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Status, Distribution and Conservation Threats of Ganges River Dolphin in Karnali River, Nepal

WWF Nepal
May 2006

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foreword

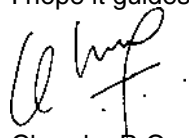
This report, "Status Distribution and Conservation Threats of Ganges River Dolphin in Karnali River, Nepal", is an important milestone in WWF Nepal's commitment not only to conservation of a flagship species but also to the needs of people, who like the river dolphin, are dependant on freshwater resources.

The research conducted in the Karnali River is the first for aquatic fauna that the Freshwater Program at WWF Nepal has undertaken since its inception in October 2004. This report is an outcome of the research. There has been a drastic decline in the status and distribution of river dolphins in Nepal. In the Karnali River, dolphins face the threat of local extinction unless conservation efforts are stepped up immediately. The situation requires urgent action because dolphins top the food chain and are indicators of healthy aquatic ecosystem. Their decline indicates the degrading quality of water resources and is a warning to use our water resources more wisely.

Economic development usually exerts tremendous pressure on environmental stability. The aquatic biodiversity of Nepal has not escaped unscathed from the effects of the irrigation and transport sector. Water diversion projects and the construction of roads, dams, and bridges have degraded the habitat of river dolphins. Before more damage is done, Nepal must strive to balance economic development with the integrity of the environment.

WWF Nepal, with the financial support of WWF UK, conducted this research and was able to secure further funding from Swedish International Development Agency (SIDA) / WWF Sweden / WWF International to carry out conservation activities at field level.

I hope it guides interventions to ensure a future for river dolphins in Nepal.



Chandra P. Gurung, Ph. D.
Country Representative
WWF Nepal Program



A graphic of a water drop falling into water, creating ripples, centered at the top of the page.

acknowledgements

The "Status Distribution and Conservation Threats of Ganges River Dolphin in Karnali River, Nepal" is a report based on research conducted on river dolphins in the Karnali River system in the western lowland of Nepal from July 2005 to February 2006.

This research was enriched by the contributions of Dr. Sarala Khaling, Regional Coordinator, Critical Ecosystem Partnership Fund, Eastern Himalayas for supporting as the Technical Director, Dr Tej Kumar Shrestha for his advisory role and Dr. Eric Wikaramanayake, Senior Conservation Scientist for critically reviewing this report and providing technical inputs. I highly acknowledge the support by Mr. Shubash Lohani, Ms. Trishna Gurung, Mr. Kanchan Thapa, Mr. Dhan Rai and the entire Terai Arc Landscape (TAL) team in making this research successful. I thank Mr. Gokarna Jung Thapa for his significant contribution.

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I acknowledge the sincere effort and dedication of Mr. Dipesh Joshi in carrying out and compiling this research.

Neera Shrestha Pradhan/ Ms.
Freshwater Officer
WWF Nepal





acronyms

| | |
|----------|---|
| AAPA | Aquatic Animal protection Act 1961 |
| CBO | Community Based Organization |
| CFCC | Community Forestry Co-ordination committee |
| CFUG | Community Forest Users' Group |
| DDC | District Development Committee |
| IUCN/SCC | International Union for Conservation of Nature/ Species Survival Commission |
| NBC | National Biodiversity Strategy 2002 |
| NGO | Non Governmental Organization |
| NPWCA | National Parks and Wildlife Conservation Act, 1973 |
| TAL | Terai Arc Landscape |
| RBNP | Royal Bardia National Park |
| VDC | Village Development Committee |





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executive summary

The present study was initiated with the objective to update and map the status and distribution of river dolphins in Karnali River and its tributaries in the Terai Arc Landscape and identify threats and issues in conservation at the local to wider context. The study has provided recommendations for conservation interventions, policy decision makers and further researches. Unlike previous studies (Smith, 1990; Shrestha, 1995) that used upstream and downstream surveys, this study was conducted through synchronized surveys that took place at various sections identified as dolphin habitats through review of literature, local consultations and initial field observations of the area.

Surveys in Geruwa River resulted in a minimum population estimate of 4 individuals during the four surveys in medium and low water seasons. Their distribution in Geruwa River was limited up to Golaghat, which lies at a distance of 20km from Kothiaghat though sightings of a single dolphin was reported by locals upstream of Chisapani, which is an indication of occasional movements of dolphins to that area. The status of dolphins in Geruwa does not fluctuate during different water levels but they were not sighted at

Golaghat in post-monsoon surveys when the water level was high in the river, thus limiting their distribution within a range of 12.5km during high water levels. Similarly, a maximum of 12 and minimum of 9 individuals were counted in Mohana River, a feeder stream on Karnali River during the three surveys conducted in high, average and low water seasons in monsoon. The status and distribution of dolphins in Mohana River entirely depends upon the water level in these tributaries during monsoon and thus their presence is limited to high water level periods. Even in these rivers, their status and distribution range has decreased.

Habitat alteration by floods, intensive fishing and past development interventions like Chisapani bridge construction, motorized ferry at Kothiaghat, Rajapur irrigation rehabilitation project and an increase in the intensity of agricultural practices in the area have had a cumulative impact on the dolphin population. Additionally construction of "barrage" at Kailashpuri barrage (Indian frontier) has impeded migration of dolphin and divided them into small population units thus limiting possibilities of genetic mixing. Segregation of



breeding population by down stream barrage poses a dire threat to dolphin population. Further, development of any water use system in the future will make survival of the residual dolphin populations difficult. Low level of awareness on negative impacts of over fishing and legal aspects of conservation also pose a threat to the last remaining population. There is an urgent need to minimize fishing pressure throughout the entire stretch of Karnali River. As these animals live and breed in the waterfronts of Nepal, India and Bangladesh, their protection is therefore a matter of international concern and thus a transboundary initiative is necessary.

Certain locations in the study area hold potential for community managed eco-tourism where the traditional lifestyle of Tharu communities along with river dolphins and other fauna are an attraction but poor infrastructure is a concern for its promotion that provides a possibility for increasing local livelihood options. Considering the infrastructure of the area the frequency of dolphin sightings, Kothiaghat and Bardahawaghat are suitable locations for tourism promotion.



1.1 Background

Of the seven species of dolphins worldwide, four live only in freshwater: the Ganges River Dolphin (*Platanista gangetica*), the Yangtze River dolphin (*Lipotes vexillifer*), the Indus river dolphin, (*Platanista minor*) and the Amazon dolphin (*Inia geoffrensis*). The Ganges River dolphins were historically distributed throughout the Ganges, Meghna, Brahmaputra and Karnaphuli river systems of India, Nepal and Bangladesh (Jones 1982, Reeves and Brownell 1989, Shrestha 1989). But with the construction of more than 50 dams and other irrigation-related projects, the dolphins are threatened by population fragmentation and isolation, pollution of their habitat, drowning in fishing nets or deliberate removal for trade and prey depletion. As a result, the range and abundance of dolphin has reduced in many areas (Reeves and Leatherwood 1995).

The Ganges River dolphins are not gregarious, being frequently sighted alone or in small groups of 2-3 (Jones 1982, Smith 1993). Sightings of pairs are generally mother and calf (Kasuya and Haque 1972, Jones 1982). During the dry

season from October to April many dolphins leave the tributaries of the Ganges and Brahmaputra systems and congregate in the main channels only to return to the tributaries the following rainy season (Reeves and Brownell 1989). In the main rivers, a decrease in abundance during the summer season confirms a seasonal pattern of migration (Shrestha 1989). This migration seems to be associated with the migration and dispersal of fishes, which are their main prey (Kasuya and Haque 1972).

Smith (1993) identified primary and marginal habitats in Karnali River. Primary habitats are characterized by an eddy counter-current system in the main river flow caused by a fine sand/silt point bar formed from sediment of a convergent stream branch or a tributary. Marginal habitats are characterized by a smaller eddy counter-current system caused by an upstream meander. Dolphins concentrate on locations of high prey availability and reduced flow. The primary habitats are also areas of greater human activity. The high biological productivity of habitats result in fishermen



concentrating the majority of their efforts in these river reaches.

Burgeoning human population and rapid economic development threaten the survival of Cetaceans in much of the world but nowhere more than in Asia (Smith 1993). Dolphins are particularly threatened in the upstream reaches of the smaller tributaries, where populations are often isolated behind barrages and are more vulnerable to human activities because of the reduced habitat area and perhaps the most endangered populations are in Nepal (Sinha et al 2000). Although dolphins were once abundant in Nepal throughout the Koshi, Narayani, Karnali and Mahakali rivers and their feeder streams (Jnawali and Bhujju 2000), due to construction of low gated dams across river systems for irrigation and flood control, over exploitation of prey species, illegal killing and wide range of other human disturbances, the populations are more or less restricted to Karnali and Koshi river systems (Smith 1993). The only river in Nepal that supports an even questionably viable population is the Karnali upstream of the Girijapur barrage, but this population may become extinct in the absence of conservation action on both sides of the Nepal/India border (Smith 1996).

The dolphin is legally protected animal in Nepal. Government of Nepal has protected the dolphin as an endangered mammal in the National Park and Wildlife Conservation Act 1973. But populations migrating outside the protected areas are vulnerable to poaching. At the same time, identification of prime habitats/"Hotspots" where these animals are frequently sighted is essential for long-term conservation of this mammal. It is therefore imperative to carry out a detail study on dolphin population and related threats and issues in long-term conservation.

1.2 Objectives of the Study

The general objective of the study was to update the existing information on dolphins in Karnali River and its tributaries in Terai Arc Landscape (TAL) and provide recommendations for long-term conservation and management of the animal. The specific objectives of the study were as follows:

1. To update the population status of dolphins in Karnali River of TAL.
2. To update and map the current distribution of dolphin in Karnali River of TAL.
3. To analyze threats and issues of dolphin conservation at the local to wider context.
4. To provide recommendations for:
 - Conservation interventions,
 - Support policy and decision makers,
 - Further research recommendations.



2

study area

Karnali is a perennial river with an average annual runoff of 1291m³/s (Shankar, 1985). The total drainage area of Karnali within Nepal is 43,000 sq. km. and the depth of the river section above Chisapani varies between 50-100m whereas the depth of sections downstream varies from 3-10m. (Shrestha, 1995). Karnali has a very high sediment load and not much is known about fish in the upper watershed, further downstream fish diversity is rich with around 74 species (Shrestha, 2003). Based on secondary information and local consultations present study was conducted in sections of Geruwa and Mohana River as shown in Figure 1.

2.1 Geruwa River

In the Gangetic Plains near Chisapani, Karnali River diverges into two channels, Karnali (Kauralia) in the west and Geruwa in the east. The western channel forms the political boundary between Bardia and Kailali districts whereas Geruwa forms the western boundary of the Royal Bardia National Park (RBNP). The Geruwa River contains the greater flow. The river is further sub divided into number of

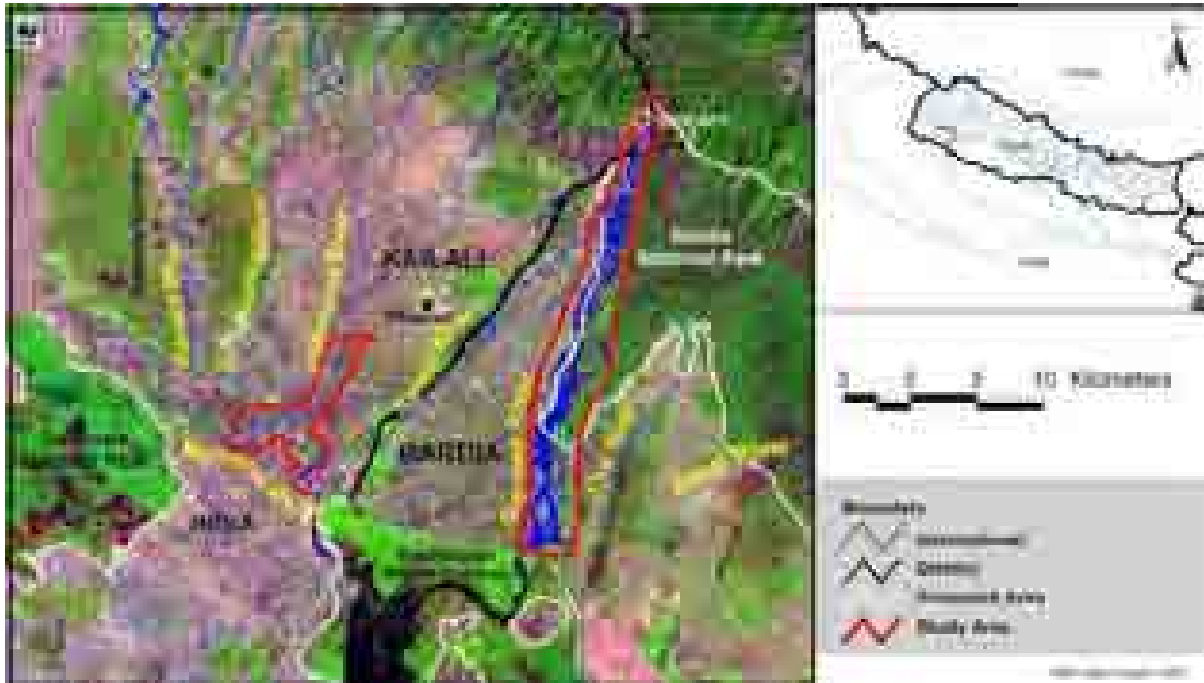
channels making different islands between these channels.

Geruwa River flows approximately for 37km in Nepal between Chisapani and Kothiaghat. Only 10km of this length falls outside the jurisdiction of RBNP. During its flow of 37km, Khauraha Khola and Orai River join Geruwa. Both these rivers are seasonal channels originating at the foothills of Churia range and flowing through RBNP. Geruwa River is inhabited by dolphins (*Platanista gangetica*), Otters (*Lutra perspicillata*), Gharial (*Gavialis gangeticus*), Crocodile (*Crocodylus palustris*), and various species of turtles.

2.2 Mohana River

Mohana River, flows along the Indo-Nepal border in Kailali district before joining the Karnali River. During its flow along the border, numerous rivers that originate from the foothills of *Churia* range and flow southwards join Mohana River. Kaada, Kanara and Pathariya are some of the major ones that lie within the scope of this study. During the monsoon, these rivers hold a high volume of water along with high turbidity and



Figure 1: Study area

swift current. All these tributaries have a very low flow during the dry periods thus resulting in a significant reduction of volume in Mohana River. Dolphins (*Platanista gangetica*), Gharial (*Gavialis gangeticus*) and various species of turtles and fishes inhabit Mohana River during the monsoon.

2.3 Limitations of the study

The study was limited to lower Karnali river system with particular emphasis on the Geruwa River section and the western tributary Mohana

River. As the research was initiated towards the end of monsoon, it limited the number of surveys in the tributaries as dolphins migrate to smaller tributaries only during high water level in monsoon. Despite that, the three surveys were conducted during high, average and low floods in the tributaries and adequate data was generated and analyzed. Along with this, movements were prohibited to some segments of the river systems due to security concerns, but all major distribution areas were covered.



Based on the review of secondary data and in consultations with research advisors, local communities and Terai Arc Landscape staff, sites were selected for field visits and primary data collection.

3.1 Reconnaissance surveys

In order to identify the areas of high dolphin activity, a preliminary survey was conducted prior to initiation of the status survey. The preliminary survey was followed by a detailed survey along Geruwa and Mohana River to find out the level of awareness among local residents and fishermen and the problems associated with conservation and management of dolphin.

3.2 Key informant survey and local consultations

The earliest settlers of the study area were identified and interviewed to gather local knowledge on the population trend and abundance of dolphins in the areas. The interviews were semi-structured and open-ended discussions. The fishermen, who

traditionally interact with the river ecosystem and come across dolphins of the area, were given high priority during discussions. Local residents inhabiting riverbanks were invited for group discussions and to help identify sites for stationary observations.

3.3 Population survey

Based on secondary data and information gathered through local consultations, a range of 38 km was surveyed on the Geruwa River and 18km on Mohana River for a couple of times before final sighting spots were selected. Because of the low number of the reported animals in recent years and following the recommendations of Smith and Reeves (2000) a direct count method was used in narrow channels.

Unlike previous status surveys in the Karnali River system (Shrestha 1995; Smith, 1993), which were conducted through upstream and downstream surveys, we carried out synchronized surveys¹ at specified locations. To estimate the status and distribution of dolphins in the Karnali River system, observations were

¹ Selected sighting spots were surveyed at the same time on the same day to provide a minimum population estimate and minimize double counting.



made in two parts. The first part covered Mohana River and its smaller tributaries in Kailali district during the monsoon and the second part covered Geruwa River towards the end of monsoon and during low water periods of winter.

Observers traveled along the riverbanks on foot or bicycle where convenient, and at times by raft and dugout canoe covering the entire stretch before finalizing the spots for observations. Searches were conducted along the length of river, including the sections outside the areas identified by local people and previous studies, but areas of slow-moving water downstream from convergent streams and adjacent to point bars received greater attention. Search efforts were maintained in these areas for at least 30 min. to avoid missing quiescent behaviour² or long diving animals in counter current areas and at sighting locations specified by locals. Due to the nature of rivers, sighting spots were chosen on the basis of identified areas rather than by dividing the sections into transects of equal length.

Each survey extended for a period of two and half hours and was sub-divided into five consecutive observations each of 30 minutes. Data forms modified from Smith and Reeves (2000) were used on all surveys to note down required information. The data forms included information such as time period and location of

sighting, direction of travel and environmental conditions of the area. Close observation for structure, size and colour of the individual animals was made to minimize the chances of double counting.

3.4 Mapping of prime habitats and distribution range

Based on the above observations, dolphin sighting spots and the range of their distribution was mapped. This map identified the hotspots in the river systems and the range of distribution of dolphins in the study area.

3.5 Data analysis

Minimum count estimates of dolphin populations inhabiting the mainstream and tributaries were made by combining the results of synchronized multiple observer ground counts. The highest combined total of the day was taken as the minimum population estimate. To reduce the chances of over estimating or double counting, observation spots that were within 1 km were collectively considered as a single spot. Animals of same size i.e.; adult, sub-adult or calf, seen at more than one spot falling within 1 km during a scan of 30 minutes was counted as a single individual. But if the animals sighted within 1 km area were of different size class, they were taken as two different individuals.

² During quiescent behaviour, dolphins surface without an audible blow and expose only the uppermost dorsal surface of the melon (Smith, 1994).



4.1 Geruwa River

4.1.1 Status

No dolphins were observed in western branch of Karnali River, and even the locals did not report any sightings in the last five years. A minimum of four dolphins was observed in the Geruwa River. The first two surveys in Geruwa River were conducted immediately after the end of monsoon when water level was still high in the river and the second two surveys during the winter when water level was relatively low in the river. All four surveys observed 3 dolphins but there was a difference in the size class of animals sighted during these surveys. The first survey observed 1 adult and 2 sub-adult, the second survey sighted 2 adults and 1 sub-adult while the two surveys during the winter sighted 1 adult and 2 sub-adults. This indicates that there are at least 4 individuals, 2 adults and 2 sub adults in the Geruwa River. But it was observed that these individuals move downstream into Indian territory frequently.

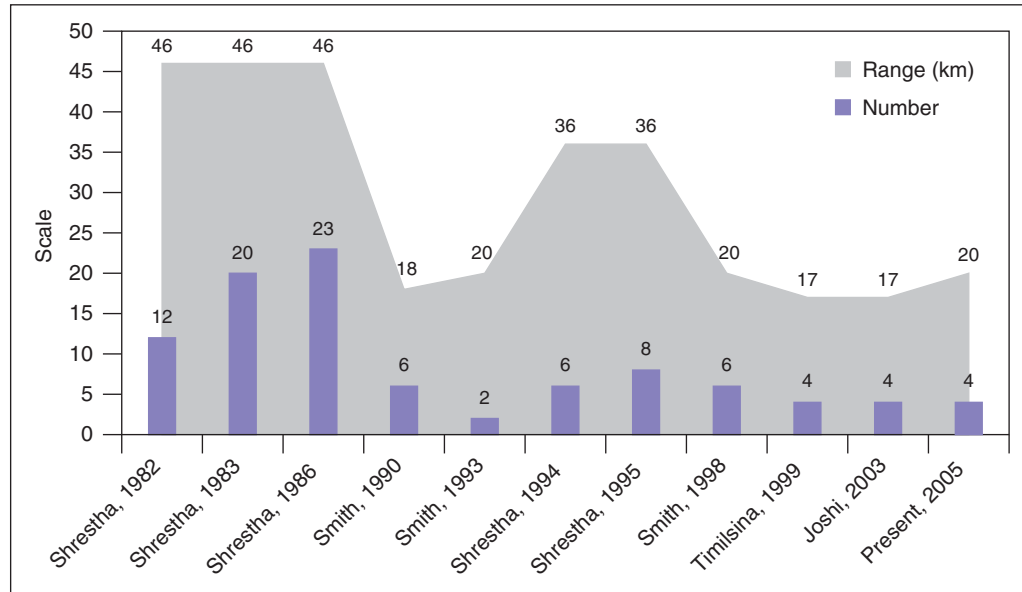
Additionally, the presence of sub-adults indicates that there is reproduction and survival of juveniles beyond calf stage. Similarly, the locals

reported the presence of a male and a female five years back, which later reproduced, and the male migrated to other place leaving behind the female and two calves. However, dolphins give birth to single calf and thus there is every possibility that these calves could have migrated from downstream areas. As the surveys were carried out during different water levels in the river system, the presence of same number of animals during all surveys provides evidence that probably there is no impact of fluctuation in water level on dolphin population. Population counted during previous studies has been illustrated in the Figure 2 below.

4.1.2 Distribution

Dolphins were observed in the 20km stretch of river from Kothiaghat to Golaghat. They were sighted at Kothiaghat, Orai, Khauraha, Guptipur and Golaghat (Figure 2). Dolphin distribution within the surveyed area was characterized by a high degree of patchiness, determined by the availability of habitats with suitable environmental conditions. Differences in sighting



FIGURE 2: Status and distribution range of dolphins in Karnali River as identified by previous studies

frequencies among habitats showed preferential occupation of primary habitats characterized by greater mainstream flows and a large eddy counter current system caused by a convergent flow as identified by Smith (1993). Kothiaghat lies just below the point of convergence of the numerous channels of Geruwa. Orai is the confluence of Orai River and Geruwa. Khauraha is the confluence of Khauraha and a channel of Geruwa. Guptipur and Gola are characterized by a smaller eddy counter-current system caused by an upstream meander (See Annex I). The channels have been converted into wide deep pools at these two locations, with high prey availability and reduced flow.

Dolphins were not sighted outside the length of 20km from Kothiaghat to Golaghat but locals at Chisapani reported of two rare sightings of one individual at Batase danda, 17km north of Golaghat. Sightings at Batase danda were made in the month of June and September, prior to onset of monsoon and towards the end of

monsoon respectively. It shows that either the dolphins make occasional upstream movements or a small remnant population does still exist above the Chisapani Bridge, though it was not sighted during the study.

Shrestha (1989) observed dolphins within a range of 46 km during his surveys in 1982 and 1983. Shrestha (1995) during his survey in 1986 sighted dolphins in the same range. Smith (1993) during his survey of 1990 observed within a range of 18km from Kothiaghat as compared to previous distribution range of 46 km. Similarly, Smith (1994) during his survey of 1993 observed dolphins within a range of 20km from Kothiaghat to Golaghat. Shrestha (1995) sighted these animals with a comparatively increased range of 36km from Kothiaghat during his surveys in 1994 and 1995. Timilsina (1999) and Joshi (2004) also sighted dolphins in the range of 17km. The fluctuations in distribution range of dolphins have been illustrated in Figure 2 above.



FIGURE 3: Distribution of dolphins in Geruwa River



4.2 Mohana River

4.2.1 Status

The minimum population estimate in Mohana River and its tributaries varied between 9- 12. Three surveys were carried out in the Mohana River during the monsoon of 2005 (August-September) during high, low and medium water levels in the river system. The first two surveys during high and medium water levels recorded 12 dolphins while 9 dolphins were recorded during low water level towards the end of monsoon. Joshi (2004) in monsoon survey of 2003 in the Mohana River system estimated a minimum of 17 and a maximum of 28 dolphins in the area during various surveys carried out

between July -September. His study covered areas that were not incorporated in this research and it must be emphasized that there is a substantial difference in population assessment methodology between these two surveys.

4.2.2 Distribution

The distribution of dolphins in Mohana river system was observed only during the monsoon when the water level in the river system is high. They are not sighted during the low water levels in the river after the monsoon. The dolphins were found primarily in deep pools located near

FIGURE 4: Distribution of dolphins in Mohana River



confluences and meanders, which are also primary fishing grounds and subject to intensive boat traffic. All the sighting spots along the Mohana and Pathraiya River are confluences except for Khakraula where a deep pool has been created due to ox-bow bend of Mohana River just above Khakraulaghat (Figure 4). Their distribution was observed up to 15km from Chaugurdi northwards on Pathraiya River and 11km westwards on Mohana River. Locals say that dolphins move upstream from the Mohana-Kanara confluence along the Mohana and Kanara River depending on the water level. (See Annex II)

4.3 Threats and Issues in Dolphin Conservation

4.3.1 Prey depletion

The lower Karnali River basin lies in Bardia and Kailali districts. Most people in the area belong to the indigenous *Tharu* and *Sonaha* communities. *Tharu* have traditionally fished in the Karnali River but their major occupation is agriculture. The other communities arrived after successful eradication of malaria in the 1950's. They have now settled and deforested virtually all land above the floodplain, except areas incorporated within national parks (Smith, 1993). Thus a major reason behind intensive fishing is the fishing skills and life style of the *Tharu* communities.

While fishing is prohibited within the national park boundary, licenses are provided to locals by the District Development Committee (DDC) to fish in the river falling outside the national park.

Generally, one individual acquires the contract from the committee and local fishermen are granted fishing permits by the contractor on paying a nominal amount of money. Out of the 100 respondents, which reflected equal representation from both the river systems, 90% of them along Mohana and 74% along Geruwa stated that there has been an increase in the number of fishermen along these rivers. In

response to their purpose of fishing, 93% of the fishermen along Mohana and 62% along Geruwa stated that fishing was only for domestic consumption. This clearly emphasizes the need to address local communities during conservation interventions through fulfilling their domestic consumption needs. Despite the fact that commercial fishing is limited, it was observed that fishing was intensive in the river segment lying outside the national park as well as within the jurisdiction of national park around human settlements.

The fishermen commonly use three types of fishing gears, cast nets, gill nets and hook lines. Gill net fishing is widely practiced in pools of Karnali River below Chisapani gorge. In the present study different sizes and types of gill nets and driftnets were recorded. Despite the fact that there has not been any instance of dolphin entanglement in the recent years, it has been stated that floating gillnet used in flooded river appear deadly since they are not easily detected visually and acoustically by dolphin. They are set across river during monsoon (May-July) when dolphins lose their sonar ability due to murky runoff and become easy victims (Shrestha, 1995). Additionally gills nets are destructive as they entangle fish fauna of all size and thus pose a dire threat to breeding fish populations. A small portion of respondents used fishing lines that do not pose any serious threat to dolphin population through prey depletion but it must be mentioned here that Joshi (2004) reported of an instance of entanglement and death of a calf dolphin in Mohana River 10 years ago by hook line fishing.

Additionally, it should be noted that fishing and fish harvest is high in Geruwa along with the receding water levels. Due to low water levels, dolphins are limited to a reduced range of distribution almost entirely outside the jurisdiction of protected area where fishing is not restricted. Thus, the practice of intensive fishing



during low water level has more adverse effects on dolphin prey availability.

4.3.2 Population Segregation

Dams can alter or eliminate prime dolphin habitat areas by changing the hydrology of rivers and modifying their flow patterns. The Girijapur barrage located at Kailashpuri, 20km downstream of India-Nepal border has effectively isolated the remnant population from any possible genetic mixing. As evident from surveys carried at the end of monsoon and during winter, there is no fluctuation in status of dolphins, which confirms that there is no possibility of genetic interchange between animals migrating from outside or the resident animals migrating from this section of the river towards the Indian frontier. Barrages on the Mahakali River (Sarda in India) at Banbasa on the India-Nepal border in 1928, and at Sardanagar in 1974 about 160 km into Indian Territory, have resulted in the extinction of dolphins from the Mahakali River. If constructed, the proposed high dam at Chisapani gorge will further threaten the remaining population (Smith 1994).

Small isolated populations may also be more susceptible to risks of human impacts and environmental catastrophes (Zhang *et al.*, 2003). It is evident that fragmented populations are challenged by a number of factors that increase the likelihood of population extinction simply because the population is remnant and confined within a certain area. Although fragmented population may survive in short to medium term, altered habitat and other factors contribute to their demise on the long term. Along with environmental impacts of the proposed dam at Chisapani, the feeder roads will increase vehicular movement along the Karnali River banks, which will further degrade the pristine environment of Chisapani gorge where the animal is occasionally sighted. Shrestha (1995) states that construction of the main dam and reservoir

would reduce the habitat available for dolphin by 40%. A reduction by such a degree in already sparsely located habitats will prove catastrophic to the remnant population.

4.3.3 Habitat Degradation

During the rainy season (June-July), dolphins are found in perennial feeder streams such as Mohana, which contain scattered deep pools rich in migratory fish population. Changes in land use pattern and deforestation due to increased human pressure have caused the river banks to slump and erode, reducing flows and eliminating the deep pools because of silting. The process of erosion starts from *Churia* foothills and thus will require additional effort to be tackled. Such an effect has considerably reduced the habitable stretch of the river and the dolphins are forced to those areas where human activities are extreme. This may be one of the reasons for dolphin population depletion during the recent years in tributaries. Locals admit that riverbanks of smaller tributaries have constantly undergone erosion and the width of these rivers has drastically widened in the last two decades. It was reported that dolphins migrated upstream into Orai River during high water levels of monsoon a decade earlier but they have not been sighted there in recent years.

Though the upper stretch of Karnali River above Chisapani still remains relatively undisturbed, Shrestha (1995) stated that dolphins seem to be rather unaffected by rowboats or canoes, but had not been seen in former habitat areas above Chisapani and at Kothiaghat since the introduction of motorized boats in 1986. They were observed during the operation of motorized boats at Kothiaghat during the present study. But review of secondary sources show a steep decline in population after the introduction of motorized ferry at Kothiaghat. Gravel road along the Karnali riverbank northwards from Chisapani for a length of about 8km allows trucks and



tractors that transport logs to ply, and disturb the pristine environment of the upper reaches of Karnali. Similarly, human settlements have immensely increased degrading the dolphin habitat that existed before 1990, as pollution and human activities like sawing, washing and swimming has escalated along the riverbanks at Chisapani.

Commercial fishing is not widespread but both the major settlements along the river segment, Chisapani and Kothiaghat sell substantial amount of dried fish. It should be emphasized here that the process of drying of fish demands additional amount of firewood, which in turn exerts an extra pressure on the adjoining forests resulting in deforestation and erosion in the long run.

The Rajapur irrigation rehabilitation project that commenced in 1991 and completed in 2001 has constructed embankments along the Geruwa River at major dolphin habitats. Most of the structures in the irrigation system were upgraded to concrete structures and farmers no longer used brushwood and timber for maintenance. Embankments interrupt access to spawning habitat for floodplain-dependent fishes and eliminate eddy counter-currents where the dolphins spend much of their time. In absence of over spilling of water onto adjacent floodplains, there is a marked reduction in fish production as annual flooding of rivers with floodplains results in a massive increase in fish production far in excess (approximately 1000%) of what an equivalent river without a floodplain could

TABLE 1: **Chronology of major events along the lower Karnali River basin**

| Year | Event | Effects of the event | Previous status | Post event Status |
|-----------|---|---|-----------------------------|--|
| 1972-1976 | Construction of Girijapur barrage 20km below India-Nepal border | Obstruction in dolphin movement, mining and excavation just below the India-Nepal border causing disturbances in ecology of river. | NA | 12 in 1982, Shrestha (1989) |
| 1984 | Devastating flood in Karnali River | Changed river course from Golaghat to Kothiaghat, branching out of Karnali into numerous smaller channels, reduction in depth and increase in width of channels. | 20 in 1983, Shrestha (1989) | 23 in 1986, Shrestha (1995) |
| 1986 | Operation of motorized boat at Kothiaghat | High noise level at Kothiaghat, which also is the route of migration for dolphins to move upstream into Nepal territory. | 23 in 1986, Shrestha (1995) | 6 in 1990, Smith (1993) |
| 1990-1993 | Construction of Chisapani Bridge | High noise output due to explosions, mining and excavation along the river system at Chisapani. Obstruction in dolphin movement into pristine habitats above this area. | 6 in 1990, Smith (1993) | 2 in 1993. Smith et. al (1994) |
| 1992-2000 | Rajapur Irrigation Rehabilitation project | Embankment of river segments, disturbances crated due to vehicular mobility along the Golaghat stretch of river, reduction in biological diversity of river. | 6 in 1990. Smith (1993) | 8 in 1995 (Shrestha 1995) 5-6 in 1998 Smith (2000) |
| 2000 | Operation of Pontoon Bridge at Kothiaghat | Extremely high noise level resulting from vehicles crossing the river and increased number of vehicles in the area. | 4 in 1999. Timilsina (1999) | 4 in 2003 Joshi (2004) |



produce (Bernacsek, 1984). Additionally, dredging and the removal of stones, sand, and woody debris also compromise the ecological integrity of the riverine environments, especially in small tributaries (Reeves *et al.* 2003). Table 1 below summarizes the major events that have taken place along the lower Karnali River stretch, which have had impacts in some way on the dolphin habitat, population and their migration route.

4.3.4 Pollution

Population pressure and diversion of water for irrigation and transportation facilities after the commencement of diesel powered boat in 1986 and the Pontoon bridge at Kothiaghat intensified agricultural activities in the 11 VDCs located between the two channels of Karnali River. Along with intensification of agriculture, farmers use higher yielding but low pest resistant varieties of crops along with application of higher chemical fertilizers and pesticides. At the same time, the open border with India has resulted in local farmers acquiring higher amount of chemical fertilizers Urea and Potash from India at lower rates. These agrochemicals harm the dolphins both directly and indirectly through the food chain (Behera, 2005).

The Bashulinga DSM Sugar Mill established in 1996 in Chuha VDC of Kailali district discharges its effluents into the Pathraiya River. The quality of such industrial effluents has not been monitored and locals have reported a decrease in fish population in the river segment immediately below the point source of discharge. It is likely to have negative impact on the aquatic biodiversity of this river in the long run. Thus further investigations may be necessary in this matter. Figure 5 below shows possible threats in long-term survival of dolphin in the Karnali River system.

4.3.5 Transboundary issues

Dolphins are migratory by nature and thus move upstream and downstream along the Mohana and Geruwa Rivers. The monsoon population in Mohana faces threats from destructive fishing gears, which result in prey depletion as well as accidental entanglements in nets. It was observed that fishermen from India and Nepal fish extensively in Mohana River. Fishermen from India use large nets, which has resulted in accidental entanglements of dolphins though deaths have not occurred. Similarly, along the Geruwa River, area downstream of Kothiaghat is incorporated into Katarniaghat Wildlife Sanctuary where fishing is restricted but it should be emphasized that fishermen from Indian side harvest large sized fish by using spears. This ultimately affects the prey base by hampering breeding population.

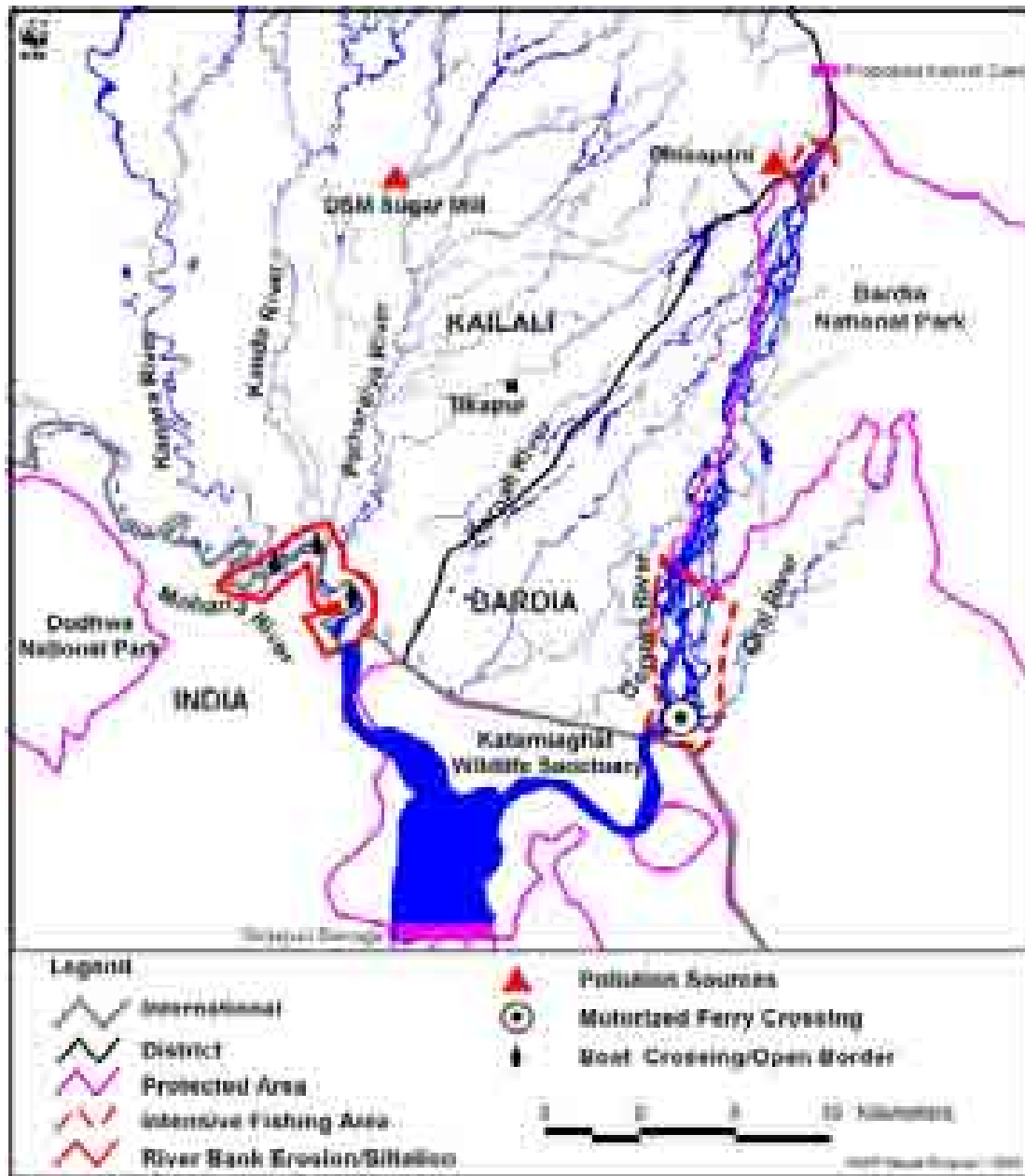
Protected areas connected through large hydrological regimes are affected by activities on either side of an international boundary. As the animals are migratory in nature and feed on the fish populations that breed along the stretch of Geruwa River, lack of exchange of scientific data and joint monitoring may result in wrong estimation of status and distribution as well as threats which always is crucial for conservation and long-term survival of endangered species like dolphins. Similarly, conservation and management concept may also be different on both sides, which further needs to be in-sync.

UNESCO (EABRN-5 meeting³) has listed the advantages of Transboundary conservation categorized in terms of conservation, scientific research and education, monitoring, management and development. In case of conservation, better knowledge and coherent data on protected species, especially migratory species and identification of differences in

³ East Asian Biosphere Reserve Network meeting in 1997 in Ulaanbaatar



FIGURE 5: Possible threats for long term survival of dolphins in Karnali River system



conservation policy and management strategies on both sides of border are the major advantages. In case of scientific researches, it reduces the chances of research duplication and helps to build a common database. Additionally, it provides a better chance for organizing integrated scientific surveys and research projects along with the possibility of providing

better support for international research and training. The meeting has stated that such efforts are more effective in controlling illegal hunting and poaching crossing borders and also provides better data on migratory animals.

Considering the overall benefits of transboundary cooperation in conservation of migratory animal



like dolphin, it is necessary to initiate transboundary measures to tackle issues which impact dolphin population and their migration as well fish migration and breeding. Any conservation efforts on one side need to be complemented from the other side. Thus, a transboundary initiative both at local and national level is required for conservation and management of the river systems.

4.3.6 Policy Issues

Aquatic Animal Protection Act, 1961 (AAPA) recognizes the value of wetlands and aquatic animals. However, no agency has been designated to administer and enforce the Act. The AAPA has not been effective in protection of the biodiversity of aquatic ecosystem as both explosive and noxious materials are employed in aquatic ecosystems (NBS). **NPWCA 1973** provides complete protection to 27 species of animals including dolphins. But very little has been done for protection and management of this specific animal. There have been occasional incidents of poaching of dolphins for trade of meat, oil and bones (Shrestha, 1995) that have failed to attract the attention of concerned bodies in order to initiate any legal actions against such violations of the Act. **National Conservation Strategy, 1988** has stated that the aquatic species receive little protection which results in a substantial percentage of wildlife being harvested indiscriminately both for commercial and domestic purpose. This also has reduced the prey for dolphins in Karnali River.

Till date no such plans and programmes have been designed to address the aquatic animals that inhabit areas within and outside protected areas. Their habitat and migratory nature has not yet been integrated in any of the plans. **National Biodiversity Strategy (2002)** recognizes the need for wetland conservation while the **National Wetland Policy (2003)** has emerged as the central plank of government's approach to

wetland biodiversity conservation for future. Despite the formulation of supportive policies in recent years, there is a need to develop species-specific strategy regarding dolphins that envisions managing the river ecosystems through a comprehensive conservation plan. As recognized by **NBS, 2002**, lack of awareness and sufficient data regarding status, distribution and range of migration outside protected areas where the animal is highly vulnerable to poaching is lacking in the case of dolphins. Though many wetlands including dolphin habitats exist on government land and under the legal jurisdiction of the Department of Forests, the focus on forestry issues has meant that wetland conservation has not received adequate attention.

4.3.7 Awareness

About 40% of respondents in Mohana River basin and 58% in Geruwa River basin were aware that dolphin is an endangered animal. On the issues of knowledge about legal provisions in the NPWCA 1973 regarding fines, imprisonment and punishment for capturing, disturbing or poaching of an endangered animal like dolphin, only 12% in Mohana River basin had thorough knowledge whereas no respondents had such level of knowledge in Geruwa river basin. Most of the locals in both the river basins (42% in Mohana and 56% in Geruwa) had a certain degree of knowledge meaning that they at least knew that there were provisions for punishment in the NPWCA. While a large number of respondents (46% in Mohana and 44% in Geruwa River basin) were ignorant about any such legal provisions regarding dolphins specifically.

It was reported that a couple of year's back, some Indian fishermen caught a dolphin calf accidentally. Though it was released following the request of local youth volunteers, lack of awareness and absence of official government



representatives can be accounted for this incident. The study identifies local level awareness as an important aspect that needs to be addressed immediately. This may be initiated through the Khata Community Forest Coordination Committee in Bardia and Bhajani CFCC in Kailali. Information can be conveyed through local media, posters, pamphlets and local level discussion forums.

4.4 Conclusion

Based on the findings of this study, it is concluded that the status and distribution of dolphins in Geruwa River has not altered in the last five years. The primary sighting spots remain the same since 1999 with slight changes that is due to changes in river regime as a result of seasonal floods. In Mohana River, there is a slight change in status though the distribution range and sighting areas remain the same. Intensive fishing, habitat degradation and population segregation are the major threats to dolphins in Geruwan river. Similarly, dolphin population in Mohana River is seasonal, limited

to high water level periods of monsoon, they are threatened by habitat degradation through bank erosions/siltation resulting in decrease of habitable areas. Intensive fishing and accidental entanglement in these narrow rivers also pose a threat to dolphins in smaller tributaries. The impact of chemical fertilizers and pesticides needs to be accessed as studies in other parts of Asia have shown considerable impact on dolphin and its prey species resulting from agricultural run-off.

Major activities that have influenced dolphin population in the river basin are construction of Girijapuri barrage, motorized ferry crossing at Kothiaghat and Chisapni bridge construction. Girijapuri barrage has impeded the migration of dolphins and associated prey species thus limiting the possibilities of genetic mixing. Motorized ferry crossing at Kothiaghat has degraded an important migration route of dolphins. During the construction of Chisapani Bridge, the disturbances created by blasting, drilling and vehicular movement has isolated the pristine area above this point, thus limiting dolphin movements downstream.



5

recommendations

Based on the outcomes of this study, recommendations have been made for conservation and management of river dolphin in Karnali River basin. First set of recommendations are made as a whole for the policy level initiatives, the second set of recommendations are specific for the area and third set are for further long-term studies in the area.

5.1 Policy

- 1) There is need to develop effective mechanism of conveying key information to decision-makers and the general public in order to gain support for conservation initiatives of Endangered migrant aquatic species
- 2) Species conservation plan that focuses on population surveys, monitoring, protecting key habitats, relocation and restoration of dolphins is needed.
- 3) Special attention should be paid for documenting existing and planned water development projects. All possible impacts of water development projects should be evaluated and results from these investigations should be disseminated to resource management agencies along with recommendations to reduce or eliminate any potential threats to aquatic fauna including dolphin.
- 4) A comprehensive river basin ecosystem conservation policy should be developed and supported with statutory measures. River basin conservation strategy should for all significant river systems take steps to protect rivers and their tributaries.
- 5) The existing population is contained within the western end of the park and the Girijapur barrage in India, located approximately 20km south of the Nepal-India border. As previously recommended by IUCN/SSC Cetacean Specialist group, the entire stretch of the Karnali River from Golaghat to Katarniaghat (in India) can be designated as an international biodiversity zone for the conservation of the dolphin, crocodiles and turtles. Major parts of the river systems both in Mohana and Geruwa form the boundaries of protected areas in India and Nepal. Royal Bardia National Park, Katarniaghat Wildlife sanctuary and Dudhwa National Park lie in close proximity and form TAL, a visionary



landscape level program of WWF Nepal, which also focus on species conservation. Thus some mechanism should be developed at Indo-Nepal level so that segments of river system outside the jurisdiction of these protected areas are incorporated or developed into conservation areas.

5.2 Specific Recommendations

- 1) Based on findings of the present study, raise awareness about importance of conservation of dolphins in lower Karnali River basin. For this purpose, local NGOs, CBOs and school level eco-clubs will be the most effective means to achieve the target.
- 2) The ecosystem of lower Karnali River should be considered as a single conservation unit and priority should be given to preserving all of its components including fishes that provide food for the dolphins as well as the indigenous people. Efforts should be made to establish the entire area as conservation area and its management should be given to local bodies.
- 3) Fishing should be regulated to reduce the pressure on the feeding ground of dolphins. Fishing gear that harm dolphins should be banned in primary habitats. Private and community managed fishing culture can be promoted in ditches and small ponds around the area through the CFUGs and CFCC as opportunity costs of restrictions in the river.
- 4) Effectiveness of regulations should be monitored and evaluated. As fishing activities takes place during the night, local counterparts should be encouraged to tackle such issues. For this purpose, the existing Community Based Anti-Poaching Units can be motivated and mobilized.
- 5) It is inevitable to involve local resource managers and community groups for long-term survival of these animals as conservation efforts do succeed if guardianship is developed in and around the animal's habitat. This can be achieved through the involvement of CFCC and Community Based Anti-Poaching Units in the Khata corridor of TAL.
- 6) Community managed tourism in could be promoted in the area. This would also help to improve the local economy. The parts of river system can be managed through community participation. However necessary infrastructure of the entire region such as roads and lodges must be developed for efficient mobility and accommodation during all seasons. Kothaighat on Karnali River can be promoted as the prime location for dolphin watching during low water seasons whereas Bardahawaghat on Mohana River has the potential in Mohana river basin.
- 7) As the dolphins usually feed upon smaller fishes and shrimps, the mesh size of fishing nets can be regulated so that the fishermen catch only larger fishes and allow smaller fishes to escape. It was observed that the use of gill net is destructive to the fishing population as it entangles fishes of all size that ultimately hampers breeding fish population though instances of dolphin entanglement have not been reported.
- 8) As the study has found that the local communities have religious and cultural belief regarding dolphin as a holy animal, conservation effort should be built on their existing belief rather than trying to impose a scientific basis for conservation at the very beginning.
- 9) Unless the local people recognize the significance of wildlife values of their immediate surrounding and the river dolphins as a whole, implementing many of the recommendations that involve local participation would not yield desirable success. Both local and national media, print (news paper and magazines) and electronic (radio and TV), should extensively be made



use of in highlighting the issues on the existing dolphin population.

- 10) Along with population increase, there is bound to be a rise in demand for stones, boulders and sand from the banks of these river systems, thus it is of utmost importance that certain sections of the river should be banned for such activities as well. DDC/VDCs should issues license only for already disturbed river segments and rotate such activities in a sustainable manner.

5.3 Further research:

- 1) Future survey methods should be standardized and modified and survey reports should include detailed description of habitats, methods, search effort, environmental conditions and dolphin sightings so that data can be properly evaluated and future surveys can be designed for comparability.
- 2) More extensive surveys are imperative to understand the status and distribution of dolphin in Karnali River system. Concerned authorities in Nepal and India to assess the actual status of the animal during wet and dry seasons should do this jointly. Seasonal and annual movement should be investigated on both sides of the border above the barrage.
- 3) The habitats identified by this study should be marked for ecological study in future. Besides this, changes in river ecology and associated aquatic fauna should also be monitored and studied simultaneously. The study of fish population should be an integral part of future research.
- 4) Long-term studies on reproductive biology and behaviour, ecology, population dynamics and movements should be initiated under the present scenario of human pressure and habitat degradation.
- 5) Studies on the impact of chemical fertilizers and pesticides on water quality during periods when agricultural activities are intense along the river banks should be initiated as these inorganic substances do have a considerable impact on fish and dolphin populations and other associated aquatic fauna that comprise a part of dolphin food chain.
- 6) Taking into account any future monitoring activities, Kothiaghat on the Geruwa channel and Bardahawa cluster on Mohana River are the most appropriate locations. Kothiaghat can be monitored at any time of the year as the presence of dolphins is reported to be throughout the year but at least two monitoring are recommended, one towards the end of monsoon and the other during low water level periods of winter or prior to onset of monsoon. In Mohana, monitoring may be carried out only during the high water level, which extends from June to Mid September depending upon the amount of rainfall. The involvement of local people in future monitoring should be of high priority to ensure that subsequent monitoring is also conducted using consistent and practical methodology.





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Description of areas with dolphin sighting in Geruwa River

| River section | Habitat Description | Number during four different surveys | | | |
|----------------------------|--|--------------------------------------|----------|----------|----------|
| | | 25 Oct | 29 Oct | 26 Dec | 30 Dec |
| Golaghat | Wide river section, numerous channels converge just above this spot, river bed is composed of pebbles, a wide pool of 50-100m width has been created at this spot, dolphins are mostly sighted after the end of monsoon, river banks highly disturbed during the sighting periods due to grass cutting activities in RBNP as this is a major boat crossing section leading into RBNP. | 0 | 0 | 1 | 1 |
| Guptipur | Shoreline very wide and unstable, bed load consists of stones, pebbles and sand, human settlements, a major rowboat ferry crossing point, | 1 | 1 | 1 | 1 |
| Khauraha-Geruwa Confluence | River water clear, Geruwa channel meandering and creates many channels and oxbows making rainy season resort for dolphin, width varies from 100 to 300m., deep pool created just at the confluence, river bed is composed of stones; pebble and sand, no human settlements near, river banks utilized for livestock rearing, fishing activities high, hooks and hoop nets (heluka) commonly used. | 1 | 1 | 1 | 1 |
| Orai-Geruwa Confluence | Width and depth vary between 50-400m and 5-20m respectively, confluence turned into a large pool during the monsoon whereas the depth and width is reduced up to 5m and 50m during the dry period, occasionally wildlife such as river otter, turtles, crocodile seen, dolphins sighted only during monsoon, no human settlement along this section and fishing activity also moderate here. | 1 | 0 | 0 | 0 |
| Kothiaghat | Flood plain wide and disturbed by human activities, width varies from 400m during monsoon up to 100m during the dry periods, human settlement on one side of this section, heavily disturbed throughout the year, motorized boat in operation during the wet periods and a pontoon bridge laid during the dry period. Excessive fishing throughout the year with the use of Gill net, dolphins sighted at this spot throughout the year. | 2 | 1 | 1 | 1 |
| TOTAL | | 3 | 3 | 3 | 3 |

Note: Identically shaded columns indicate the sighting of same individual at the two points



annex 2

Description of areas with dolphin sighting in Mohana River

| River section | Habitat Description | Number during three surveys | | |
|--------------------------|--|-----------------------------|-----------|----------|
| | | 19 Aug | 29Aug | 8 Sep |
| Chaugurdi | Confluence of western branch of Karnali and Mohana, dolphins sighted on Mohana which flows in a single channel, river bed is composed of sand, width of Mohana River varies from 150mts during high floods to 50m during low floods in monsoon, river banks on the Nepal side cultivated and constantly eroded, one of the least disturbed sighting spots in Kailali, and fishermen use hooks and cast nets. | 0 | 2 | 1 |
| Khakraula | Highly disturbed area, large oar powered ferry along with numerous smaller boats operate at this point, Mohana River flows in a single wide channel at this point and its width varies from 200m during high floods to 80m in low floods, human settlements on the Nepal side whereas the India side is covered with forest. Cast net fishing is intensive along the river, riverbank erosion; meandering nature of the river has created a deep pool. | 0 | 1 | 2 |
| Bardahawa Cluster | Bardahawa cluster is a group of four confluences that lie within a distance of 1km. Deep pools characterize each confluence. The width and depth of these pools varies for each location. Bardahawaghat and Rapti sections have clustered settlements and thus activities like bathing and washing are common here. Both these sections are subject to frequent boat movements. Agricultural activities are intense around this cluster and use of cast nets for fishing is prevalent. River bank erosion common. | 4 | 4 | 3 |
| Mohana-Kanara Confluence | Width varies from 80m to 200m during the monsoon, oar powered ferry operates just below the confluence, river bed composed of sand and clay agriculture fields around this area, Cast nets commonly used, highly disturbed due to ferry crossing and fishing, Dolphin surfacing occurs frequently in areas where deep pools with slow flowing eddy counter currents have been created due to converging rivers, location of these deep pools also varies each season but is mostly situated nearby the point of convergence. | 4 | 2 | 2 |
| Janakpur | This stretch of Pathrayia River has a meandering nature, width varies from 40m to 70m during the monsoon, and riverbed is composed of pebbles. The riverbanks either cultivated or occupied by human settlements, frequent movements of small boats at Janakpur Cast nets widely used, washing and bathing common. | 2 | 3 | 1 |
| TOTAL | | 10 | 12 | 9 |



Photographs



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Research team with staffs of WWF Nepal and Royal Bardia National Park at Manaughat, Karnali



© WWF-Nepal Program / Dipesh JOSHI

Karnali River above Chisapani is less disturbed but dolphins have not been sighted in this area in recent years.





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Dolphin making parallel dive during October at Manaughat, Geruwa Channel of Karnali River



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Engine powered boats at Kothaighat on Geruwa Channel Karnali





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Fishing is intense during the early hours, a fisherman at Kothiaghat on his way home soon after dawn



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Despite intense human activities, dolphin sighting is common at Kothiaghat during low water levels





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An adult dolphin diving at Bardahawaghat on Pathraiya River - a spot for sighting dolphins from very close range



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A fishermen's chain Pathraiya River-human intervention into a spot of high dolphin activity during monsoon



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The common mode of transport during monsoon at Khakraulaghat, Mohana River



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