 2000 in the Outer, Central, Southern and Northern sectors of Chilika lagoon. A total of 50 hours were spent searching for dolphins. Most of the dolphins were sighted in the Outer Channel, mainly between Magarmukh and New Mouth at Sipakuda (Fig. 1).

Outer Channel: Surveys in the Outer Channel were conducted on June 9 and 10, September 2, and December 26 and 28, 2000. On June 9, the survey was conducted from Satpada to Sipakuda (New Mouth), 8 km; and Satpada to Mahisha - Brahmpur - Rajhans Forest Rest House (*c.*12 km).

A total of about 30 dolphins were sighted in the Outer Channel in a stretch of about 12-13 km between Magarmukh and New Mouth at Sipakuda. In June only 13 adults were sighted, whereas in September 19 adults, two juveniles and one calf were sighted. In December, 30 adults and one calf were sighted (Table 1) in the outer channel. The choppy surface of the lake, due to high breeze from the Bay of Bengal, led to poor sighting of dolphins in June. The New Mouth at Sipakuda was opened on September 23, after which the fish catch increased significantly. In December the calmer water surface, compared to June and September, facilitated the dolphins sightings.

Table 1: Dolphin sightings in Chilika Lagoon (June-December, 2000)

	Outer Channel	Northern Sector	Central Sector	Southern Sector	Total
Jun.-Jul.	13 adults	Not done	6 adults	4*	23 adults
Aug.-Sep.	19 adults 02 juveniles 01 calf	Nil	4**	2***	25 adults 02 juveniles 01 calf
Dec.	30 adults 01 calf	Not done	Nil	Not done	30 adults 01 calf

* and **: Sighted by Mr. Bishnu of CDA on July 21 and August 20 respectively

***: Sighted by local fishermen

Central and Southern Sectors: The Central and Southern part of the lake were surveyed on June 11, September 1 and December 27, 2000 (only Central Sector). On June 11, we surveyed for about 10 hours. Six adult dolphins were sighted in the Nalabana Bird Sanctuary in the Central Sector. In this area, no fishing activity was noticed, but fishing is reportedly done at night. No dolphin was sighted in the Southern Sector, but one of the researchers of the Chilika Development Authority, Mr. Bishnu, sighted 4 adults each in the Southern Sector and Central Sector on July 21 and August 20, during a monthly limnological sampling of the lake. On September 1, the survey was started from Barkul, a small town on the western end of the Central Sector about 5-6 km from Kalijai Temple Rock Island, to cover the Central and Southern sectors, but no dolphins were sighted. However, the local fishermen reported sightings of 2-3 adults near Rambha in the Southern Sector. Though no dolphin could be sighted in the Central and Southern Sectors in September, it can be reasonably accepted that dolphins are found in these sectors in the monsoon, i.e. June to September. However, the population density is very low as compared to the Outer Channel.

Northern Sector: Due to insufficient water, surveys could not be conducted in this sector in June and December. However, on September 3 we surveyed almost the entire Northern Sector, which receives fresh water from a large number of tributaries of the River Mahanadi, resulting in highly turbid water in the lake. A major portion of the lake in this sector was infested with weeds, which have severely affected the dolphin habitat here. We could not sight any dolphins, but the local fishermen informed us of regular sightings in the area about 20 years ago. In the 1999 monsoon, one dolphin was sighted in this sector (Bishnu *pers. comm.*).

Dhandapani (1992) estimated only 20 dolphins in the lake. During the three surveys in June, September, and December 2000, the total number of dolphins in Chilika was estimated to be more than 30, though the entire lake was not

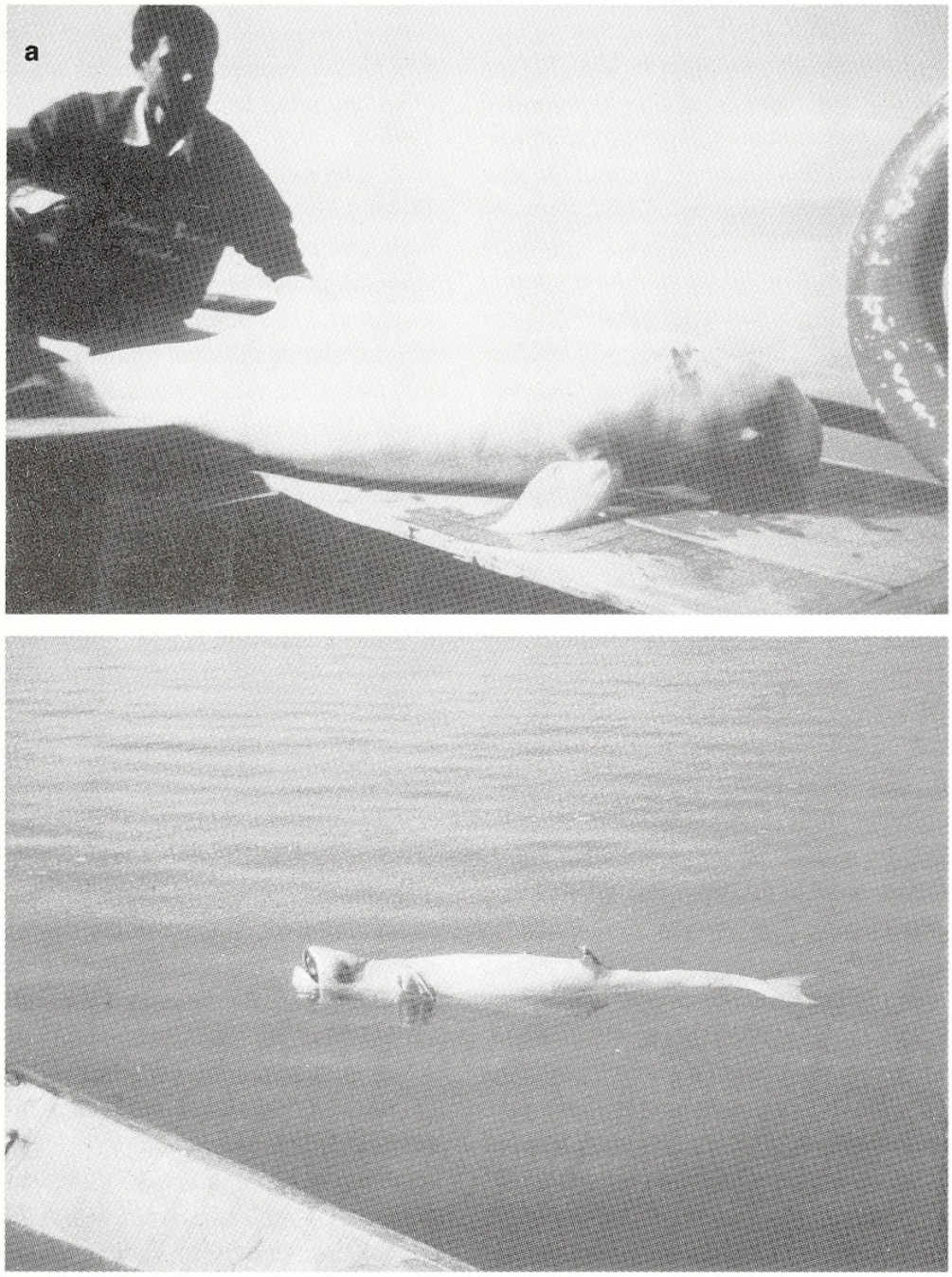

Fig. 2: a. A dead Irrawaddy Dolphin on the Central Sector of the Chilika Lagoon, probably hit by a mechanized boat; b. The wound on the neck can be seen

thoroughly and systematically surveyed for various reasons. Taking the size of the lake and width of the Outer Channel into account, some dolphins must have been missed during the survey. Optimistically, the expected number of dolphins in Chilika would be 40-50.

CONSERVATION STATUS

The species is listed as IUCN category K, i.e., insufficiently known (Klinowaska 1991). Irrawaddy Dolphins are protected under the Indian Wildlife (Protection) Act, 1972; hunting, capture and trade in the species is illegal. Besides India, the species has been given legal protection in Laos, Cambodia, Indonesia, and Australia; however, enforcement is a problem (Stacey and Arnold 1999). Fifteen dolphins were killed in Chilika Lagoon in 1999 and 2000. One carcass of a calf was collected by Mr. Bishnu, a researcher of the Chilika Development Authority (CDA), from the lagoon 4-5 km east of Kalijai Temple Rock Island on November 23, 1999. It is preserved in the museum of the CDA at Bhubaneshwar. The calf was probably entangled in a gill net, as blood was oozing from a wound near the gape of the calf at the time of collection.

In the Central Sector, another adult carcass was sighted floating in February 2000, which was left in the lake (Bishnu *pers. comm.*). An adult female carcass (2 m) was collected from the Outer Channel on September 24, 2000 at Satpada. Again in January 2001, two adult dolphins 2.0 and 2.2 m long were found dead in the Outer Channel. Thus, between November 1999 and January 2001 six carcasses of Irrawaddy Dolphins were found in the lagoon, which is unfortunate and endangers the survival of these dolphins, considering the small population. Besides these, the State Forest and Wildlife Department collected some more carcasses. Two skeletons are lying in their museum at Barkul, while many have reportedly been buried in the Nalabana area in the Lake. In January 2002, four more dolphins were killed by the mechanised tourists boats, one of which was photographed (Fig. 2).

During the present study, the dolphins were sighted in the main area of the lake in June at the approach of the monsoon, and in the Outer Channel in September when monsoon was at its peak. If locals are to be believed, the dolphins are sighted in the lake throughout the monsoon, i.e. July-September.

During the present study, Irrawaddy Dolphins were found swimming slowly, with sluggish movements. In spite of a choppy lake surface most of the time, the melon, dorsal fin and fluke were clearly visible. The blow sound of respiration was heard many times. In the main part of the lake, 6 dolphins were observed in a semi-circular formation, probably driving fish in a particular area for community feeding. Occasionally they moved fast and vigorously, probably when chasing fish.

People's perception about the Irrawaddy dolphin in Chilika

In Chilika Lake, Irrawaddy Dolphins were observed swimming in the vicinity of a few metres of small seine-fishing nets and also following boats. Annandale, in the early part of the 20th Century, also sighted dolphins following boats in Chilika. Interest in dolphin conservation and awareness was noticed everywhere in Chilika, and many fishermen and villagers were seen to respect dolphins. Most fishermen believe that killing dolphins brings bad luck, while saving one ensures a good catch. The local fishermen reported that whenever a dolphin gets entangled in a fishing net, it 'cries' for help by making specific sounds to attract attention. The fishermen's good intentions of rescuing and releasing the dolphins entangled in gill-nets, however, are not always possible, as they hesitate to cut open their nets to release the dolphins. This results in the dolphins getting drowned. The author observed this conflict among many of the fishermen.

Some fishermen are experts in calling dolphins by producing a sound "*ku ku ku ku*..." for help while fishing. They also reportedly call Irrawaddy Dolphins by striking the side of the boat with a conical wooden pin, as has been observed in the Irrawaddy river in Myanmar (Smith *et al.* 1997b).

There is generally a positive attitude towards dolphins in many southeast Asian countries, with beliefs that dolphins have saved drowning swimmers, offered protection against crocodiles, and assisted in fishing operations (Stacey and Leatherwood 1997; Thein, 1977).

At the old mouth of Chilika, the local fishermen reported that during high tide, especially on Full and No Moon days and nights, 5-10 Bottlenose Dolphins enter through the Old Mouth from the sea up to Sanapatna, 15 km inside the Outer Channel, and return to the sea with low tide.

Kaminga *et al.* (1983) suggested that *Orcaella* was forced inshore by more specialised dolphins, implying exclusion by inter-specific competition. Stacey and Leatherwood (1997) also reported that when captive Humpback Dolphins (*Sousa chinensis*) and Irrawaddy Dolphins were held together, the former was dominant. Irrawaddy Dolphins were frequently chased and confined to a small portion of the tank. During the September survey, the local fishermen reported that whenever the Irrawaddy Dolphins and Bottlenose Dolphins came across one another in the Outer Channel, the former got frightened and was forced to return. This corroborates the above observations.

The Irrawaddy Dolphins – a Tourist Attraction at Chilika

Orissa has many archaeological and religious sites, which attract thousands of tourists from all over the world. Satpada on Chilika Lagoon is about 50 km south of the famous Puri shrine. The main attraction in Chilika, especially at Satpada is the Irrawaddy Dolphin. Data collected from the records of the Orissa Tourism Department and the Dolphin Motorboat Association, an NGO at Satpada, revealed that about 40,000 tourists visit Chilika every year. October-January and May-June are the peak season for tourists at Chilika, with a maximum 600-700 per day during December-January. The Dolphin Motorboat Association has 75 motorboats for dolphin watch. Tourists pay Rs. 250 for 60-90 minutes per boat, that has a capacity of eight persons. According to the Association, most tourists see dolphins, but 5% return disappointed. Besides the Association, the Orissa Tourism Department also organises 'dolphin-watch' for tourists. Even during monsoon, about 100 tourists visit the lake every day. This confirms that dolphins are sighted even during monsoon in the Chilika Lake. This is probably the only tourist spot in India for dolphin sightings and has 'organised dolphin-watch agencies'. As the 'dolphin-watch' is not organised by properly trained boatmen, dolphins are sometimes seriously injured. At the

request of the tourist, the boatmen continuously chase dolphins, which are hit by the boat propellers while frantically trying to escape.

Threats to Dolphin Population in Chilika Lagoon

Directed catch: Directed killing of dolphins in Chilika Lagoon to obtain oil was reported by Annandale (1915) in the early 20th Century. Dhandapani (1992) also recorded harpooning of 4 or 5 dolphins per year in Chilika during mid-1980s, but he recorded only two dead dolphins during his two year study. During the present study, no incidence of directed killing was observed, but it cannot be ruled out.

Incidental catch: Incidental catches in fishing nets have been reported from Bangladesh (Haque 1982), Myanmar (Leatherwood *et al.* 1984; Smith *et al.* 1997b), Thailand (Andersen and Kinze 1994), and the Lao-Cambodian border (Baird and Mounsouphom 1994). About 15 Irrawaddy Dolphins were killed incidentally in Chilika Lake in the last two years, the carcasses of which have either been buried or preserved by the Wildlife Department or Chilika Development Authority.

The fishing dragnets like 'Sahala jal', 'Bhetki jal' and 'Patna jal' operating in Chilika Lake are highly dangerous for the dolphins, entangling and ultimately drowning many of them.

Habitat degradation

Habitat degradation includes increased use of nylon gill nets, increased vessel traffic (e.g., associated with logging in Kalimantan), reduction in food resources (e.g. due to trawling in the Gulf of Thailand), pollution, and sedimentation of lakes. The physiography of the lake is changing due to geological causes, as well as human intervention.

Originally Chilika Lagoon was part of the sea. Gradually it became shallow due to siltation from the tributaries of River Mahanadi and the low mud-flats that have been pushing their way southward from the mouths of the rivers in the Northern Sector of the lake. The lake was formed from the sea some 3550 to 3950 years before present, when it was like a bay. The deepest portion was near Kalijai Temple Rock Island, measuring 4.5 m. It has been reported that the silt deposition has raised the lake bed by 1.8 m near Kalijai Temple in the last seven decades. Siltation in Chilika can be attributed as one of the principal factors endangering the lake and in turn the dolphin habitat. No reliable estimates of sedimentation are available.

Chilika Lake had scanty aquatic vegetation in the early part of the 20th Century. The Remote Sensing Data of IRSIA, to estimate the growth rate of vegetation in Chilika, revealed that the waterspread had reduced at the rate of 23.42 sq. km over five years between 1984 and 1989 for emergent vegetation. Another study using satellite data analysis revealed that the weed-covered area in the lagoon was 20, 60, 200 and 398 sq. km during 1973, 1977, 1985 and 1993, respectively. Thus, within 20 years, the weed-covered area had increased 20 times. *Potamogeton pectinatus* is the dominant weed in the Central and fringes of Southern Sector, whereas *Scirpus littoralis* is dominant in the Northern Sector. This drastic reduction in habitat area, both horizontally and bathymetrically, has reduced and degraded the habitat for the Irrawaddy Dolphins in Chilika Lagoon.

The total fish catch in Chilika has declined from 6,000 metric tons per year to 2,000 metric tons in the last 14 years. This can be attributed to over-fishing, obstruction of migratory route, i.e. choking of the mouth, as well as the entire 'Outer Channel' up to Magarmukh, destruction of spawn during collection of prawn seeds by the local fishermen, among others.

Chilika Lagoon faces threats from increase in freshwater weeds, aquaculture, decline in fish production, changes in species composition of fishes and other biota, eutrophication and overall loss of biodiversity. Depletion of fishery has resulted from over-dependence of people on the lake, beyond its carrying capacity. Moreover, encroachments upon the traditional fishing rights of the local fishermen occasionally lead to inter-community conflict and violence. The CDA has planned for lake traffic using a big barge to transport buses, lorries etc., which is likely to increase pollution, as well as the danger of casualties of dolphins.

Hundreds of motorboats ferry local villagers, fishermen as well as tourists in the lake. This results in noise as well as oil pollution, both of which are dangerous to the dolphins. Habitat destruction and degradation, and noise pollution as potential threats to Irrawaddy Dolphins have also been reported from Australia (Paterson *et al.* 1998).

Recommended Conservation Action Plan for Irrawaddy Dolphins in Chilika

As per the IUCN – World Conservation Union, the status of the Irrawaddy Dolphin is insufficiently known. Workers throughout its distribution range opine that the numbers are declining and measures to prevent further decline are called for. The most pressing conservation issue affecting the survival of Irrawaddy Dolphins is habitat degradation. Incidental catch is also a matter of great concern, especially if the population is as small as in the Chilika Lagoon. Conservation includes economic, political, cultural and biological components. A cultural approach is certainly called for in the case of Irrawaddy Dolphins in Chilika, where people

have a positive attitude towards them, very little direct catch and people do not need to be convinced that dolphins are worth more alive than dead.

It is clear that dolphins cannot be protected in isolation unless dedicated programmes are initiated to protect them and restore their habitat. Incidental catch and frantic chase of the dolphins may be reduced through awareness and education campaign among local communities. The conservation focus must be on habitat conservation and restoration. The following activities are recommended for dolphin conservation in Chilika Lagoon:

1. Monitor the abundance of Irrawaddy Dolphins throughout the lagoon every month or at least once in two months using standard techniques, namely carefully designed line and strip transects and mark-recapture studies by photo-identification. Identification of areas of great abundance will help in assessing conservation priorities.

2. Tissue samples should be collected from dead/ drowned dolphins and such samples should be used to study genetics to identify population discreetness and variation. If separate populations are identified, conservation efforts need to be applied in all areas. The estimation of contaminant levels in the tissues of the species will help in formulating conservation efforts so far as pollution level in the lake is concerned.

3. Sustainable and less wasteful fishing methods should be developed, with scientific and community development and education components. The IUCN has also identified Chilika as a suitable site for such a programme.

4. Research is needed to study the impact of water traffic in the lake. Such studies should examine incidental killings, pollution load due to the river traffic and impact of noise pollution on the dolphins. The CDA is planning to operate a transport barge in the lake. Such study will be useful to mitigate the likely impact of such developmental activities: motorised vessels, noise pollution.

5. Detailed study should be carried out on dolphin biology, ecology, and behaviour in response to human interaction. Morphological data of every carcass should be collected, which would be useful in taxonomic studies.

6. Habitat preference, population dynamics, and reproductive behaviour of the dolphins should be studied.

7. Infrastructure to promote tourism based on ecological principles should be created for financial benefits to the local community, including training of boatmen. This will motivate the locals to save the dolphins, and generate additional income and employment for them. It will also reduce the pressure on the fishery of the lake.

8. Fishing at the mouth of the lake should be discouraged and, if possible, banned. Only subsistence fishing may be allowed. It will increase availability of fish in the lake.

9. Measures must be taken to check the increasing growth of weeds.

10. It is essential to study the nature and rate of sedimentation of the lake and to take ameliorative steps to control it. This may be achieved by intensive and extensive tree and shrub plantation in the catchment areas of the lake. This will maintain the depth and waterspread of the lake.

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