PROTECTION OF ENDANGERED GANGES RIVER DOLPHIN IN BRAHMAPUTRA RIVER, ASSAM, INDIA

Final Technical Report to Sir Peter Scott Fund, IUCN

Report submitted by -

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Overview

Title of the Project:	Protection of endangered Ganges River dolphins in the Brahmaputra River, Assam, India.
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Project Advisors:	Randall Reeves, Brian Smith, Tom Akamatsu
Project Assistants:	Sanjay Das, Dhruba Chetry, Abdul Mazid, Sanjib Baruah

Executive summary:

Ganges River dolphins (*Platanista gangetica gangetica*) occur in the Ganges-Brahmaputra River system primarily in India and Bangladesh. They are listed as Endangered by the IUCN due to a probable population decline of at least 50% over the last 50 years and projected future population declines. No quantitative estimates of abundance are available for the Ganges River dolphin although an overall abundance of about 2000 has been suggested. Dolphins have been extirpated from the upper reaches of many rivers, the population has been fragmented by irrigation barrages and dry season habitat is further reduced by diversion of water. In comparison to the Ganges, the Brahmaputra River is less degraded and is therefore of great importance for persistence of the subspecies. For this reason, a recent proposal by Oil India Ltd. to initiate seismic exploration (using explosives and airguns) along the bed of the Brahmaputra River to prospect for oil has potentially disastrous implications for Ganges River dolphins. This project was designed to provide missing baseline information on distribution, abundance, behaviour and acoustics of Ganges River dolphins in the Brahmaputra River and suggest suitable locations to establish protected areas. The hope is that the robust scientific data generated will enable informed management decisions that will safeguard this important and vulnerable population. An extensive survey was conducted in the entire 1044 km of dolphin inhabited sections of the Brahmaputra River from the Assam-Arunachal Pradesh border to India-Bangladesh border. The best estimate of 264 dolphins in the entire Brahmaputra River system was recorded, with 80.3% occurring in the Brahmaputra mainstream, 11% in the Kulsi River and 8.7% in the Subansiri River. Dolphin encounter rate in the Brahmaputra was 0.24 dolphin/km, in the Kulsi was 0.40 dolphin/km and in the Subansiri it was 0.24 dolphin/km. Behavioural studies on dive time and surfacing interval and acoustic investigations were also carried out in two dolphin hotspots. Dolphins spent an average 107.3 seconds under water and 1.26 seconds above water. Mortality through fisheries by-catch was identified as one of the major threats to Ganges dolphins in the Brahmaputra. Based on high abundance, potential for protection and possibilities for dolphin eco-tourism, eight river sections were identified as potential protected areas and community-based conservation areas.

Background

The species:

The Gangetic dolphin is one of four species of obligate river dolphin, and is found in Ganges-Brahmaputra-Meghna and Karnaphuli River systems of India, Nepal and Bangladesh (Anderson 1878, Kasuya & Haque 1972, Jones 1982, Mohan 1989, Reeves & Brownell 1989, Shrestha 1989 and Reeves *et al.* 1993). In the nineteenth century, the dolphins were plentiful in the entire distributional range (Sinha & Sharma 2003), however, the range and abundance of this species has sharply declined in the last 100 years (Reeves & Leatherwood 1995) and the IUCN correspondingly revised its threatened status from Vulnerable (Klinowska 1991) to Endangered (IUCN 1996). It is estimated that currently there are less than 2000 individuals of this subspecies globally.

In comparison to the Ganges River system, little research on dolphins has been undertaken in the Brahmaputra River system of Assam in India. Choudhury (1997) mentioned the distribution of the species in both the Brahmaputra and Barak River systems of Assam. Mohan *et. al*. (1997) investigated the population of dolphins in the Brahmaputra and confirmed the existence of the species in Brahmaputra mainstream, Kulsi and Subansiri River. Mohan *et. al.* (1998) also documented one residential dolphin population in the Kulsi River, near Guwahati. Biswas & Baruah (2000) investigated the habitat ecology of the Gangetic dolphin in the Brahmaputra river stretch within Eastern Assam and Bairagi (1999) reported the impact of the oil bait fishery on the dolphins of Brahmaputra River. Most recently, Wakid (2005) assessed the population status and distribution pattern of dolphin population in the entire Brahmaputra river system and conducted detailed ecological investigations on the dolphins in Eastern Assam.

According to the older human generation in Assam, three decades ago, the Gangetic dolphin was one of the most commonly sighted aquatic mega-fauna in the Brahmaputra River system. However, due to increasing anthropogenic pressures, the overall population of the species has been declining and they have been extirpated from most of the major tributaries of the Brahmaputra and are now restricted to pockets in the Brahmaputra mainstream. This current project was initiated with the aim of identifying hotspots for long term conservation of the last remaining dolphins in Brahmaputra river system.

Study area

A comprehensive dolphin survey conducted in 2005 confirmed the existence of Ganges River dolphins in only three rivers in Assam – a. the Brahmaputra mainstream, b. Kulsi River, and c. the Subansiri River. The present project was therefore conducted only in these three rivers. The details of these study areas are mentioned below.

a. Brahmaputra River: The Brahmaputra flows through Tibet, India (Arunachal Pradesh & Assam) and Bangladesh and is one of the longest rivers in the world. The river is known as the Tsangpo in Tibet, Siang or Dihang in Arunachal Pradesh, Luit or Brahmaputra in Assam, Jamuna and later further downstream as the Padma in Bangladesh. The 2,880 km long Brahmaputra, longer than the Ganges in length and volume, traverses its first 1,625 km in Tibet, the next 918 km in India and the remaining 337 km in Bangladesh up to its confluence with the Ganga. After entering India the river flows as the Siang or Dihang River about 52 km from Pasighat in the foothills of the Himalayas before its confluence with two other major rivers, namely the Dibang and the Lohit. From this large confluence, the river is known as the Brahmaputra (Fig-1). From here the river enters a narrow flat valley, which is known as the Assam or Brahmaputra Valley.

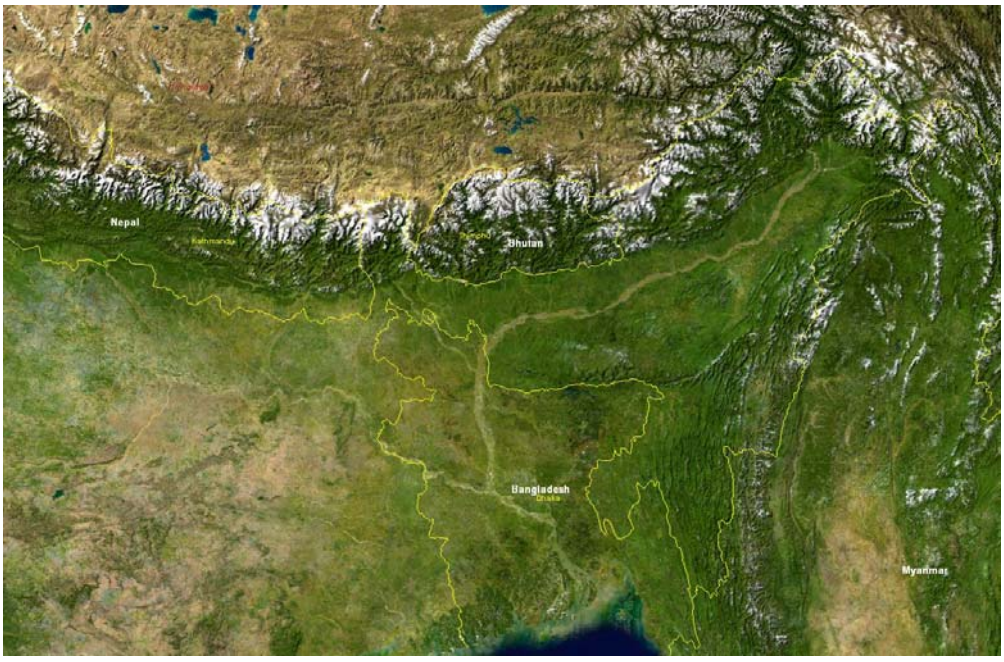

Fig-1: Satellite image of Brahmaputra Valley

After traversing through Brahmaputra Valley, the river finally enters into Bangladesh near Sukhchar. From the Assam-Arunachal Pradesh border to the India-Bangladesh border (Sukhchar), the river has a length of about 900 km where the river has a minimum 1 km width (at guwahati) to maximum 15-18 km width (Fig-2) (Sharma, 2004).

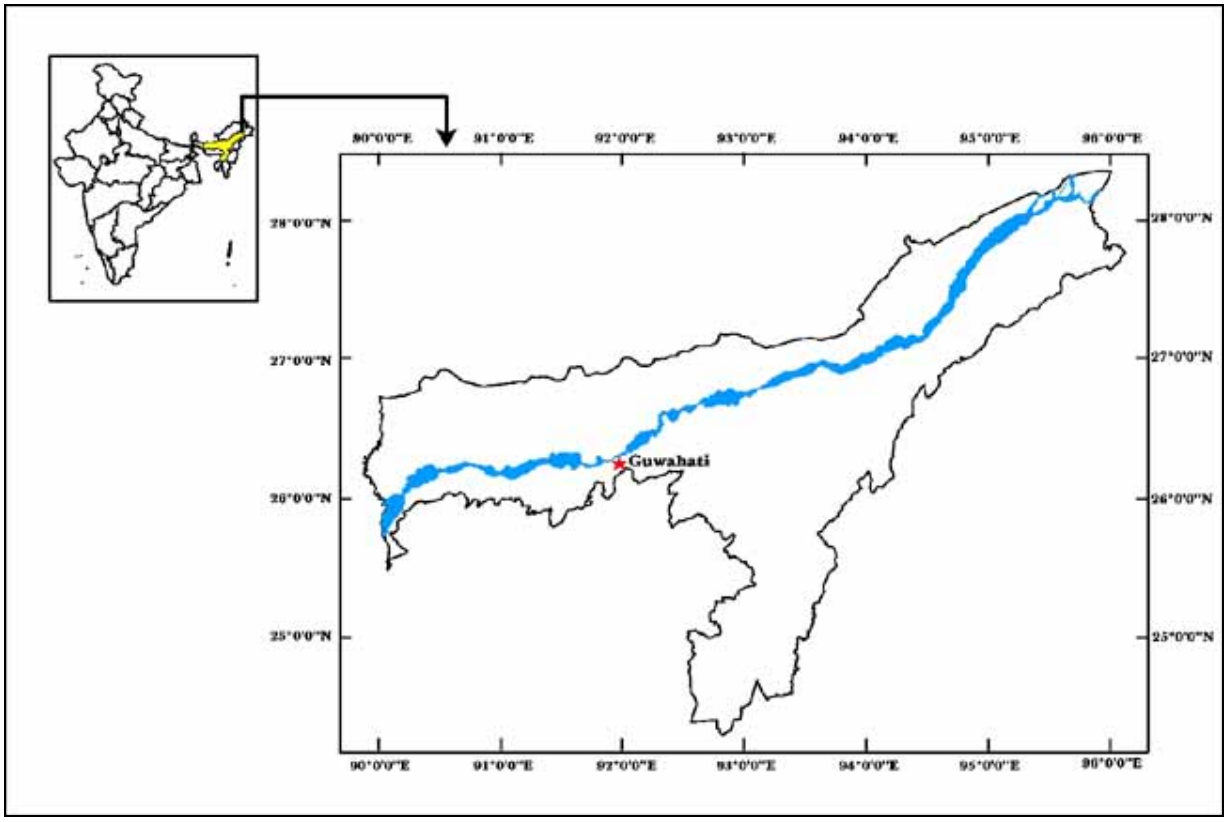

Fig-2: Location map of Brahmaputra river system

Fig-3: Brahmaputra near Kobo island

Fig-4: Lohit River near Miri Chapori

b. Kulsi River: Kulsi River is in the Kamrup district of Western Assam (Fig-5). The river originates from Meghalaya ($25^0 38^/$ N, $91^0 38^/$ E) where it is known as the Khri River. After traveling about 12 km from its origin, the river enters Kamrup district in Assam at Umkiam ($25^0 38^/$ N, $91^0 38^/$ E) and is known as the Kulsi from this point on (Fig-6). The river finally discharges into the Brahmaputra at Nagarbera. The river is about 76 km in length from Kulsi town to the Brahmaputra confluence.

Fig-5: Kulsi River near Kukurmara village

c. Subansiri River: Subansiri is the largest tributary (443 km) of the Brahmaputra River (Fig-6) and it originates from Purum peak (5059 msl) in Tibet, where it is known as Lokong Su. From its origin the river crosses about 143 km through Tibet and then enters into Arunachal Pradesh of India. The River crosses about 191 km through Arunachal Pradesh and finally enters Assam near Garukamukh of Lakhimpur district. It crosses 37 No. National Highway at Sawoldhuwaghat, which is about 10 km downstream of Garukamukh. The river finally discharges into the Brahmaputra at Jamugurighat which is about 99 km downstream from Sawoldhuwahghat (Fig-7).

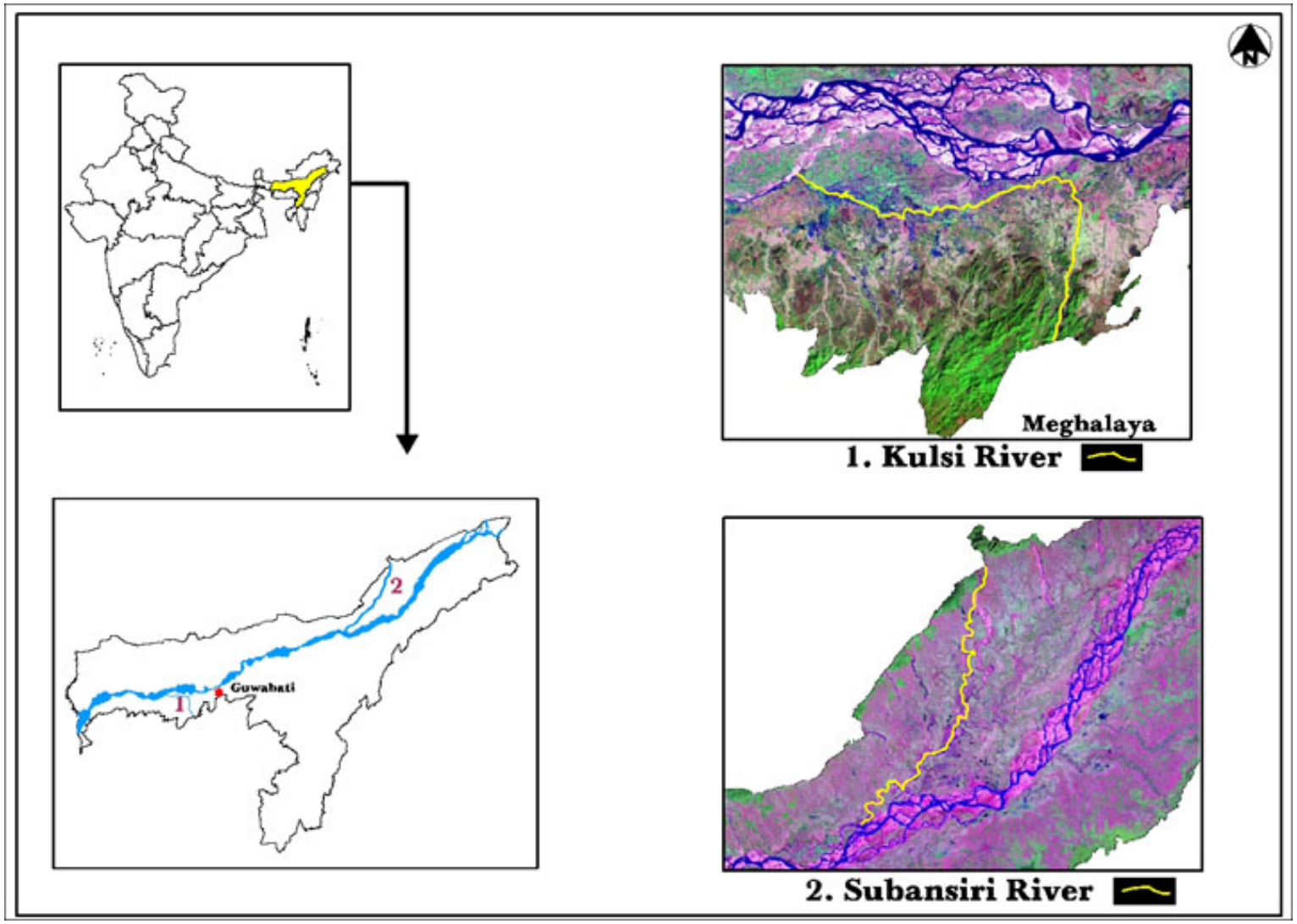

Fig-6: Location map of Kulsi and Subansiri River

Fig-7: Subansiri River near Bhimpara

Objectives

This project had the following objectives:

1. Obtain information on distribution, abundance and density of Ganges river dolphin throughout Brahmaputra river system.
2. Examine dolphin occurrence at identified dolphin hotspots.
3. Collect information on dolphin behaviour.
4. Suggest appropriate protected areas and management options for Ganges River dolphins in the Brahmaputra river system.

Fig-8: A glimpse of Brahmaputra River

Outcomes

Objective-1: Investigation on the status, distribution and abundance of Ganges river dolphin in the Brahmaputra river system

Methodology:

The vessel-based dolphin survey was conducted from February-April, 2008 as this is the period of minimum river discharge when dolphins are easiest to count. The team members (observers & data recorders) were already experienced in dolphin survey methods in the Brahmaputra River, as they participated in the 2005 Brahmaputra dolphin survey.

Smith & Reeves (2000) survey methods for wide channel (for Brahmaputra mainstream) and for narrow channel (for Kulsi and Subansiri River) were followed. Boat speed was maintained at 8-10 km in a downstream direction following the deepest channel with a zig-zag pattern from bank to bank. A three meter high observation platform was used on the Brahmaputra River (Fig-9) and in the Kulsi and Subansiri River the observation platform was 1.5 m and 2 m respectively, since these rivers are comparatively narrower than Brahmaputra mainstream (Fig-10 & 11). Altogether 5 observers were used at a time with 3 Primary Observers (2 searched 60^0 right & left, whereas the 3rd observer in the central 30^0 right & left), 1 data recorder and 1 rear observer (observing 180^0 behind the survey vessel). Positions of observers were rotated every 30 minutes to avoid fatigue. During the night camping, it was assumed that an equal number of dolphins were missed due to their movements in between surveyed and un-surveyed areas overnight. Vessel speed was reduced in preferred dolphin microhabitats, viz, confluences, meanderings, downstream of mid-channel islands and where there is large aggregation of fishermen or water birds.

Fig-9: Dolphin survey team in Brahmaputra River

Fig-10: Dolphin survey team in Kulsi River

Fig-11: Dolphin survey team in the Subansiri River

Survey track and location of dolphin sightings were recorded with a Garmin-12 GPS, and were later plotted on satellite images using GIS. A dolphin group was defined as dolphins no more than 500 m apart, within an area of similar hydrological characteristics. Group sizes were evaluated with a best, high and low estimate of numbers to incorporate a degree of uncertainty. A low and best estimate of zero was used if the sighting was unconfirmed or if there was a possibility that the dolphin was following the vessel and might have already been counted. A 20 minute stoppage was made in areas of high dolphin abundance to make a more accurate group size estimate. When a dolphin was sighted, the vessel continued moving downstream but active surveying for new dolphin groups was temporarily suspended while observers focused on obtaining an accurate group size estimate. All sightings were confirmed by a second observer.

When a group was sighted the ‘detection’ location was recorded via GPS, a second ‘exact’ location was recorded when the boat was located in the centre of, or perpendicular to the group. When the vessel was abeam of the group, channel width was recorded by adding the distance from the vessel to each bank, measured using laser range finders when less than 800m or estimated visually, if greater.

Fig-12: Satellite imageries and GPS were widely used during the survey

Satellite images were used to identify secondary channels. In reaches where more than one channel was present, a decision, based on width and estimated proportion of discharge, was made as to which branch constituted the main channel. No such decision was needed in case of the Kulsi River since it was a single channel or in the case of the Subansiri River where the main channel was very prominent.

To quantify the number of dolphins missed during this survey, duplicate survey effort was conducted from a vessel travelling approximately 5 km behind the primary survey vessel in a 118 km stretch of Brahmaputra mainstream from Balijan to Dikhowmukh. Survey methods were identical on both vessels and observers rotated between teams. Primary and duplicate survey data was compared only when sighting conditions is good (i.e., river surface state <2) for both survey vessels. Sightings from the duplicate survey were considered as missed by the primary vessel if they were greater than 750m from another group according to the 'exact' GPS position. The number and percentage of dolphin groups missed by the primary survey vessel was determined and this factor was used to correct the abundance estimate to account for undetected animals.

Weather conditions were recorded at every 1 hr interval during the survey time with the following scale:

0 =Water surface glassy

1 = ripples without crests

2 = small wavelets with crests but no white-caps

3 = large wavelets with scattered white-caps

4 = small waves with fairly frequent white-caps

From '3' scale, the survey was postponed.

Visibility was assessed with following scale:

0 = clear;

1 = visibility less than 2 km

2 = visibility less than 1 km.

From visibility code '2', the survey was postponed until conditions improved.

Results:

A. Brahmaputra River:

Altogether 1044 km of the Brahmaputra River system within Assam were surveyed during the reported period. Sighting conditions were excellent with 94% of effort conducted in river surface state of 0-1 with clear visibility. During the survey the water level in the Brahmaputra was at its annual minimum with the result that few secondary channels were navigable and therefore, unbroken survey effort was conducted in the mainstream and very rarely on major secondary channels.

Of the total 1044 km of surveyed river, 84.2% (879km) was on the Brahmaputra mainstream. Dolphins were observed throughout the entire Brahmaputra River from the Assam-Arunachal border to India-Bangladesh border and in the downstream areas of the Lohit River and Siang River. During the low water period, the upstream limit of dolphin distribution in the River Lohit is Tengapanimukh (the confluence point of Tengapani stream and Noa-Dihing River in Eastern Assam) and Kobo island is the upstream limit of range for dolphins in the Siang River. This was also confirmed by interviews with local people. We could not survey the Dibang River due to security concerns.

The sum of the best estimates of group size for the entire survey indicated 264 dolphins in the entire Brahmaputra River system, with 212 individuals in the Brahmaputra mainstream and an encounter rate of 0.24 dolphin/km.

A best estimate of 25 dolphins were recorded from Tengapanimukh-Oiramghat (the Assam-Arunachal Pradesh border) to Balijan, 22 dolphins from Balijan to Dikhowmukh, 28 dolphins from Dikhowmukh to Dhansirimukh, 42 dolphins from Dhansirimukh to Tezpur, 24 dolphins from Tezpur to Guwahati, 36 dolphins from Guwahati to Jugighopa and 35 dolphins from Jugighopa to Dhubri (Table-1).

The highest abundance of dolphins was recorded in the river stretch from Tezpur to Guwahati with 19.8% of total dolphin population of Brahmaputra River, followed by Guwahati to Jugighopa with 17%, Jugighopa to Dhubri with 16.5%, Arunachal border to Balijan with 11.8%, Tezpur to Guwahati with 11.3% and Balijan to Dikhowmukh with 10.4%. However, encounter rate analysis showed that the river stretch from Dhansirimukh to Tezpur has the density of dolphins, whereas Tezpur to Guwahati stretch has the lowest density (Fig-13).

Table-1: Abundance of dolphin in Brahmaputra mainstream

Sectors	**Distribution**	**Length (km)**	**Best estimate**	**Encounter rate**
I	Arunachal border to Balijan	136	25	0.18
II	Balijan to Dikhowmukh	127	22	0.17
III	Dikhowmukh to Dhansirimukh	115	28	0.24
IV	Dhansirimukh to Tezpur	99	42	0.42
V	Tezpur to Guwahati	153	24	0.16
VI	Guwahati to Jugighopa	131	36	0.27
VII	Jugighopa to B. border	118	35	0.30
Total		**879**	**212**	**0.24**

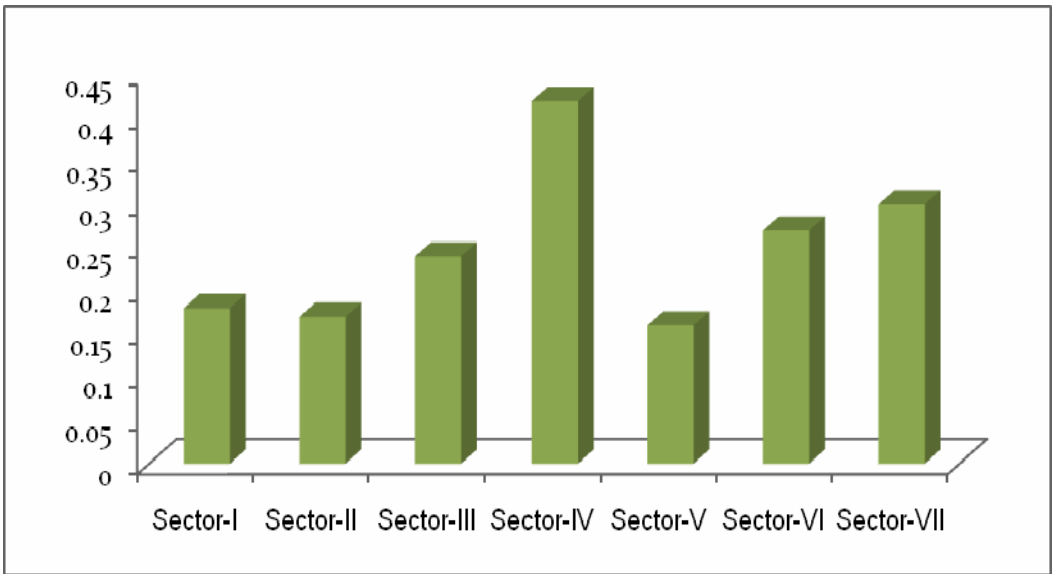

Fig-13: Encounter rate of dolphins in different sectors of Brahmaputra River

B. Dolphins of Kulsi River:

Altogether 71 km of the Kulsi River was surveyed from Ghoramara to Nagarbera, where the river discharges into the Brahmaputra River. A best estimate of 29 dolphins was recorded. The river stretch from Ghoramara to Jarabari comprised of 55.2%, Jarabari to Sampupara comprised of 13.8%, Sampupara to Ghuramara-2 comprised of 24.1% and Ghoramara-2 to Nagarbera comprised of 6.9% of the total number of dolphins in the river (details in Table-2). The highest dolphin encounter rate was in Sector-I, followed by Sector-III (Fig-14).

Table-2: Distribution of dolphins in Kulsi River

Sectors	**Area**	**Location**	**Best estimate**
S-1	Ghoramara to Jarabari	N $26^0 00'$,$E91^0 25''$ - $N26^0 05'$, $E91^0 23'$	16
S-2	Jarabari to Sampupara	$N26^0 05'$, $E91^0 23'$ - $N26^0 04'$, $E91^0 14'$	4
S-3	Sampupara to Ghoramara-2	$N26^0 04'$, $E91^0 14'$ - $N26^0 04'$, $E91^0 05'$	7
S-4	Ghoramara to Nagarbera	$N26^0 04'$, $E91^0 05'$- $N26^0 07'$, $E91^0 00'$	2
Total			**29**

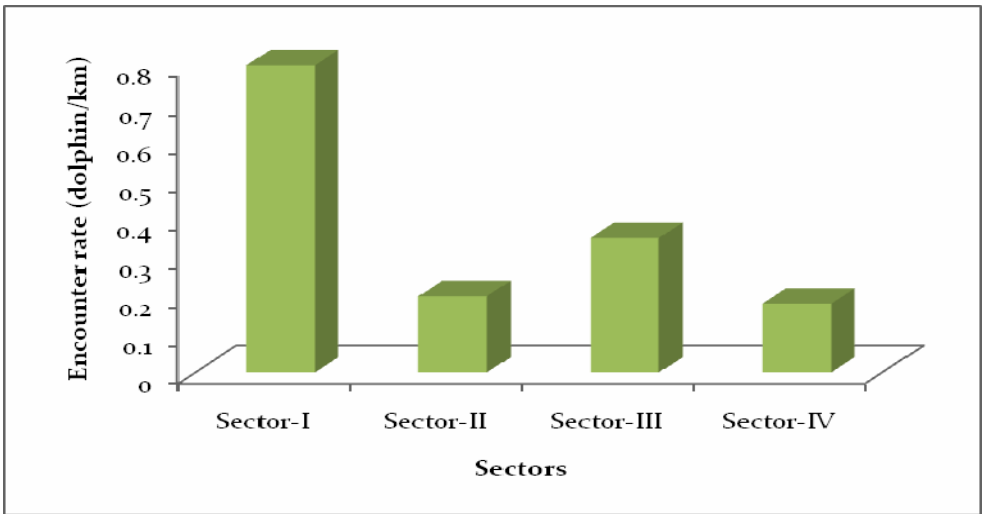

Fig-14: Encounter rate of dolphins in different sectors of Kulsi River. The river discharged into Brahmaputra at Sector-IV

C. Subansiri River:

A 94 km stretch of Subansiri River was surveyed, from Katoi Sapori to Jamuguri, where the river discharges into the Brahmaputra mainstream. A best estimate of 23 dolphins was recorded with an encounter rate of 0.24 dolphin/km (Table-3). The highest dolphin encounter rate was recorded in Sector-III, followed by Sector-IV, which is the closest to the Brahmaputra (Fig-15).

Table-3: Distribution locations of dolphins in the Subansiri River

Sectors	Area name	Location	Best estimate
I	Katoi sapori - Badhakora	$N27^{0}25^{/},E94^{0}15^{/}$- $N27^{0}18^{/},E94^{0}11^{/}$	2
II	Badhakora-Solmari	$N27^{0}17^{/},E94^{0}11^{/}$- $N27^{0}09^{/},E94^{0}10^{/}$	3
III	Solmari-Borolia	$N27^{0}09^{/},E94^{0}10^{/}$- $N27^{0}01^{/},E94^{0}06^{/}$	9
IV	Boroliya-Bodoti	$N27^{0}01^{/},E94^{0}06^{/}$- $N26^{0}56^{/},E93^{0}58^{//}$	7
V	Bodoti-Hilikhaguri	$N26^{0}55^{/},E93^{0}57^{/}$- $N26^{0}51^{/},E93^{0}52^{/}$	2
Total			**23**

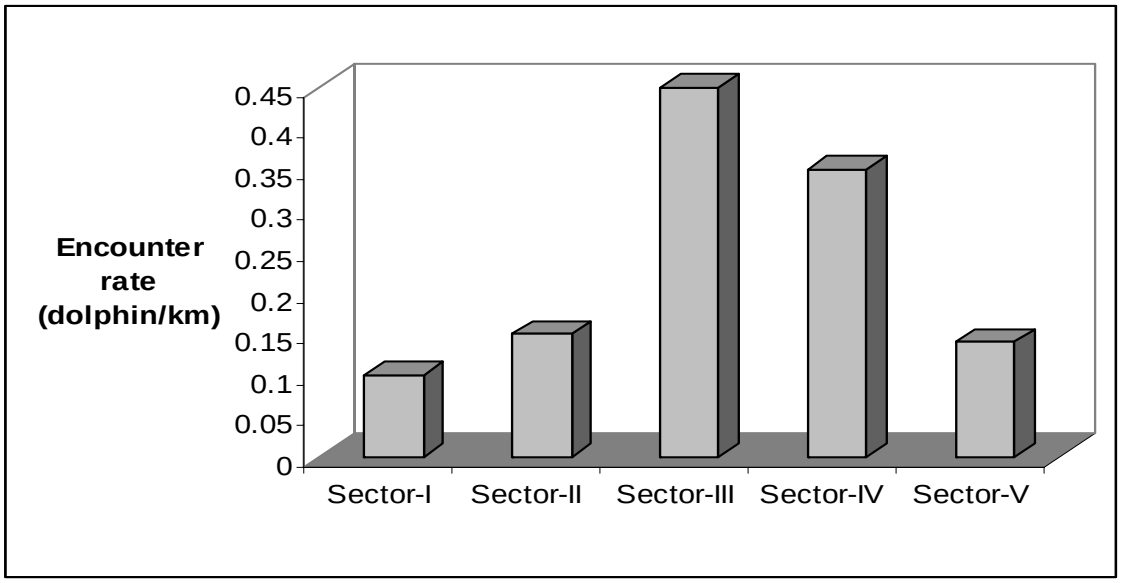

Fig-15: Encounter rate of dolphins in different sectors of Subansiri River

Objective-2: Examine dolphin occurrence at identified dolphin hotspots

It was proposed that if feasible acoustic monitors would be deployed at dolphin hotspots during the dry season to determine the number of days that dolphins are present in these locations and the relative importance of these areas to dolphins.

Acoustic monitors have not been used with South Asian river dolphins before and there were therefore considerable challenges involved in adapting existing technology to this species and environment. There are no specialists on cetacean acoustics inside India and it was necessary to rely on outside expertise for this component of the project which added another challenge. One of the Principal Investigators of the Project Dr. Abdul Wakid received acoustic training working on bioacoustics of bottlenose dolphin with a dolphin acoustic expert Dr. David Mann, an Associate Professor from University of South Florida, USA. Dr. Wakid also gathered experience of dolphin acoustic studies working on Irrawaddy dolphins in Chilika Lake of India with Dr. Tomonari Akamatsu, an acoustic expert from the National Marine Fisheries Research Institute, Japan as well as an IUCN recognized cetacean expert.

Acoustic equipment was loaned to this Project from Florida State University, USA (one hydrophone, made by High Tech Inc, USA; one Microtrack 24/96 2-channel mobile digital recorder) and the National Marine Fishery Research Institute, Japan (one Click Detector, model Clicker – 45, Tachibana Electric Co. Japan make) were specialized for the marine dolphins. The conducted field test using the borrowed equipment confirmed that these hydrophones were not appropriate to record the primarily high frequency sounds emitted by Ganges River Dolphins (Fig-16, 17 & 18). Due to the lack of sufficient equipment and expertise, this objective was not completely fulfilled. However, much was learnt during the testing of these acoustic devices and now that the professional links have been established there is a planned collaborative project between the Japanese and Indian teams to deploy refined acoustic devices in the Brahmaputra River next year and thus this objective will hopefully be fulfilled in the near future.

Fig-16: Project team tried to conduct acoustic study

Fig-17: Dr. Abdul Wakid getting the experience of using of acoustic equipments from Dr. Tomnari Akamatsu in Chilka Lake

Fig-18: Towing mode hydrophone is being tested in Chilika Lake for Irrawaddy dolphin by Dr. Tom Akamatsu and his team

Objective-3: Collect information on dolphin behaviour

Methodology:

Dolphin behaviour was observed in the Kukurmara area of the Kulsi River in October, 2008 (Fig-19). This site was selected as there is constant occurrence of dolphins, very easy accessibility and it is easy to follow the observed dolphin because the river is very narrow (60m wide) at this point. Only single, adult dolphins were selected for observations as they are comparatively easy to locate. Observations continued for 3 hrs and were conducted from 7-00 to 10-00 am, 11-00 am to 2-00 pm and 2-00 to 5-00 pm. Based on the speed and intensity of surfacing, the surfacings were grouped as active surfacing or calm surfacing. Two trained observers worked together in a team, one was measuring dive and surface times and the other was data-recorder. Visual observation and a stop watch were used to record all the required data.

Activity patterns were classified as follows:

a. Foraging: Dolphins were seen chasing fish, making circles, fish leaping out of the water, and even dolphins with fish in their mouths.
b. Travelling: directional and persistent movement at speed.
c. Resting: very slow movements
d. Foraging-travelling: foraging in a directional movement

Fig-19: Behavioural observation at Kulsi River

Result:

Altogether 27 hrs of observations on dolphin behaviour were conducted during which 828 dives were recorded. An average 107.3 (SD ± 46.8) seconds time under water and 1.26 (SD ± 0.23) seconds above water were recorded. Altogether 81.9% active surfacing and 18.1% calm surfacings were recorded. Exposure of blowhole, rostrum & dorsal fin accounted for 44.2% of all surfacings, showing blowhole and rostrum by 38.4% of individuals and exposure of only the blowhole accounted for 17.4% of surfacings. Leaping clear of the water was recorded only for 0.3% of all surfacings.

We also conducted activity budgeting during the observations. Maximum activity was recorded as foraging and minimum as resting (Fig-20).

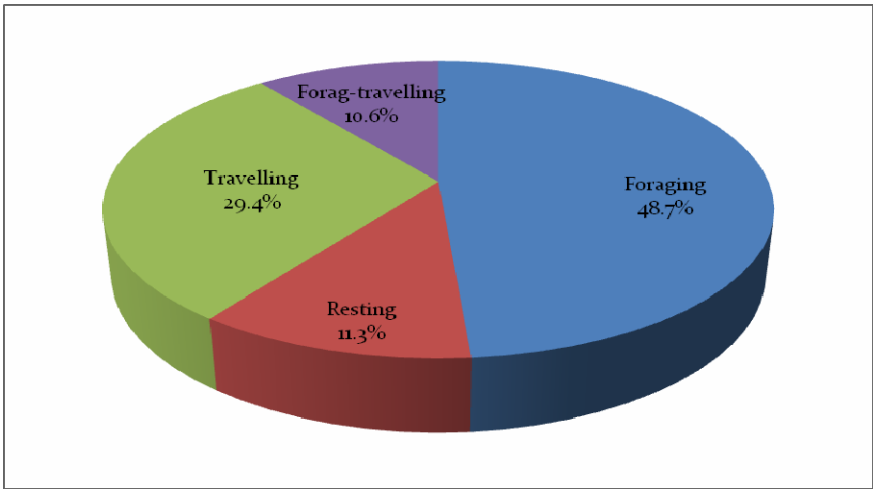

Fig-20: Activity budgeting of Ganges River dolphin (adult) in the Kulsi River

The diving behaviour of a single adult dolphin throughout a 9 hr day, from 7-00 am to 4-00 pm was recorded. A summary of these observations are presented in Table-4 below.

Table-4: Summary of day-long dive time observation

Parameters	**7-8 am**	**8-9 am**	**9-10 am**	**10-11 am**	**11-12 am**	**12-1 pm**	**1-2 pm**	**2-3 pm**	**3-4 pm**
Total dives (n)	29	38	12	37	21	36	33	35	35
Dive/minute	0.48	0.63	0.20	0.61	0.35	0.60	0.55	0.58	0.58
Mean dive time (sec)	114.1	94.3	310.8	95.1	169.4	100.3	109.5	102.5	105.2

Objective 4 - Suggest appropriate protected areas and management options for Ganges River dolphins in the Brahmaputra River

Protected area:

Based on our 2008 survey, and the survey conducted by Wakid, 2005 the following sites are being recommended as protected areas for the Ganges River dolphin.

Table-5: Proposed dolphin protected area in Brahmaputra river system

River	River stretch	Stretch length (km)	Selection criteria
Brahmaputra	Saikhowa-Balijan & Baluchar-Balijan	100 km	This site includes several important dolphin hotspots and there is high potential to improve protection as this area borders Dibru-Saikhowa National Park.
	Dhansirimukh-Bhumuraguri	92	High dolphin abundance and breeding dolphin population. The site is in Kaziranga National Park.
	Borsola-Hazarbigha	32	Good future potential for protection since the river forms the southern boundary of Orang National Park.
	Kuruwa-Suwalkushi	25	High dolphin abundance. Potential for future dolphin tourism, since Guwahati City is situated on the bank of this stretch of the Brahmaputra.
	Goalpra-Balapara	10	High dolphin abundance; immense fishing pressure; high dolphin mortality
Kulsi	Borpit-Jiakur	10	High dolphin abundance; prospect for dolphin eco-tourism as it has good accessibility to Guwahati city; local communities are keen for conservation
	Jambari-Malibari	23	High dolphin abundance
Subansiri	Adihuti-Bodoti	45	High dolphin abundance

The distance different between the Kaziranga National Park and Orang National Park is about 50 km, where other protected areas viz., Laokhowa and Burha-Chapori Wildlife Sanctuaries are existed. Therefore, with a view to get future potentiality of existing management protection, the entire stretch from Dhansirimukh (the eastern-most

boundary of Kaziranga National Park) to Dhansrimukh (the western-most boundary of Orang National Park) can be considered as protected areas for Brahmaputra dolphin.

Additionally, it is suggested that special community based conservation initiatives should be taken in the following dolphin hotspots:

Table-6: Proposed community-based dolphin conservation areas in Brahmaputra river system

Sl. No.	Sectors	Existed dolphin habitats
1.	Assam-Arunachal border to Baliajn	Mirichapori, Hatighuli, Memdubi, Balijan, Laika, Mohmara
2.	Balijan-Dikhowmukh	Nagaghuli, Bogibeel, Dihingmukh, Disangmukh, Dikhowmukh
3.	Dikhowmukh-Dhansirimukh	Jhanjimukh, Salmara, Nimati, Kamalabari, Misamara
4.	Tezpur-Guwahati	Dhansrimukh, Pasnoimukh, Kalangmukh
5.	Guwahati-Jugighopa	Dokhola pahar, Simna puturi, Bohori, Baghbor, Kolonibazar, Uzirchar
6.	Jugighopa-Bangladesh border	Sunari, Singimari, Burhaburi, Dhubri, Bankshi char

Discussion & Conclusion

Due to its highly threatened status, the action plan of the IUCN/SSC Cetacean Specialist Group calls attention to the need for range-wide population assessments in support of conservation efforts for the four freshwater species of dolphin, including the Gangetic dolphin (Reeves et al 2003). This survey resulted in the best estimate of 264 dolphins in the entire Brahmaputra river system, with 212 in Brahmaputra River and 52 in two tributaries. The occurrence of dolphins is not uniform throughout the river system, they are distributed as single animals and groups of 2 to 12, in 82 different locations. In 2005 an identical survey was conducted on the Brahmaputra River recording a best estimate of 250 dolphins in the entire Brahmaputra river system, with 197 in the Brahmaputra mainstream, 27 in the Kulsi River and 26 in the Subansiri River (Wakid 2005). A comparison of the results from each survey are summarized in Fig-21.

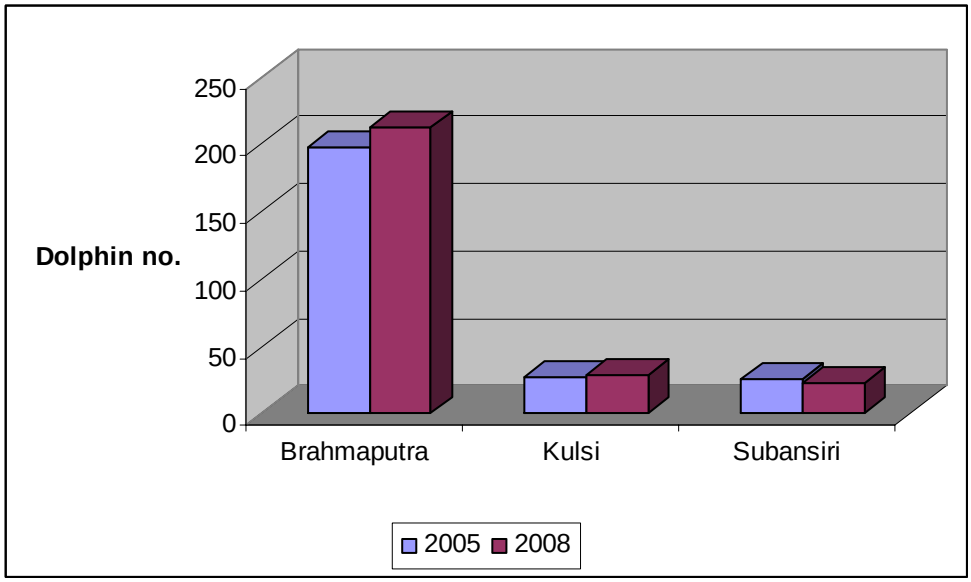

Fig-21: Comparative abundance estimate of dolphin numbers in 2005 and 2008 in the Brahmaputra River system

In the Brahmaputra River mainstem Mohan *et al.* (1997) sighted altogether 266 dolphins in 1993, although they estimated the population at around 400. We recorded a best estimate of 197 in 2005, and 212 in 2008. From the comparative encounter rate analysis between the sighting record of 2005 and 2008 in the Brahmaputra mainstream, we found the maximum increase in encounter rate in the river stretch from Dhansirimukh to Tezpur and maximum decrease in the stretch from Jugighopa (Balapara) to Bangladesh border (Fig-22). One of the reasons for the increase in Dhansirimukh to Tezpur is likely to be the strict protection of the Brahmaputra by the Kaziranga National Park. In our 2005 survey we also recorded the second highest encounter rate within this stretch of the Brahmaputra River, whereas Mohan *et al.* (1997) recorded the highest sighting of dolphins in Sector-IV between Tezpur and Guwahati.

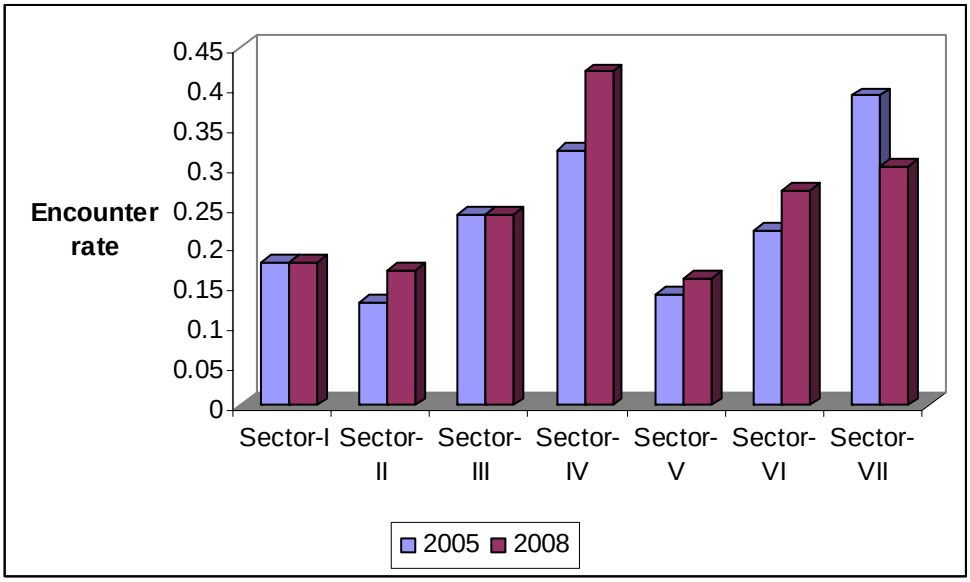

Fig-22: Encounter rate analysis of 2005 and 2008 dolphin survey in Brahmaputra mainstream

In the Kulsi River we recorded a best estimate of 27 dolphins in our 2005 survey (Wakid, 2005), and in the 2008 survey in the same river stretch we recorded a best estimate of 29 dolphins. The highest dolphin abundance was recorded in the first sector of the river from Ghoramara to Jarabari however all these dolphins were concentrated in an 8 km long river stretch between Borpit to Jiakur.

Mohan *et al.* (1998) reported sand mining as the greatest threat to the dolphins of the Kulsi River (Fig-23). He reported that the population was declining from 1992 to 1995 at a rate of 14-29%. However, during our surveys in 2005 and 2008 there was no evidence of a population decline. One reason that the population does not appear to be declining may be due to an increase of awareness by the local people. The local communities of Kukurmara and other fringe villages of Kulsi River strongly believe that killing of dolphins will be harmful to their families. This was reported by Mohan *et al.* (1997 & 1998) and this traditional belief continues. However, the dolphin hotspot in the Kulsi River is only approximately 40 kms from Guwahati, the capital city of Assam. Due to wide publicity by the local media in recent years, the Kukurmara area of the Kulsi River is now a tourist attraction for dolphin observation. A good number of tourists visit this area every year, which has directly increased the conservation awareness among local people. Another factor may be that the major livelihood of the villagers in this area is sand mining, not fisheries as is the case in all other dolphin habitats of Assam. The lower fishing effort

in the Kulsi River may mean that prey is more abundant in this river than elsewhere. The river stretch from Borpit to Jiakur is surrounded by wetlands, (Koloni, and Sol beel on the northern side and Dora beel on the southern side) which are spawning sites for riverine fish which may increase the food supply for dolphins in this stretch of the river.

Fig-23: Sand mining in Kulsi River

Although the high rate of sand mining is one of the major disturbing factors to the dolphins of this river, it has had the effect of maintaining or possibly increasing the depth of this part of the river which may have a positive effect on the dolphins. To more fully understand the effects of sand mining on dolphins in the Kulsi River and their conservation status more in-depth studies are required.

In the Subansiri River, Wakid (2005) recorded a best estimate of 26 dolphins in the 2005 survey with an encounter rate of 0.26 dolphin/km, whereas in our 2008 survey we recorded a best estimate of 23 dolphins with an encounter rate of 0.24 dolphin/km. Mohan *et al.* (1997) recorded altogether 25 dolphins in the Subansiri River in 1993 and from Dikrangmukh to Subansirimukh (22 km) a higher encounter rate of 1.13 dolphins/km. However, due to the difference in survey methodology, these results are not comparable with our present study. Although Mohan *et al.* (1997) gave a detailed account of dolphin distribution and population status in the Brahmaputra and Kulsi Rivers, their assessment of the Subansiri River was not so detailed. However, they did mention that large numbers of dolphins in this river were killed during the 1950 great earthquake and that the local '*Missing'* tribe people killed the dolphins for meat, which often were brought to the Jengraimukh fish market.

Kasuya & Haque (1972) reported the occurrence of dolphins in Bangladesh immediately downstream of shallow areas or at tributary junctions. Smith (1993) recorded the dolphins of the Karnali river most often in “primary habitats” where convergent streams created eddy counter-currents in the mainstream flow and less often in “marginal habitats” where sharp upstream bends created a similar, but smaller counter-current. In the single narrow channel of the Kushiyara River, Bangladesh, Smith *et al.* (1998) observed all dolphins located within the boundaries of obvious counter-currents, with large counter-currents containing more dolphins than small ones. In the Ganges river system, Sinha *et al.* (2000) reported high concentrations of dolphins at the convergences of the Yamuna, Tons, Ghagara, Gandak and Kosi Rivers with the Ganges; below sharp meanders and mid-channel islands scattered throughout the river course. Mohan *et al.* (1997) observed that majority (70%) of dolphins recorded in the Brahmaputra River were solitary individuals and only 2% of the entire population remained in a group of more than 10 individuals. These groups were concentrated at the river confluences of the tributaries with fast current. Biswas & Baruah (2000) reported the river meandering and river confluences as the favourable microhabitats of dolphins in Eastern Assam. In our survey in the Subansiri River, we observed major dolphin aggregations in river meanders and at the few confluences of small streams. In the Brahmaputra River, the largest aggregations of dolphins are found just downstream of confluences or junctions of major tributaries, viz., Noa-Dehing, Dibang, Lohit, Burhi-Dehing, Subansiri, Disang, Dikhow, Jhanji, Dipholu, Dhansiri, Bharali, Kalang, Beki, Gadadhar etc., both inside and outside of river meanderings and just below the mid-channel island (locally called as Char or Chapori). Since fish is the main food for dolphins (Sinha *et al.*1993) and the confluences, river meanderings, downstream of sand bars are favourable microhabitats for fishes (Pilleri 1970, Sinha 1997, Biswas & Baruah 2000), therefore, piscivorous dolphins occur in large numbers in these microhabitats.

Fig-24: A typical tributary junction in Brahmaputra River, which offers ideal habitat for the dolphins in Assam

Accidental killing of dolphin through gill net entanglement, poaching, population fragmentation through water development projects, water pollution and over-exploitation of fish fauna, are the major factors threatening the Gangetic dolphin subspecies (Sinha *et al.*, 2000). Water development projects and water pollution are not the major threatening factors for the dolphins of Brahmaputra Valley at present, and accidental killing through fisheries by-catch is thought to be the major threat for the dolphins in the Brahmaputra River. Out of the 16 recorded in 2008, 12 were the victim of by-catch mortality and rest were the victim of poaching.

Dolphins are killed for meat and oil. '*Missing*' tribes of Eastern Assam kill dolphins mainly for meat, whereas in Western Assam, they are killed for oil, which is used as bait for catfish *Clupisoma garuam* (Mohan *et al.*, 1997; Bairagi, 1999). Most of the riverine villagers in remote areas believe that dolphin oil has medicinal value and they use it to treat different rheumatic diseases (Wakid, 2005). Dolphin poaching for medicinal oil and for the oil bait fishery is one of the major causes of dolphin mortality in Assam, however extensive community-based conservation initiatives of the Gangetic Dolphin Research & Conservation Programme of Aaranyak has reduced the mortality considerably over last 3 years.

Fig-25: Gill net, the major threatening factor for the dolphins of Brahmaputra

Although gill net entanglement is usually described as accidental killing, our investigation showed that most of the gillnet entanglements were in fact intentional, rather than accidental. Most of the gillnet entangled dolphins were killed during the pre-monsoon and monsoon season. During the high flood season, most of the dolphins make a local migration into the tributaries and when the water recedes they return to the main Brahmaputra River. During the migration local fishermen use their gill nets to block the tributary mouths and dolphins can't help but become entangled. Since the dolphin oil has a high market value and the killing areas are so remote legal action against this crime is almost impossible. Weak management infrastructure exacerbates the problem.

Fig-26: Mosquito-net, a destructive fishing gears for the dolphin habitats

Fig-27: Hook fishing

Water development projects have been directly affecting the ecology of river systems throughout southern Asia and all the three river dolphins in this region are directly affected through interrupted movements and habitat degradation (Reeves *et al.*

1991, Reeves & Leatherwood 1994, Smith *et al.* 1998, Ahmed 2000, Liu *&* Ding 2000, Sinha *et al.* 2000, Smith & Reeves 2000). At least 42 water development projects in India, 16 in Bangladesh and 8 projects in Nepal have affected the rivers that historically supported or currently support Ganges dolphins (Smith *et al.* 2000). Although at present there are no water development projects in the main Brahmaputra River, according to the Central Electricity Authority's "Preliminary ranking study of hydroelectric schemes" in the Brahmaputra basin published in October 2001, 22 schemes (each greater than 25 MW) have been identified in the Subansiri basin with a cumulative installed capacity of 15,191 MW (Vabolikar & Ahmed, 2003). Under this plan, the National Hydro Power Corporation (NHPC) is constructing a 116 m high dam on the River Subansiri in the Garukamukh area, which is on the Assam-Arunachal Pradesh border and about 70 km away from Lakhimpur (Fig-28). The construction of this dam on the River Subansiri will directly affect the dolphin population of the river by changing its whole ecological system. An in-depth study is required to assess the impact of the dam on the concerned dolphin population.

Fig-28: Ongoing construction of water development project on Subansiri River at Garukamukh

The food of the Gangetic dolphin consists of a large variety of fish and crustaceans (Anderson, 1878). Reported species include prawns, *Wallago attu*, *Saccobranchus fossilis* and *Palaemon carcinus* (Anderson, 1878) mud-frequenting fishes and freshwater shrimps (Norman & Fraser, 1948) and crustaceans, molluscs, and fish especially of the catfish family (Shrestha, 1989) Biswas & Michael (1992) noticed that the dolphin severed the head of prey, especially the cat fish, with their teeth. Sinha *et al.*

(1993) observed a wide variety of food fishes including *Mastacembelus panculus*, *Puntius sophore*, *Colisa fasciatus*, *Chela laubuca*, *Chanda ranga*, *Glossogobius giuris*, *Nangra punctata* and *Puntius sp.* in the gut content analysis. Extensive use of various types of gill nets in the Brahmaputra River over the last 15 years has resulted in the sharp decline of fish fauna and has likely reduced the amount of dolphin prey (Mohan *et al.*, 1997; Biswas & Baruah, 2000, Wakid & Biswas, 2006). Although fishing using very small mesh-sized gill nets (current jal) is banned in Assam from 1st May to 15th July we observed this banned activity throughout the year. Lack of proper management attention to this important issue, has resulted in a severe increase in anthropogenic pressure on fish fauna in the Brahmaputra river system, which in turn affects the dolphins through food shortage and habitat disturbance.

Fig-29: Mono-filament gill nets are being prepared for fishing in a dolphin hotspot

Conservation initiatives

A. Capacity building: One dolphin conservation workshop cum training programme was organized (in association with Rufford Small Grant) from the 15th-17th December 2007 in the Kukurmara area of the Kulsi River which has one of the highest densities of dolphins. Altogether 48 participants from 35 different areas of the Brahmaputra Valley participated in the training camp. The participants were from the wildlife management authority, NGOs, media, local villagers, fishermen communities and defence organisations. The status of the Ganges River dolphin in the Brahmaputra River, threats and conservation measures were discussed. Participants were trained on a variety of community based conservation efforts. The Principal Chief Conservator of Forest (Wildlife), Chief Conservator of Forest (Wildlife) and Joint Secretary of Department of Environment & Forest, Govt of Assam participated in the workshop and this is an important step to raising their awareness of the complex issues facing the Brahmaputra river dolphins and in setting the scene for their collaboration in designating protected areas and improving management.

Fig-30: Inaugural session of the workshop

Fig-31: The participants of the workshop

B. Awareness campaign:

During the project altogether 32 awareness campaigns were conducted in different parts of the Brahmaputra Valley. Special attention was given to those areas surrounding identified dolphin hotspots and to the fishermen communities (Fig-32 to 35).

Fig-32: Awareness campaign among fishermen communities

Fig-33: Awareness campaign among defence officials

Fig-34: Awareness campaign among fishermen children

Fig-35: Awareness campaign among villagers

Reference

Ahmed, B. (2000): Water development and the status of the shushuk (*Platanista Gangetica*) in Southeast Bangladesh. In *Biology and Conservation of Freshwater Cetaceans in Asia*, Occasional Papers of the IUCN Species Survival Commission no. 23 (eds R. R. Reeves, B. D. Smith and T. Kasuya), pp. 62-66. IUCN, Gland, Switzerland.

Anderson, J. (1878): Anatomical and zoological researches comprising an account of zoological results of two expeditions of western Yunnan in 1868 and 1875; and a monograph of two cetacean genera*, Platanista* and *Orcella*. B. Quatrich, London, 2vol.

Bairagi, S.P. (1999): Oil bait fishery of catfishes in Brahmaputra River affecting river dolphin populations in Assam, India. *Journal of the Bombay Natural History Societ* 96: 424-426.

Biswas, S. P. and R. G. Michael (1992): Fishery characteristics and the present status of fisheries of the river Brahmaputra. *Proc. Seminar on Conservation of River Dolphin in Indian Sub-continent*, 18-19 August, New Delhi. (Abst.)

Biswas, S. P. and S. Baruah (2000): Ecology of river dolphin (*Platanista gangetica*) in the Upper Brahmaputra. *Hydrobiologia*, 430: 97 – 111.

Choudhury, A. U. (1997): *Checklist of the Mammals of Assam*. Gibbons Books, Guwahati. 103 pp.

IUCN (1996): *1996 IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland and Cambridge, UK. 448pp.

Jones, S. (1982): The present status of the Gangetic susu, *Platanista gangetica* (Roxburgh), with comments on the Indus susu, *P. minor* (Owen). FAO Advisory Committee on Marine Resources Research, Working Party on Marine Mammals. *FAO Fisheries Series*, 5(4): 97-115.

Kasuya, T. and A. K. M. Aminul Haque (1972): Some information on distribution and seasonal movement of Ganges dolphin. *Sci. Rep. Whales Res. Inst*., 24: 109-115.

Klinowska, M. (1991): *Dolphins, Porpoises and Whales of the World*. The IUCN Cetacean Red Data Book. IUCN, Gland, Switzerland and Cambridge, UK, 429 pp.

Mohan, R. S. L. (1989): Conservation and management of Ganges River Dolphin *Platanista gangetica* in India. Pp 64-69. *In*: W.F. Perrin, R.L. Brownell Jr., Zhou kaiya and Liu Jiankang (eds.) *Biology and Conservation of the River Dolphins*. IUCN Species Survival Commission Occasional Paper No. 3. IUCN, Gland, Switzerland.

Mohan, R. S. L., S. C. Dey, S. P. Bairagi and S. Roy (1997): On a survey of the Ganges River Dolphin, *Platanista gangetica* of the Brahmaputra river, Assam. *J.Bombay nat Hist. Soc.*, 94(3): 483 - 495.

Mohan, R. S. L., S. C. Dey and S. P. Bairagi (1998): On a residential dolphin population of the Ganges river dolphin, *Platanista gangetica* in the Kulsi river (Assam), a tributary of Brahmaputra. *Ibid*, 95(1): 1 – 7.

Norman, J. R. and F. C. Fraser (1948): *Giant fishes, whales and dolphins*. Putman Press, Bath, England. 376 pp.

Pilleri, G. (1970): Observations on the behaviour of *Platanista gangetica* in the Indus and Brahmaputra rivers. *Invest. Cetacea*, 2: 27 – 60.

Reeves, R. R. and R. L. Brownell, JR. (1989): Susu *Platanista gangetica* (Roxburgh, 1801) and *Platanista minor* (Owen, 1853). Pp 69-99. In: S. H. Ridgway and R. Harrison (eds.) *Handbook of Marine Mammals*. Vol. 4. Academic press, London.

Reeves, R. R., A. A. Choudhury and U. Khalid (1991): Competing for water on the Indus Plain: is there a future for Pakistan's river dolphins? *Environmental Conservation* 18: 341-350.

Reeves, R. R., S. Leatherwood and R. S. L. Mohan (eds.) (1993): *A Future for Asian River Dolphins*: Report from the Seminar on the Conservation of River Dolphins of the Indian Subcontinent, 18-19 August 1992, New Delhi, India. Whale and Dolphin Conservation Society, Bath, U.K.

Reeves, R. R. and S. Leatherwood (1994): Dams and river dolphins: can they co-exist? *Ambio* 23: 172-175.

Reeves, R. R. and S. Leatherwood (eds.) (1995): Report of the First Meeting of the Asian River Dolphin Committee, Ocean Park, Hong Kong, 5-7 December 1994. Ocean Park Conservation Foundation. Honkong.

Reeves, R. R., Smith, B. D., Crespo, E. A. and Notarbartolo di Sciara, G. (eds.). 2003. *Dolphins, Whales and Porpoises: 2002-2010 Conservation Action Plan for the World's Cetaceans.* IUCN/SSC Cetacean Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. 139pp.

Sharma, J. N. (2004): *Study of the pattern of erosion and channel migration of the Brahmaputra River in Assam using remote sensing data*. Final Technical Report submitted to the Indian Space Research Organization. 189 pp.

Shrestha, T. K. (1989): Biology, status and conservation of the Ganges river dolphin *Platanista gangetica* in Nepal. Pp 70-76. In: W.F. Perrin, R.L. Brownell Jr., Zhou kaiya and Liu Jiankang (eds.) *Biology and Conservation of the River Dolphins*. IUCN Species Survival Commission Occasional Paper No. 3. IUCN, Gland, Switzerland.

Sinha, R. K., B. D. Smith, G. Sharma, K. Prasad, B. C. Choudhury, K. Sapkota, R. K. Sharma and S. K. Behera (2000): Status and distribution of the Ganges susu. *Platanista Gangetica*, in the Ganges river system of India and Nepal. In: *Biology and Conservation of Freshwater Cetaceans in Asia*, Occasional

Papers of the IUCN Species Survival Commission no. 23 (eds R. R. Reeves, B. D. Smith and T. Kasuya), pp. 54-61. IUCN, Gland, Switzerland.

Sinha, R. K. and G. Sharma (2003): Current status of the Ganges river dolphin, *Platanista gangetica* in the rivers Kosi and Son, Bihar, India. *J. Bombay nat. Hist. Soc*., 100(1): 27-37.

Sinha, R. K., N. K. Das, N. K. Singh, G. Sharma and S. N. Ahsan (1993): Gut content of the Gangetic dolphin, *Platanista gangetica*. *Invest. Cetacea*, 24: 317-321.

Smith, B. D. (1993): 1990 status and conservation of the Ganges River Dolphin (*Platanista gangetica*) in the Karnali River, Nepal. *Biological Conservation*, 66: 159-169.

Smith, B. D., A. K. M., Haque, M. S. Hussain and A. Khan (1998): River dolphins in Bangladesh: conservation and the effects of water development. *Environmental Management*, 22: 323 335.

Smith, B. D. and R. R. Reeves (2000): Survey methods for population assessment of Asian river dolphins. In *Biology and Conservation of Freshwater Cetaceans in Asia*, Occasional Papers of the IUCN Species Survival Commission no. 23 (eds. R. R. Reeves, B. D. Smith and T. Kasuya), pp. 97-115. IUCN, Gland, Switzerland.

Smith, B. D., R. K. Sinha, Z. Kaiya, A. A. Choudhury, L. Renjun, W. Ding, B. Ahmed, A. K. M. A. Haque, R. S. L. Mohan, K. Sapkota (2000): Register of water development projects affecting river cetaceans in Asia. In *Biology and Conservation of Freshwater Cetaceans in Asia*, Occasional Papers of the IUCN Species Survival Commission no. 23 (eds. R. R. Reeves, B. D. Smith and T. Kasuya), pp. 22-39. IUCN, Gland, Switzerland.

Vabolikar, N. and F. Ahmed (2003): Tracking a hydel project, the story of Lower Subansiri. *The Ecologist Asia.* Vol. 11 (1): 25-32.

Wakid, A (2005): Studies on certain Aspects of Ecology and Behaviour of River Dolphin (*Platanista gangetica*) in Dibru-Saikhowa National Park, Assam. Ph. D. Thesis, under Dibrugarh University, Assam. Pp 151 + plates.

Wakid, A. (2005): *Conservation of Gangetic dolphin in Brahmaputra river system, India.* Final Technical Report submitted to the BP Conservation Programme-Rufford Small Grant and Department of Environment & Forest, Govt of Assam. 80 pp.

Wakid, A. and S. P. Biswas (2006): Status and diversity of fish fauna in Dibru-Saikhowa National Park, Assam. Journal of Bombay Natural History Society, 102 (1): 50-55.

Wakid, A. (2006a): Status and distribution of a newly documented residential Gangetic dolphin (*Platanista gangetica* Roxburgh 1801) population in Eastern Assam. Journal of Bombay Natural History Society, 102 (2): 158-161.

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