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**Article** *in* International Journal of Ecology and Environmental Sciences · December 1997

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*International Journal of Ecology and Environmental Sciences* 23: 343-355, 1997


# Status and Conservation of Ganges River Dolphin in Bhagirathi-Hooghly River Systems in India

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## ABSTRACT

The Ganges river dolphin, *Platanista gangetica* is a freshwater dolphin, commonly known as susu and is distributed in Ganga-Brahamputra-Meghna and Karnaphuli river systems in India, Nepal and Bangladesh. It is found in the freshwater and estuarine zones but never enters sea. It is one of the four freshwater cetacean species found in the world.

Over-exploitation and habitat destruction are the major factors for rapid decline in dolphin population. Construction of Farakka Barrage in mid-1970s has genetically isolated the susu population. For the first time dolphin count in Feeder Canal, Bhagirathi and Hooghly rivers, and downstream Farakka Barrage was undertaken in low water season of 1995. Actual count as suggested by Cetacean Specialist Group of IUCN/SSC was done between Farakka and Calcutta. A best count of 152 dolphins was obtained. Habitat preferences of susus and impact of pollution and other human activities were studied. Based on the study, current status of dolphin in Bhagirathi and Hooghly rivers has been discussed and conservation measures suggested.

*Key Words*: Farakka Barrage, Ganges river dolphin, Genetic isolation, Habitat fragmentation, *Platanista gangetica*, Pollution, River traffic.

## INTRODUCTION

The Ganges river dolphin or 'susu', *Platanista gangetica*, is a freshwater dolphin distributed throughout the Ganges-Brahamputra-Meghna and Karnaphuli river systems of India, Bangladesh and Nepal with a closely related Indus Dolphin *Platanista minor* (Anderson 1878, Kasuya and Haque 1972, Jones 1982, Reeves and Brownell 1989, Shreshtha 1989 and Reeves et al. 1991). It comprises a separate, family of cetaceans, the Platanistidae (Reeves and Brownell 1989).The status of the species in the IUCN Red List of Threatened animals has recently been changed from Vulnerable (Klinowska 1991) to Endangered (Baillie and Groombridge 1996). The only other extant river dolphins are the 'Baiji' (*Lipotes vexillifer*) in China's Yangtze River, and the 'Boto' (*Inia geoffrensis*), Amazon and Orinoco basins of South America (Perrin et al. 1989). The 'Franciscana' (*Pontoporia blainvillei*) is a platanistoidal and thus, phylogenetically, a river dolphin, but its distribution is marine rather than riverine- along the east coast of South America. A delphinid, the Tucuxi (*Sotalia fluviatilis*) is sympatric with the Boto, but its distribution includes estuaries and coastal waters, and its phylogeny places it with the marine

dolphins. Another delphinid, the Pesut (*Oreaella brevirostris*) is found in freshwater zone of Irrawady River of Myanmar, Mekong River of Laos, Combodia and Thailand but its distribution includes estuaries, coastal waters and marine areas. Like Tucuxi, its phylogeny places it with the marine dolphins (Reeves et al. 1991).

During the second half of this century, the Ganges River and all its major tributaries have been subdued and transformed by constructing dams and barrages to control water level and divert water for irrigation with little regard for dire environmental consequences. It has resulted in salinization, water logging, deforestation, and vast areas of wildlife habitat and natural beauty have thus been lost. The cost of such progress has been very high and the burden of paying for it will fall mainly on future generations. Among the wild species that have been very seriously affected by water 'development' projects is the endemic Ganges River Dolphin or 'susu' (*Platanista gangetica* Roxburgh 1801).

In India, most of the direct responsibility for wildlife conservation and environmental protection is state Government affairs, however, central Government also shares the responsibility as and when needed. In India the distribution of the Gangetic Dolphin falls mainly within four states: Uttar Pradesh, Bihar, West Bengal and Assam. Besides these states a small population is found in Chambal River which passes through Rajasthan, Madhya Pradesh and Uttar Pradesh. Most of the current population of several hundred dolphins is confined to Bihar, where a Vikramshila Gangetic Dolphin Sanctuary has been set up between Sultanganj and Kahalgaon in 50-km stretch of the main channel of the River Ganga in 1991. The largest extent of available river dolphin habitat estimated at thousands of kilometres in total length is in Uttar Pradesh, Bihar and West Bengal. However, the dolphin population in West Bengal has largely declined after construction of Farakka Barrage in 1975.

## Historical Context

Though western science could know Ganges Dolphin's existence in 1801, it has been mentioned and illustrated in the miniatures of the "Babar-Nama" manuscript which dates from 1598 and is at present in the Indian National Museum in New Delhi. In the Moral Edicts of King Ashoka (240 BC) the Ganges dolphin-as puputaka of the Ganges is included among the protected animals. In Indian mythology the Ganges dolphin appear in the legend of the origin of the Ganges in the Mahabharata. Bhattasali (1929) identified dolphin as 'vahana' of the Ganges. Anderson (1878) published a detailed report on morphology and biology of this animal with a distribution map. However, in recent time concern about its conservation became widespread only in the present decade when Government of India under its Ganga Action Plan sponsored a research and conservation project in 1991 to protect the endangered species of Ganga including susu, the Ganges dolphin, and use this animal as an indicator species for biomonitoring of Ganga water quality.

After Anderson's classic work of 1878 virtually no information on Ganges dolphin in India was available until the present author undertook both intensive and extensive study under Dolphin Conservation Project of Govt of India in 1991. The range of susu in the Ganges fall between 77°E and 89°E, and in the Brahamputra up to 95°E and 28°N (Anderson 1878). The upstream limits were determined by lack of water and rocky barriers, and the downstream limits by sea water. He reported that even in the month of

May, when the Ganges is very low, it extended up the Yamuna river as far as Delhi. In recent years, dolphin was last seen at Delhi in Yamuna River in 1967 when a dead dolphin caught in fishermen's net was brought to Delhi Zoo (Personal Communication by late Dr. K.S. Sankhla, the then Director, Delhi Zoo). Nath (1974) published a very small paper on his casual observation on habit and habitat of susu in R. Ganga near Patna. About 45 dolphins were estimated in the Chambal river, a south western tributary of R. Ganga, in early 1980 (Singh and Sharma 1985). One time survey in discrete segments of the mainstream of R. Ganga was carried out in 1978 by a Zoological Survey of India scientist who observed that the Ganges dolphins were most abundant from Munger to Sahibganj in Bihar; common upto the Farakka Barrage towards east and upto Varanasi or slightly more westward (Gupta 1986). The estimated population of dolphins in the Ganga river in Bihar in 1988-89 was around 2000 (Ali 1992).

During 1992-93 census of Gharials in National Chambal Sanctuary from Pali to Pachnada in 435 Km distance 72 dolphins were counted (Sharma 1993). Total count of 1326 dolphins in Brahamputra river and its tributaries was reported by Lal Mohan, a naturalist of Nature Conservation Trust, Calicut, Kerala in 1992 in a Seminar on Conservation of River Dolphins in the Indian sub-continent (Reeves et al. 1993). Again in the First Meeting of the Asian River Dolphin Committee at Hong Kong in December, 1994 total population of dolphins in the same river was estimated to be 400 by the same worker, i.e. Lal Mohan (Reeves and Leatherwood 1995). The data on census of the dolphins in Brahamputra and its tributaries needs verification.

The census of Ganges dolphins have been undertaken in Nepal in recent years. In Karnali river seven dolphins were sighted in 1990 (Smith 1993). R.K. Sinha (the present author) with Brian D. Smith and a Nepalese wildlife official surveyed all the four major rivers of Nepal viz-Mahakali, Karnali, Narayani and Kosi, and recorded 2-3 dolphins in Karnali, only one in Narayani, 3 in Kosi and none in Mahakali (Smith et al. 1994).

The present paper deals with the current status of the Ganges river dolphin in Bhagirathi-Hooghly rivers in West Bengal in India. After construction of the Farakka Barrage the flow pattern in these two rivers has completely changed and so the dolphin habitat. The human activities including cultivation upto the water line of river and industrialization along the twin river system has seriously degraded the dolphin habitat. Intense river traffic specially near Calcutta has also affected the dolphin population in Hooghly river.

## STUDY AREA

The status survey of the Ganges river dolphin was carried out in the Bhagirathi-Hooghly rivers in West Bengal. The two river system are the main distributary of Ganga River in India. R. Ganga after originating from Gaumukh glacier in Himalayas traverses through plains of Uttar Pradesh and Bihar. Downstream, 43 km from Bihar border, R. Ganga bifurcates into Bhagirathi River and Padma River. River Bhagirathi (approx. 323 km) passes through west Bengal upto Tribenighat near Kalyani where it changes into tidal zone and is called R. Hooghly which ultimately flows into the Bay of Bengal through Calcutta. River Padma flows about 90 km along India-Bangladesh border before entering Bangladesh and join Brahamputra river (Jamuna river in Bangladesh). In mid-fifties

Ganga water flowed largely through River Padma resulting in reduced flow in Bhagirathi. In the process River Hooghly was not getting enough flow of water. This adversely affected the premier Calcutta Port (now Haldia Port). To preserve and maintain the Calcutta Port which has greatly been adversely affected over the years due to reduced flow of water into Hooghly River, Farakka Barrage was constructed in 1975 about 40 km upstream of bifurcation point of Padma and Bhagirathi. The Farakka Barrage through a Feeder Canal (38 km) provide silt free water in the River Bhagirathi which in turn flows into Hooghly river. At the head of Bhagirathi River another barrage, called Jangipur Barrage, has been constructed which facilitates flow of water from R. Ganga to R. Bhagirathi but not vice-versa. A continuous dolphin survey was undertaken in low water season in the Feeder Canal, Bhagirathi and Hooghly river between Farakka and Calcutta Botanical Garden. Both Feeder Canal and Bhagirathi river has barrier at its head which has completely isolated the dolphin population in Bhagirathi-Hooghly river system from the mainstem of the Ganga. The flow of water in these rivers is regulated and during low water season the flow of water is approximately twenty thousand cusecs in the Feeder Canal.

## MATERIALS AND METHODS

The research team consisted of five individuals and assisted by local fishermen. Surveys were conducted by two teams of researchers, using "country boats" powered by sail or paddle. Each team was led by an experienced researcher. The two teams coordinated their activities fully during the survey. Following the recommendations of a panel of experts (Perrin and Brownell 1989), we used a direct count survey method to estimate dolphin abundance. When dolphins were sighted, we remained in the area for approximately 15 minutes before recording the count. Usually, the number of dolphins was greater near confluences and downstream of bridge pilings and sand bars. At such sites we devoted at least one hour observing in order to reduce the chances of counting a single animal more than once or of undercounting when more than one animal was present.

During the continuous survey between Farakka and Calcutta (3-11 April, 1995) we used sail/oar driven country boat floating down almost for 12 hours every day from sun rise to sun-set. We used a direct count survey method to estimate dolphin numbers. We recorded best high and low estimates of the number of animals in the group. The high and low estimate, were used to reflect our confidence in the accuracy of the best estimate. The low estimate was considered to be an absolute minimum count and the high estimate an absolute maximum count. We used identical best, high, and low estimates to indicate a high level of confidence in our best estimate. During some sightings dolphins appeared to follow the boat which added uncertainty to whether subsequent sighting were new or the same animals(s). In this case we used a low estimate of zero to reflect the possibility of making double counts.

Long dive times, unpredictable movements and quiescent behaviour also made using a single count unreliable. During quiescent behaviour dolphins surface without an audible blow and expose only the upper most dorsal surface of the melon. Sightings that could not be substantiated by subsequent surfacings or confirmation by a second member of the team were given a best and low estimate of zero and a high estimate of one. We also used

distinctive physical characteristics of individual animals (e.g. scarring, length of rostrum relative to the height of melon, and body size) and the location of surfacings relative to shore line features or other animals to assist in making group-size estimates. Estimates were arrived by consensus among the team of observers that initially sighted the dolphins.

## RESULTS AND DISCUSSION

Anderson (1878), based on reports from British colonial officers posted throughout the then Indian Empire, indicates that dolphins ranged as far as the foothills of Himalayas in the Ganges and its tributaries, including Yamuna, Chambal, Ghaghara, Gandak, Kosi, Sone etc. and dolphins occurred downstream in the Ganges to the deltaic zone. No information about status of Ganges dolphins is available in West Bengal except. Gupta (1986) who undertook survey in discrete segments of the river in February, 1978. But it appears to be just a gussestimate and probably he did not spend much time in censusing the dolphins. In Ganges at Farakka Barrage he could sight only five dolphins whereas locals estimate was plenty. In the whole Feeder Canal and at confluence of River Bhagirathi and Feeder Canal he sighted only two dolphins. Another two dolphins were sighted near Calcutta. Thus a total of nine dolphins were sighted in 1978 in Ganga, Bhagirathi and Hooghly rivers in West Bengal. Anderson (1878) sighted dolphins more frequently in R. Hooghly at Calcutta in the cold weather (January-February). During hot months he rarely observed them in the Hooghly and anticipated that dolphins deserted Hooghly in summer. Even observing most carefully Anderson never sighted surfacing of dolphins during rains and explained that strength of the current in Hooghly was so great during rains that the dolphins were prevented from rising to the surface in the marked manner i.e. the surfacing could not be detected.

During 3-11 April 1995, a continuous survey of dolphin was carried out between Farakka Barrage and Calcutta Botanical Garden covering a total length (461 km) of Feeder Canal (38 km), Bhagirathi River (323 km) and Hooghly River (100 km). The flow of water is regulated in this stretch of river due to construction of Farakka Barrage and a Head-regulator in the Feeder Canal. The Feeder Canal has bed width of 495 ft (148 m). The full supply depth is 20 ft (6 m). The design discharge is 40,000 cusecs (cubic feet per second). April being the leanest season the discharge through the Feeder Canal was about 20,000 cusecs. At the end, the Feeder Canal joins river Bhagirathi near Jangipur.

The Farakka Feeder Canal was surveyed on 3 April, 1995 and 16 dolphin groups for a total of 14-20 dolphins (overall best estimate = 20 dolphins; min. 1, max. 2; mean group size 1.25, SD = 0.45) were sighted. (Table 1) Large concentrations of dolphins were located downstream bridge pilings and at the convergence of the Feeder Canal and Bhagirathi river.

During 3 to 9 April, 1995 a continuous survey was conducted in River Bhagirathi from Jangipur Barrage to Tribenighat near Kalyani (approximate distance of 323 km) where the river changes its name to R. Hooghly. 86 dolphin groups for a total of 104-132 (overall best estimate 119 dolphins; min. 0, max. 5, mean group size 1.4, SD = 0.83) (Table 2) were sighted in River Bhagirathi. The largest concentrations of dolphins were located at the confluence of Farakka Feeder Canal and below sharp meanders scattered throughout the length of the river. Interestingly dolphins were sighted at every Ferry

station; probably due to human activities some food material/eatables are available for the fishes which in turn attract the dolphins.

Table 1. Summary of Dolphin sightings in the Farakka Feeder Canal during a continuous survey on 3 April, 1995.

| Time | Location | GPS Position | | Group Size | | |
|---|---|---|---|---|---|---|
| | | | | H | B | L |
| 12:50 | D/S New By Pass Bridge, NTPC, Farakka | N-24°47.142′ | E-87°54.419′ | 1 | 1 | 0 |
| 14:07 | D/S Baghmarighat | N-24°40.267′ | E-87°55.281′ | 1 | 1 | 1 |
| 14:10 | D/S above location | | | 1 | 1 | 0 |
| 14:35 | U/S Pankur Bridge | N-24°38.565′ | E-87°55.688′ | 1 | 1 | 1 |
| 14:40 | D/S above location | | | 1 | 1 | 1 |
| 14:47 | D/S above location | N-24°37.890′ | E-87°55.910′ | 1 | 1 | 1 |
| 14:58 | D/S above location | N-24°37.160′ | E-87°56.520′ | 1 | 1 | 1 |
| 15:09 | D/S above location | N-24°36.718′ | E-87°57.048′ | 1 | 1 | 0 |
| 15:25 | U/S Belaghati, Ferry Ghat | N-24°35.868′ | E-87°58.021′ | 2 | 2 | 1 |
| 15:55 | D/S above location | N-24°34.428′ | E-87°59.667′ | 2 | 2 | 1 |
| 16:15 | U/S Ahiran Bridge | N-24°33.671′ | E-88°00.588′ | 2 | 2 | 2 |
| 16:25 | D/S above location | N-24°33.131′ | E-88°01.218′ | 1 | 1 | 1 |
| 16:35 | D/S above location | N-24°32.919′ | E-88°01.402′ | 1 | 1 | 0 |
| 16:49 | D/S Ahiron Bridge | N-24°32.249′ | E-88°02.182′ | 1 | 1 | 1 |
| 17:06 | D/S above location near Jangipur Barrage | N-24°31.691′ | E-88°02.785′ | 1 | 1 | 1 |
| 17:25 | D/S above location | N-24°30.962′ | E-88°03.216′ | 2 | 2 | 2 |

During 9-11 April, 1995, a continuous survey of Hooghly River from Tribenighat to the Calcutta Botanical Garden (approximately 100 km) was conducted and 10 dolphin groups for a total of 10-16 dolphins (overall best estimate 12 dolphins; min. 0, max. 3 mean group size 1.18 dolphins; SD = 0.83) were sighted (Table 3). Large concentrations of dolphins were located downstream of the Bandel and new Howrah bridges. Due to unforeseen circumstances we had to continue our float down survey in hightide from downstream Barrackpore (5 km) and Howrah (total distance 18 km) during night. So we could not count any dolphin in a stretch of 18 km of Hooghly. Originally the survey was planned for Ganga Sagar Island i.e. upto the mouth of the Ganges in the Bay of Bengal but due to cyclonic weather the survey was abandoned near Calcutta Botanical Garden. We visited the Sagar Island by road and ferry to ascertain the presence of dolphins. On 12 April, 1995 a single dolphin was sighted at Kakdwip ferry station near the mouth of the Hooghly.

Table 2. Summary of Dolphin sightings in River Bhagirathi during April, 1995.

| Time | Location | GPS Position | | Group Size H | B | L |
|---|---|---|---|---|---|---|
| 03-04-1995 | | | | | | |
| 17:30 | At the mouth of Feeder Canal | N-24°30.864′ | E-88°03.155′ | 6 | 5 | 5 |
| 17:50 | Just D/S above location | N-24°30.319′ | E-88°02.669′ | 1 | 1 | 1 |
| 17:59 | D/S above location | | | 1 | 1 | 1 |
| 04-04-1995 | | | | | | |
| 08:32 | Jangipur | N-24°24.929′ | E-88°06.011′ | 4 | 3 | 3 |
| 09:13 | D/S above location | N-24°24.155′ | E-88°80.233′ | 1 | 1 | 1 |
| 09:27 | D/S above location | N-24°24.246′ | E-88°08.940′ | 1 | 1 | 0 |
| 11:55 | At Gandhi Bhatpara | N-24°22.950′ | E-88°08.628′ | 2 | 2 | 1 |
| 13:55 | D/S above location | N-24°22.774′ | E-88°08.699′ | 2 | 2 | 2 |
| [illegible]:04 | D/S above location | | | 1 | 1 | 0 |
| 14:07 | D/S above location | | | 1 | 0 | 0 |
| 14:10 | D/S above location | N-24°18.585′ | E-88°12.822′ | 2 | 2 | 2 |
| 14:16 | D/S above location | | | 3 | 2 | 2 |
| 14:20 | D/S above location | | | 1 | 1 | 1 |
| 14:25 | D/S above location | N-24°18.585′ | E-88°12.831′ | 1 | 1 | 1 |
| 15:35 | D/S above location | N-24°18.562′ | E-88°13.258′ | 3 | 2 | 2 |
| 15:10 | D/S above location | N-24°15.746′ | E-88°15.169′ | 1 | 1 | 1 |
| 05-04-1995 | | | | | | |
| | Vishrampur Bank | N-24°15.521′ | E-88°15.055′ | | | |
| 07:00 | D/S above location | N-24°15.592′ | E-88°14.628′ | 1 | 1 | 1 |
| 07:10 | D/S above location | | | 1 | 1 | 1 |
| 07:17 | U/S Ajimganj | N-24°14.607′ | E-88°14.992′ | 1 | 1 | 1 |
| 07:24 | Ferry Ghat, Ajimganj | N-24°14.642′ | E-88°15.642′ | 1 | 1 | 1 |
| 07:28 | D/S Ferry Ghat, Ajimganj | | | 2 | 2 | 2 |
| 08:06 | D/S Ajimganj | N-24°12.250′ | E-88°15.390′ | 1 | 1 | 1 |
| 11:35 | D/S above location | N-24°04.432′ | E-88°14.476′ | 1 | 1 | 0 |
| 12:19 | U/S Baharampur | N-24°01.415′ | E-88°12.669′ | 1 | 1 | 1 |
| 12:35 | Near Bathing Ghat, Baharampur | N-24°00.616′ | E-88°12.914′ | 3 | 2 | 2 |
| 13:19 | Baharampur Bridge | N-23°59.686′ | E-88°12.788′ | 1 | 1 | 1 |
| 13:44 | D/S above location | N-23°59.466′ | E-88°11.724′ | 1 | 1 | 1 |
| [illegible]:44 | D/S above location | | | 1 | 1 | 1 |
| 14:16 | D/S above location | N-23°59.103′ | E-88°12.210′ | 1 | 0 | 0 |
| 14:59 | D/S above location | N-23°58.417′ | E-88°11.846′ | 1 | 1 | 1 |
| 17:24 | U/S Bindpara/Mirjapur | N-23°59.904′ | E-88°12.200′ | 3 | 2 | 2 |
| 06-04-1995 | | | | | | |
| 06:30 | Bindpara/Mirjapur | N-23°53.448′ | E-88°12.404′ | 1 | 1 | 1 |
| 07:03 | D/S above location | N-23°52.243′ | E-88°13.555′ | 1 | 1 | 1 |
| 07:06 | D/S above location | | | 1 | 1 | 0 |
| 07:26 | Near Samar Danga village | N-23°51.655′ | E-88°12.690′ | 1 | 1 | 1 |
| 07:45 | D/S above location | | | 1 | 1 | 0 |
| 07:50 | D/S above location | N-23°50.389′ | E-88°12.633′ | 1 | 1 | 1 |
| 08:48 | Behind diara land (sand bar) | N-23°50.370′ | E-88°12.649′ | 1 | 1 | 1 |
| 10:06 | D/S Ram Nagar | N-23°45.411′ | E-88°13.177′ | 1 | 1 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10:55 | Ferry Ghat | N-23°45.345′ | E-88°11.589′ | 1 | 1 | 0 |
| 11:05 | D/S above location | | | 3 | 2 | 0 |
| 11:20 | D/S above location | N-23°44.270′ | E-88°11.739′ | 1 | 1 | 1 |
| 11:45 | D/S above location | N-23°45.874′ | E-88°11.044′ | 1 | 1 | 0 |
| 11:55 | D/S above location | | | 2 | 2 | 2 |
| 11:58 | D/S above location | | | 2 | 2 | 2 |
| 12:02 | D/S above location | | | 6 | 5 | 5 |
| 12:31 | D/S above location | N-23°42.996′ | E-88°10.548′ | 2 | 2 | 2 |
| 12:55 | D/S above location | N-23°42.282′ | E-88°10.385′ | 1 | 1 | 0 |
| 13:22 | D/S above location | N-23°42.380′ | E-88°09.431′ | 4 | 4 | 3 |
| 14:45 | D/S above location | N-23°39.167′ | E-88°08.142′ | 1 | 1 | 1 |
| 15:40 | D/S above location | N-23°39.160′ | E-88°08.188′ | 1 | 1 | 1 |
| 15:50 | D/S above location | | | 1 | 1 | 1 |
| 16:30 | D/S above location | N-23°37.267′ | E-88°10.614′ | 1 | 1 | 0 |
| 17:08 | D/S above location | N-23°36.857′ | E-88°12.945′ | 1 | 1 | 1 |
| **07-04-1995** | | | | | | |
| 06:25 | D/S above location | N-23°36.684′ | E-88°13.255′ | 1 | 1 | |
| 07:00 | D/S above location | N-23°37.025′ | E-88°15.163′ | 3 | 2 | 2 |
| 07:35 | D/S above location | N-23°35.894′ | E-88°15.096′ | 1 | 1 | 1 |
| 08:34 | D/S above location | N-23°33.951′ | E-88°15.400′ | 1 | 1 | 1 |
| 09:01 | At Patuli | N-23°33.713′ | E-88°15.999′ | 1 | 1 | 1 |
| 09:54 | D/S above location | N-23°33.708′ | E-88°16.010′ | 1 | 1 | 1 |
| 14:54 | D/S above location | N-23°28.480′ | E-88°21.270′ | 2 | 2 | 2 |
| 15:56 | U/S Mayapuri | N-23°25.895′ | E-88°22.060′ | 2 | 2 | 1 |
| 16:10 | Near Mayapuri | N-23°25.323′ | E-88°23.025′ | 2 | 2 | 2 |
| **08-04-1995** | | | | | | |
| 08:08 | Nabadwip Ferry Ghat | N-23°22.447′ | E-88°21.514′ | 4 | 3 | 3 |
| 08:32 | D/S Nabadwip | N-23°22.447′ | E-88°21.514′ | 1 | 1 | 1 |
| 09:06 | D/S Nabadwip | N-23°20.351′ | E-88°22.618′ | 1 | 1 | 0 |
| 09:25 | D/S Nabadwip | N-23°19.840′ | E-88°22.705′ | 1 | 1 | 1 |
| 09:36 | D/S above location | | | 1 | 1 | 1 |
| 10:47 | D/S above location | | | 1 | 1 | 1 |
| 10:55 | Near Baludenga Ghat | N-23°21.902′ | E-88°19.695′ | 1 | 1 | 1 |
| 11:32 | D/S above location | N-23°20.142′ | E-88°19.937′ | 2 | 2 | 1 |
| 12:54 | D/S above location | N-23°16.646′ | E-88°20.409′ | 2 | 2 | 2 |
| 13:11 | Near Dhatrigram Railway Stn | N-23°16.416′ | E-88°19.791′ | 1 | 1 | 1 |
| 15:29 | D/S above location | N-23°13.710′ | E-88°21.713′ | 1 | 1 | 1 |
| 16:30 | D/S Kalan | N-23°12.427′ | E-88°25.078′ | 1 | 1 | |
| 16:49 | D/S above location | N-23°12.427′ | E-88°25.078′ | 1 | 1 | 1 |
| 17:09 | D/S Guptipara Ghat & Station | N-23°13.221′ | E-88°26.382′ | 1 | 1 | 1 |
| 18:30 | D/S above location | | | 1 | 1 | 1 |
| **09-04-1995** | | | | | | |
| 07:47 | D/S above location | N-23°11.418′ | E-88°28.152′ | 3 | 2 | 2 |
| 08:05 | D/S above location | | | 1 | 1 | 1 |
| 09:44 | D/S above location | N-23°07.721′ | E-88°27.742′ | 1 | 1 | 0 |
| 10:02 | D/S above location | N-23°07.105′ | E-88°27.779′ | 1 | 1 | 1 |
| 11:06 | D/S above location | N-23°06.619′ | E-88°30.604′ | 1 | 1 | 1 |
| 11:47 | D/S above location | N-23°05.001′ | E-88°29.799′ | 1 | 1 | 1 |
| 13:29 | D/S Haldarpara | N-23°03.696′ | E-88°27.536′ | 1 | 1 | 1 |
| 14:55 | Near DVC Hi-Tension wire | N-23°00.791′ | E-88°25.995′ | 1 | 1 | 1 |

Table 3. Summary of Dolphin sightings in River Hooghly (tidal zone) during April, 1995.

| Time | Location | GPS Position | | Group Size H | B | L |
|---|---|---|---|---|---|---|
| **09-04-1995** | | | | | | |
| 17:55 | D/S Railway bridge near Bandel | N-22°54.456′ | E-88°24.360′ | 3 | 2 | 2 |
| **10-04-1995** | | | | | | |
| 13:32 | Near Ichhapore | N-22°49.712′ | E-88°22.345′ | 2 | 2 | 2 |
| 16:20 | Near Barackpore | N-22°46.054′ | E-88°20.211′ | 1 | 1 | 1 |
| 16:44 | D/S above location | N-22°45.385′ | E-88°20.983′ | 2 | 2 | 2 |
| 17:00 | D/S above location | N-22°44.770′ | E-88°21.582′ | 1 | 0 | 0 |
| 17:22 | D/S above location | N-22°43.943′ | E-88°21.572′ | 1 | 0 | 0 |
| **11-04-1995** | | | | | | |
| 04:55 | U/S Howrah Bridge, Howrah | N-22°35.695′ | E-88°20.896′ | 1 | 1 | 0 |
| 11:30 | D/S Howrah Bridge | N-22°33.809′ | E-88°20.058′ | 1 | 1 | 1 |
| 12:30 | Near Autram Ghat, Hooghly | N-22°33.407′ | E-88°19.938′ | 3 | 2 | 2 |
| 14:02 | Near Botanical Garden | N-22°33.938′ | E-88°17.478′ | 1 | 1 | 0 |
| **12-04-1995** | | | | | | |
| 11:55 | Near Kakdwip Jetty | N-22°33.001′ | E-88°09.816′ | 1 | 1 | 1 |

## Protection and Exploitation

The Ganges fiver dolphin has been legally protected in India since 1972 under the Wildlife (Protection) Act 1972. Effective surveillance and enforcement of the Wildlife (Protection) Act have proved difficult because of the apathy, ignorance, shortage of funds and personnel in the Wildlife Department. During study in different segments of the Ganga and its tributaries directed killing of dolphin was not confirmed, however, throughout its distribution range in India dolphins are killed accidentally usually in fishing gill nets. People of 'Banpar' community and few people of other community of lower strata of the society were found eating dolphin meat. Dolphin oil is used as fish lure and for relieving rheumatism and muscular pain. In West Bengal though dolphins are accidentally killed in fishing gill nets, the dolphin oil is not used as fish bait. The fishermen retained the oil for medicinal purposes and discard the carcass. Sometimes they sell the oil to Bihar's fishermen who use the oil as fish lure. Anderson (1878, p. 422) considered the accidental capture of Ganges dolphins a common occurrence near Calcutta where he carried out most of his research.

## Loss of Habitat

The most obvious and immediate threat to the Ganges dolphin is from loss of habitat. Anderson (1878) reported that rivers in the Ganges system were occupied by the Ganges

dolphin between foothill of the Himalayas and the deltaic zone. After India got independence in 1947, almost all the rivers originating from Himalayas or forming a part of the Ganges system has been dammed between 1950s and 1980s. In Nepal only 3 dolphins are surviving in river Kosi upstream Kosi Barrage (on Indo-Nepal border), one dolphin is surviving in Narayani river upstream Gandak Barrage and in Karnali-Girwa river approximately 20 dolphins are surviving upstream Girija Barrage which is constructed 20 km inside India from Indo-Nepal border. No dolphin could be recorded in Mahakali river in Nepal upstream Banbasa Barrage on India-Nepal border. In Sarda river's navigable stretch no dolphin could be sighted during our survey in March, 1994 upstream Sarda Barrage.

In the mainstem of R. Ganga, dolphins were not found during December, 1996 survey upstream Madhya Ganga Barrage at Bijnor (approx. 100 km downstream foothill of the Himalayas). Thus the potentially available habitat has shrunk to a greater extent and dolphins are almost absent in the Terai region (plains along the Himalayas) in India and Nepal.

The Farakka Barrage, constructed in 1975, created a barrier to the movement of susus and other aquatic wildlife between the lower reaches of the Ganges system, including the biologically rich Sundarbans, and the middle and upper Ganges (Jones 1982). Besides subdividing the Ganges population of dolphins, the barrage has degraded the riverine habitat, both upstream and downstream of the structure. The extent to which the dolphin move through the barrage is unclear, though it is generally agreed that any upstream movement on their part is virtually impossible. The only opportunities would be during the peak of the flood-season, when the barrage gates are open. To move upstream, a dolphin would need to be highly motivated in addition to being a powerful enough swimmer to advance against the torrent (Reeves et al. 1991). Downstream movement, on the other hand, is likely to occur, at least occasionally, however, inspite of our best effort and observation for five years in different seasons at Farakka we could not get any direct evidence for it.

In the Feeder Canal though a small population of 20 dolphins are surviving the intensive fishing activities near the head and mouth of the canal has posed a great threat to the dolphins. Occasionally dolphins are accidentally cought in fishing gill nets in the Feeder Canal at Farakka.

The extraction of water through lift irrigation throughout Bhagirathi river and paddy cultivation upto the waterline of the river is another cause of habitat loss. Use of chemical Fertilizers and pesticides by the cultivators along the river also degrade the habitat of dolphin. Kannan et al. (1993, 1994) have recorded high content of organochlorines in the tissues of the dolphins collected from Ganga near Patna. However, no data is available on toxic chemical content in dolphin tissues from West Bengal. Heavy industrialization all along the river Hooghly and their effluent discharge in the river is also responsible for habitat loss of the dolphin. No dolphin could be sighted in the vicinity of industrial discharge.

With the development of economy and population explosion at Calcutta, the number of motorized vessels in the river Hooghly has increased many fold in recent past. The navigation channels have endangered the safety of the dolphins. There are many anchorages and ships in the city, and the underwater noise may have harmful effects on the susu. Heavy river traffic in Hooghly near Calcutta is the greatest threat for the

dolphin population. In Yang-t-ze river of China river traffic has accounted for 21.2% of the total mortality of the dolphin (Peixun and Yuanyu 1989). We could not confirm any death of dolphin by motorized boats in Hooghly at Calcutta but we observed that dolphins are confined to small undisturbed area in Hooghly near Calcutta where the motorized boats either do not operate or operate occasionally. It appeared that the dolphins were frightened.

### Effects of Fragmentation

Artificial fragmentation of species populations into isolated subpopulations is an increasingly common consequence of human activity. Such fragmentation affects species survival negatively in most cases (Wilcox and Murphy 1985). Construction of Farakka Barrage has directly restricted the movements of dolphin, thus inhibiting genetic, social and ecological interactions among individual's and groups and changed the ecology of the river. The river distance from Farakka Barrage to Sagar Island is 560 km and thus the dolphins in Bhagirathi-Hooghly rivers have sufficient available habitat but definitely have been isolated from the Ganga mainstem population. Moreover, the population size is relatively small.

The problem of defining minimum viable population-size for various species has been widely discussed (Schaffer 1981, Soule 1987). Doubts can be raised about the viability of the small dolphin population of 152 in Bhagirathi-Hooghly river system in West Bengal.

Fragmentation limits gene-flow and increases the vulnerability of individual subpopulations to natural catastrophes. It also limit the exposure of some groups 'of dolphins to certain environmental hazards such as high level of chemical pollution.

## RECOMMENDATIONS

The Ganges river dolphin is scattered throughout the stretch of Bhagirathi-Hooghly River covering 560 km in West Bengal. The population is very small. Protection to ensure adequate reproduction is very difficult. Following measures are suggested to be taken:

Protected areas must be established for dolphins. Places where dolphins are found in high density and where mortality rate is high could be selected to be such protected areas. Farakka Feeder Canal may be one such area. Regulations must be promulgated effectively and patrol boats should be provided for protection of the habitat. Harmful fishing gears viz. monofilament nylon gillnet should be banned to reduce the incidental deaths. With the development of navigation and fisheries on the river, the susu is becoming progressively more endangered. River water pollution due to river traffic and industries must be taken care off effectively. The farmers along the river must be educated for proper use of chemical fertilizers and pesticides.

## ACKNOWLEDGEMENTS

I am grateful to the Ganga Project Directorate, Ministry of Environment and Forests,

Government of India. and Whale and Dolphin Conservation Society, Bath, England, for financial assistance.

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