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Original Research Paper

Status, Distribution and Conservation Threats of Endangered Cetacean *Platanista gangetica gangetica* Roxb. in Subansiri River, Northeastern India

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ABSTRACT

Critically endangered Ganges River Dolphin (*Platanista gangetica gangetica* Roxb.) is found in substantial numbers in the downstream of Subansiri river, a major tributary of the River Brahmaputra. Best estimates of 21, 23 and 26 dolphins were recorded in 2005-06, 2006-07 and 2007-08 respectively. Until recently, the Subansiri river was considered one of the safe havens for residential dolphin due to relatively healthy downstream environment coupled with awareness of river bank inhabitants. Water environment of the un-damming Subansiri river strongly influence the existence of dolphin population. However, compositional changes of their distribution may have occurred after regulation of the river by the 2000 MW Lower Subansiri Hydroelectric Projects, whose construction has begun. Only 25 cumec/sec water will be released to the downstream after operation of the project against the present minimum flow discharge of 188 cumec/sec. This huge irreversible reduction (87.60%) in water discharge will make the downstream extremely vulnerable for this IUCN's red listed mammal, the dolphin. Flushing of reservoir sediment will accelerate the degradation by increasing, decreasing the riverbed and water table respectively. To protect the ecological and social security of the downstream, in general, and Ganges dolphin in particular, the minimal environmental flows for long term sustaining of the recently declared India's national aquatic animal is to be calculated and executed accordingly.

INTRODUCTION

Ganges river dolphin *Platanista gangetica gangetica* Roxb is distributed throughout the Ganga, Meghna, Brahmaputra and Kamaphuli river systems of India, Nepal and Bangladesh (Jones 1982, Reeves & Brownell 1989, Shrestha 1989, Sinha 1997, Baruah 2007). However, with the construction of hydel project and other irrigation related projects, the dolphin are threatened by population fragmentation and isolation, pollution of their habitat, drowning in fishing nets or deliberate removal for trade and prey depletion (WWF 2006). As a result, the ranges and abundance of dolphin have reduced in many areas (Reeves & Leatherwood 1995). Burgeoning human population and rapid economic development threaten the survival of Cetaceans in most of the world but nowhere more than in Asia (Smith 1993). It is categorized as endangered by IUCN, the World Conservation Union in the IUCN Red Data Book in 2002 (IUCN 2004). The World Wildlife Fund-WWF recognizes this species as a flagship species for freshwater ecosystems. The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) has listed this species as a species endangered by trade in Appendix I (CITES 2005). The river dolphins are included in the Schedule 1 of Indian Wildlife Act, 1972. The Govt. of Assam has also declared this as state aquatic animal on 5th June 2008.

Dolphin is at the apex of the aquatic food chain maintained the balance of riverine ecosystem of the Subansiri river and its presence in satisfactory numbers symbolizes greater biodiversity of the river (Hazarika 2008). Being a carnivore, dolphin feeds on a wide range of fish species (normally chase surface dwellers and gravel mud dweller fishes in shallow water). Thus, they help in controlling the population of carnivorous fish species. This is a unique example of natural population balance in riverine ecosystems.

Alteration of the river course due to construction of dams for hydroelectric power generation is one of the most important threats for the survival of this cetacean species in the whole geographical region. Damming of river affects the flow variability in the downstream. In addition to change in the flow regime of the river, dam also affects the total volume of run-off; all these changes may be either temporary or permanent. Temporary changes arise primarily from filling the reservoir, which may take several years, where reservoir storage greatly exceeds the mean annual run off (Petts 1986). Water storage in reservoirs induces physical, chemical and biological changes in the stored water (McCartney 2007). As a result, the water discharge from reservoirs can be of different composition and shows a different seasonal pattern to that of the natural river. It has been established that, dams constitute always obstacles for longitudinal exchange along fluvial system and results in the fragmentation of river ecosystems (Ward & Stanford 1995, Li xining & Lijuan 2008).

Construction of dams for generation of electricity and irrigation in the Ganga river system has divided dolphin population into small isolated subpopulations, preventing migrations and reducing food availability. The population above the Kaptai dam in the Karnaphuli river disappeared over a period of 6 to 7 years after completion of the dam. The population of dolphins in the Padma river system is said to be fast declining due to the construction of the Farakka Barrage (Reeves & Brownell 1989).

The 2000 MW Lower Subansiri dam with height of 116 m is expected to be one of the largest river dams in Asia. National Hydroelectric Power Corporation (NHPC) has already started the construction of this large dam close to the Assam-Arunachal Pradesh border town of Gerukamukh in Dhemaji district of Assam. The present investigation aims to make an in depth investigation on the status of the residential population of river dolphin in the Subansiri river prior to the regulation of the river.

MATERIALS AND METHODS

Study area: River Subansiri is one of the largest tributary of River Brahmaputra, originating from the western part of Mount Pararu (5059 m mean sea level) in the Tibetan Himalayas. After flowing for about 190 km through Tibet, it enters into India. It continues its journey through the Himalayas of India for 200 km and enters into the plains of Assam. Its total length is 520 km and draining basin of 37,000 sq. km. Approximately 130 km downstream from the dam site (Fig. 1), the Subansiri river was studied for three years (2005-06, 2006-07 and 2007-08). To assess dolphin densities, the survey area was arbitrarily divided into five locations namely (A) Gerukamukh (B) Chowaldhowa (C) Khabolo (D) Dhunaguri and (E) Jamuguri, with four sectors viz., Sector I between locations A & B; Sector II between locations B & C; Sector III between locations C & D, and Sector IV between locations D & E.

Physical status of sampling locations: Physical status like the stream length, width, mean sea level of the sampling locations and slope of the riverbed were measured with GPS (Global Positioning System, Model No. GPS 12/FC, GARMIN, Taiwan). Bed type in the surveyed stretches of the river

and distance from the dam site were recorded according to Fischenich (1999) and Konkel (2001). Depth of the river was also measured by using graduated folding bamboo sticks.

Certain water quality parameters were also observed. Water temperature, pH and transparency were recorded by using mercury thermometer, digital pH meter and Secchi disc respectively. The current flow was recorded according to the standard method of Trivedy & Goel (1987). Sample data were subjected to statistical treatment using normal or Gaussian distribution statistics. Some more statistical estimates derived from the normal distribution were also made in the present study for analysing water quality data.

Skewness: Measure of the asymmetry of distribution. For symmetric normal distribution skewness has a value of zero.
Kurtosis: An indicator of the relative sharpness or fatness of the peak compared to normal distribution.
Percentile: Percentile at 25% was calculated. Pi at 25% is called first quartile. Pi is also known as the cumulative probability function which lies in the range $0 < Pi < 1$ for $i = 1\ldots n$.
Confidential limit at 95% (CL 95%): CL 95% will give the range within which the unknown value the parameter is expected to lie.

The vessel-based dolphin survey was conducted in the months of November-January for three consecutive years from 2005-2008 as this is the period of minimum river discharge when dolphins are easiest to count (Wakid 2005). Smith & Reeves (2000) survey methods were adopted for dolphin surveys. 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. Altogether 5 observers were used at a time with 3 primary observers (2 searched 60° right & left, whereas the 3rd observer in the central 30° right & left), 1 data recorder and 1 rear observer (observing 180° 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 unsurveyed areas overnight.

Location of dolphin sightings was recorded with GPS. A dolphin group was defined as dolphins not 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.

The inhabitants of the downstream river banks were identified and interviewed to gather local knowledge on the population trend and abundance of dolphins in their area. Mortality rate and their causes were recorded by interviewing the fishermen as well as cross verifying the record from local inhabitants and *mahalders* (lease holders) in each sector. The interviews were semi-structured and open-ended discussions. The fishermen, who regularly come across dolphins of the area, were given high priority during discussions.

RESULTS

Physical status like total length, locations, mean sea level, maximum depth and width of the sam-

pling sites along with distance, slope of the river bed from dam site to its confluence with the river Brahmaputra, are summarized in Table 1. The statistical analysis of certain water quality parameters have are given in Table 3. Variation in water temperature is seasonal. The velocity of water current is high with turbid in the monsoon season, whereas low during dry period. The seasonal fluctuation in pH is negligible. Statistical observations show that all the parameters of different sampling sites under investigation exhibit an unsymmetrical distribution with a long asymmetric tail either on the right or left of the median. Differences in mean, mode and median, significant skewness and kurtosis value indicate that the distribution of various water physico-chemical properties in the study area is widely normal.

DISCUSSION

Statistical observations show that all the parameters of different sampling sites under investigation exhibit an unsymmetrical distribution with a long asymmetric tail either on the right or left of the median. The width of the third quartile was consistently found to be more than the second quartile for each parameter of different sampling sites. Difference in mean, mode and median, significant skewness and kurtosis value indicate that the distribution of various water physico-chemical properties in the study area is widely normal, which may be considered to be healthy hydrobiological factors for survival of the animal in the study areas.

The dolphin population in Subansiri river showed an increasing trend from 21 in 2005-06; 23 in 2006-07 and 26 in 2007-08 with an encounter rate of 0.16, 0.17, 0.2 dolphins/km in 2005-06, 06-07 and 08-09 respectively. The highest dolphin encounter rate (0.26 dolphins/km) was recorded in Sector II during 2006-07 (Table 2, Figs. 1-5). In first 20-25 km downstream of the Subansiri river from the dam site, no dolphin was recorded. Local inhabitants as well as fishermen confirmed that they did

Table 1: Physical status of the downstream of River Subansiri.

Total length of Subansiri River (km)	Length in Tibbet (km)	Length in India (km)	Length in Arunachal Pradesh (km)	Length in Assam (km)	Total number of feeder stream
530	200	330	200	130	10
Locations	Gerukamukh (A)	Chowaldhowa (B)	Khabolo (C)	Dhunaguri (D)	Jamuguri (E)
Mean Sea Level (m)	99	76	65	64	59
Slope of the river bed between the locations	(Initial spot)	2.3 m/km (A&B)	0.2 m/km (B&C)	0.03 m/km (C&D)	0.12 m/km (D&E)
Approximate distance between locations (km)	0	10 (A&B)	45 (B&C)	35 (C&D)	40 (D&E)
Approximate maximum width of the river in dry spell (m)	74	118	107	113	89
Approximate Maximum river depth in dry spell (m)	6.0	9.3	11.5	13.6	15.3

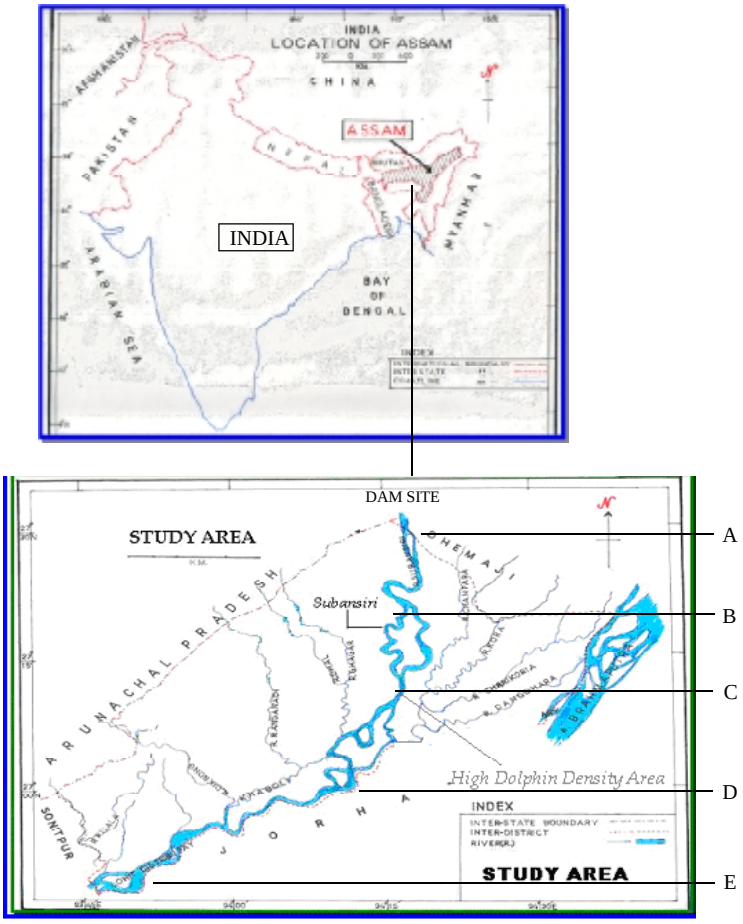

Fig. 1. Location maps of the study area. A: Gerkamukh, B: Chowaldowa, C: Khabolo, D: Dhunaguri, E: Jamuguri

not observe any dolphin in this particular stretch of the river for last 5 years during dry season. Here, the riverbed is composed of hard sediment (mixture of gravel and sand). In fact, up to 30 km downstream of the dam, dolphin could not be seen during the survey presumably due to moderately high water velocity (1.21-2.87 m/sec), hard riverbed composition, reasonable depth and human disturbance (sand and gravel mining). However, during the flood, dolphins were occasionally encountered near Chowaldhowa (about 15 km from the dam site). Subansiri, from Katori Chapori to Jamuguri area, in and around 100 km river stretch is found to be safe habitat of the animal. The riverbed is almost exclusively sandy from Sector II to downwards with deeper pools. Ganges dolphin prefers deep pools (>3 m) in the river as their habitats where plenty of prey fish are available even during non-rainy months (Biswas & Baruah 2000). Increasing trend in their number for the last three years signifies the healthy status of the river and the observed water quality values along with river width and depth may be regarded as suitable range for survival of this species in the study area. Differences in sighting frequencies among habitats may be due to variations in the habitat type, density of the prey food and degree of disturbances in the dolphin faces.

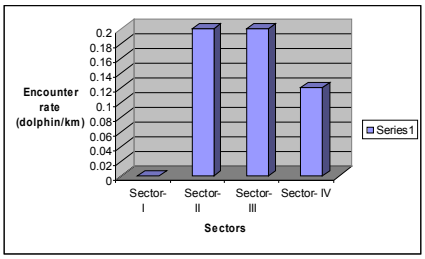

Fig. 2: Encounter rate of dolphins in different sectors of Subansiri river (2005-2006).

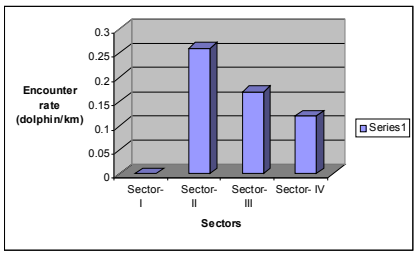

Fig. 3: Encounter rate of dolphins in different sectors of Subansiri river (2006-2007).

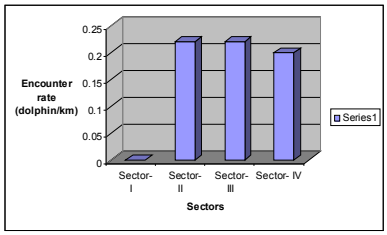

Fig. 4: Encounter rate of dolphins in different sectors of Subansiri river (2007-2008).

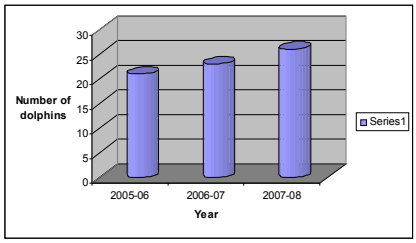

Fig. 5: Number of dolphins in Subansiri river (2005-06, 2006-07, 2007-08).

Awareness among the river bank people in the vicinity of the study area plays an important role in conservation of the animal. Green Heritage, an environment group of North Lakhimpur, Assam, has been working for conservation of the animal in the Subansiri with their own efforts. The members of Green Heritage have been campaigning for protection of the river dolphin by interacting with river bank inhabitants and fishermen; distributing leaflets and stickers to generate awareness about the protection of river dolphin. During the last 8 years, this has been a grand success as there was no record of intentional killing of this aquatic mammal in the Subansiri river. During 2005-6, no mortality was recorded, but in 2006-7 one calf got trapped in fishing net near the Kerker area and died, while in 2007-8, a pregnant dolphin died due to some unknown cause in the Bonpur Jamuguri area.

In the Subansiri, flow ranging from minimum flows in the winter to spring that are necessary for long term maintenance of the dolphin's house. Habitat shrinkage resulted after regulation of the river by the 2000 MW Lower Subansiri Hydroelectric Projects may pose a serious threat to the river dolphin. Instead of minimum 188 cumec/sec, only 25 cumec/sec water will be released after commissioning of the dam (EIA 2003). 86.70% reduction in lean period downstream discharge will be certainly unable to maintain the dolphin house in the river. Flushing of sediment and debris from this large impoundment after operation will equally enhance the fragmentation of dolphin habitat.

Although the project received environmental clearance in 2003 and final forest clearance in 2004 but no such measures for conservation of habitat and wildlife have been taken (Vogholikar 2007). No record on IUCN Red listed endangered river dolphin was found in the Environment Impact Assessment (EIA) report of the Lower Subansiri hydroelectric project (EIA Report 2003). To protect the ecological and social security of the downstream, in general, and Ganges dolphin in particular, the minimal environmental flows for long term sustenance of the animal is to be calculated and appropriate measures should be taken to save this recently declared India's national aquatic animal. Otherwise, NHPC authorities will be responsible for complete elimination of this endangered animal population forever from the Subansiri river.

Table 2: Distribution locations of dolphins in the Subansiri river (2005-2008).

Sectors	Area name	Location	2005-2006	2006-2007	2007-2008
I	Gerukamukh - Chowaldhowa	N27^{0}33' E94^{0}15' - N27^{0}26' E94^{0}15'	0	0	0
II	Chowaldhowa - Khabolo	N27^{0}26' E94^{0}15' - N27^{0}03' E94^{0}07,	9	12	10
III	Khabolo - Dhunaguri	N27^{0}03' E94^{0}07' - N27^{0}00' E94^{0}01'	7	6	8
IV	Dhunaguri - Jamuguri	N27^{0}00' E94^{0}01' - N26^{0}50' E93^{0}48'	5	5	8
Total			21	23	26

Table 3: Statisitical analysis of certain physico-chemical parameters of Subansiri river.

Statistics	Sectors	Mean	Standard Error	Standard Deviation	Skewness	Kurtosis	P_{25}	95% CL
Water temperature (^{0}C)	I	18.52	1.23	4.28	0.101	-1.151	14.45	2.72
	II	18.70	1.23	4.26	-0.180	-1.322	15.15	2.71
	III	18.50	1.41	4.90	0.140	-1.628	13.15	3.11
	IV	18.55	1.26	4.39	-0.057	-1.293	15.15	2.79
Transparency (cm)	I	38.61	5.47	18.97	0.703	-0.881	22.60	12.05
	II	42.29	5.69	19.72	0.908	-0.747	26.85	12.53
	III	43.90	5.52	19.12	0.566	-1.240	28.00	12.15
	IV	45.32	6.08	21.08	0.749	-1.044	28.65	13.39
Current flow (m/s)	I	1.91	0.15	0.52	-0.307	-1.350	1.35	0.33
	II	1.73	0.13	0.45	-0.467	-1.109	1.30	0.28
	III	1.79	0.11	0.38	0.075	-0.548	1.45	0.24
	IV	1.70	0.12	0.43	-0.325	-0.393	1.45	0.27
pH	I	7.44	0.09	0.33	0.334	-1.219	7.15	0.21
	II	7.55	0.10	0.38	-0.341	-1.182	7.20	0.24
	III	7.53	0.10	0.35	-0.298	-1.583	7.15	0.22
	IV	7.58	0.10	0.37	-0.159	-1.966	7.20	0.24

At 0.05 level, the means are significantly different; Sector I: Gerukamukh-Chowaldhowa; Sector II: Chowaldhowa-Khabolo; Sector III: Khabolo-Chunaguri; Sector IV: Dhunaguri-Jamuguri

The NHPC authorities take too lightly the importance of Environment Impact Assessment in these Indo-Myanmar biodiversity hotspot areas of Eastern Himalayan region. Inadequate investigations in respect to downstream ecology and biodiversity will be crucial for the future existence of Ganges dolphin in the river. It is believed that the dam authorities intentionally avoided the inclusion of Ganges dolphin in their EIA report for easy getting of environmental clearance.

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