



**THE CONSERVATION ACTION PLAN
FOR
THE GANGETIC DOLPHIN
2010-2020**



**National Ganga River Basin Authority
Ministry of Environment & Forests
Government of India**



जहाँ है हरियाली ।
वहाँ है खुशहाली ॥

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November, 2010

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MINISTER'S FOREWORD

I am pleased to introduce the Conservation Action Plan for the Gangetic Dolphin (*Platanista gangetica gangetica*) in the Ganga river basin. The Gangetic Dolphin is one of the last three surviving river dolphin species and we have declared it India's National Aquatic Animal. Its conservation is crucial to the welfare of the Ganga river ecosystem.

Just as the Tiger represents the health of the forest and the Snow Leopard represents the health of the mountainous regions, the presence of the Dolphin in a river system signals its good health and biodiversity. This Plan has several important features that will ensure the existence of healthy populations of the Gangetic dolphin in the Ganga river system.

First, this action plan proposes a set of detailed surveys to assess the population of the dolphin and the threats it faces. Second, immediate actions for dolphin conservation, such as the creation of protected areas and the restoration of degraded ecosystems, are detailed. Third, community involvement and the mitigation of human-dolphin conflict are proposed as methods that will ensure the long-term survival of the dolphin in the rivers of India.

This Action Plan will aid in their conservation and reduce the threats that the Gangetic Dolphin faces today. Finally, I would like to thank Dr. R. K. Sinha, Dr. S. Behera and Dr. B. C. Choudhary and others who have been working on this document. I look forward to the implementation of this Conservation Action Plan.

Regards,

JAIRAM RAMESH
Minister of State for Environment & Forests (Independent Charge),
Government of India

ACKNOWLEDGEMENTS

We are indebted to Dr. Manmohan Singh, Hon'ble Prime Minister of India, Shri Nitish Kumar, Hon'ble Chief Minister of Bihar, and Sri Jairam Ramesh, Hon'ble Minister of State for Environment and Forests (Independent Charge), Government of India for their support in declaring the Gangetic Dolphin as the National Aquatic Animal and to the National Ganga River Basin Authority, Ministry of Environment and Forests, for constituting a Working Group for the preparation of this Conservation Action Plan for the Gangetic Dolphin and for financial support through the same.

We are thankful to all the contributions received from the participants to the Workshop, for formulation of this Action Plan, held at Patna on the 22 and 23 February, 2010. We are grateful especially to Dr. Randall R. Reeves, Chairman of the Cetacean Specialist Group of International Union for Conservation of Nature (IUCN), Shri P. R. Sinha, Director, Wildlife Institute of India, Dehradun, Shri B. A. Khan, Chief Wildlife Warden, Government of Bihar, and Dr. A. R. Rahmani, Director, Bombay Natural History Society for their scientific and technical support during the Workshop and later. The participation, enthusiasm and willingness to devote time and thought to our requests for advice and assistance are testimony to their commitment to the Gangetic Dolphin's conservation. We would like to acknowledge the contribution of Shri. Vijai Sharma, Secretary, Ministry of Environment and Forests, Government of India in conceptualizing the idea of Gangetic Dolphin as the epitome of the ecological integrity of the River Ganga

We are grateful to Shri Rajiv Gauba, Joint Secretary, Ministry of Environment and Forests, Government of India for his untiring support and encouragement for long term initiatives for Gangetic Dolphin in India.

Finally, thanks to Shri Shashank Srinivasan for his contribution to the editorial process of this document.

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Patna University, Patna

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PREAMBLE

The Gangetic Dolphin, *Platanista gangetica gangetica*, is one of the most charismatic mega-fauna of the Indian subcontinent.

It is among the four obligate freshwater dolphins found in the world with the others being the 'bhulan' or *Platanista gangetica minor* in the Indus River in Pakistan, the 'baiji' or *Lipotes vexillifer* in the Yangtze River in China, and the 'boto' or *Inia geoffrensis* in the Amazon River. The 'baiji' was reported to be functionally extinct in 2006.

The Gangetic Dolphin is distributed in the Gangetic-Brahmaputra-Meghna and Karnaphuli-Sangu river systems of India, Nepal and Bangladesh. The total population is estimated to be between 2500 and 3000 individuals in its entire distribution range, out of which more than 80% is within Indian territory.

This species has been included in Schedule I of the Indian Wildlife (Protection) Act 1972, in Appendix I of the Convention on International Trade in Endangered Species (CITES), in Appendix II of the Convention on Migratory Species (CMS) and categorised as Endangered on the International Union for the Conservation of Nature (IUCN) Red List.

The Gangetic Dolphin is extensively mentioned in India's mythological and historical literature. However, it was William Roxburgh, the then Superintendent of the Calcutta Botanical Garden, who wrote the first scientific paper on this species in 1801. John Anderson published a report on its biology, including a distribution map, in 1879 after which there is no record of further scientific work on this animal for the next one hundred years.

The first efforts in the 20th century to document the status and threats faced by the Gangetic Dolphin were made under the Ganga Action Plans (GAP) I (1985) and II (1991) through research and conservation projects. These provided baseline scientific information about the species, including the fact that habitat degradation, through pollution and reduced water flow, and poaching were threatening its existence.

The Prime Minister declared the Gangetic Dolphin as the National Aquatic Animal in the First Meeting of the National Ganga River Basin Authority (NGRBA) on the 5th of October 2009 and constituted a Working Group under the chairmanship of Dr. R. K. Sinha of Patna University to prepare a Conservation Action Plan for the Gangetic Dolphin on October 28, 2009. The Ministry of Environment and Forests (MoEF) subsequently notified the Gangetic Dolphin as the National Aquatic Animal on the 10th of May 2010. Thus India became the first country in the world to have a cetacean fauna as National Aquatic Animal.

This plan recommends a number of specific conservation actions, including some related directly to management. The challenge is to implement these plans and ensure the long-term survival of the dolphin in the rivers of India

Note:

This Action Plan for the Conservation of the Gangetic Dolphin has been prepared under the auspices of the National Ganga River Basin Authority and thus these recommendations concern dolphin populations only in the Ganga and its tributaries. Conservation recommendations for the Brahmaputra River and its tributaries will be covered in a subsequent publication.

INTRODUCTION

There are three recognised obligate species of river dolphins, which inhabit rivers and estuaries in Asia and South America, and all are among the most endangered cetaceans on Earth. In fact, one species, the 'baiji' or Chinese river dolphin, was declared functionally extinct in 2006 (*Turvey et al 2007; Hopkin 2007*). The remaining species are the Amazon River dolphin, the Gangetic Dolphin and the Indus River dolphin. Although some marine dolphin species are facultative and commonly found in rivers quite far upstream, river dolphins are morphologically and phylogenetically distinct from marine dolphins and most are restricted to freshwater ecosystems. Because rivers are more vulnerable to degradation than the oceans, river dolphins are facing worse situation compared to the marine cetaceans.

The Gangetic Dolphin is endemic to the Indian sub-continent and has a fairly extensive distribution range. It is found in the Ganga-Brahmaputra-Meghna and Karnaphuli-Sangu river systems of India and Bangladesh, while a few individuals may survive in the Karnali, and the Sapta Kosi Rivers in Nepal. While there is no meaningful estimate of range-wise abundance, approximately 2500-3000 Gangetic Dolphins are assumed to survive across their entire range. Due to a continued decline in its population, the IUCN changed its status from 'Vulnerable' to 'Endangered' in 1996.

Numerous factors exist for this decline; the deliberate killing of Gangetic Dolphins for oil and meat still occurs. The demand for these products means that there is little incentive for fishermen to reduce the by-catch or to release dolphins that are still alive when they are found entangled in nets. The construction of more than 50 dams and barrages within the Gangetic Dolphin's historic range has drastically altered its habitat and fragmented the meta-population. Construction of embankments as flood control measures in eastern Uttar Pradesh, Bihar and West Bengal has disrupted the

connections between the river and its flood plains and wetlands. About 3500kms of embankment were constructed in Bihar post-Independence resulting in the increase of the flood prone area from 2.5 million ha to almost 7 million ha. Similarly 1811kms and 1184kms of embankment were constructed in Uttar Pradesh and West Bengal respectively. Embankments interrupt access to the spawning habitat for floodplain-dependent fish and eliminate eddy-counter currents where the Gangetic Dolphins spend much of their time. Dredging and the removal of stones, sand, and woody debris also compromise the ecological integrity of the riverine environment, especially in small tributaries. Increasing pollution in the river may adversely affect dolphin health and their bioaccumulation may have serious consequences.

DISTRIBUTION

Historical distribution

"The water-hog is in all Hindustan rivers" said Babur in the Babur Nama (circa 1500 AD). Probably by "all Hindustan rivers", Babur was talking about the rivers of North India, where he had traveled widely. Cuvier (1836) claimed that the 'susu' ascended the Ganga in great numbers to the limit of their navigability. Anderson (1879) recorded its distribution in the Ganga over an area comprised between 77°E and 89°E; in the Brahmaputra it occurred throughout the main river, as far eastwards and upstream as 95°E by 27°30'N. He also reported that even in the month of May, when the Ganga was very low, dolphins were seen as far up the Yamuna at Delhi. He also emphasised that the upstream range of this dolphin was only limited by insufficiency of water and by rocky barriers. The Gangetic Dolphin occurred in the entire length of the Ganga and Brahmaputra, and all their tributaries from the delta at the Bay of Bengal till the Himalayan foothills, where only rocky barriers, high velocities or shallow water limited its distribution.

Current Status and Distribution

The Gangetic Dolphin ranges into most of the large tributaries in the Ganga Basin: the Ramganga, Yamuna, Gomti, Ghaghara, Rapti, Son, Gandak and Kosi besides the main channel of the Ganga. In the Brahmaputra valley it ranges into the major tributaries such as the Tista, Adadhar, Champamat, Manas, Bhareli, Subhansiri, Dihang, Dibang, Lohit, Disang, Dikho and Kulsi rivers. Downstream it ranges through the larger tributaries between the Hugh and Meghna rivers, as far as the tidal limits at the mouth of the Ganga. They are also reported from the Fenny, Karnaphuli, and Sangu rivers to the southeast of the mouths of the Ganga (Rice 1998).

Gangetic Dolphins have been extirpated from portions of their upstream range in Nepal and India, and populations have been fragmented and reduced in numbers where they still occur (Table 1; Sinha et al., 2000).

Importance of the species

The Gangetic Dolphin is an indicator species for the river ecosystem and is at the apex of the food chain. It is an endemic and rare aquatic mammal found only in the Indian subcontinent and is part of our natural aquatic heritage. Developing a comprehensive program to conserve river dolphins in Ganga is required for the following reasons:

- India is the last stronghold with extant populations in the Ganga-Brahmaputra River Systems. The species is in peril in Nepal and Bangladesh.
- It is an excellent indicator of river ecosystem health.
- As a signatory to numerous international conventions, India must fulfill its treaty obligations to aid in the conservation of this species.
- It is a unique charismatic mega-fauna.
- The species has recently been declared the 'National Aquatic Animal' by the Government of India, and is part of our national heritage.

Lessons learned from the Yangtze River dolphin

The Yangtze River dolphin, *Lipotes vexillifer*, whose population in 1980s was about 400, has been declared functionally extinct due to uncontrolled development, illegal fishing activities and intense vessel traffic in the river (Turvey et al., 2007). Both the Ganga River and Yangtze River dolphins have similar environmental requirements. The Indus River dolphin has a low population estimated to be around 1600-1700 individuals (WWF-Pakistan 2010). Therefore, rapid conservation actions are required before the Gangetic Dolphin population declines irreversibly. Freshwater dolphins in Asia are among the world's most endangered mammals and there is an urgent need to establish conservation priorities based on scientifically credible abundance estimates (Perrin and Brownell, 1989; Smith and Reeves, 2000a; IWC 2001; Smith and Jefferson, 2002).

The Gangetic Dolphin is a Flagship species for river conservation

It is clear that there is enormous public support for ensuring the maintenance and protection of the Gangetic Dolphins. As a flagship species, its conservation requires greater efforts along the lines of that provided to the tiger and the elephant. Other endangered river species such as the softshell turtle (*Aspideretes gangeticus*), gharial (*Gavialis gangeticus*) and smooth-coated otters (*Lutra perspicillata*) will also benefit from conservation actions that benefit the Gangetic Dolphin.

HABITAT

Water levels in the Ganga are seasonal in nature. Peak flows occur between July and September when the river is fed by monsoon run-off and Himalayan melt-water, while leanest flow occurs from February to March. The flow in the Ganga and its tributaries is regulated, and the natural flow regime has been disrupted, by the construction of dams and barrages. While there were occasional reports of dolphin sightings in some of the smaller tributaries of the Ganga during the 1980s, it is now likely that dolphins have been completely extirpated from these rivers due to insufficient and inconsistent water supplies. The large-scale diversion of river water for irrigation in the dry season causes water flow to diminish especially between Haridwar and Allahabad.

Habitat preference

Although the Gangetic Dolphin is fluvial in habit, it may also be found in brackish water, though it never enters the sea. It is generally assumed that salinity defines the downstream limits of its distribution, while physical barriers and low prey densities at high elevations define the upstream limits. Dolphins are abundant in the long stretches of deep water in association with shallow water meanderings, confluences and mid-channel sand bars.

The primary habitats preferred by the Gangetic Dolphins are characterised by an eddy-counter current system in the main river flow caused by a point bar formed from sediments and deposits, a convergent stream branch, or by an upstream meander. They are also found below sand bars and bridges where eddies are formed.

Being a mammal, the Gangetic Dolphin can survive a wide range of temperature fluctuations. It can tolerate temperatures as low as 5°C in the River Karnali in winter in Nepal, and as high as 35°C in summer in the plains of Uttar Pradesh and Bihar. They have also been found in highly turbid water in monsoon and it is thus assumed that the water temperature and turbidity are not significant factors in determining the distribution of this species.

Habitat Fragmentation

The complex geomorphology of freshwater and estuarine systems tends to concentrate the distribution of cetaceans in counter-currents associated with confluences, meanders and mid-channel islands (Hua et al., 1989; Smith, 1993; Smith et al., 1997, 1998). The Gangetic Dolphin population was fragmented by construction of the dams and barrages on the main stem of the Ganga and its tributaries (Smith et al., 2000). Barrages are low gated diversion dams comprised of a series of gates used to control the elevation of an upstream 'head pond'. Barrages also restrict the movement of river dolphins and other aquatic mega-fauna, thereby separating them into subpopulations. Reeves et al., (1991) questioned the degree to which dolphin subpopulations are isolated, suggesting that individuals may occasionally move downstream through barrages.

Dolphins in the main channel of the Ganga were split into two subpopulations in 1975 when the Farakka Barrage was commissioned. The Lower Ganga Barrage at Narora (1966) and the Middle Ganga Barrage at Bijnor (1984) further fragmented the Ganga main stem population into four subpopulations. Dolphins have now been

extirpated above the Middle Ganga Barrage at Bijnor. Today they occur in three subpopulations bounded by the Bijnor, Narora and Farakka Barrages.

Previous dolphin surveys

Abundance monitoring of the dolphin population has been conducted since the early 1990s using direct visual counts from vessels through continuous surveys, surveys in discrete segments or point counts from the river bank (Smith, 1993; Smith et al., 1994; Sinha et al., 2000). Methods were insufficiently detailed and hence it was not easy to evaluate bias, estimate precision, or reliably detect trends from the data. In addition, different workers used different methods, precluding direct comparison of counts in different stretches of different rivers.

There has been considerable international concern regarding the endangered status of the Gangetic Dolphin. The IUCN Cetacean Specialist Group and other researchers have emphasised the importance of establishing conservation priorities based on scientifically credible abundance estimates (Perrin and Brownell, 1989, Smith and Reeves, 2000a, IWC, 2001, Smith and Jefferson, 2002).

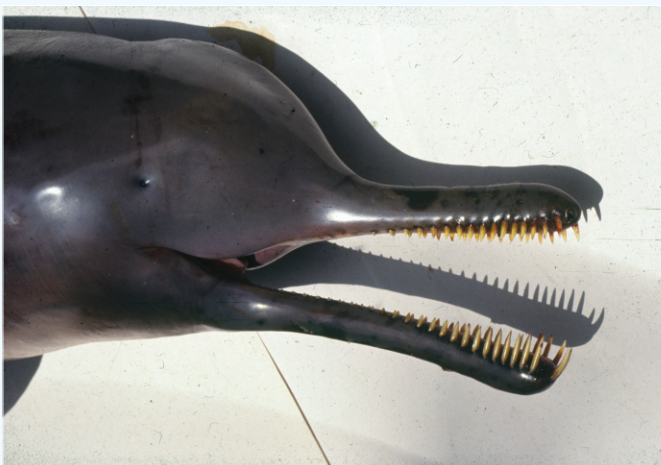
CONSERVATION STATUS

This species has been included in Schedule I of the Indian Wildlife (Protection) Act 1972, in Appendix I of the Convention on International Trade in Endangered Species (CITES), in Appendix II of the Convention on Migratory Species (CMS) and categorised as Endangered on the International Union for the Conservation of Nature (IUCN) Red List.



← Ventral surface of a dolphin, crenellated flippers, and fluke with a notch

Dorsal surface of a dolphin, blow-hole, dorsal fin, crenulated flipper, snout and fluke



← Close up photo showing pin-hole eye, part of buccal cavity and prehensile teeth of a young dolphin



← Ventral part of a Gangetic Dolphin showing female genital organ very close to anus, and two lateral slits concealing nipples.

Ventral part of a Gangetic Dolphin showing male genital organ near the navel



← Prehensile teeth of a young Gangetic Dolphin.

Chapter 2

A SCIENTIFIC ACCOUNT OF THE SPECIES

Taxonomy

Though the names of William Roxburgh and Heinrich Julius Lebeck are associated with the first description of the Gangetic Dolphin in 1801, priority for the description goes to Dr. Roxburgh who named it *Delphinus gangeticus* (Pilleri 1978). In 1828 Rene Lesson adopted a genus based on the Bengali name 'Susuk' and described the species as *Susu platanista*. However, Johann Wagler adapted *Platanista* as a genus in 1830 and from then onwards it is known as *Platanista gangetica*.

The Indus and Ganga populations were long regarded as identical. However, Pilleri and Gehr (1971) divided them into two species based on differences in skull structure, but Kasuya (1972) reduced the two taxa to subspecies of a single species. This is supported by the results of Yang and Zhou (1999), who found that there was little difference between the cytochrome-b sequences of the Ganga and Indus river dolphins. There was probably sporadic exchange between the Indus and Gangetic Dolphin populations by head-stream capture on the low Indo-Gangetic plains between the Sutlej (Indus) and Yamuna (Ganga) rivers (Rice, 1998). Thus one species is recognised in the genus *Platanista*; the Gangetic Dolphins are currently *Platanista gangetica gangetica* and the Indus River dolphins are *Platanista gangetica minor*.

Physical description

The Gangetic Dolphins have a long, pointed snout that is characteristic of all river dolphins. Both the upper and lower jaw sets of long sharp teeth are visible even when the mouth is closed. While the snout is long and widens at the tip, the female's snout is generally longer than that of the male and

may curve upwards and to one side. The eyes are extremely small openings slightly above the mouth. The species does not have crystalline eye lens rendering it effectively blind, although it may still be able to detect the intensity and direction of light. Navigation and hunting are carried out using echo-location. The body is a deep brown colour, stocky in the middle and attenuating to a narrow tail stalk behind the dorsal fin. The dorsal fin is a very low triangular hump located two-thirds of the body length from the anterior end. The broad flippers have a crenellated margin, with visible hand and arm bones. The flippers and flukes are thin and large in relation to the body size.

Body size is about 2m - 2.2m in males and 2.4m - 2.6m in females. At the time of birth they measure 70cm - 90 cm and weigh between 4 kg to 7.5 kg. While adults usually weigh between 70 kg and 90 kg, an adult pregnant female (2.5 m) caught at Araria in north-eastern Bihar in February 1993 weighed 114 kg. Similarly an adult female (2.4 m) killed in the Ganga at Patna on the 29th of April 2010 weighed 97 kg.

Primitive characters

Platanista gangetica gangetica bears some very primitive characters not known in other cetaceans, such as the presence of a caecum at the junction of the small and large intestines. The position of the testis is more dorsal than that in other marine cetaceans and subcutaneous muscle is present between two layers of blubber (Sinha et. al. 2010).

Behaviour

Gangetic Dolphins swim and vocalise constantly. Due to the turbid nature of the Ganga, the underwater activities of Gangetic Dolphins in the wild are difficult to observe. Their short surfacing time is also a

major constraint for behavioural studies. A recent study recorded six types of surfacing patterns, which were dependent on age-class and off-shore distance of the individual (Sinha et al. 2010a).

Gangetic Dolphins exhibit greater preference for the surface than other river dolphins; even when swimming, which they do on their sides, they occasionally keep their beaks out of water. Newborn calves frequently leap completely out of the water.

Group behaviour

The Gangetic Dolphin is not usually considered to be gregarious. In one of the few quantitative studies of group size, it was observed that 90% of the groups and 80.4% of the total dolphins observed during the dry season in the Meghna and Jamuna Rivers of Bangladesh were solitary individuals. While the calves accompany mothers, adults are normally found alone or in small groups. However, other investigators reported groups of as many as 25 to 30 dolphins at the confluence of the Ganga and Gandak at Patna.

Reproduction and Life History

Though the breeding season of the Gangetic Dolphin extends from January to June, newly born calves can be seen even in other months. While mating usually takes place between March and June, it has been observed even in July. Only a single baby is born after a gestation period of about 9 months. At the time of birth the neonate is about 70-90 cm and weighs about 4 kg – 7.5 kg. The mother and calf remain together for about one year. The male attains sexual maturity at an age of about 10 years when they reach a length of 1.7 meters while the females are known to attain sexual maturity at 10 or less years (Kasuya 1972) when they are around 2m long (Harison 1972). During the surveys, newborn calves were sighted throughout the distribution range by various surveys, which indicates that the

river habitat is conducive for dolphin breeding in spite of various biotic pressures.

Food and feeding

Gangetic Dolphins are catholic feeders and feed on several species of fishes, invertebrates (Sinha et al., 1993), and possibly turtles and birds. A list of prey species documented for the Gangetic dolphins is presented in Table 2. They exhibit active foraging behaviour in the morning (0700 hrs - 1000 hrs) and after noon (1500 hrs - 1700 hrs). The dolphins have been observed chasing and preying upon surface dwelling fish species, such as *Rhinomugil corsula*. On some occasions it was noticed that they drive fishes to a particular area for community feeding.

Migration and Dispersal

The marked seasonal changes in the dolphin distribution and density over much of its range are due, at least in large part, to fluctuations in water levels. During the dry season from October to April, many dolphins leave the tributaries of the Ganga and Brahmaputra systems and congregate in the main channels, only to return to the tributaries the following monsoon. Dolphins were seen more than 150 km upstream in the River Son in the flood season in the early 1990s, returning to the main stem of the Ganga after the floods abated in October. They may become isolated in pools and river branches during the dry season (Reeves and Brownell, 1989). One dolphin, which had entered a deep pool in River Damodar from the River Hooghly, was rescued in January 2001 after it stayed behind even after the end of the flood season.

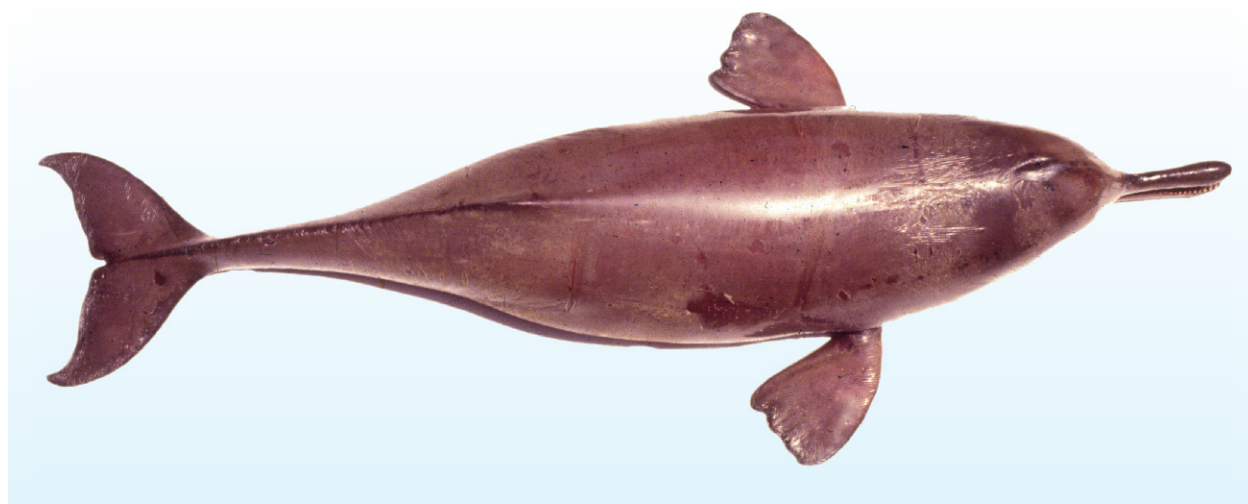
The Gangetic Dolphins even disperse in the main channel of the Ganga in search of prey. Observations in Nepal show that they move in and out of tributaries of the Gandaki, Koshi, and Karnali systems

during high water seasons, probably spending low-water seasons in deep pools of the tributaries. In the main rivers, a decrease in abundance during the summer would confirm a seasonal pattern of migration (Shreshtha, 1989).

Relatively high densities of dolphins are found at sites where rivers join or just downstream of shallow stretches, in areas where the current is relatively weak, off the

mouths of irrigation canals, and near villages and ferry routes. In the Indus, about 40%-45% of the dolphin population is found at junctions of tributaries with the main river stem, at least during the dry season, presumably being attracted to these areas by concentrations of prey (Reeves and Brownell, 1989).

The population above the Kaptai dam in the Karnaphuli River in Bangladesh disappeared over a period of 6 or 7 years after the construction of the dam. Similarly, dolphin population disappeared from the main stem of the Gangetic, above the Middle Ganga Barrage at Bijnor (about 100 km downstream Haridwar) after 12 years of its construction in 1984. Dolphins in Nepal are almost extinct in Mahakali, Narayani and Sapta Kosi due to construction of barrages at their heads at India-Nepal border.



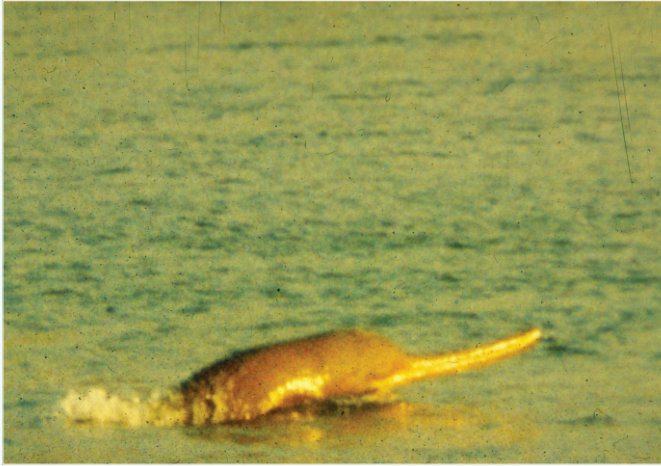


← A Gangetic Dolphin surfacing in the Ganga at Patna showing snout and melon.

A Gangetic Dolphin's parallel surfacing in the Ganga at Patna showing 2/3rd of its body, dorsal fin, blowhole, melon and up-curved snout



← Great dive: A Gangetic Dolphin diving in the River Karnali in Nepal in 1993 showing dorsal fin, fluke and entire posterior body part (Photo B.D. Smith)



← A Gangetic Dolphin surfacing in the Ganga at Patna

A Gangetic Dolphin surfacing in the Ganga at Ganga-Gandak confluence at Patna in February 1995. Two big sail boats carrying sand are in the background. (Photo by Christian Gallissian)



← A great leap indeed: A young Gangetic Dolphin leaping in the Ganga at Patna (Photo B. K. Jain)

Chapter 3

THREATS TO THE GANGETIC DOLPHIN

HUMAN – DOLPHIN CONFLICT

Poaching

In its entire distribution range, and especially in Bihar, the species is facing threats to its existence from poaching. Deliberate killing of 'susus', especially harpooning, is believed to have declined in most areas but some individuals are still taken each year. Their oil and meat is used as liniment, as an aphrodisiac and as bait for catfish. A few cases of poaching are recorded in the middle Ganga in Bihar (Sinha et al., 2000), in the Kalni-Kushiyara River of Bangladesh, and in the upper reaches of the Brahmaputra River in Assam, India (Mohan et al. 1997). With very low population of the species in rivers, even a few catches will have devastating effects on long-term survival of this endemic species. Appendix A details some anecdotes of dolphin killings.

Accidental killing

Entanglement of Gangetic Dolphins in fishing nets causes significant damage to the local population. Accidental killing is a severe problem for Gangetic Dolphins throughout most of their range. The primary cause is believed to be entanglement in fishing gear such as nylon gillnets because their preferred habitat is often in the same location as primary fishing grounds. The problem of accidental killing is expected to worsen with increasing fishing intensity. Accidental killing due to collisions with vessels has also been observed.

Dolphin - fisherman competition

Riverine areas of high productivity sustain a rich and diversified fish community, which attracts dolphins as well as fishermen. Dolphins face intense

competition with the fishermen, and are brought into close proximity with them, in these regions. Accidental killing in fishing nets, as well as directed killing by the fishermen to reduce competition, affects dolphin populations.

Use of dolphin products

The fishermen and other riparian people in many areas have traditionally been using dolphin oil for burning and as a liniment (Anderson 1879). Some people regularly eat the meat and in Bangladesh pregnant women consume the dolphin oil (Smith et al. 1998). Currently the dolphin oil is used as fish bait in Bihar and Assam for catching two economically important fish, *Eutropiichthys vacha* and *Clupisoma garua* (Sinha 2002). Demand for these products creates an incentive for poaching and a disincentive to dolphin conservation. Appendix B details the use of dolphin oil as bait.

HABITAT DEGRADATION

Construction of dams and barrages

Development of hydroelectric power and irrigation in the Ganga River system has prevented dolphin migration and has led to the segregation of populations. This fragmentation of the metapopulation has reduced the dolphin gene pool, leading to a loss of genetic diversity.

These developments have also altered the overflow and flooding cycles of the Ganga river system, which influences the movements and spawning of flood-plain dependent fishes.

In addition to fragmenting dolphin populations, dams and barrages degrade downstream habitat and create reservoirs with high sedimentation and altered assemblages of fish and invertebrates (IWC, 2000).

Luxuriant growth of macrophytes and excessive siltation have eliminated suitable habitat immediately above Farakka Barrage (Sinha, 2000).

Irrigation

Excess extraction of the river water for irrigation has lowered water levels throughout the species range and has threatened suitable habitat in the Ganga. The long-term implications of the reduction of dry-season flow in the Ganga are catastrophic for the survival of 'susus'.

The total measured flow of suspended sediment in the tributaries to the Ganga River is 488×10^6 t/yr, while the quantity of sediment moving in the Ganga at Farakka is 729×10^6 t/yr of which 328×10^6 t/yr is transported down the Hooghly River (Wasson, 2003).

The River Kosi, one of the major tributaries of the Ganga, carries maximum silt load in the Ganga system with average annual suspended load to the tune of 2774 tonnes/km² which is the second highest for any river of the world. The Huang River carries the highest load of 2804 tonnes/km² (IUCN 1980).

Riverine resource extraction

Dredging and development of the river environment has altered its nature and eliminated counter currents, one of the most preferred habitats of the dolphin. Increasingly heavy river traffic in the Ganga and Brahmaputra may result in habitat restriction, noise pollution, depletion of prey base and changes in feeding behavior of the 'susus' in the rivers. Other sources of habitat degradation include the removal of stones, sand (Mohan et al. 1997) and woody debris (Smith, 1993). These activities threaten the ecological integrity of the riverine environment, especially in small tributaries where suitable habitat is more

confined and therefore more vulnerable to local sources of degradation.

Sedimentation

Due to loss of vegetation cover in the catchment area and in floodplains, the increasing rates of sedimentation cause a rise of the river bed, reducing the river's water retaining capacity. Sedimentation has a direct impact on the physical and biological characteristics of the river basin. It affects the other river biota, including fish, reducing the prey base of the dolphin. High altitude grazing, forest management, limited cultivation, and road building in the mountain ranges from where these rivers originate are the prime factors influencing sedimentation (Wasson, 2003). The River Ganga receives sediments from Himalayas as well as the central India.

Pollution

The concentrations of fertilizer and pesticide residues, and industrial and domestic effluents are very high in the Ganga River. The effects of such pollutants may be deleterious to dolphin populations, and pollutant loads are expected to increase with industrialisation and the spread of intensive modern agricultural practices (Smith and Reeves 2000a).

About 1.5 million metric tons of chemical fertilizers and about 21,000 tons of technical grade pesticides are dumped annually to the Ganga-Brahmaputra river system in India in 2002-2003. Earlier Lal Mohan (1989) reported that the river basin received 1.15 million metric tones of chemical fertilizers and 2,573 tonnes of pesticides annually. Concentrations of polychlorinated biphenyls (PCBs), hexachlorocyclohexane (HCH), chlordane compounds, and hexachlorobenzene (HCB) in the Gangetic Dolphin blubber, muscle, kidney, liver and prey collected from stomach of the dolphins collected

during 1993 through 1996 from the River Ganga in and around Patna, India were determined by Senthilkumar et al., (1999). The study compared the organochlorine concentrations with values reported for samples analysed during 1988 through 1992 and suggested that the contamination by these compounds has increased in the river. Kannan et al., (1997) determined concentrations of butyl-tin compounds in dolphins, fish, invertebrates and sediments collected from the Ganga in and around Patna. Total level in dolphin tissues was up to 2000 ng g⁻¹ wet weight, which was about 5-10 times higher than in their diet. The bio-magnification factor for butyl tins in river dolphin from its food was in the range of 0.2-7.5. Butyl-tin concentrations in Ganga River organisms were higher than those reported for several persistent organochlorine compounds. A recently discovered micro-pollutant, perfluorinated compounds, was assessed in tissues of the dolphin carcasses collected from the Ganga in and around Patna (Yeung et al., 2009). Organochlorine and organo-tin concentrations in the tissues of Gangetic Dolphins are high enough to cause concern about their effects (Kannan et al., 1993, 1994, 1997)

Possible impacts of river traffic

There have been numerous proposals to utilise sections of the Ganga for inland water transport. Currently, cargo steamers carry goods from Haldia to Patna regularly, occasionally travelling up to Varanasi. There is heavy river traffic in and around Kolkata and river tourism has recently been started between Kolkata and Varanasi.

Collisions with these vessels, and the effects of the noise they generate, are a serious concern for the dolphins. Since this species depends upon echolocation for many of its activities, including foraging,

sonic pollution may adversely impact their well-being. The Gangetic Dolphins were seen to be avoiding the river stretch with heavy traffic in the River Hooghly in and around Kolkata, preferring relatively undisturbed areas where a lower number of mechanised vessels ply (Sinha 1997).

Mortalities in irrigation canals

Small numbers of dolphins occasionally enter the large irrigation canals in Uttar Pradesh. While reports of such occurrences are received regularly, it is only in rare cases that the final fate of these animals can be monitored. Rarely can any such individuals successfully return to the main channel of the river; most of them get stranded and are subsequently killed, either by the locals or because of the water-regulating gates in these canals.

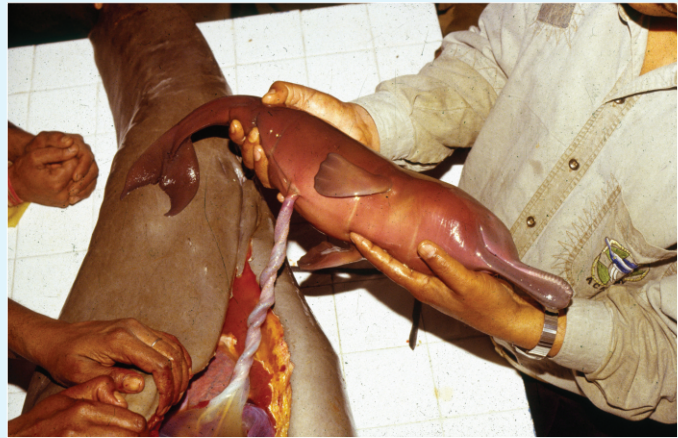
The depletion of prey base

The sustained and heavy exploitation of small fishes of rivers by the wide spread use of the mosquito nets in river may affect the prey base of the Gangetic Dolphin. While the rate of renewal of this resource is remarkable, very few studies have been conducted in a small segment of the river on prey abundance estimates (Choudhay et al. 2006 and Kelkar et al. 2010) and further research is required to quantify this threat in larger areas.



← Face to face with the catastrophe: R. K. Sinha's initial encounter with poaching of the dolphin at Patna in 1993.

→ During necropsy of a dead dolphin from Araria in Bihar near Indo-Nepal border, a dead fetus of about seven months, being taken out by R. K. Sinha in February 1993



← A dead fetus of the Gangetic Dolphin.



← A dolphin hit with propellers of mechanized boat in Ganga at Patna in September 2005. A dead small fetus with placenta is in foreground

Farmers using organochlorine pesticides in close vicinity to Ganga at Fatuha, near Patna.



← Ganga, choked with filamentous algae and macrophytes, behind Farakka Barrage in November 1991.

Chapter 4

STRATEGY FOR THE CONSERVATION OF GANGETIC DOLPHINS

Successful strategies to facilitate the recovery of depleted populations, reverse trends of population decline and habitat deterioration, and to ensure that robust populations with high-quality habitat are secure will need to be multifaceted, adaptable, and tailored to particular local or regional conditions (Reeves et al., 2003). The many elements outlined below are integral to a comprehensive conservation strategy for the Gangetic Dolphin.

The Vikramshila Gangetic Dolphin Sanctuary (VGDS) stretches for about 60 km of the Ganga between Sultanganj and Kahalgaon in Bihar, and is the only protected area designated for Gangetic Dolphin. A Management Plan for the VGDS was prepared in 2001 by the State Government, but could not be implemented due to lack of dedicated manpower and financial support. Three members of the Bihar State Wildlife Board visited VGDS in the first week of April 2010 to assess the current status of the sanctuary management plan. Activities harmful to dolphins, such as oil fishing, and use of fishing nets dangerous to the dolphins, were found to be conducted within the VGDS. In the absence of vigorous education, monitoring and enforcement, dolphins are at risk in VGDS.

Ensuring that any catch or other uses of the Gangetic Dolphin are sustainable

The following factors make the deliberate exploitation of Gangetic Dolphin a high-risk endeavor from a conservation viewpoint:

- (a) They have intrinsically low rates of population increase;
- (b) Most populations are subjected to by-catch in fisheries;

- (c) There is uncertainty associated with estimates of their life history parameters, absolute abundance, trends in abundance, and total mortality;
- (d) The effects of chemical and noise pollution, reduced prey abundance, and habitat degradation are potentially serious but difficult to quantify.

Concern about unsustainable exploitation applies particularly to small cetaceans (Perrin, 1999). Gangetic Dolphins are especially vulnerable because of their inland freshwater distribution. A complicating factor is that their small size makes the carcasses easy to handle, transport, process and conceal from management authorities. Measures to regulate directed takes are not easy to devise and implement, but without them, the species population is at risk. Among the elements needed for an effective management scheme are abundance estimation and reliable demographic knowledge of how many animals are being removed. Developing and encouraging alternative fishing techniques. Dolphin oil is used as bait to attract two target fish species (*Clupisoma garua* and *Eutropiichthys vacha*), which are then netted or hooked. This use of dolphin oil and their body parts creates an incentive for hunting dolphins and a disincentive for fishermen to release any that may become entangled in their nets.

Oil extracted from fish offal available at outdoor markets has been tested and found to be an effective substitute for dolphin oil (Sinha, 2002), and encouraging its use may result in a reduction of dolphin kills.

Protected areas

Reducing incidental mortality through rescue and release efforts

A program was initiated in Pakistan in 2000 to rescue Indus river dolphins that are stranded in irrigation canals or isolated deep pools where they are unlikely to survive (Braulik, 2000). A similar program in Indian river systems for the Gangetic Dolphin will contribute to its conservation.

Managing future dolphin-oriented tourism

Though no dolphin-oriented tourism exists on the Ganga yet, recently introduced river tourism between Kolkata and Varanasi attracted foreign tourists to watch dolphins in the Ganga.

While dolphin watching is a potential sustainable income source for fishermen and locals, it is important to ensure that dolphin watching on the Ganga is conducted in a manner that is respectful to the animals, local people and fellow tourists. Guidelines and codes of conduct should be developed, adopted and promoted by both the tourism industry as well as by government agencies to ensure that unregulated dolphin watch tourism does not become a menace for the Gangetic Dolphin.

Habitat protection and restoration

Existing protected areas in the Ganga and its tributaries fall far short of what is needed. Few protected areas are not capable of providing comprehensive protection to the species they support.

A major challenge in extending the coverage and level of protection conferred through protected areas is to convince stakeholders that conservation measures

can benefit them and thus deserve their support.

While a buffer zone aids in protection, animals that are relatively safe from entanglement in fishing gear while inside a reserve with strong enforcement may meet a gauntlet of nets as they move beyond its borders.

Researching and reducing environmental pollution

While more research is needed to elucidate the impacts of contaminant exposure on dolphin health, the precautionary principle demands that restrictions on the discharge of untreated effluents into the Ganga river system should be enforced to ensure a reduction in dolphin exposure to toxins.

Reducing the effects of water development on rivers in Ganga basin

The Gangetic Dolphins need to be considered in the assessment of impacts of water development projects. The preferred option from a conservation perspective is to refrain from interfering with the natural flow regime and to avoid constructing barriers to animals and sediment movement. However, socio-political conditions make it impractical to completely halt water developmental activities especially in the Ganga basin, so the immediate goal must be to manage such activities in ways that will minimise the harm to dolphins and other aquatic species.

The following principles, elucidated at a 1997 IUCN workshop at Rajendrapur, Bangladesh, on water development and

freshwater cetaceans, may be adopted to this context:

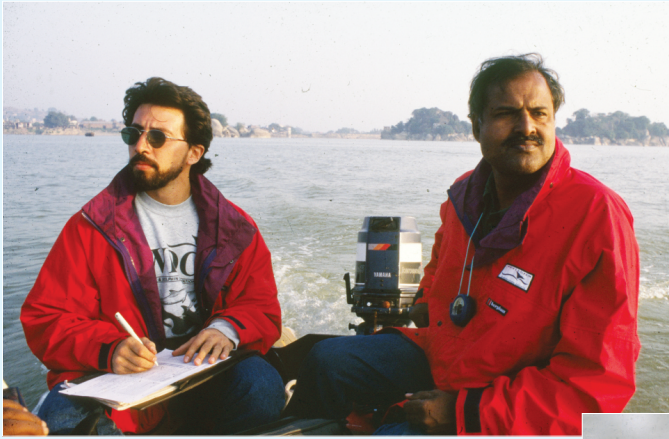
- Gangetic Dolphins require sufficient year-round water flow to move, forage, and carry out activities that ensure reproductive success and recruitment into breeding population.
- Large daily fluctuations in flow should be avoided.
- Equilibrium between sediment erosion and deposition is necessary to maintain essential habitat features, which can often be accomplished by managing flow releases according to environment criteria.
- Access to floodplains should be preserved to ensure natural spawning and rearing habitat for fishes which are prey base of the dolphin.
- Information on the pre-development ecological conditions of a river is essential for evaluating mitigation

efforts (like provision of fish ways etc.) and to implement future development decisions.

- Post-development empirical studies are needed to monitor the operational aspects of projects as well as the effects on upstream and downstream populations of cetaceans and their habitat.
- Cumulative and synergistic impacts of multiple developments should be considered in assessments of environmental impact.

Enhancing the capacity and governance framework for Gangetic Dolphin conservation

Capacity-building refers to enhancement of human capabilities through a combination of education and infrastructure improvement. It is vital that local scientists and activists be able to provide the impetus and expertise for dolphin conservation efforts in their own regions.



In search of Gangetic Dolphin:
Vikramshila Gangetic Dolphin
Sanctuary, Bihar, December 1995,
← R. K. Sinha and Fernando
Trujillo of Bogota, Columbia

Lapping up the precious
dolphin: a fisherman in the
Ganga, Patna →



From Damodar to the Bhagirathi
in West Bengal: translocating a
pregnant dolphin
← on 25th January 2001- R. K. Sinha.

Toward greater awareness -
expanding outreach:
R. K. Sinha distributing
handbills among the people
→ at Simariaghat, Begusarai,
Bihar during month long Kartik
(Oct-Nov) Mela in 1995.





Officials of Bihar Government, Department of Environment and Forests creating awareness to save the Gangetic Dolphin among common mass during world famous Sonapur Cattle fair in 2001

Education and awareness program organized by students and faculty of Patna University in a fisher village to save the dolphins in the Ganga



Reaching to the larger mass: R. K. Sinha with banners depicting messages to save Gangetic Dolphin on a country boat in the Ganga during 'Chhath' festival (six days after Deewali) at Patna in early 1990s.



RECOMMENDATIONS FOR THE CONSERVATION OF THE GANGETIC DOLPHIN

The Gangetic Dolphins have narrow ecological requirements and a fragmented population structure. Conserving this species requires coordinated efforts among agencies, organisations, and communities within the species range. Conservation issues can best be addressed by adopting population or regional level approaches for sustainable co-management. The intention is to tailor conservation strategies to the specific character of highly threatened ecological environments. It is important to implement the strategies under the leadership of local scientists, managers and community groups or stakeholders. Conservation efforts will ultimately succeed only if embraced by the people living in and near the animals' habitats.

In the Ganga basin, the river dolphins have declined in abundance and in the extent of their range. This species is competing with humans for shrinking water resources. Large-scale engineering projects that give people hope for economic development and relief from flood and famine, pose dire threats to this animal and other aquatic wildlife.

Anderson (1879) published a distribution map of the Gangetic Dolphin (Map I). While much of the historical distribution range has been surveyed in the last few decades, surveys of many areas are yet to be conducted. The stretches in the rivers that contain healthy breeding dolphin populations with long-term survival potential designated as 'critical stretches' need to be identified. 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 obligate or true river dolphins including the Gangetic Dolphins (Reeves and Leatherwood, 1994).

Identified Critical Stretches

Some areas of the Ganga river system which need urgent protection measures were identified during a workshop on the 'Conservation of Gangetic Dolphin' organised at Patna on 22-23 February, 2010, based on inputs from the participants, which included, members of the Working Group, most Indian dolphin researchers as well as the Chair of the IUCN Cetacean Specialist Group Dr Randall Reeves.

Critical Stretches for Gangetic Dolphins

Uttar Pradesh

Middle Ganga Barrage at Bijnore to Lower Ganga Barrage at Narora (165 km)

Fatatehpur to Mirzapur (150 km).

Chambal-Yamuna confluence near Etawah to Ganga-Yamuna confluence at Allahabad

Bihar

Gangi-Ganga Confluence near Sinha Ghat, Ara 20km upstream Ghaghara-Ganga confluence at Doriganj, Chhapra) to Fatuha (confluence of Ganga and Punpun (80 km).

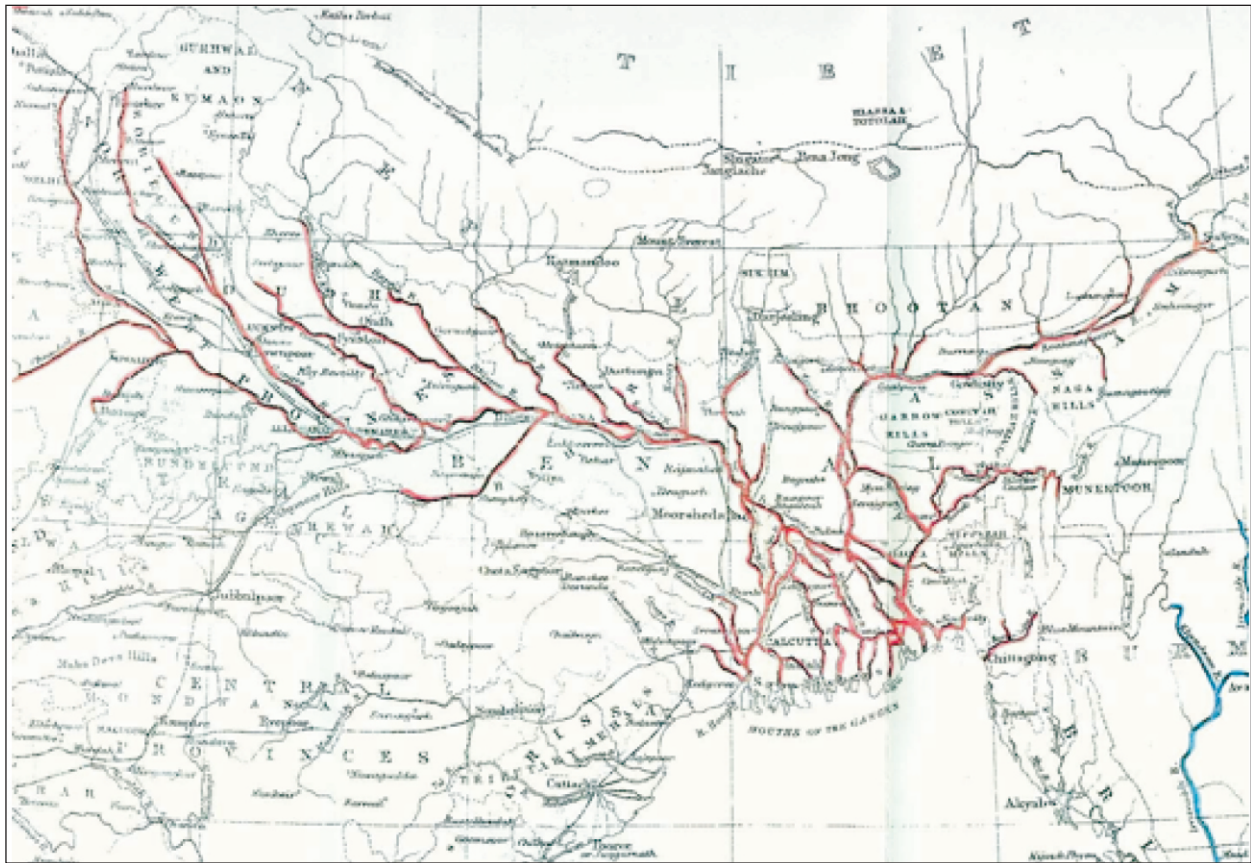
Barh to Mokama to Maniharighat (Katihar) (210 km). This stretch includes the Vikramshila Gangetic Dolphin Sanctuary (60 km).

River Gandak from Triveni Barrage at Indo-Nepal border to Ganga – Gandak confluence at Patna (332 km)

Identification of gap areas in dolphin distribution range

Participants in the workshop defined 'gap areas' as

- (a) areas within the known historical range of the Gangetic Dolphin that have not been surveyed systematically and scientifically or



Map 1: Historical range of the Gangetic Dolphin (Anderson, 1879)

(b) areas within the known historical range where there is evidence indicating that the dolphins are no longer present (i.e. gaps or discontinuities in dolphin distribution). These areas are detailed in Appendix D.

Areas identified and prioritised by the Working Group set up by the Ministry of Environment and Forests must be surveyed at least once a year to monitor the population.

Immediate support should be provided by the Central government to researchers, organisations and NGOs identified by the Working Group to carry out surveys and researches following appropriate survey methods in the critical stretches.

Identification of areas of research for long-term conservation of the Dolphin in the River Ganga and its tributaries.

- Evaluate the viability of the Gangetic Dolphin populations for long-term survival, and prepare management plans for each population.
- Develop and utilise the most appropriate methodology for the population estimation of dolphins.
- Develop methods for safe handling of Gangetic Dolphins for scientific and rescue efforts.
- Assessment of the habitat of the Gangetic Dolphin
- Study the movement and dispersal pattern of the Gangetic Dolphin to assess the home range and habitat utilising modern technologies such as satellite tracking.
- Develop and utilise health markers in the Gangetic Dolphin to rapidly assess the health of an individual.
- Study bio-accumulation of toxins, and their effects, in the Gangetic Dolphins.

- Evaluation of the genetic diversity of the species and development of *in vitro* systems for possible future captive breeding efforts..

To increase National Awareness about the Gangetic Dolphin and the importance of freshwater ecosystems

- Identification of target groups to execute conservation actions
- Designation of Brand Ambassadors for awareness campaigns.
- Development of education and publicity material.
- Development of a dedicated web portal for the Gangetic Dolphin

Identification of potential dolphin sanctuaries in the Ganga River system

Potential sites for intense dolphin conservation should be demarcated in the Ganga River System.

Provision of institutional support for the long-term survival of the Gangetic Dolphin

The establishment of Dolphin Conservation Centers and strengthening of research facilities available in India will aid in better coordination among agencies responsible for the conservation of the Gangetic Dolphin.

Each state with Gangetic Dolphin populations should have a regional Dolphin Conservation Center, with a nodal agency responsible for its operation. It is proposed that WWF-India for Uttar Pradesh, Morena

Center of National Chambal Sanctuary for Madhya Pradesh, Patna University and Central University of Bihar for Bihar, and Zoological Survey of India, Kolkata for West Bengal should be designated as the state-specific nodal agencies.

The use of nylon monofilament fishing gillnets in stretch of rivers having dolphin population should be banned, as this net injures dolphins. Use of fishing nets made up of mosquito netting material (Hindi - 'Kapda jal') should also be banned as it collects small fish which serve as food for dolphins, and fetch very little or no income to fishermen.

Since the Gangetic Dolphin is a Schedule I animal under Wildlife (Protection) Act 1972, use of its body parts, such as tissue and oil, is illegal. Wildlife officials should conduct frequent raids to enforce this law and culprits must be punished under the Wildlife (Protection) Act 1972, amended till date.

The 5th of October should be celebrated as "National River Dolphin Day" as on this day the animal was declared as the National Aquatic Animal of India by the Prime Minister. This date is also suitable as the week from the 2nd October to 8th October is celebrated as the Indian 'Wildlife Week'.

Universities and research organisations should be encouraged to develop dolphin research programs

Chapter 6

ACTIONS FOR CONSERVATION OF THE GANGETIC DOLPHIN

Action 1. Initiating state-wise Gangetic Dolphin Population Status Surveys and Threat Assessment

Status surveys need to be conducted simultaneously in identified critical and gap areas at least twice a year depending upon local conditions for a minimum period of three consecutive years. This will help in the preparation of state-wise national Gangetic Dolphin population status reports.

The Chief Wildlife Wardens of each state should consult experts to conduct surveys using standardised survey methods, detailed in Appendix C. Local scientists should conduct the initial surveys, aided by experts and wildlife officials. This will help in the preparation of a Gangetic Dolphin Status Report

Action: State Chief Wildlife Wardens;
Timeframe: Immediate
Estimated Budget: Fifty crore rupees

Action 2. Setting up of Protected Areas for the Gangetic Dolphin

Based on the results of the status survey and identification of river stretches that support breeding populations of the Gangetic Dolphin, states need to be encouraged to propose manageable Protected/Conservation Areas under the provisions of the Wildlife (Protection) Act (1972) taking local stakeholders into confidence. The Chief Wildlife Wardens of states in the Gangetic Dolphin distribution range may seek the aid of professional institutions and organisations for the development of such proposals.

The establishment of Trans-boundary Protected Areas for Gangetic Dolphins may also be considered between India, Nepal and Bangladesh.

Action: Chief Wildlife Warden and MoEF
Timeframe: Immediate
Estimated Budget: Five crore rupees

Action 3. Capacity Building for Gangetic Dolphin Conservation and Management

Even though the endangered river dolphins are found in the Ganga and Brahmaputra basin, there have been few comprehensive research programs and status surveys that cover the entire distribution range. Universities and other institutions in India need to be supported to develop programmes to study dolphins and their habitat conditions. In addition to establishing dedicated Centres in Ganga Basin for Dolphin research, identified institutions may need to be supported for conducting training programme for frontline protection staff as well as university researchers and teaching staff on research methodologies. Some of the identified organisations who could take up such capacity building programmes in various regions are WWF-India, Wildlife Institute of India, and Patna University and Central University of Bihar. The MoEF may also need to initiate a National Dolphin Conservation Project on the lines of Project Tiger and Project Elephant to ensure continuous funding support for capacity building and other conservation efforts.

System has to be developed for guiding and adopting the research scholars by the peers for encouragement of the guided research and development activities on Gangetic Dolphin.

Action: MoEF
Timeframe: Immediate
Estimated Budget: Ten crore rupees

Action 4. Minimising Fisheries Interface and Incidental Capture of River Dolphins

There is a serious need to review the existing fisheries practices, legislations and Acts. Also there is a need for the development of a sustainable fishery

management plan compatible with river dolphin existence. The Central Inland Fisheries Research Institute, Barrackpore or the Tata Institute of Social Sciences, Mumbai could take up this as a national review with help of each of the concerned state level fishery department.

Action: MoEF.

Time: Immediate

Estimated Budget: Five crore rupees

Action 5. Prevention, Mitigation and Restoration of Impacts on Dolphin Habitats from Developmental Projects

Intensive development projects proposed in the river basins that have direct impacts on the dolphins and their habitat need to be identified. Environmental Impacts Assessments (EIAs) of such projects need to focus and indicate the possible impact of the proposed activities on dolphins.

A model Dolphin Habitat Restoration Project in stretches of habitat that are considered to have been degraded to a suboptimal level may be initiated.

Action: MoEF

Timeframe: Immediate

Estimated Budget: Five crore rupees

Action 6. Community Involvement in river dolphin Conservation and Management

The involvement or active participation of local stakeholders like traditional fishing community and other riverbank communities is essential for dolphin conservation. There have been some initiatives in this direction such as 'Dolphin Mitra' in Bihar and 'Community based Dolphin Watch Programme' in Chilika Lake. Communities involved in such activities with benefit sharing options such as 'River Cruise' or 'Dolphin Watch Programme' have helped popularise Dolphin Conservation and Management Activities.

Similar 'Dolphin Watch' programmes in the Ganga river basin may be developed with appropriate guidelines and environmental safeguards. Organisations such as Patna University, Central University of Bihar, Bhagalpur University, WWF-India and Wildlife Institute of India may be entrusted to develop and implement such model programmes through the development of appropriate mechanisms including involvement of National and State Tourism Organisations.

Action: MoEF, Central and State Tourism Departments.

Timeframe: Two Years

Estimated Budget: Five crore rupees

Action 7. Ensuring Critical Levels of Water Flow in Riverine Habitats of Dolphins

The survival of the Gangetic Dolphin and a host of other aquatic wildlife is dependent on riverine ecology in general and the maintenance of an optimum water flow. Based on systematic and continued research and regular monitoring with the involvement of hydrologists and other multi-disciplinary professionals, critical water flow and minimum depths for all river dolphin habitats should be determined, and management actions should be set in place to ensure such flow and depth.

Action: MoEF.

Time frame: Three years

Estimated Budget: Five crore rupees

Action 8. Education & Awareness

With the declaration of the Gangetic Dolphin as the National Aquatic Animal, there is a need to educate and increase the awareness level of all spectrums of the society about the species, its habitat requirements and its current threatened status.

Special attention should be given by River Dolphin states to set up Interpretation Centers along the Ganga.

The Communication materials such as films, poster, etc and media campaigns should also be given higher priority. There is also the need of development of a dedicated portal for the Gangetic Dolphin.

Action: MoEF

Time frame: Five years

Estimated Budget: Five crore rupees

Action 9. Rescue & Rehabilitation of Gangetic Dolphin

Since the Gangetic Dolphin is an endangered species, every single animal is an important source for the gene pool.

Rescue and rehabilitation of dolphins is a specialised operation and there is a need to establish Rescue and Rehabilitation Centres and specialised teams in the Ganga basin at appropriate locations.

Action: MoEF and State Forest Department

Time frame: Five years

Estimated Budget: Five crore rupees

Action 10. Initiation of Identified Research

Based on the recommendations of the Gangetic Dolphin Conservation Working Group Workshop at Patna, focal themes of research have been identified and recommended for support by National Ganga River Basin Authority and other funding agencies. This action may include organisation of national, regional, state level symposium, workshops and seminars for stock taking of success of conservation management efforts in the field. Some of the identified thrust areas of research are as follow:

- Estimation of dolphin populations and evaluation of the threats being faced by them to evaluate the viability of long-term survival of the population, and preparation of a management plan.

- Development and/or adoption of the most appropriate and robust methodology for the population estimation of dolphins.
- Development of methods for safe handling, sampling and rescue of Gangetic Dolphins.
- Preference assessment and characterisation of habitat preference of the Gangetic Dolphin
- Studies on the movement and dispersal pattern of the Gangetic Dolphin to assess the home range and habitat use utilising modern technologies such as satellite tracking.
- Development and adoption of health markers in this species to assess health status.
- Continue pollution studies and estimation of toxic chemicals in dolphin tissues using carcasses as and when available.
- Conduct basic research on natural breeding, feeding, prey, social behaviour, anatomy, etc of the Gangetic Dolphin.
- Evaluation of the genetic diversity of the species and development of *in vitro* systems such as cell lines to study effects of pollutants on the health and survival of dolphin as well as for the long term conservation.

Action: MoEF

Time frame: Five years

Estimated Budget: Twenty crore rupees

All these activities can be initiated/carried out by active researchers / scientists and conservationists having experience in the related fields. Scientists of the organizations identified in the above noted Actions should take lead and implement it.

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TABLE 1:
POPULATION STATUS OF THE GANGETIC DOLPHIN IN THE
GANGA RIVER SYSTEM

NAME OF THE RIVER	LENGTH OF RIVER SURVEYED	DOLPHIN COUNT	SOURCE
INDIA			
THE MAIN GANGA CHANNEL			
The Ganga (Haridwar to Bijnor Barrage)	100 km	Nil	Sinha et al.(2000)
The Ganga (Bijnor Barrage to Narora Barrage)	169 km	36 (d/s survey) 56	Sinha et al. (2000) (pers. comm. S. Behera 2010)
The Ganga (Narora to Allahabad) Kanpur to Allahabad	600 km 200 km	10 (discrete segment survey) 78	Sinha et al. (2000) (pers. comm. S. Behera 2010)
The Ganga (Allahabad to Buxar)	425 km	172 (d/s survey)	Sinha et al.(2000)
The Ganga (Buxar to Maniharighat)	500 km	808 (u/s survey)	(Sinha et al. 2010)
The Ganga (Maniharighat to Farakka)	100 km	24 (d/s survey)	pers. comm. R. K. Sinha
The Farakka Feeder canal	38 km	21 (d/s survey)	Sinha et al. (2000)
The Bhagirathi (Jangipur Barrage to Triveni)	320 km	119 (d/s survey)	Sinha et al.(2000)
The Hooghli (Triveni to Ganga Sagar)	190 km	97 (d/s survey)	(pers. comm. G. Sharma 2008)

TRIBUTARIES OF THE GANGA

The River Yamuna (from confluence of Chambal to Allahabad)	250 km	104	WWF Nepal (2006)
The River Ghaghara (Kailashpuri Barrage to Deorighat, U.P.)	505 km	295	WWF Nepal (2006)
The Kosi (Kosi Barrage to Kursela)	200 km	85 (discrete survey)	Sinha and Sharma (2003a)
The Gandak (Gandak Barrage to confluence with Ganga at Patna)	320 km	267 (d/s survey)	Multi-Organisational survey 2010
The River Girwa (India-Nepal border to Girijapuri Barrage)	20 km	23 (d/s survey) 28	Smith et al.(1994) WWF Nepal (2006)
The Sarda (Sarda Barrage to Palya)	100 km	Nil	Sinha and Sharma (2003)
The Chambal (Keshoraipatan to Pachnada)	567 km	93	WWF Nepal (2006)
The Ken (from confluence of Yamuna at Chilla to Sindhana Kala village)	30 km	08 (d/s survey)	Sinha et al. (2000)
The Kumari (from confluence of Sind River)	100 km	Nil	Sinha et al. (2000)
The Betwa (from confluence of the Yamuna at Hamirpur to Orai)	84 km	06 (d/s survey)	Sinha et al. (2000)

The Sind (from confluence with the Yamuna)	110 km	05 (d/s survey)	Sinha et al. (2000)
The Son	130 km	10 (d/s survey)	Sinha et al.(2000)
The R. Rupnarayan (Gadiara to Mankur, W. B.)	42 km	18	WWF Nepal (2006)
The Brahmaputra	600 km 856 km	400 (1996) 197 (2004-05)	Mohan et al. (1997)Wakid (2009)
The Barak River	17 km	12 (Nov. 1999) 8 (2004) 6 (2006)	Pers. comm. Paulan Singh
The Subhansiri River	99 km	26	Wakid (2009)
The River Kulsi	76 km	27	Wakid (2009)

BANGLADESH

The Jamuna	189 km	38-50	Smith et al. (1998)
The Kushiyara	113 km	34-43	Smith et al. (1998)
The Burhi Ganga		03	Smith et al. (1998)
The Karnaphuli-Sangu	222 km	131	Smith et al.(2006)
The Sundarbans	1488 km	225	Smith et al.(2006)

NEPAL

The Karnali (from Kachali to Kotiaghat)	60 km	06	Smith et al.(1994)
The Saptakosi (from confluence of Arun and Sun Kosi to Kosi Barrage)	60 km	03	Smith et al. (1994)
The Narayani (Devghat to Triveni Barrage)		1-2	Smith et al. (1994)
The Mahakali		Nil	Smith et al.(1994)

TABLE 2:
PREY SPECIES OF THE GANGETIC DOLPHIN IN
THE GANGA RIVER SYSTEM

SPECIES	NATURE OF EVIDENCE	SOURCE
Teleost Fishes		
<i>Wallago attu</i>	Stomach; seen chasing	Anderson (1879); Haque et al. (1977); Shreshtha (1989)
<i>Bagarius bagarius</i>	Stomach; seen chasing	Shreshtha (1989)
<i>Mystus seenghala</i>	Stomach	Shreshtha (1989)
<i>Mystus tengra</i>	Stomach	Kasuya and Haque (1972)
<i>Ompok bimaculatus</i>	Stomach	Shreshtha (1989)
<i>Tor putitora</i>	Stomach	Shreshtha (1989)
<i>Chela laubuca</i>	Stomach	Sinha et al. (1993)
<i>Puntius sophore</i>	Stomach	Sinha et al. (1993)
<i>Puntius ticto</i>	Stomach	Haque and Haque (1992)
<i>Puntius sp.</i>	Stomach	Sinha et al. (1993)
<i>Colisa fasciatus</i>	Stomach	Sinha et al. (1993)
<i>Chanda ranga</i>	Stomach	Sinha et al. (1993)
<i>Glossogobius giuris</i>	Stomach	Sinha et al. (1993); Kasuya and Haque (1972).
<i>Mastacembelus pancalus</i>	Stomach	Sinha et al. (1993); Kasuya and Haque (1972)
<i>Nangra nangra</i>	Stomach	Sinha et al. (1993)
<i>Barbus ticto</i>	Stomach	Kasuya and Haque (1972)
<i>Saccobranthus fossilis</i>	Stomach	Anderson (1879)
Crustaceans		
<i>Penaeus indicus</i>	Stomach	Shreshtha (1989)
<i>Palaemon carcinus</i>	Stomach	Anderson (1879)
<i>Macrobrachium sp.</i>	Stomach	Kasuya and Haque (1972)
Molluscs		
<i>Indonea coerulea</i>	Stomach	Shreshtha (1989)
<i>Snails with operculam</i>	Stomach	Sinha et al. (1993)
Insects		
Gomphus sp. (nymph of Odonata)	Stomach	Sinha et al. (1993)

TABLE 3:

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Appendix A: Anecdotes of Dolphin Killing

In 2001, the Hon'ble Patna High Court directed both the State Government of Bihar and the Central Government of India to stop poaching of the Gangetic Dolphin. The State Government, in its written affidavit, had promised patrolling of the Ganga River where dolphins were found. The government officials became active and killings were reduced in the following years but recent killings of dolphins have proved that the steps taken so far are inadequate. Unfortunately six dolphins, one in Patna in November 2009, one in the Vikramshila Gangetic Dolphin Sanctuary, and four at Patna on the 29th April 2010, were deliberately killed. The poachers were trying to remove the carcasses from the site, but the local people raised the alarm and even pelted stones at the poachers, forcing them to abandon the carcasses. Thus deliberate killings of six dolphins were recorded since the dolphin was declared National Aquatic Animal of India by Hon'ble Prime Minister of India on 5th October 2009. There is anecdotal evidence of more killings since January 2010 but the carcasses could not be recovered as the killings were reported a few days after the incident.

Appendix B: Four ways to fish using Dolphin Oil

- a) A mixture of cow-dung and plant seeds, impregnated with dolphin oil, is initially sprinkled on the flowing river water from an offshore bamboo platform and allowed to disperse downstream (Mohan and Kunhi, 1996). A scoop net, operated by 4-6 fishermen, is then used to catch the fish that congregate there.
- b) Another 'lure' is prepared using minced goat fat and viscera along with some dolphin oil. This lure is carried by hand into waist-deep water and

allowed to disperse slowly as the fisherman splashes the water rhythmically. A scoop net is used again to catch the fish here. It is reported that this type of fishing is carried out at a number of places in the Ganga, usually downstream from Kahalgaon until Rajmahal.

- c) The fishermen fix their small fishing boat in the river where the current is strong. A piece of goat's head hide with burnt hairs has dolphin oil applied over and is allowed to float in the flowing water, tied with a string with the boat. This allows the dolphin oil to disperse downstream with fast flowing water which attracts the two target species of fish to the fixed boat.
- d) Minced roasted goat's gut, goat's fat, and dolphin oil is made into a paste and used on a simple hook as bait (Sinha 2002).

Appendix C: Development of Survey Protocol

The survey of river dolphins must be conducted with rigorous application of a well-defined design. Unless survey methods are standardised and made more rigorous, accurate detection of trends in population abundance will be difficult (Reeves et al., 1993).

Certain problems of survey methodology are related to the complex morphology of freshwater systems, which tends to concentrate dolphin distribution in microhabitats associated with specific hydrological features (Hua et al., 1989, Smith, 1993) and limits the ability of survey vessels to follow required search patterns. Annual flood cycles of variable intensity add a strong seasonal element to dolphin distribution and constantly alter the structure of the animals' alluvial channel habitat. These factors complicate attempts to conduct repeated surveys that are consistent with respect to coverage and

sighting conditions. Such consistency is a requirement for detecting population trends.

Fiscal reality may dictate that surveys will be conducted on a shoe-string budget. In many instances, field scientists have limited experience with the analytical methods of population sampling and statistical theory. Moreover, ready access to the computer software and hardware needed to analyse large volumes of numerical data are required. Therefore, economy and simplicity are important when developing survey protocols. Such methods have been proposed by Smith and Reeves (2000). Many of the researchers have been following this method in India and Pakistan. However, a training program may be needed for those who are not aware of this method or finding it difficult to adopt due to some other constraint. Analytical methods of population sampling and statistical theory will also be a part of training which help researchers in generating reliable and acceptable dolphin data. Thus it is essential to organise such training program.

Appendix D Gap Areas

The following gap areas were identified:

Areas not surveyed systematically and scientifically

Uttar Pradesh

- River Ramganga
- River Ghaghara from Girijapuri Barrage in Bahraich District, U.P. to Ghaghara-Ganga confluence at Doriganj, Chhapra in Bihar
- River Sarda from Sharda Nagar Barrage to Barabanki (confluence of the Sharda and Ghaghara)
- River Saryu
- River Rapti
- River Gomti
- River Sone
- River Yamuna from Chambal-Yamuna

confluence to Yamuna-Ganga confluence at Allahabad.

Bihar

- River Bagmati,
- River Burhi Gandak,
- River Skrahana,
- River Kamala,
- River Balan,
- River Mechi at Indo-Nepal border to its confluence with Mahananda,
- River Mahananda in Indian territory,
- River Kosi from Birpur Barrage to Kursela (confluence of Kosi and Ganga)

West Bengal

- River Jalangi
- River Damodar
- River Rupnarayan
- Sundarbans in Indian territory
- Main stem of Ganga below Farraka Barrage to Bangladesh border (~90 Km)

Areas within the historical range where there is evidence indicating that the dolphins are no longer present

Uttar Pradesh

- River Ganga between Haridwar and Middle Ganga Barrage at Bijnor.
- River Yamuna from Hathnikund to Chambal-Yamuna Confluence near Etawah; River Sarda upstream of Sardanagar Barrage in District Lakhimpur
- Khiri as far up as the river is navigable;
- Sarda Link Canal between Girijapuri Barrage and River Sarda.

Madhya Pradesh

- River Ken
- River Betwa
- River Sind
- River Tons
- River Sone

Bihar

- River Sone
- River Punpun