

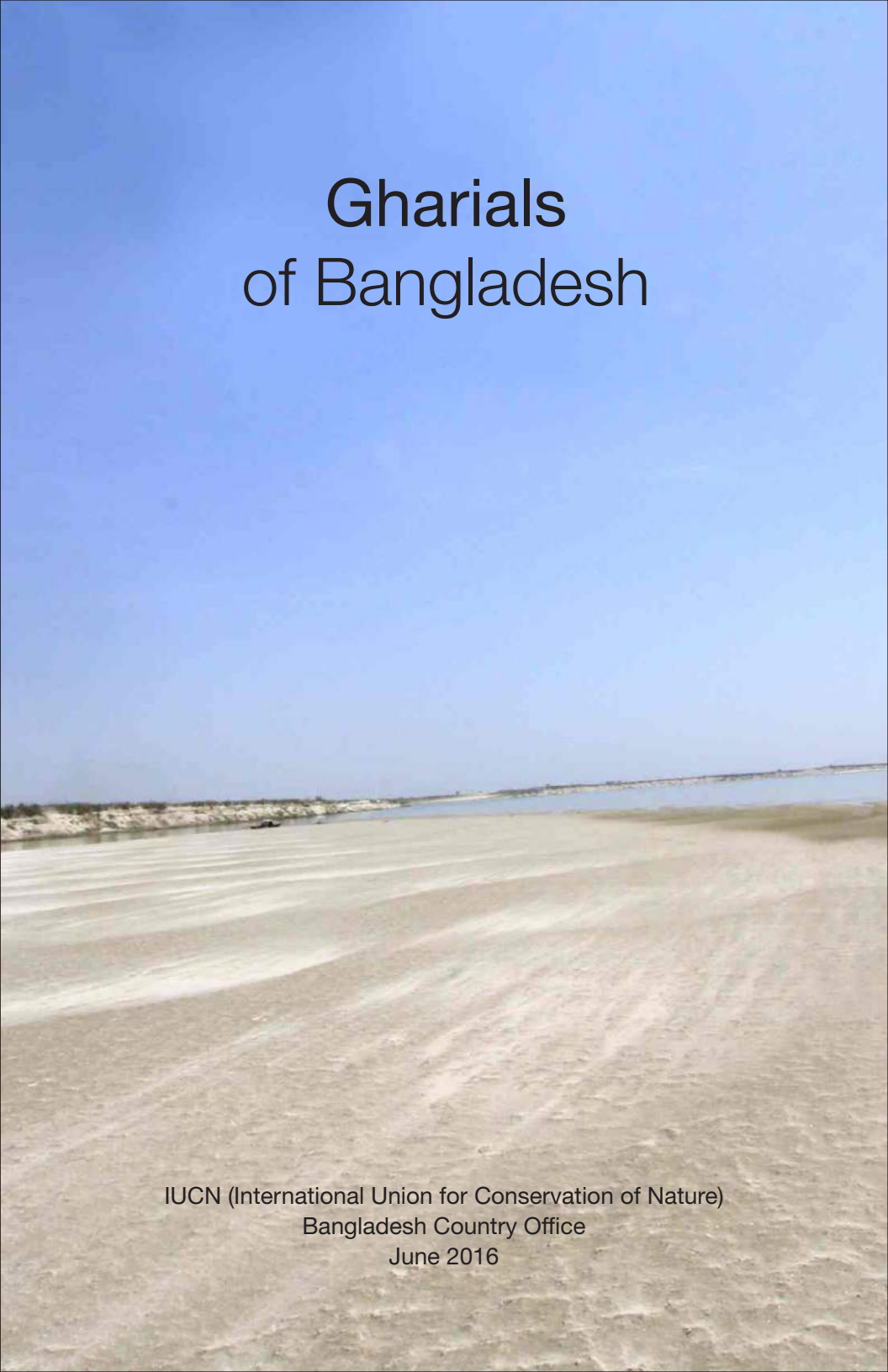


Gharials of Bangladesh



INTERNATIONAL UNION FOR CONSERVATION OF NATURE





Gharials of Bangladesh

IUCN (International Union for Conservation of Nature)
Bangladesh Country Office
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Gharials of Bangladesh

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Preface

Gharial, a freshwater crocodilian endemic to the Indian Subcontinent, mostly inhabits large bodied, deep fast-flowing rivers and primarily feeds on fishes. It is a keystone species of flowing freshwater ecosystem and plays an important role in maintaining the balance of aquatic ecosystems. They help to distribute nutrients from the bottom of the riverbed to the surface of the water. This globally Critically Endangered species has drastically declined over the past 60 years. Gharials once inhabited all the major river systems of the Indian Subcontinent, from the Irrawaddy River in the east to the Indus River in the west. Gharials are now limited to only 2% of their former range. Presently the wild populations of Gharials are only found in Bangladesh, India and Nepal. In Bangladesh, Gharials were once quite common in the Padma and Jamuna Rivers. Now they are facing their worst nightmare and are on the verge of extinction.

A basic step in any conservation plan for a species involves estimation of its population status, structure, and geographical distribution. Bangladesh Forest Department has implemented a project entitled “Strengthening Regional Cooperation for Wildlife Protection (SRCWP)” funded by The World Bank. The Wildlife Management and Nature Conservation Division, Rajshahi was awarded a sub-project entitled “The Gharial (*Gavialis gangeticus*) Conservation in Bangladesh”, which aims to understand these baselines. A part of that sub-project has been implemented by IUCN Bangladesh.

The general objective of this project was to initiate *ex situ* and *in situ* conservation initiatives for Gharials, to identify Gharial hotspots with GIS maps and the formation of a Gharial Conservation Management and Action Plan for the future long-term conservation initiatives of this species, both in the wild and captivity. This book is an outcome of that sub-project, that shares all the findings from the project period along with the management and action plan.

Researchers will find this book helpful as it provides a great source of knowledge and reference about this vanishing crocodilian. It is our hope that this book will also help to better understand this highly misunderstood yet charismatic species and its primary threats, and to initiate the necessary conservation steps for the remaining Gharials of Bangladesh.

Dhaka
June 2016

Ishtiaq Uddin Ahmad
Country Representative
IUCN Bangladesh

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We express our sincere gratitude to the Wildlife Management and Nature Conservation Division, Rajshahi for awarding us a part of the sub-project. We would like to thank Bangladesh Forest Department of the Government of Bangladesh for giving us the opportunity to conduct this study on this charismatic crocodilian species.

Thanks should be given to the Department of Zoology, Jahangirnagar University for their continuous support. Finally, we would also like to express our heartfelt gratitude to the Divisional Forest Officers of Bangladesh Forest Department, Mr. Mollah Rezaul Karim, Mr. Moazzamel Haq and Mr. Abul Kalam for their enormous support in the implementation of this project.

We are thankful to the project director of SRCWP Mr. Abdul Mabud and the former director Mr. Akbar Hossain for their support.

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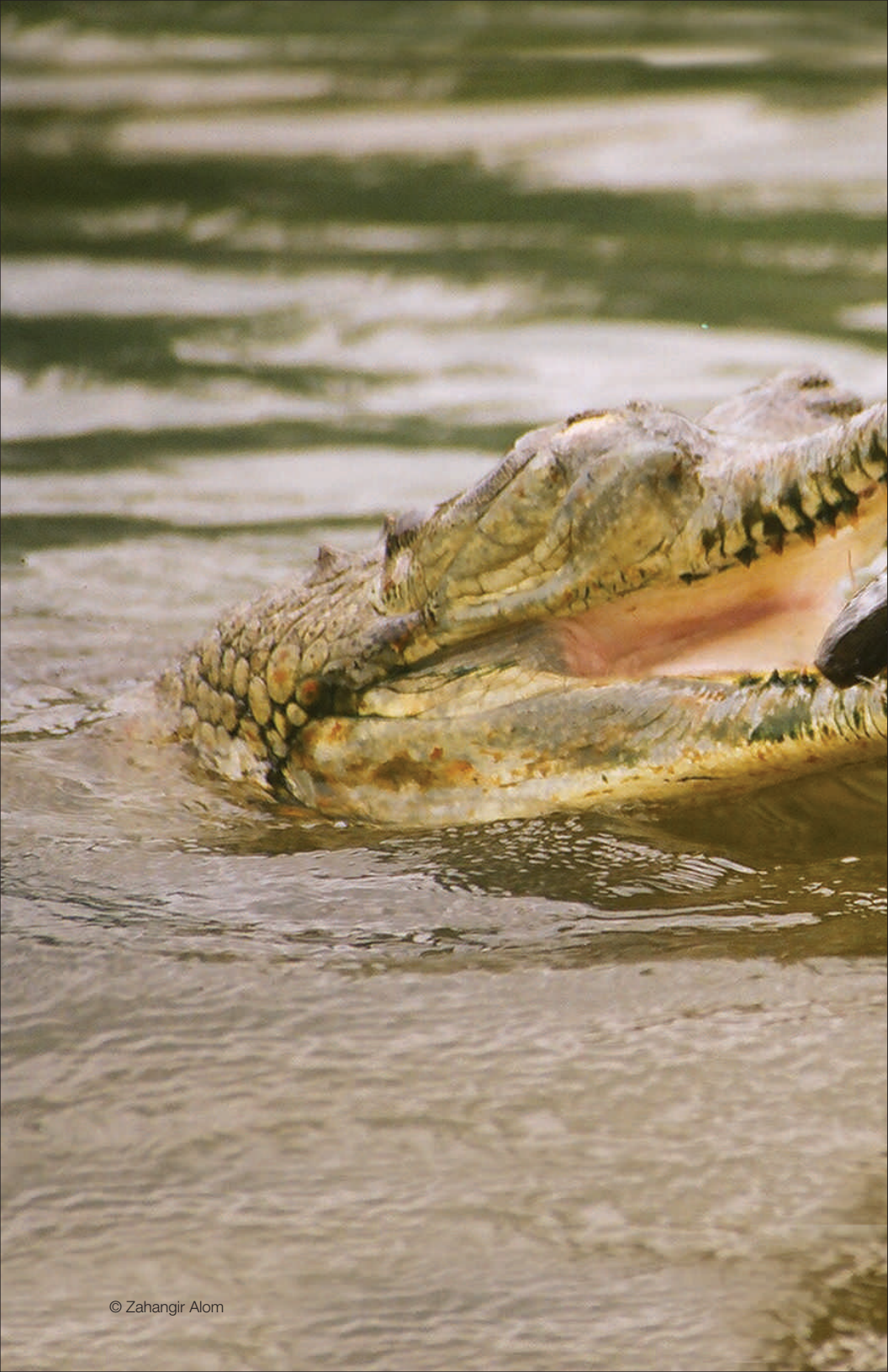


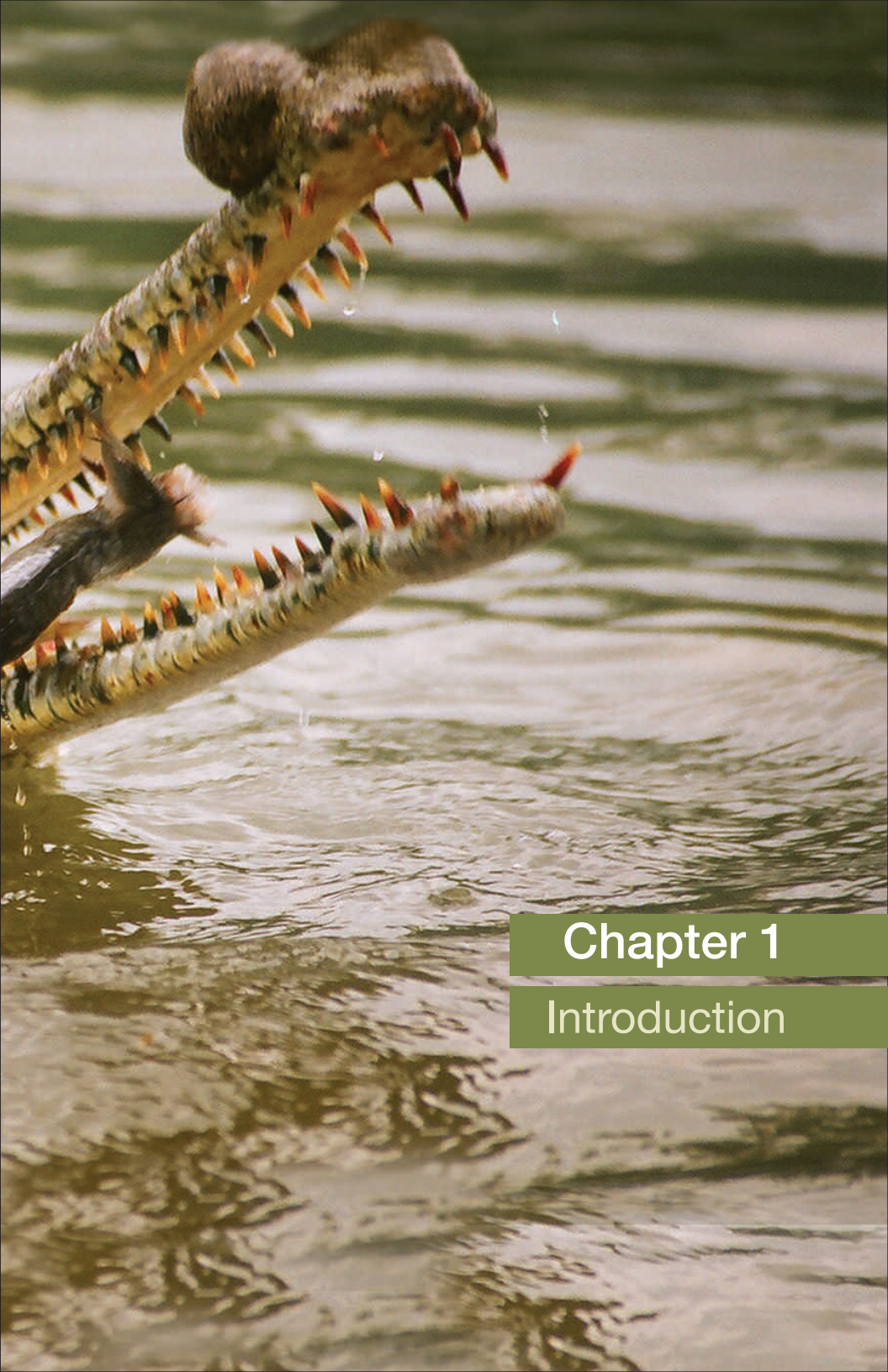
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Chapter 1

Introduction

1.1 General

Gharial (*Gavialis gangeticus*) is a unique crocodilian species characterized by its long and slender snout. It is the only surviving member of the family, Gavialidae (Maskey 1989). The name “Gharial” has been derived from the large, cartilaginous protuberance on the end of the adult male's snout resembling to a *Ghara* or earthenware pot common in India and Nepal (Smith 1931) and *Ghati* in Bangladesh.

Gharial mostly inhabits large bodied, deep and fast-flowing rivers, and primarily feeds on fishes (Shah and Tiwari 2004). Gharial is a keystone species of running freshwater ecosystem and plays an important role in aquatic ecosystem. Gharials help to distribute nutrients from the bottom of the riverbed to the surface of the water. They help to increase primary production and fish populations and maintain aquatic ecosystem (CSG 1998).



Gharials are the top predators and as such are an essential part of the biodiversity of river ecosystem. They feed on the slow moving prey among moving predatory fish thus removing the diseased individuals, thereby maintaining good stocks of commercially valuable fish in any water body (Rashid 2003).

Gharial is a globally Critically Endangered species. The Gharial population has drastically declined over the last 60 years (Choudhury *et al.* 2007). Overhunting for skins and trophies, egg collection for consumption, killing for indigenous medicine, and opportunistic killing by fishermen when caught in fishing nets are the leading causes for this rapid decline of Gharial population (Biswas 1970, Whitaker 1975, Choudhury *et al.* 2007). Moreover, the construction of dams, barrages, irrigation canals, siltation, changes in river course, artificial embankments, sand mining, riparian agriculture, and domestic and feral livestock have combined to cause an extreme limitation to Gharial range due to this excessive, irreversible loss of riverine habitat (Choudhury *et al.* 2007).

Presently the wild populations of Gharials are only found in Bangladesh, India and Nepal. In Bangladesh, once Gharials was quite common in the Padma and Jamuna Rivers (Khan 1982). With the rapid increase in the magnitude of threatening anthropogenic activities like use of river bank in different purposes, river



bank erosion, sand mining, river traffic, fishing, and construction of upstream dams restricting water flow, the Gharials in Bangladesh are standing on the verge of extinction. Comprehensive surveys are urgently needed in their natural habitats to ascertain the present population status, habitat utilization and threat assessment for future conservation initiatives in conjunction with on-the-ground participatory actions and awareness campaigns.

The ecological role played by the Gharials as the top predator in the river ecosystem is yet to be appreciated and disseminated to the general masses and most importantly to the policy makers and the people dependent on the rivers. People usually consider Gharial as a dangerous crocodile species and bear a negative attitude towards this species. Mass awareness build up among the different stakeholders is essential. Immediate conservation initiatives are necessary to conserve the remaining declining Gharial population.

1.2 Biography of Gharials

1.2.1 Origin

The order *Crocodylia* appeared 83.5 million years ago in the Late Cretaceous period (Campanian stage) and is the closest living relatives of birds, as the two groups are the only known survivors of the Archosauria. Fossil records show that they evolved in different ways and were semi-aquatic in habit, with characteristics similar to mammals and birds. Though a molecular dating of the divergence between Alligatoridae and Crocodylidae suggests that this basal split among recent crocodilians took place approximately 140 million years before present, at the Jurassic/Cretaceous boundary (Janke *et al.* 2005). At present, the order Crocodylia includes 23 living species in three families viz. the Alligatoridae (which includes the genera *Alligator*, *Caiman*, *Melanosuchus*, and *Paleosuchus*), the Crocodylidae (*Crocodylus*, *Osteolaemus*, *Tomistoma*), and the Gavialidae, which includes only one species, the Gharial, *Gavialis gangeticus*.

The earliest Gharial may have been related to the modern types. Some died out at the same time as the dinosaurs at the end of the Cretaceous (65 million years ago), others survived until the early Eocene (55 million years ago). The modern forms appeared at much the same time, evolving in the estuaries and coastal waters of Africa, and crossing the Atlantic to

reach South America as well. The discovery of the fossil remains of the Puerto Rican Gharial *Aktiogavialis puertorisensis* in a cave located in San Sebastián, Puerto Rico, suggested that the Caribbean served as the link between the two continents (Vélez-Juarbe *et al.* 2007).

Gharials have lost the great mechanical strength of the robust skull and jaw that most crocodiles and alligators have, and consequently are unable to prey on larger creatures. The reduced weight and water resistance of their lighter skull and very narrow jaws enable Gharials to catch rapidly moving fish, using a side-to-side snapping motion. At their peak, the Gavialoidea were numerous and diverse; they occupied much of Asia and America up until the Pliocene (3 million years ago).



www.wikipedia.org

Gharial skeleton

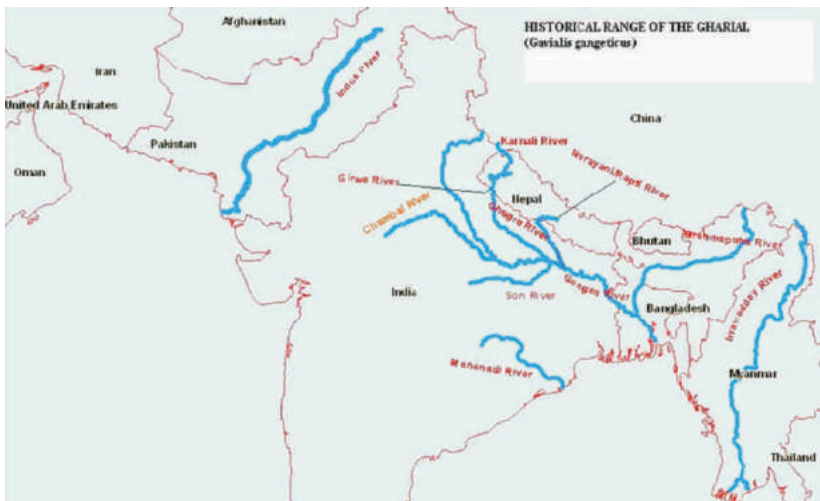
1.2.2 Status and Distribution

The early records indicate that Gharials were abundant in the past. It was common in the Indus River in Pakistan, Gandak River in Nepal, Jumuna River in Uttar Pradesh, and Kosi river in Bihar (Francis 1910, Rao 1933, I.A.K. 1921, Hornaday 1885, Shortt 1921, in Choudhury *et al.* 2007). Several authors reported groups of Gharials were basking together on the river banks and in 1885 Hornaday mentioned that he could count 64 Gharials in two hours on the banks of the Jamuna. Gharials inhabited approximately 11,000 kilometer of river system covering an area of 20,000 square kilometer from the Indus river system in the west to the Irrawaddy in the east (Choudhury *et al.* 2007).

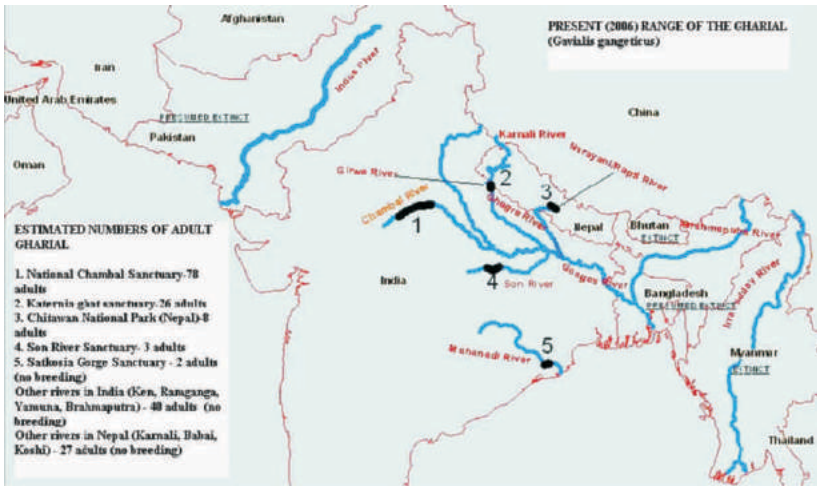


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Gharial was enlisted as a globally Endangered species in 1982 then categorized as Critically Endangered after 1996 (Choudhury *et al.* 2007). The western-most historic occurrence of the Gharial was the Indus River in present day Pakistan and the eastern-most was the Irrawaddy River in present day Myanmar. Today, three widely separated breeding subpopulations are left in India (Chambal River, Girwa River and Son River) and one in Nepal (Rapti/Narayani River) (Maps 1 and 2).



Map 1. Historical distribution of Gharials (Choudhury *et al.* 2007).



Map 2. Present distribution of Gharials (Choudhury *et al.* 2007).

1.2.3 Population

Gharials were once abundant in the major river systems of India and Bangladesh, the Indus River in Pakistan, northern Nepal and Bhutan. About 5000 – 10000 individuals of Gharials were reported from the early 20th century (Whitekar *et al.* 1974). There was a rapid decline of Gharial population and by 1976, the total population of wild Gharial in the world was estimated less than 200 individuals (Choudhury *et al.* 2007). In 2006, less than 200 mature individuals was estimated from India and less than 35 from Nepal (Sharma and Basu 2004, Andrews 2006) (Table 1). In recent years, the overall Gharial population has also been declined by about 58% (Table 2).



Table 1. Gharial population size reduction in the last three generations (Choudhury *et al.* 2007).

Subpopulation (river system)	Population size (inferred) three generations ago (1946)	Population size in 2006	Estimated reduction
Indus River		Nil	
Ganges River		< 200	
Mahanada River		2	
Irrawaddy River		Nil	
Overall	5000 to 10000	<200	96%-98%

Table 2. Recent declines in the number of adult Gharia

ls by subpopulation (Choudhury *et al.* 2007).

Subpopulation	In 1994-1999	In 2006	Estimated % reduction within one generation
Chambal (India)	226 (1997)	78	13
Katerniaghat (India)	30 (1997)	26	66
Others (India)	50 (1997)	40	20
Chitwan (Nepal)	20 (1999)	8	80
Others (Nepal)	100 (1994)	27	73
Overall	436	182	58

The species is supposed to be extinct in Pakistan (Whitaker and Basu 1983), and Bhutan (Singh 1991). Only two records for the species were recorded from Myanmar in 1927 and it is presumed long extinct (Choudhury *et al.* 2007). Some of the sources presumed the extinction of Gharia

ls from Bangladesh (Whitaker 1976, Khan 1979), but later Gharials were spotted in the wild (Khan 1982, Faizuddin 1985, Rashid *et al.* 1986, Sarker *et al.* 2003, 2008).

In Bangladesh, limited information on Gharials is available from published sources. Most of these reports were based on the information provided by the fishermen and through questionnaire surveys and very few on direct field observation (Khan 1982, Faizuddin 1985, Rashid *et al.* 1986, Sarker *et al.* 2003, 2008). Khan in 1982 mentioned that Gharials were quite common in the Padma and Jamuna Rivers and were wiped out from the Tista, Atrai, and Karotoa Rivers and other tributaries of the Jamuna. It was also mentioned that about 20 juvenile Gharials were caught by the villagers between March 1980 and December 1981 at Rajshahi and Sirajganj. Faizuddin (1985) mentioned that the estimated Gharial population in 1985 was 28, while Rashid *et al.* (1986) mentioned the estimated population in 1986 was 8 to 10 individuals. According to Sarker *et al.* (2003), in the past (1957-1990) the total estimated population was 52 individuals while in recent past (1991-2000) 32 and in recent years (2000-2002) 1 individual. In another publication, Sarker *et al.* (2008) revised the information and mentioned that from 1961 to 2006 the estimated Gharial population was 18 individuals. Rashid *et al.* (2014) mentioned that a total of 21 Gharials were caught in fishing net between 2009 and 2012 of which 17 individuals were released in the rivers and 4 individuals were brought to zoos and safari parks (Table 3).



Table 3. Estimated Gharial population/ record of Gharials in different time periods.

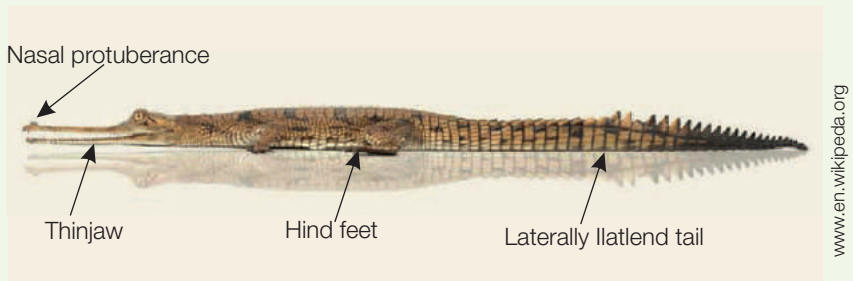
Source	Number of Gharial individuals	Time period
Sarker <i>et al.</i> 2003	52	1957 - 1990
	32	1991 -2000
	1	2000 - 2002
Sarker <i>et al.</i> 2008	8	1961 - 1990
	2	1991 - 2000
	8	2001 - 2006
	18	1961 - 2006
Khan 1982	20	1982
Faizuddin 1985	28	1985
Rashid <i>et al.</i> 1986	8 to 10	1986
Rashid <i>et al.</i> 2014	21	2009 -2012

1.2.4 Morphology

The unique characteristic of Gharial is the presence of its extremely long, thin jaws, which are regarded as an adaptation to a primarily fish diet. The jaws have interlocking set of 27- 29 undifferentiated teeth on each side of upper jaw and 25-26 teeth in the lower jaw (Shah and Tiwari 2004) have adapted perfectly for holding struggling prey (CSG 2000). The thin shape gives the snout low resistance under water, which is suited to fast lateral snatching movements underwater. Dorsal surface of this species is dark or light olive above with dark cross-bands and speckling on the head, body and tail. Dorsal surfaces become dark, almost grey-black, at about 20 years of age. Ventral surfaces are yellowish-white. The dorsal ridges are more or less restricted to the median regions of the back. It has an elongated and thick neck. The fingers are extremely short and thickly webbed. Gharial is the only crocodilian species which is sexually dimorphic (males look obviously different from females). Males develop a hollow bulbous nasal protuberance at the tip of the snout upon sexual maturity (Brazaitis 2001). Although the function of the nasal boss is not well understood, it is apparently used as a visual sex indicator, as a sound resonator, or for bubbling or other associated sexual behaviors (Martin and Bellairs 1977).

The average size of adult Gharials is 3.5 to 4.5 m (11 to 15 ft) though males reach up to 6 m (20 ft) with an average weight of around 160 kg (350 lb) (Stevenson and Whitaker 2010). The largest recorded length is 6.25 m (20.5 ft), and the largest recorded weight is 977 kg (2,154 lb). The length of hatchlings is about 37 cm (15 in) (Maskey and Percival 1994). Young Gharials can reach a length of 1 m (3.3 ft) in 18 months (Whitaker and Basu 1983). Females are smaller and reach a body length of up to 2.7 to 3.75 m (8.9 to 12.3 ft) (GCA 2009).

Gharials have an outer row of soft, smooth, or feebly keeled scutes in addition to the bony dorsal scutes. They also have two small post-occipital scutes. The outer toes are two-thirds webbed, while the middle toe is only one-third webbed. The well-developed, laterally flattened tail and webbed hind feet provide tremendous maneuverability in deepwater habitat. The laterally compressed tail serves both to propel the animal and as a base from which to strike at prey (Whitaker 2007).



1.2.5 Biology

Adult Gharial is primarily fish eater, but occasionally also feeds on crustaceans and other smaller river animals, and scavenging is also known (Das 2010). Young Gharials eat insects, tadpoles, small fish, and frogs. Their jaws are too thin and delicate to grab larger prey, especially people. They catch fish by lying in water for fish to swim by, and then catch the fish by quickly whipping their heads sideways and grabbing it in their jaws. They do not chew their prey, but swallow it whole (GCA 2009). Young Gharials forage and hide in shallow water. With the increase of the body size, they forage in deeper water. Gharials up to

120 cm (47 in) in length prefer 1–3 m (3.3–9.8 ft) deep water, those up to 180 cm (71 in) hunt and hide in 2–3 m (6.6–9.8 ft) deep water. Adult Gharials prefer water deeper than 4 m (13 ft) for foraging and hiding (Hussain 2009).



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Gharials need a long time to get sexual maturity. They usually become adult after the age of 13 years for the male and 16 years for the female, when they are nearly three meter in length (Maskey and Mishra 1981, Bustard 1984, Whitaker 1987, Singh 1999). Thus, a long time is needed to get an adult individual which poses vulnerability of the species. One adult male guards a harem of several females and mates with all of them. The mating period lasts for two months during November, December and into January, while nesting happens in March, April and May (Whitaker, 1983). Nesting occurs during the dry season in holes excavated in river sand banks (Bustard 1980, Whitaker and Basu 1983, Groombridge 1987).



The breeding life of Gharial is usually considered to be 50 years and the life span 100 years (Whitaker and Basu 1983, Singh 1999). Individuals less than 0.6 meter long are considered hatchlings, 0.6 to 0.9 meter are yearlings, between 0.9 to 2.7 meter are sub adults and those larger than 2.7 meter are considered adults (Hussain 1999). Adult female lays 4 to 62 eggs in a clutch (Maskey 1989). The survival rate of young hatchlings in the wild is very low. Less than one percent of the hatchlings survive in natural population (Murthy and Menon 1977, Singh 1978, Roy *et al.* 1982).

Like other reptiles, Gharials practice

thermoregulation through basking, upon which their metabolism depends. Sandy river banks, next to clean and deep water, are the preferred habitat of Gharials (Maskey *et al.* 1995). Gharials bask on the sand banks for long periods during the winter when water temperatures and water level is low.

Presence of undisturbed sand banks for both basking and nesting are very important for the survival of Gharials. Gharials usually use the same basking site for a long time which increases the risk of poaching. Since the population of the Gharial is decreasing day by day, it is an urgent need to know more about its present population, ecological requirements, and habitat status for their conservation. Moreover, it is also important to know the captive Gharial population and the facilities for captive breeding in Bangladesh.



1.2.6 Conservation Initiatives

Several conservation programs (both *in situ* and *ex situ*) for Gharials have been undertaken in India and Nepal focusing on the establishment of protected areas and restocking these with animals born in captivity. More than 5000 juvenile Gharials were released into largely inhospitable habitats in Indian and Nepalese rivers and left to their fate. Most of the reintroduction programs were not so fruitful with some exceptions like in the Chambal River (the tri-state, National Chambal Sanctuary) where 3,552 Gharials were released (Whitaker and Andrews 2003). There were 12 nests recorded in 1978 and 68 in 2006. While nesting has increased by over 500%, these recruited mature, reproducing females were only about 2% of the total number released (GCA 2009).

Scarce conservation funds and human resources need to be also focused on other rigorous actions, such as habitat assessment, fisheries

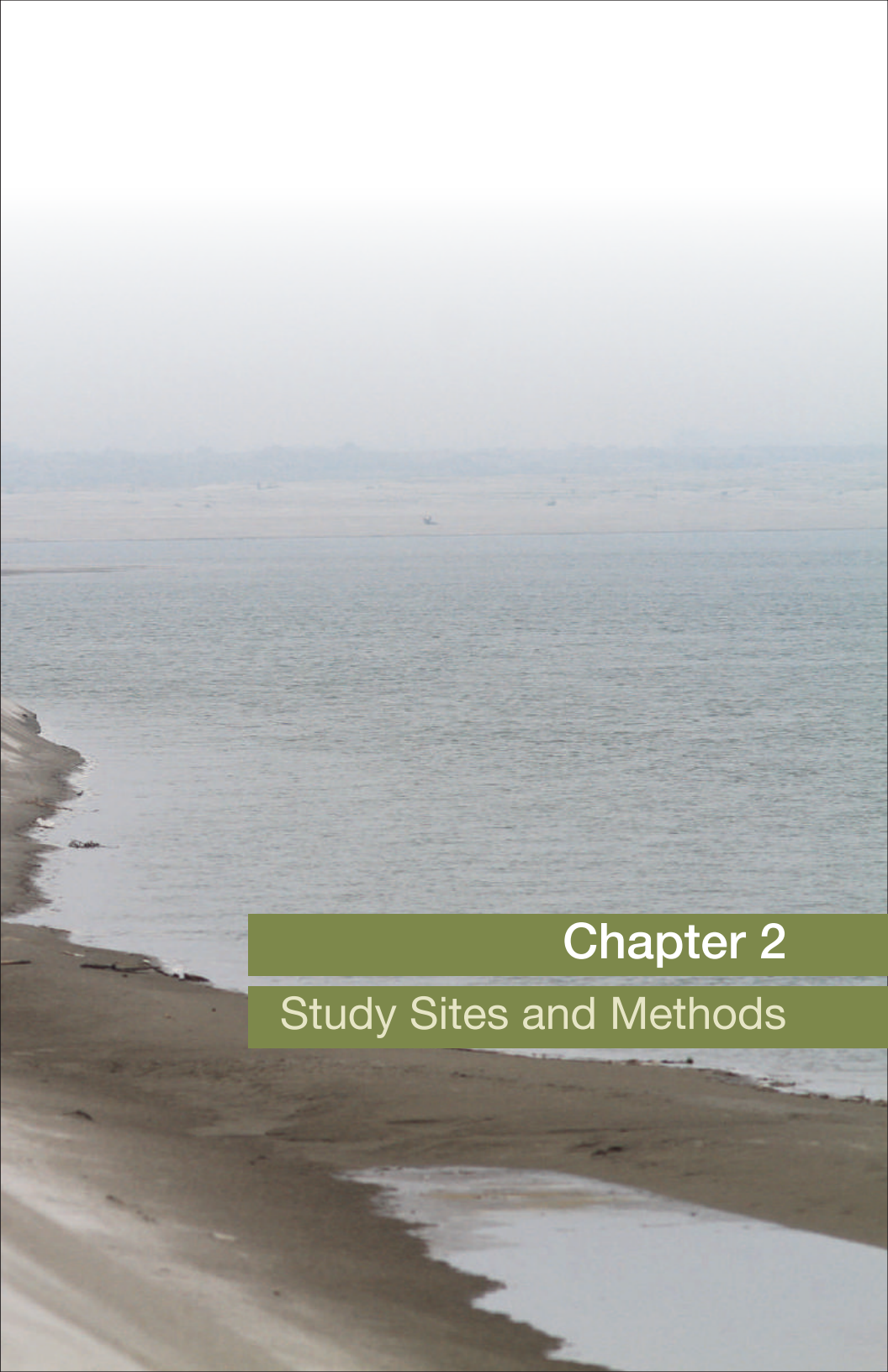


enhancement and conflict mitigation, and educating river people concerning conservation efforts in order to improve the survival odds of the Gharial (GCA 2009). It is to note that the Gharial is listed on CITES Appendix I and on CMS Appendix I.

In Bangladesh, very few initiatives have been taken for the conservation of Gharials. Gharial has been declared as a Critically Endangered species in Bangladesh in 2015 (IUCN Bangladesh 2015). Recently, the Forest Department of the Government of Bangladesh has implemented a project entitled “Strengthening Regional Cooperation for Wildlife Protection Project (SRCWPP)” funded by The World Bank. The Wildlife Management and Nature Conservation Division, Rajshahi has awarded IUCN a sub-project entitled “The Gharial (*Gavialis gangeticus*) Conservation in Bangladesh”. The project has been implemented for one year starting from 21 June 2015 (Chapter 4).







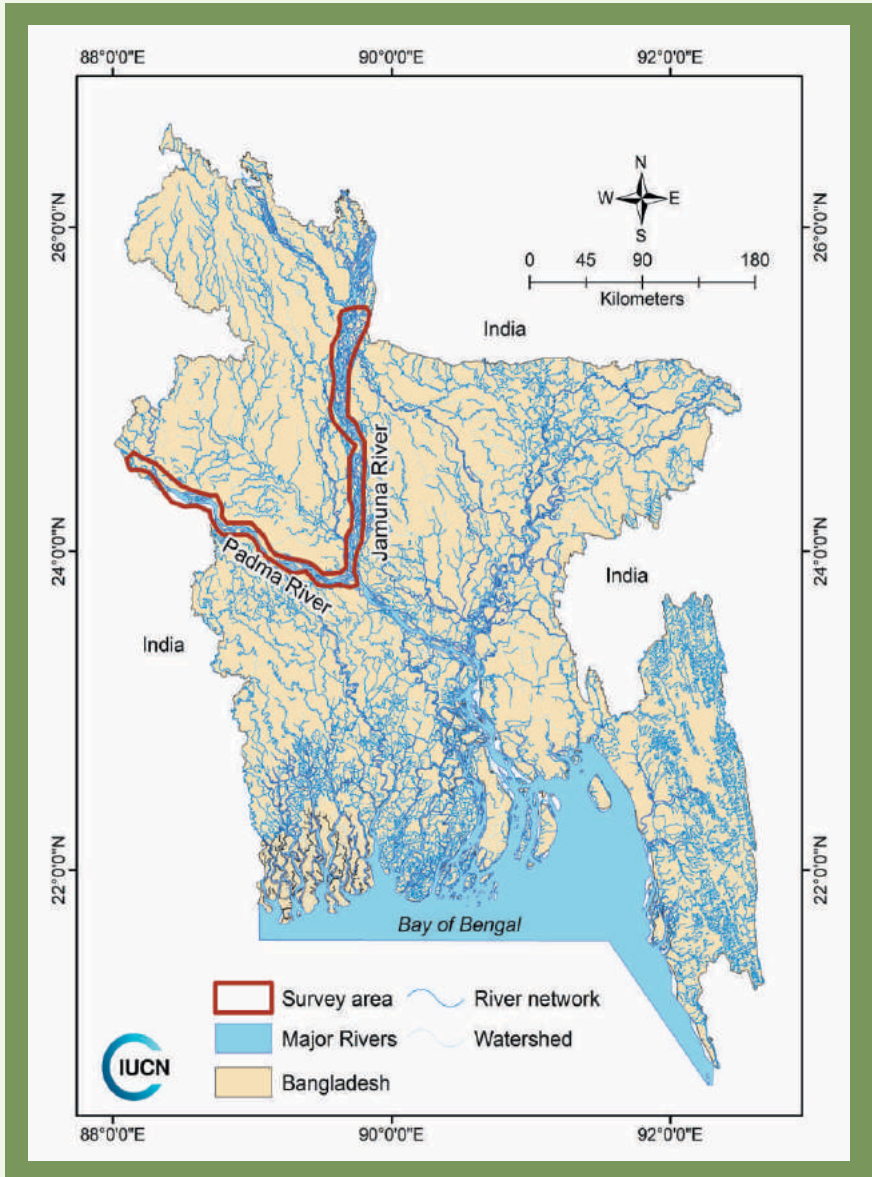
Chapter 2

Study Sites and Methods

2.1 Survey Area

A survey was conducted during June 2015 - May 2016 along the Padma (Ganges) and the Jamuna (Brahmaputra) Rivers. The Padma River enters in Bangladesh at Thutpara of Shibganj Upazilla, while the Jamuna River enters at Narayanpur of Kurigram District. Both of the rivers merge together at their confluence at Aricha. The study carried out from the entry point of both of the rivers to their confluences (Map 3). Direct observation surveys using boat in the potential areas were carried out. Potential areas included chars (sandbars) in the Padma and the Jamuna Rivers. Questionnaire surveys and Focused Group Discussions (FGDs) were carried out among the stakeholders dependent on the river system. Fish markets, fishermen, and boatmen were interviewed at the study sites. Potential Gharial habitats (charlands) were physically visited to assess habitat quality.





Map 3. Survey area in the Padma and Jamuna Rivers.



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Gharial preserved in the museum of Department of Zoology, Rajshahi University

2.2 Survey on Gharial Population

2.2.1 *Present Status of Gharial Population: Secondary Information*

To know the present status of the Gharial population, relevant literature were collected and studied from various sources. At the same time, local and national newspapers and newspaper offices were consulted. Any report on Gharial published in these newspapers from 1990 to 2015 was collected and analyzed.

2.2.2 *Questionnaire Survey and FGD*

Information through personal communication, questionnaire, and Focused Group Discussions (FGDs) were collected among the randomly selected people of different occupations who are living in and around Gharial habitats or who are directly or indirectly involved with the river systems. Bangladesh Forest Department office records and staff in the survey areas were also consulted to evaluate the past and present distributions of Gharials.





Questionnaire survey on Gharials in and around Gharials habitats.

Questionnaire surveys were conducted among 283 respondents in six districts (Fig. 1). Among the respondents, 97 were in the Jamuna River area and 186 were in the Padma River area. Most of the respondents (47%) were from Rajshahi district followed by Chapai Nawabganj district (19%) (Fig. 1). The respondents were mostly senior citizens; 41-60 years old and above (61%) (Fig. 2).

Most of the respondents were illiterate (83%), a small group has primary education (11%) and very few completed up to class eight (1%) and above (Fig. 3). Though the respondents were from 24 different occupations, the majority of them were fishermen (122 individuals) followed by farmers (44 individuals) and boatmen (32 individuals) (Fig. 4).

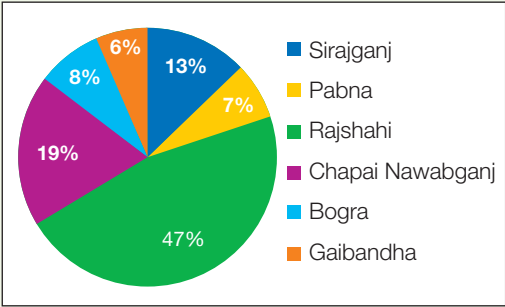


Fig.1 Percentage of respondents in six districts where the surveys were conducted.

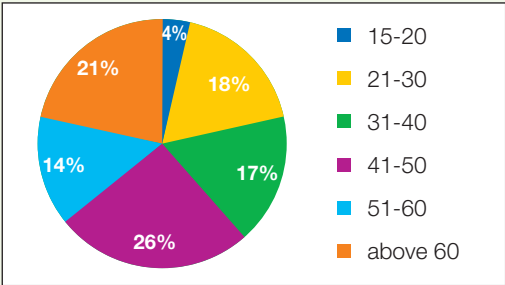


Fig.2 Age class of the respondents during the survey period.

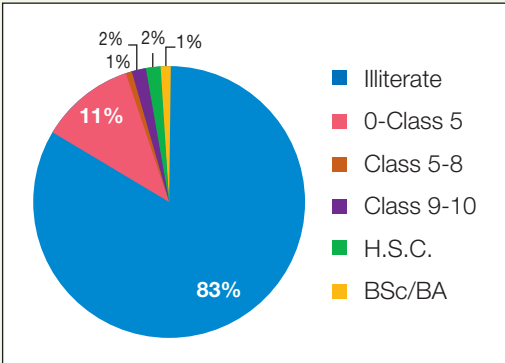


Fig. 3 Education level of the respondents during the survey period.

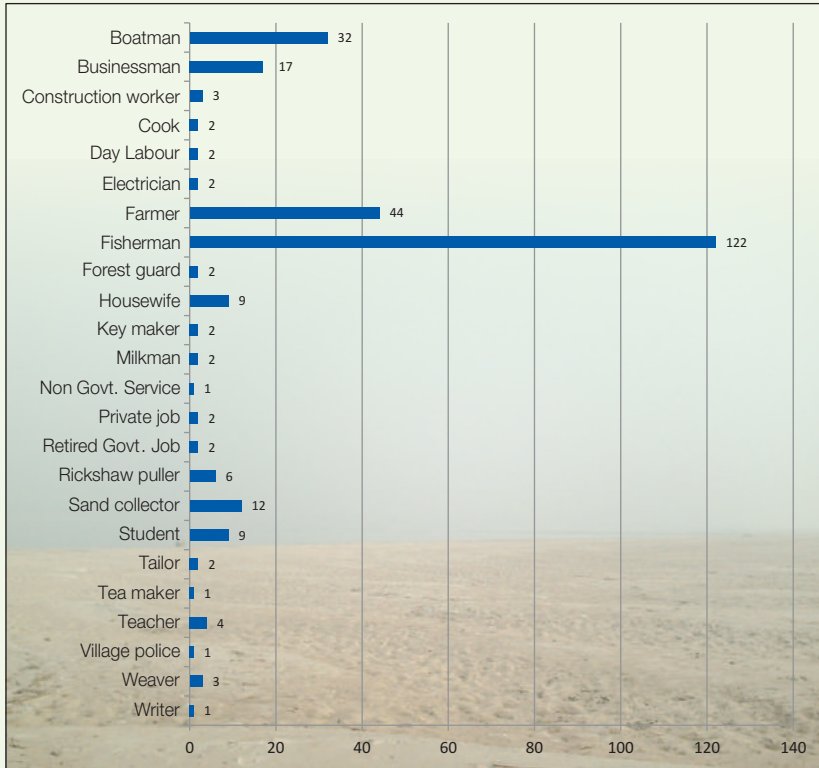


Fig.4 Occupations of respondents of the survey.

2.2.3 Survey in Gharial Habitats

An extensive survey was conducted along the Padma (Ganges) and the Jamuna (Brahmaputra) Rivers following direct observation survey method using boat in the potential Gharial habitats between June 2015 and May 2016. The water in these rivers is the lifeline of all activities for both the humans and the aquatic life. With reduced water levels, the whole landscape changes and huge sand bars (locally known as chars) emerge mostly due to the deposition of sand washed down from upstream as well as from river bank erosion during the monsoon. These chars and the sandy riverbanks provide the nesting and basking habitat for the Gharials. The exposed riverbanks and chars are cultivated for agricultural crops during the dry season of the year, thus conflict between human and Gharial arises at that time. Physical condition of the char lands, agricultural status, anthropogenic activities were also quantified.



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Basking Gharia

ls in Rajshahi Zoo

The preliminary information on the occurrence of Gharial in natural habitats that came out from questionnaire surveys and Focused Group Discussions were surveyed for confirmation. The basking sites in the char lands were surveyed during winter. Overnight halts were arranged for easy access to remote areas. The areas where the habitat was potentially good for the likeliness to support Gharials or from where recent sightings were reported were intensively surveyed.

Inquiries were also made at village markets and fishing villages having assemblages of people from different walks of life.



Alatuli Char and its sandbars

2.3 GIS Mapping

GPS coordinates were taken for all places where once Gharial was sighted or for the existing potential Gharial habitats. GIS maps were prepared using GPS coordinates from all the potential Gharial habitats and spotted areas. The name of the potential sites (char lands), came out from the questionnaire surveys, were plotted on the maps. Comprehensive maps were prepared by using the coordinates. The maps display the temporal and spatial distribution of the Gharials and habitats within the sampling areas with provision for site specific various information necessary for conservation and management of the species.

2.4 Identifying Gharial Hotspots

Gharial hotspots were identified on the basis of questionnaire surveys and field observations. Name of the potential sites that came out from the questionnaire surveys and FGDs were physically surveyed to quantify habitat quality. A matrix considering opportunities and threats to the potential habitats was used to determine Gharial hotspots. Three parameters under opportunities: presence of sloppy sand bank, deep water pool near the sandy bank, and water availability during dry season were considered. Four categories of threats to the habitats: agricultural practice, boat station/sand mining, fishing intensity, and other human activities were considered in the matrix. The magnitude of the parameters was determined by putting a rank between 0 and 5, where '5' indicated

Explanation of the scoring of the opportunity parameters and threat categories

If one parameter under opportunities has a score of '0', it would mean that the condition is totally unfavorable for Gharials. For example, if the parameter of deep water pool is scored '0' for one particular site, it would indicate that the site has no deep water pools surrounding it and Gharials would not favor that site. Likewise, if the parameter of deep water pool is scored '5' for one particular site, it would indicate that the site has sufficient deep water pools surrounding it and Gharials would favor that site.

Similarly, if one category under threats has a score of '0', it would mean that the category poses a large threat and condition is totally unfavorable for Gharials. For example, if the category of fishing intensity is scored '0' for one particular site, it would indicate that the site has a lot of fishing activities and Gharials would not favor that site. Likewise, if the parameter of fishing intensity is scored '5' for one particular site, it would indicate that the site has no fishing activities at all and Gharials would favor that site.



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highly favorable condition and 'O' indicated totally unfavorable condition for the Gharials. The high scoring habitats were selected as Gharial hotspots.

2.5 Survey on Captive Gharial Population

Survey to evaluate the status of captive Gharials in the country and their breeding facilities in captivity was conducted in different zoos and safari parks between June 2015 and May 2016. This survey provided a clear view on the status of Gharials in captivity and requirements to develop their breeding facilities. In collaboration with the zoo and safari park authorities, possible suggestions were provided to improve the captive conditions of the Gharials and to facilitate breeding of this Critically Endangered species.





Chapter 3

Findings

3.1 Status of Wild Gharial Population

During the present study, the sightings of Gharials in the wild were categorized into three time periods, viz. recent years (2000 to 2016), recent past (1980 to 1999), and past (1955 to 1979). In recent years, (based on questionnaire survey data) sighting of 58 Gharials were known from the major rivers of Bangladesh of which 39 were from the Padma River, 17 from the Jamuna River, and one from the Brahmaputra and the Mahananda Rivers each (Fig. 5). During recent past, a total of 40 Gharials were sighted of which 16 from the Padma River and 24 from the Jamuna River. Sightings of 25 Gharials were known in past years, of which 9 were from the Padma River, 15 from the Jamuna River, and one from the Teesta River (Table 4).



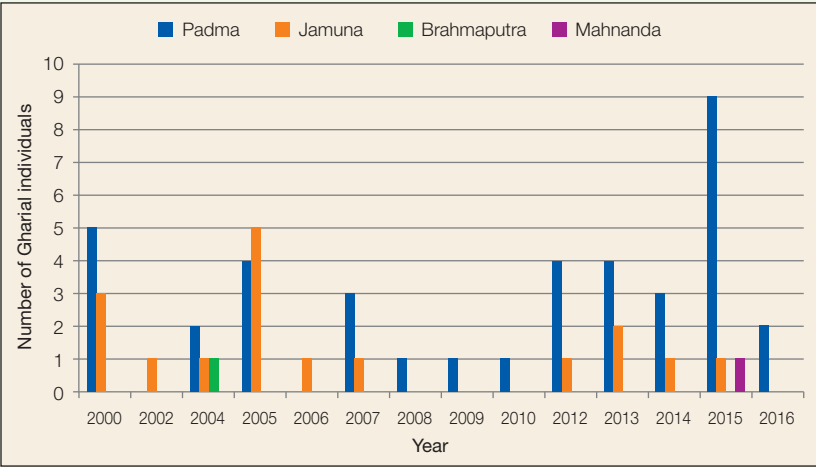


Fig. 5 Sightings of Gharial individuals in major river systems of Bangladesh in recent years (questionnaire surveys).

Table 4. Record of Gharials in different time periods in different river systems (questionnaire surveys).

Time Period	Number of Gharial individuals record					
	Total	Padma	Jamuna	Brahmaputra	Teesta	Mahananda
Recent year (2000-2015)	58	39	17	1	0	1
Recent past (1980- 1999)	40	16	24	0	0	0
Past (1955 -1979)	25	9	15	0	1	0

3.2 Gharial Hotspots

Thirty seven potential Gharial sites were evaluated in the matrix (Table 5). Four hotspots in the Padma River and one in the Jamuna River are identified as Gharial Hotspots (Maps 4-14). The hotspots in the Padma (Map 4) are-

- 1. Bakor Ali area, Chapai Nawabganj
- 2. Godagari area, Godagari
- 3. Gohomabhona area, Rajshahi
- 4. Khidirpur, Rajshahi.

The only hotspot identified in the Jamuna River is Kajla Char of Sariakandi, Bogra. The habitat quality and suitability of these chars for Gharials are described below.

Table 5. Matrix for selecting Gharial hotspots. Ranking is done between 0 and 5, where 5 indicates highly favorable condition and 0 indicates totally unfavorable condition. (For opportunities parameters, 5 represents highly favorable conditions and 0 represents totally unfavorable conditions for Ghariahs; for threats categories, 5 represents very low threats, which means favorable condition and 0 represents very high threats, which means totally unfavorable conditions for Gharial).

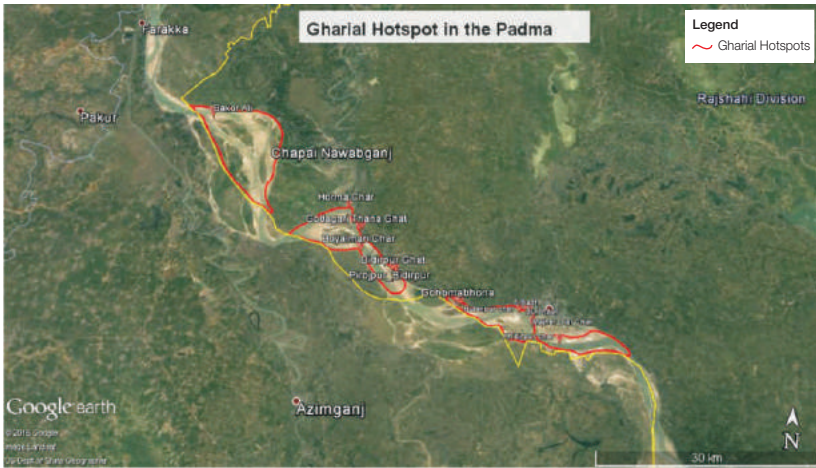
Location	Opportunities				Threats			
	Presence of sloppy sand bank	Deep water pool near the bank	Water availability during dry season	Agricultural practice	Boat station/ Sand mining	Fishing intensity	Other human activities	Total
Horma Char, Godagari, Rajshahi	4	4	5	2	3	4	3	25
Bakor Ali	5	5	5	5	4	4	4	32
Boyalmari Char, Godagari, Rajshahi	4	3	5	3	2	4	4	25
Alatuli Char, Godagari, Rajshahi	4	2	4	4	3	3	4	24
Bidirpur Char, Godagari, Rajshahi	4	4	5	4	3	4	4	28
Godagari Bazar Ghat area	3	4	5	1	0	2	2	17
Khorchaka, Godagari, Rajshahi	5	5	5	5	4	4	4	32
Gohomabhona Char, Rajshahi	5	5	5	4	4	4	5	32
T-bandh, Rajshahi	3	4	4	3	2	2	2	20
Bulanpur Char, Rajshahi	3	3	4	2	3	3	3	21
Khidirpur Char, Rajshahi	4	4	5	4	4	3	4	28

Table 5. Matrix for selecting Gharial hotspots. (Contd.)

Location	Opportunities			Threats				Total
	Presence of sloppy sand bank	Deep water pool near the bank	Water availability during dry season	Agricultural practice	Boat station/ Sand mining	Fishing intensity	Other human activities	
Bianapona Char, Rajshahi	2	2	3	1	1	2	1	12
Beripara, Rajshahi	2	1	3	1	1	1	1	10
Iswarpur, Rajshahi	3	1	2	2	1	2	1	12
Nimtola, Rajshahi	2	2	2	1	1	1	1	10
Pirijpur, Rajshahi	3	2	3	3	1	1	1	14
Mijanpur, Rajbari	3	4	3	4	3	2	3	22
Najirganj, Pabna (Padma)	4	3	3	2	3	2	2	19
Char-khallipur, Pabna Padma	2	2	3	2	2	3	2	16
Borkhapur, Pabna Padma	2	2	3	2	1	2	2	14
Mohonganj, Pabna Jamuna	3	4	4	2	2	4	3	22
Kajla Char, Sariaikandhi, Bogra	4	3	4	3	3	3	3	23
Pakhimara Char, Sariaikandhi, Bogra	3	3	4	3	4	3	3	23
Bhaitar Char, Sariaikandhi, Bogra	2	2	4	2	2	2	2	16

Table 5. Matrix for selecting Gharial hotspots. (Contd.)

Location	Opportunities			Threats				Total
	Presence of sloppy sand bank	Deep water pool near the bank	Water availability during dry season	Agricultural practice	Boat station/ Sand mining	Fishing intensity	Other human activities	
Jaygarchar, Sariakandhi, Bogra	2	1	2	1	1	1	1	9
Maijbari, Sariakandi, Bogra	3	3	4	1	2	3	2	18
Beel Sundor, Sirajganj	3	4	5	1	4	2	3	22
Berakonachar, Sirajganj	2	2	2	1	1	2	1	11
Boyalkandi, Sirajganj	2	1	2	1	1	1	1	9
Kojjuri, Sirajganj	3	2	4	1	2	1	2	15
Notokhola Char, Sirajganj	3	4	4	3	1	1	1	17
Char Girols, Kazipur, Sirajganj	2	2	2	2	1	1	1	11
Nagarbari, Pabna	3	4	5	3	2	3	1	21
Protabpur, Nagarbari, Pabna	4	3	4	3	2	3	2	21
Kamarjani, Gaibandha	2	2	2	3	0	2	1	12
Char Raghob, Sundorganj, Gaibandha	4	3	2	2	2	2	2	17
Horipur Char, Sundorganj, Gaibandha	5	3	3	3	3	2	2	21



Map 4. An overview of Gharial hotspots in the Padma River.

A. Gharial Hotspots in the Padma River

3.2.1 Bakor Ali Hotspot

Bakor Ali is situated at the north-western corner of Chapai Nawabganj District where the Padma River first enters into Bangladesh territory. The area is restricted to public entry as it is controlled by Border Guards Bangladesh and Border Security Force of India. This place holds high potential for Gharials and regular sighting of Gharials were observed in the last couple of years (Maps 5 and 6). The habitat quality of Gharials is satisfactory (Table 5).





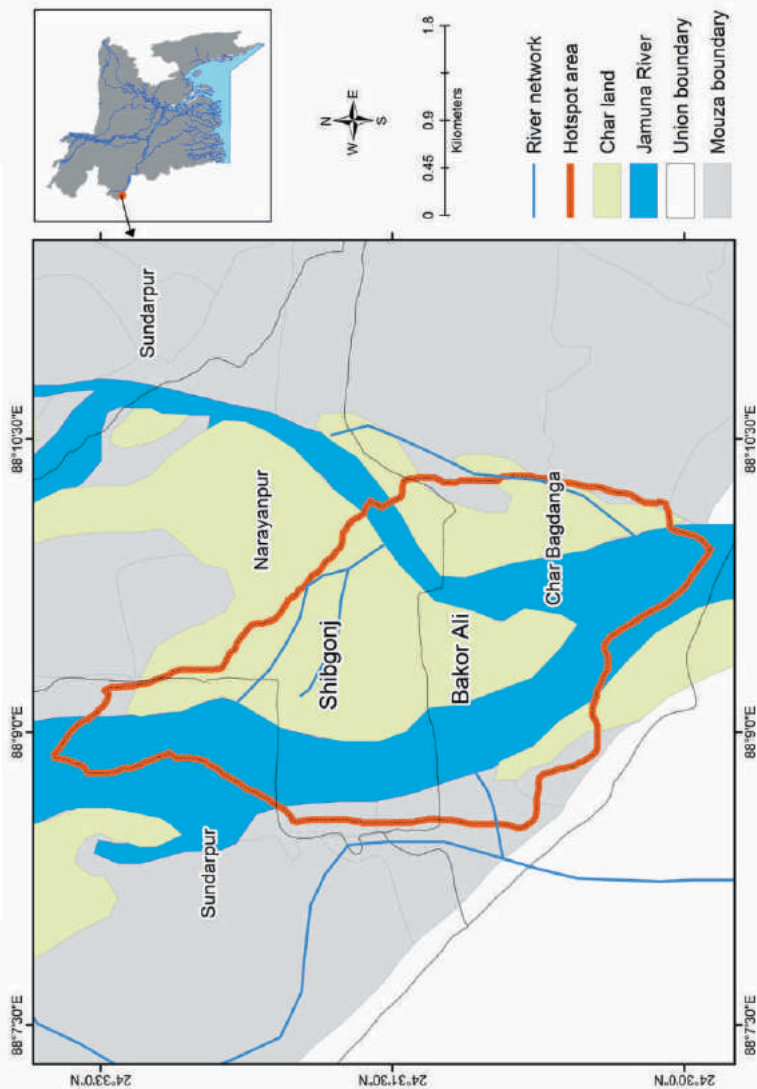
Map 5. Gharial hotspot in Bakor Ali, Chapai Nawabganj.

3.2.2 Godagari Hotspot

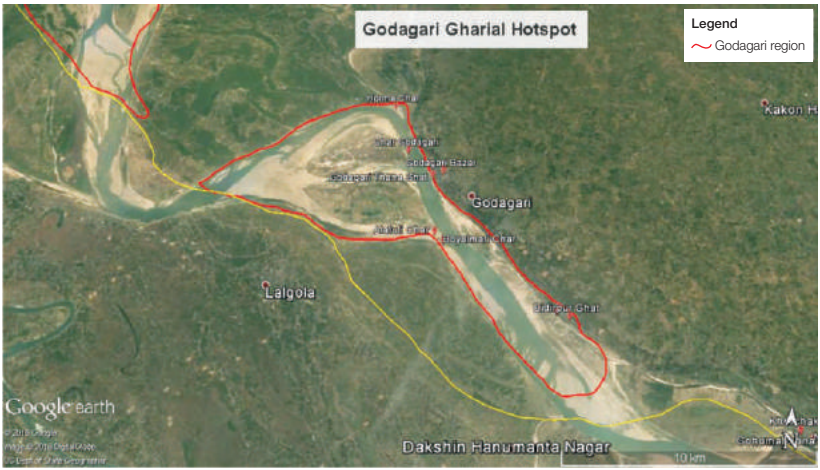
There are several char lands in Godagari Gharial hotspot (Map 7). Some of the important areas of Godagari hotspots are described below.



Gharial hotspot in Bakor Ali, Padma



Map 6. Gharial hotspot in Bakor Ali, Padma.



Map 7. Godagari Gharial hotspot in the Padma River.

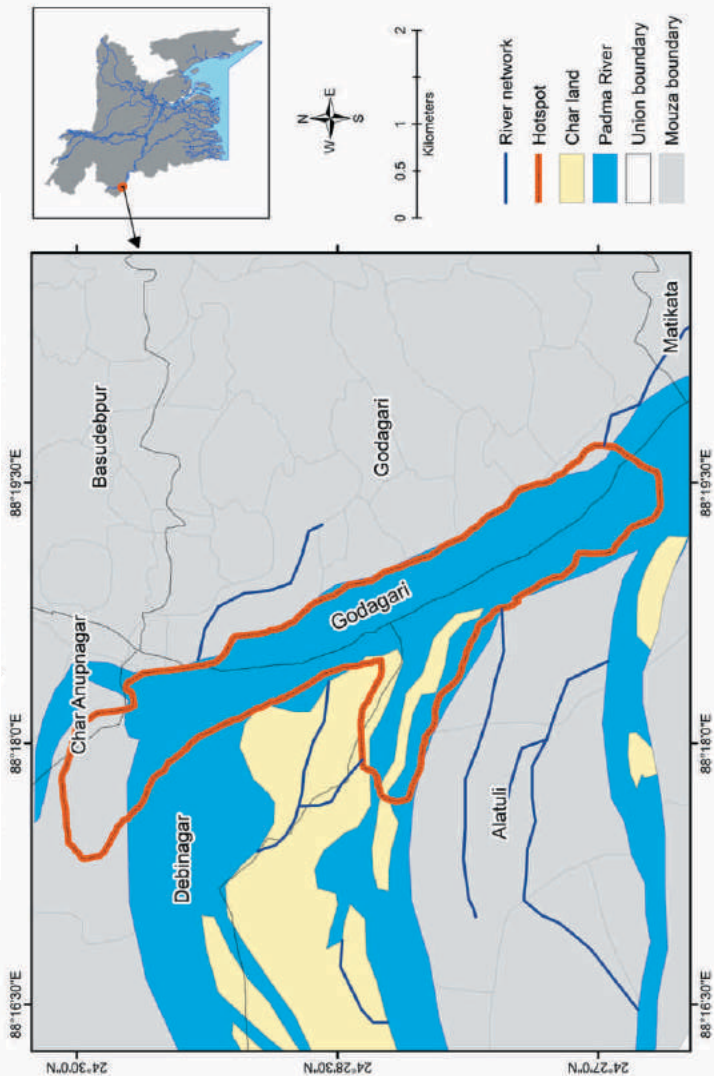
Horma Char is situated under Godagari Upazila of Rajshahi District. This char is devoid of human habitation because during wet season the whole char becomes submerged under water. The land is chiefly composed of sand. Other than small herbaceous plants, no trees are present here. Local people from nearby areas cultivate mustard plants (*Brassica campestris*) and graze cattle on the char.

Although human settlements are absent here, this char is very close to permanent lands where human habitation is high. Few brick fields are situated adjacent to this char. Other than fishermen, local people ply engine boats alongside Horma Char to meet their daily necessities. In the southern part of this char, sandy areas are present, which might act as basking sites for Ghariales. But due to high anthropogenic pressure, no Gharial has been sighted by local people in the last decade (Map 8).



Horma Char

Gharial hotspot in Godagari, Padma



Map 8. Gharial hotspot in Godagari, Padma.

Boyalmari Char also goes under water during wet season and emerges during dry season. No visible anthropogenic threats were observed during the field survey other than fishing boats. Though this char has very few or no vegetation, but its submerged areas are suitable habitat for migratory ducks, herons and other waders. The large sand banks of this char may act as probable basking ground for Gharials during winter.



Boyalmari Char, Godagari

Alatuli Char is also situated under Godagari Upazila. No human settlements are present here, but local people cultivate peanut and mustard during winter season. Manikchar, which is located in front of Alatuli Char, is a highland which supports a large number of human habitations. Other than small herbs, no other shrubs or woody plants are present in this char. Cows and goats are grazed in this char by local people. Presence of huge mass of sand flats may support Gharial for their probable basking site during winter.



Alatuli Char, Godagari

Bidirpur Char is situated under Godagari Upazila. This char is surrounded by the Padma and Mohananda Rivers. Local people regularly use this char as a route to visit nearby villages. The main crops of the char include peanut (locally known as Badam), linseed (locally known as Tishi), mustard, potatoes, and other pulses. Large numbers of cattle are grazed on this char.

This is a huge char and anthropogenic disturbances are very common, but some portion of the char near the water line provides very suitable ground for migratory birds and may also be for Gharials.



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Bidirpur Char, Godagari

3.2.3 Gohomabhona Hotspot

Gohomabhona is situated under Poba Upazila of Rajshahi (Map 9). The northern portion of this char supports large number of human habitations. This char is comparatively older than the others. The char is much diversified because of natural vegetation with plantation and various agricultural crops. People of this char depend on fishing and agriculture for their living. Large number of fishing boats run by this char every day. The southern portion of this char is close to the Indian Border. This portion of the char is undisturbed and human interference is controlled by the

BGB (Border Guards Bangladesh) of Bangladesh and BSF (Border Security Force) of India. Sightings of Ghariahs in this portion of the char were reported by several local people (Map 10).

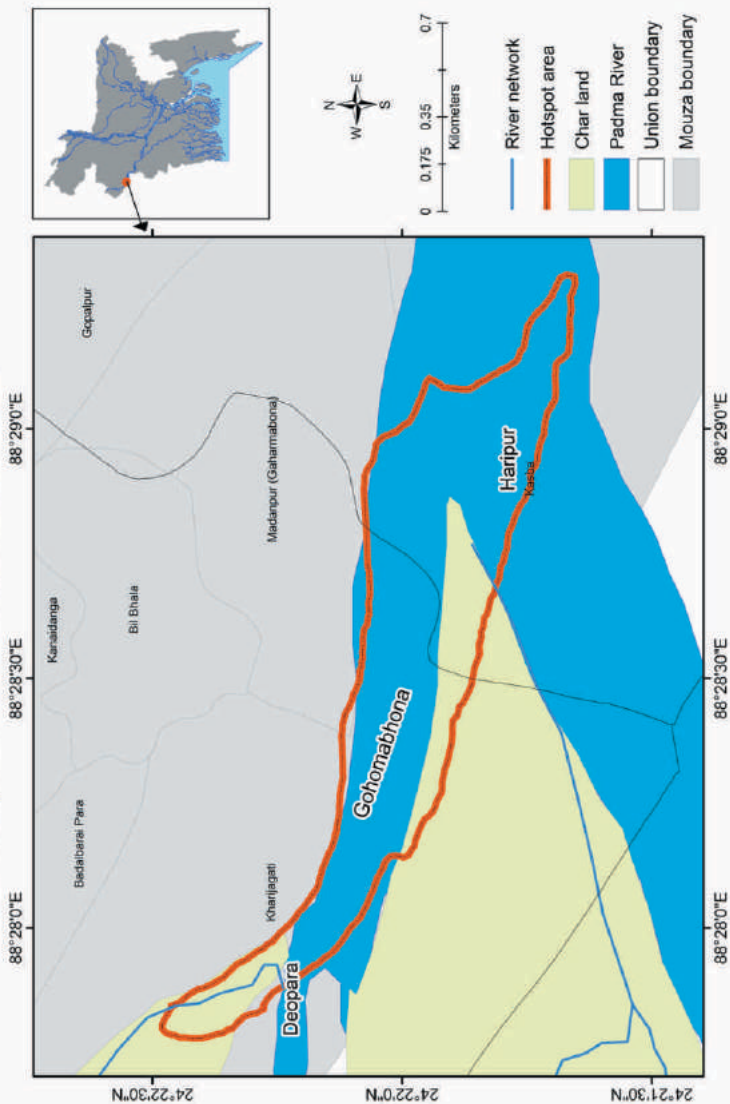


Gohomabhona Char, Gohomabhona



Map 9. Gohomabhona Gharial hotspot in the Padma River.

Gharial hotspot in Gohomabhona, Padma



Map 10. Gharial hotspot in Gohomabhona, Padma.

Khorchaka is another potential char in terms of Gharial habitat. The name of this char implies that during wet season strong water current surrounds this char. One of the channels of the Padma River from India merges here with another channel of this river in Bangladesh part. The BGB check post is very close to this char and BGB strictly controls the movement of people on this char so human intervention is absent here. Herbaceous vegetation, like *Saccharum* sp. (locally called Kansh) is very common on this char. According to the local people, Gharials were sighted several times basking in winter near the border side of this char.



Khorchaka Char, Gohomabhona

T-bandh area is situated under Rajshahi Sadar Upazila. Because of the presence of T-shaped massive embankment, this area is called T-bandh. During wet season, immature Gharials are often seen here as reported by the local fishermen. The water depth is very deep here both in wet and dry seasons. Water bodies of this area might be suitable for Gharial habitat, but due to anthropogenic pressures, it is perhaps not possible for any Gharial to show up during winter.



T-bandh area, Rajshahi

Bulanpur Char, another potential site in Gohomabhona region, is located under Rajshahi Sadar Upazila. This is one of the most potential chars in terms of probable basking and nesting ground for Gharials. No human settlements are present here, but local people cultivate mustard during winter. Cows, goats and sheep are grazed here by local people from the mainland area. As the mudflats and sandflats of this char support huge migratory birds, this char may also support Gharial as their basking ground.

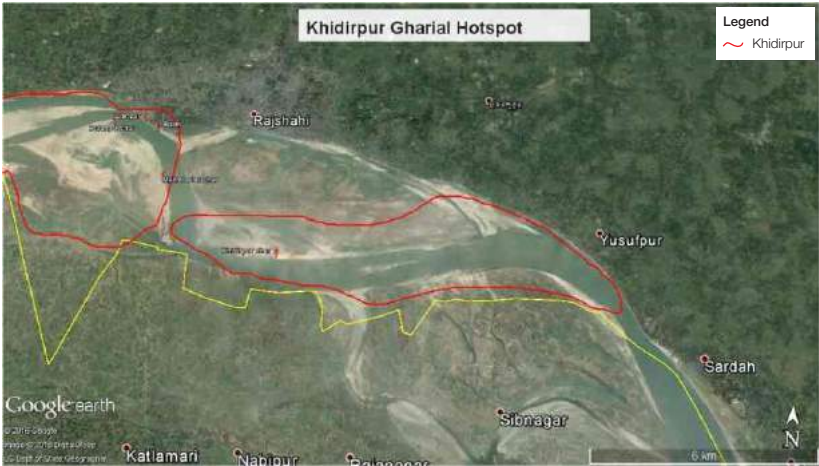


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Bulanpur Char, near Gohomabhona

3.2.4 Khidirpur Hotspot

Khidirpur Char is also located in Rajshahi Sadar Upazila (Map 11). This char is devoid of any human habitation. No visible plant communities other than grasses are present here. Cattle grazing is minimal here and no cultivable crops were seen during field survey. Movement of engine boats is a major threat. Presence of Ganges River Dolphin near this char area justifies a water depth and fish abundance near this char. Sandflats of this char may support Gharials as their probable basking sites (Map 12).

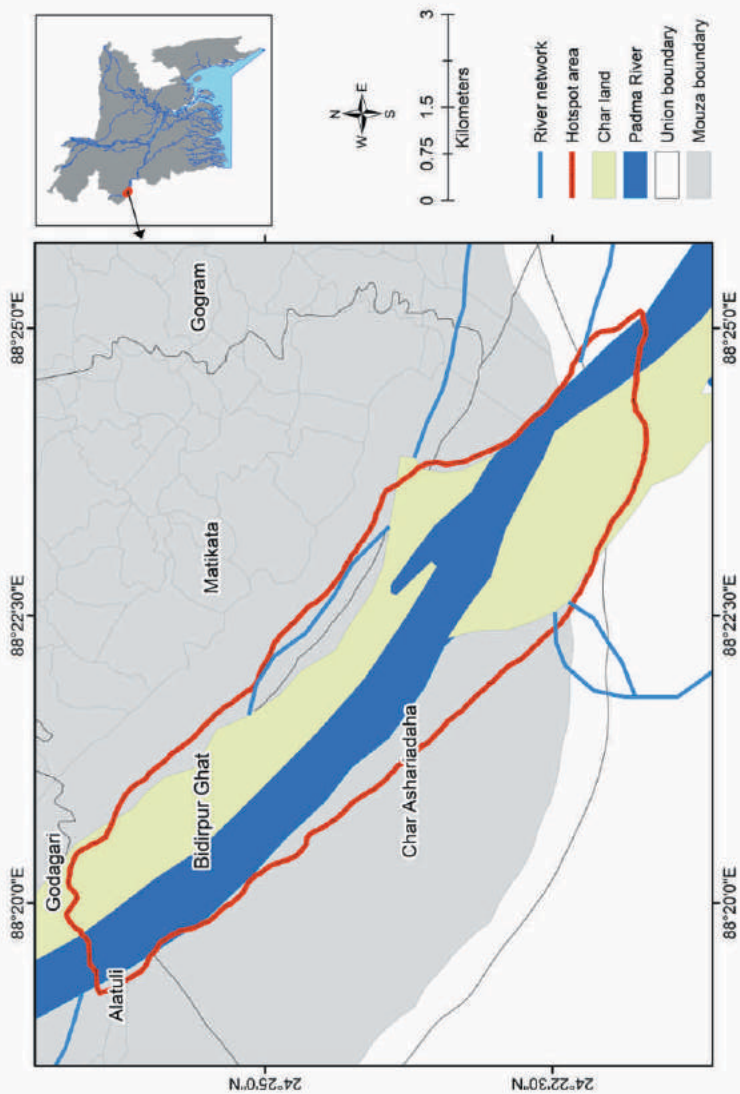


Map 11. Khidirpur Gharial hotspot in the Padma River.



Khidirpur Char, Rajshahi

Gharial hotspot in Khidirpur, Padma



Map 12. Gharial hotspot in Khidirpur, Padma.

B. Gharial Hotspots in the Jamuna River

3.2.5 Kajla Hotspot

Kajla Char is located in Bogra District under Sariakandi Upazila (N 24°55'30.2", E 89°35'17.5"). Devoid of any human settlement, at least 5 km west from Kalitola groyne, it is one of the potential chars for Gharials in Sariakandi region. Although Kajla Char submerges during wet season, emerges in winter (Map 13).

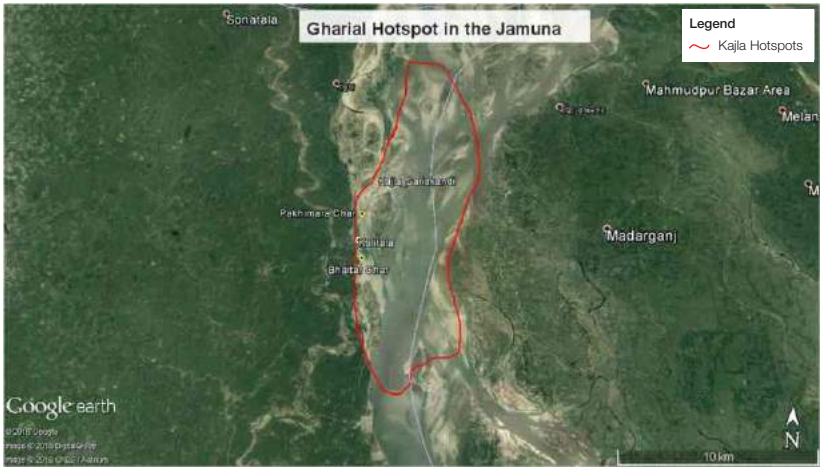
Kajla Char is mostly sandy and common vegetation includes Ghagra (*Xanthium indicum*), Thankuni (*Centella asiatica*), Durba (*Cynodon dactylon*), Hatisur (*Heliotropium indicum*), and Kalmi (*Ipomoea aquatica*).

A medium-sized reed bed is located on the west side of this char. The major plant species were Kansh (*Sachharum spontaneum*) with some other grasses. These reed beds, however, are very important habitat for different types of bird. Local inhabitants from mainland use these reeds as fuel and for thatching the roofs of their houses (Map 14).

The common cultivated crops in this area are paddy (*Oryza sativa*), ground-nut (*Arachis hypogaea*), wheat (*Triticum aestivum*), pea (*Lathyrus sativus*), lentil (*Lens culinaris*), onion (*Allium cepa*), and linseed/flax (*Linum usitatissimum*).



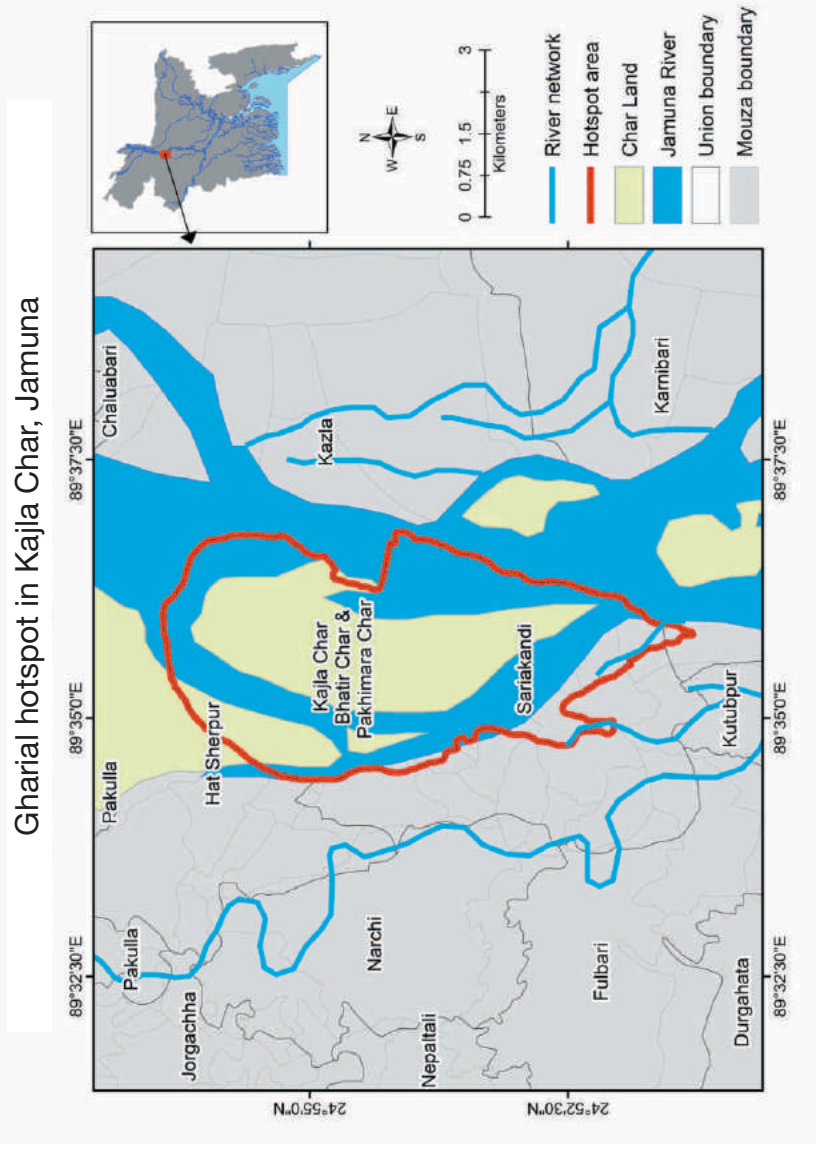
Kajla Char, Sariakandi



Map 13. Kajla hotspot in the Jamuna River.

Pakhimara is another char situated within Kajla hotspot (N 24°54' 22.5", E 89°34'38.5"). Due to huge aggregation of migratory birds during winter and subsequent hunting by local people, locally the name of the char "*Pakhimara*" derived.





This char is completely barren and no agricultural activities were observed (Map 14). However, a large number of engine and fishing boats run in the river adjacent to this char.

Bhaitar Char is also located within this hotspot (N 24°53'23.5", E 89°35'14.8"). Historically Gharials were regularly seen in this char as reported by local inhabitants. This is now more or less a permanent char, but submerged under water for few months during wet season (Map 14). At least 30 families were seen to reside on this char. Delebarir Char, which is now adjacent to Bhaitar Char, was also an important habitat for Gharials in the past.



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Bhaitar Char

The soil condition of this char is loamy and fertile, and as a result agricultural crops are seen here. Common crops include paddy (*Oryza sativa*), ground-nut (*Arachis hypogaea*), and onion (*Allium cepa*).

Anthropogenic disturbances in some portions of this char are high. Cattle grazing chiefly by cows and goats were observed during the field visit. This portion of the char is no more suitable for basking or nesting of Gharials, while some portions of the chars are less disturbed and Gharials were seen there during wet season as reported by the locals.

Other important sites in the Jamuna River with similar habitat include Beel Sundor in Sirajganj, Mijanpur Char in Rajbari, and Mohonganj Char in Pabna.



Survey conducted in 2011-2012, in the Padma & Jamuna Rivers revealed a total of 49 and 69 species of birds, respectively (Chowdhury *et al.* 2014).



- A. Indian Roofed Turtle
- B. Smooth-coated Otter
- C. Bristled Grassbird
- D. Red-naped Ibis



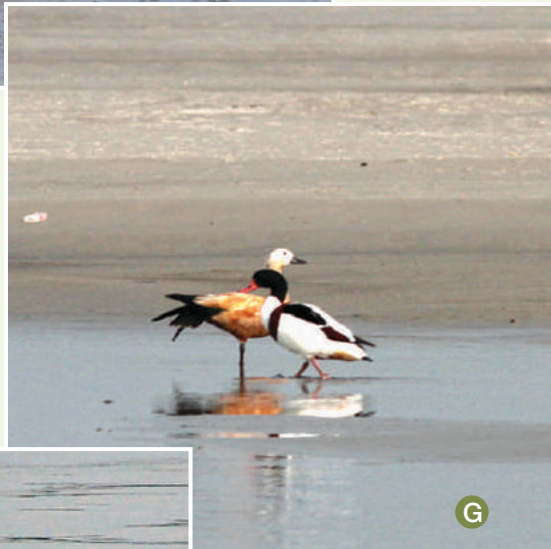
E



F

Photos: © IUCN / A.B.M. Sarowar Alam

- E. Black-billed Tern
- F. Indian Skimmer
- G. Ruddy Shelduck
- H. Ganges River Dolphin



G



H

© Zahangir Alom

A



The Padma River hosts 69 to 80 species of fish and the Jamuna River hosts 63 species of fish (Rahman *et al.* 2012, Galib *et al.* 2013, Mohsin *et al.* 2013, Joadder *et al.* 2015). Some of the important fish and fishing gears used for fishing are shown here.

B



C



D

E



- A. Hilsa
- B. Indian Glassy Fish/Chanda
- C. *Aspidopanie* sp.
- D. *Salmostoma* sp.
- E. Tellowtail Catfish/Pangas
- F. Giant River Catfish



F



Ber Jal & Cast net

Ber Jal



Different types of seine net





Khona Jal

Mono filamentous gill net / Current Jal



Seine net



3.3 Perception of Local People about Gharial

Forty six percent of the respondents have seen Gharials in their lifetime. Most of the respondents (49%) have seen Gharials once while only 9% of them have seen more than four times in their lifetime (Fig. 6). Most of the respondents (55%) have seen Gharials in captured condition while 32% of them have seen in floating condition and only 13% of them have seen in other conditions, like basking (Fig. 7). According to the respondents, most of the Gharials were sighted during rainy season (60%), followed by the winter (37%) and summer (2%) (Fig. 8).

Most of the respondents (67%) have clear idea about the diet of Gharial, while 33% have no idea on it. A vast majority of the respondents mentioned that Gharials eat fish, while 2% of them thought that they eat other animals in addition to fish (Fig. 9). Majority of the respondents (48%) considered Gharial as harmful, while 34% considered it as beneficial and 17% people had no idea on it. About 85% people were scared of Gharials because they considered it as life threatening. Most of the respondents (72%) agreed that the Gharial population in their region had been declining in an alarming rate, though 18% respondents had no idea on it. Most of the respondents (71%) had no idea about the causes responsible for the declining of Gharials in their area, while rest of the respondents mentioned that reduction of fishes in the river, the reduction of water depth, and also the reduction of suitable nesting place are the main causes of the decline of Gharials (Fig. 10).



Distribution of Gharial poster among local stakeholders.

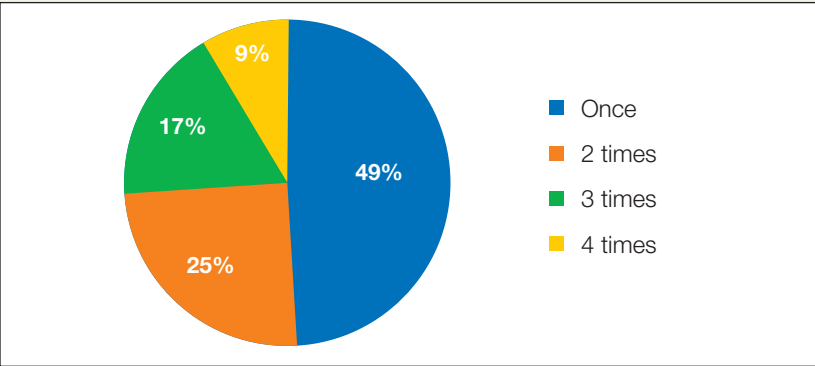


Fig. 6 Frequency of Gharial sighting among the respondents.

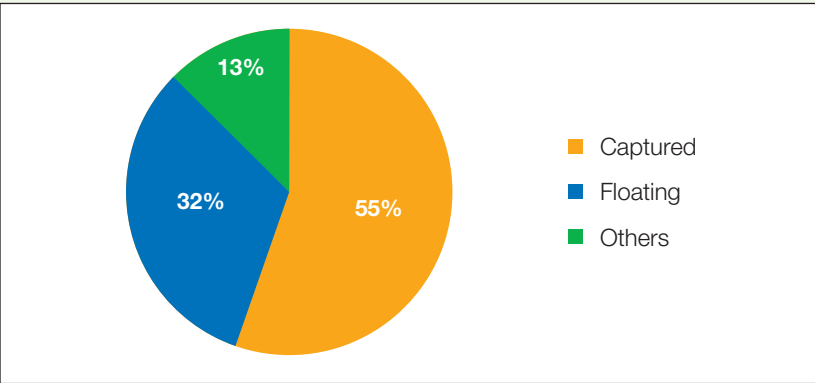


Fig.7 Condition of Gharials when observed by the respondents.

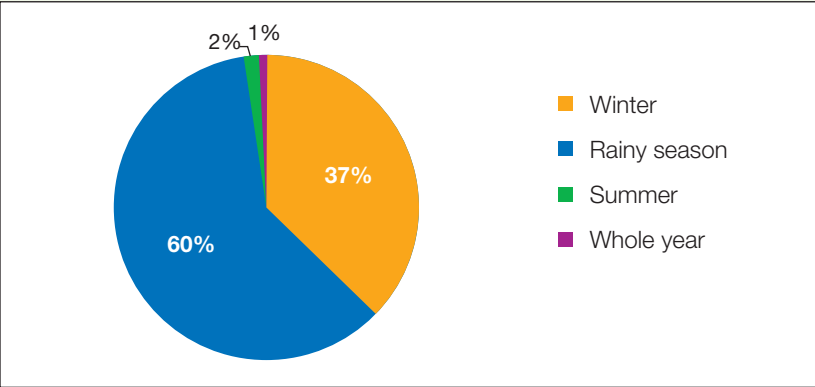


Fig.8 Sighting records of Gharials in different seasons.

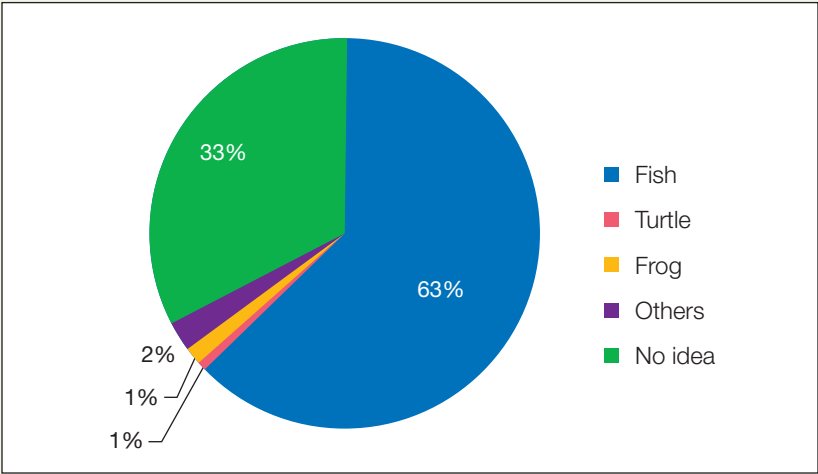


Fig. 9 Respondent's perception on the diet of Gharials.

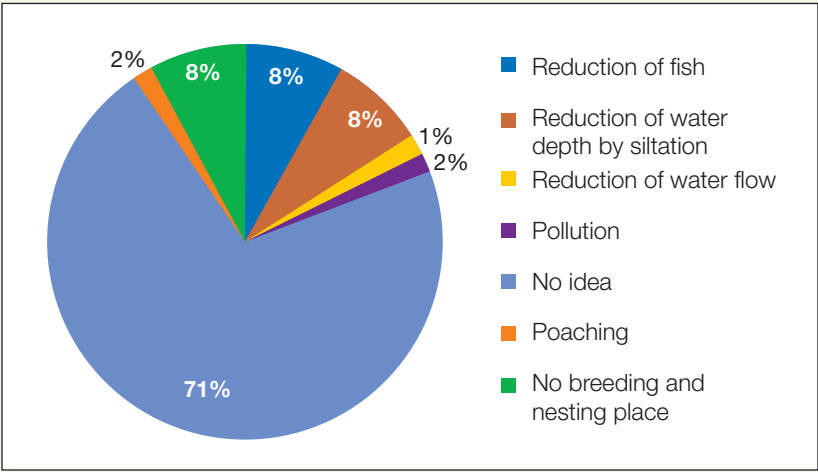


Fig.10 Perception of local people on the decline of Gharials.

About 50% of the respondents agreed on the need to conserve Gharials in natural habitats though a large group of people (31%) had no idea about conservation. More than ninety percent (93%) of the respondents have no idea of conservation measures. Some of the people suggested that the increase of river depth and water flow in the river is essential for the survival of Gharials and the Government of Bangladesh should take necessary steps regarding their conservation.

Particular fishing gears are harmful for Gharials and also responsible for their death. The respondents informed that trapped Gharials in the fishing net are eventually captured by the fishermen where the ultimate fate of the Gharials is death. The respondents mentioned the name of nine different types of fishing gears where Gharials usually trapped in (Fig. 11).

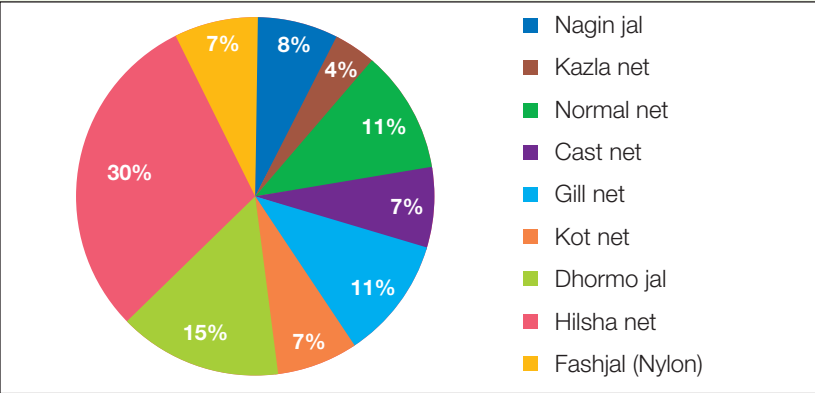


Fig. 11 Comparative view of different types of net where Gharials are found trapped in.

About 74% of the respondents know that there are some laws for the conservation of Gharials and other wild animals, but they are not aware of Wildlife (Conservation and Security) Act, 2012. About 26% people had no idea about any law for the conservation of Gharials and other wild animals. Most of the respondents (92%) are willing to help in conservation initiatives for Gharials.

It was evident from the perception of local people that majority of them considered Gharials as a life threatening creature like crocodile. This misconception must be eliminated through mass awareness. Local people are willing to conserve Gharials, but their dependency on the river system should be minimized. Banning of particular types of fishing gear must be executed through awareness and by the implementation of laws.



3.4 Status of Captive Gharial Population

Surveys were conducted for the estimation of number and condition of captive Gharials in the country. Bangladesh National Zoo (Dhaka Zoo), Rajshahi Zoo, Rangpur Zoo, and Bangabandhu Safari Park, Gazipur were surveyed. The captive habitat condition, facilities and measures needed to make the place comfortable to Gharials were also considered during the survey.



© Tareq Onu

A total of four adult males reside in Dhaka Zoo those were rescued from the fishermen's net between 1983 and 1997. Those males were healthy, but there were no female Gharial as well as there is no breeding facility.

Three adult females reside in Rajshahi Zoo. The Gharial enclosure in Rajshahi Zoo is circular with a small island in the center. Lack of gentle slope makes it difficult for Gharials to reach the island for basking. There is no other basking facility other than that small island.

Four adult females are kept in Rangpur Zoo. The Gharial enclosure in Rangpur Zoo is comparatively smaller than other zoos. There are very poor facilities exist for basking and nesting of Gharials (Table 6).

A juvenile male of 115 cm was kept in Bangabandhu Safari Park, Gazipur. The husbandry condition in the safari park seems very poor. The Gharial was kept in a small pond with more than a thousand freshwater turtles (those seized from the airports). The Gharial looked uncomfortable and stayed on the bank most of the time.



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Gharial enclosure in Rangpur Zoo.

Table 6. Existing captive Gharials in different zoos and safari parks (2016).

Sl. No.	Name of the Zoo/ Safari Park	No. of Gharial	Sex
1	Dhaka Zoo	4	M
2	Rajshahi Zoo	3	F
3	Rangpur Zoo	4	F
4	Bangabandhu Safari Park, Gazipur	1	M

3.5 Threats to Gharials

Gharials face a number of threats. At present the most significant threats are current habitat destruction and death caused by entangling in fishing nets. Gharials face these threats even within protected areas.



A fisherman with a dead Gharial trapped in his fishing net at Padma, Shibganj.



Fisherman with banned corner net on the Padma River.

3.5.1 Direct Loss of Gharials

Gharials are often caught in fishing nets, their long slender snouts easily become entangled in the fine nets, unable to surface to breathe and eventually die. If nets entangled in one jaw or nets quickly wrapped around their snouts, they may starve to death. Nowadays, the use of banned gill/ current net has increased enormously, which is a major cause of Gharial death. Gharial nests and eggs are also susceptible to predation and anthropogenic threats.

3.5.2 Habitat Loss and Degradation

River bank/Sandbar erosion

Huge volume of water and water current during the rainy season cause erosion of the river banks and sand bars. Every year existing sand bank alters a lot so that the potential nesting sites of Gharials become destroyed and probable nests might be washed away which is very harmful for the Gharials.



Fisherman preparing for fishing at the Padma.



Riverbank erosion at the Padma.

Land using for riparian agriculture and grazing

Extensive practice of agricultural crops on river bank, particularly during the winter, creates huge disturbance to Gharials. Basking sites of Gharials during winter months become scarce. Moreover, these river banks are also used for grazing. In the whole river system, it is very difficult to get any undisturbed habitat for Gharials.



Movement of large boat with sand in the Padma River.

Fishing net set in the Padma



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Movement of engine boats

Frequent movement of engine boats and establishment of boat stations here and there are another cause for the disturbance of Gharials. In addition to the frequent movement of passenger and fishing boats, large engine boats with goods and sands are also very frequent in river systems particularly during winter.



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Skull of a River Dolphin which was trapped and died in fishing net, decomposed on the bank of the Padma.

Reduction of water flow during winter

Due to the construction of several barrage in upstream of the rivers by the neighboring countries, water flow become reduced during winter. As Gharials need deep water with enough prey species, very few such habitats exist during winter. Moreover, huge siltation during monsoon reduced the depth of the rivers.



Movement of large vessels in the Padma River.

Sand-mining

Large-scale sand-mining destroys the sand banks required by Gharials for nesting and basking. Year-round sand-mining activities also create disturbance to Gharial habitats.



A view of Bakor Ali char with two rare Woolly-necked Stork. It also shows cattle trade between India and Bangladesh.



A wide-angle photograph of a large body of water, possibly a lake or reservoir, under a clear blue sky. In the foreground, a sandy beach curves along the bottom left corner. The water is dark blue with gentle ripples. In the distance, a thin line of green trees and some small structures are visible on the horizon. The overall scene is bright and open.

Chapter 4

Conservation Initiatives



Gharial Conservation Management and Action Plan

4.1 Previous Conservation Initiatives

In Bangladesh, very few initiatives have been taken for the conservation of Gharials. Gharial has been declared as a Critically Endangered species in Bangladesh in 2000 and 2015 (IUCN Bangladesh 2000, 2015). Recently, Bangladesh Forest Department of the Government of Bangladesh has implemented a project entitled “Strengthening Regional Cooperation for Wildlife Protection (SRCWP)” funded by The World Bank. The Wildlife Management and Nature Conservation Division, Rajshahi was awarded a sub-project entitled “The Gharial (*Gavialis gangeticus*) Conservation in Bangladesh”. The sub-project was implemented between April 2014 and November 2016. The project focused on to determine the status of both wild and captive Gharial populations and to facilitate *ex situ* and *in situ* conservation measures. Gharial Conservation Management and Action Plan was also prepared under this sub-project.

4.2 Gharial Conservation Management and Action Plan

In accordance to the results achieved from the program period, and from other relevant researches conducted on Gharials in Bangladesh and abroad overtime, *Gharial Conservation Management and Action Plan (2016-2025)* was developed for the long-term conservation of the species. The management and action plan has both *in situ* and *ex situ* conservation approaches, with the emphasis on engagement of local communities, relevant stakeholders and concerned authorities keeping scopes for further scientific researches (See Chapter 5).

The management and action plan has four large thematic areas that include a) minimizing threats to Gharials, b) enhancing capacity of concerned stakeholders in order to protect prime Gharial hotspots, c) methods to facilitate successful captive breeding programs and ultimately reintroduction into the wild, and d) long-term scientific research and monitoring.

In a national workshop on 28 June 2016, the *Gharial Conservation Management and Action Plan (2016-2025)* was presented to the stakeholders for their comments and suggestions. During the workshop an overview of the entire work and results of the program were portrayed and the management and action plan was presented to the stakeholders with a complete budget. The stakeholders present were representatives from Bangladesh Forest Department, curators of zoos, conservationists, researchers, scientists, students, teachers of universities, members of the civil society, and media personnel. Afterward, the comments and suggestions were noted and later incorporated into the final *Gharial Conservation Management and Action Plan (2016-2025)*. Later, the management and action plan was submitted to the concerned authorities.



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Discussion during a national workshop on Gharial in June 2016, Dhaka.

4.3 Awareness Raising on Gharial

In order to motivate and engage the local riverine communities, raise awareness, and dispel myths about Gharials and Gharial conservation, almost a dozen campaigns were organized. Meetings were held with groups of people dependent on the rivers and Gharial habitats and have the most chance of running into the endangered species during their work. These groups included communities of fishermen and boatmen. A total of six such consultation meetings were conducted.

Furthermore, awareness campaigns were carried out at five local schools, with the aim of motivating and disseminating knowledge among the future generations of stakeholders who will be relying on the river resources in the future and might have encounter with Gharials.



Awareness campaigns with communities.

4.4 Media Outreach

To spread awareness and information among the general mass, the program has heavily involved the electronic, print and social media of the country. Reports and articles in different national newspapers and television channels have covered the plight of the Gharials and the recent efforts in the conservation of the species. These reports have helped spread the importance of conserving this species among a broad spectrum of the different communities across the country and have helped in raising awareness and dispelling myths.



Distribution of Gharial posters (top) and awareness raising program.



Media Coverage

4.5 Publication and Awareness Materials

To capture the collective imagination of the members of the local communities and public, spread awareness and encapsulate knowledge, several awareness materials and one book (the present one) have been published. The awareness materials were (leaflets, posters and brochures) interactive as well as colorful, with vital information written in easy local language or illustrated simply for better understanding.

The materials were distributed among the stakeholders dependent on the riverine ecosystem throughout the entire Gharial habitat.



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ঘড়িয়াল বাংলাদেশের একটি **মহাবিশিষ্ট** বন্যপ্রাণী, যা সচরতনত্রা ও সংরক্ষণের অভাবে হারিয়ে যাচ্ছে। পদ্মা-যমুনা নদীতে একসময় এদের সাবাচর দেখা গেলেনও এখন এরা প্রায় বিলুপ্তির পথে।

আসুন এদের সংরক্ষণে এগিয়ে আসি।



ঘড়িয়াল বাংলাদেশের মহাবিশিষ্ট প্রাণী যা 'বন্যপ্রাণী সংরক্ষণ ও নিরাপত্তা আইন, ২০১২' দ্বারা সংরক্ষিত



Strengthening Regional Cooperation for Wildlife Protection Project

ঘড়িয়াল সংরক্ষণ ও বাসস্থান সংরক্ষণ প্রকল্প - www.ggharialproject.org, www.ggharialproject.org



Poster on Gharial

Leaflet on Gharial



নদীর প্রাণ ঘড়িয়াল সংরক্ষণে এগিয়ে আসুন

- ঘড়িয়াল এক সময় বাংলাদেশের বিভিন্ন নদীতে দেখা গেলেনও এখন প্রায় বিলুপ্ত হয়ে যাবার পথে
- অবাসতুল ধ্বংস আর হান্য সংকট ঘড়িয়ালের অস্তিত্ব আরও হুমকির সপুতীন
- নদীর স্বাভাবিক অবস্থা ফিরে আসলে ঘড়িয়ালের মতো প্রতাপবৃদ্ধ প্রাণীর দেখা অব্যাহতও সহজেই মিলবে
- ঘড়িয়াল বাস্তুশাে আরও বেশী নদীতে অব্যাহত রাখার সংখ্যা বৃদ্ধিতে সহায়তা করে
- ঘড়িয়াল পদ্মা জৈব পদার্থ হান্য বনন জনীয় পরিবেশ দূষণমুক্ত থাকে
- ঘড়িয়াল নির্বীহ প্রাণী। এরা কখনো মানুষ বা গরুদিপ্তের ক্ষতি করে না
- ঘড়িয়াল বাঁচাতে জ্ঞানসমর নিষিদ্ধ করেই আসনের ব্যবহার বন্ধ করতে হবে এবং জনসাধারণকে জ্ঞানসমর ও বেসংজ্ঞান ব্যবহারে আরও সচেতন হতে হবে
- জ্ঞান কখনও ঘড়িয়াল আটকা পড়লে তা সাবধানে নদীতে ছেড়ে দিতে হবে
- ঘড়িয়াল বাংলাদেশের মহাবিশিষ্ট প্রাণী যা 'বন্যপ্রাণী সংরক্ষণ ও নিরাপত্তা আইন, ২০১২' দ্বারা সংরক্ষিত
- আগামী প্রজন্মের জন্য ঘড়িয়াল সংরক্ষণের এখনই সময়
- আসুন আমরা সবাই সচেতন হই, ঘড়িয়াল বাঁচাতে এগিয়ে আসি

বিঃ দ্রঃ পদ্মা-যমুনাতে এদেরকে যে কেউর নদীতে বা যে কোন স্থানে ঘড়িয়াল দেখা গেলে তাকে বিতরণ করে কলার জন্য অনুরোধ করা হল। ঘড়িয়াল সংরক্ষণ যে কোন তথ্য অসহন-ভ্রান্তের জন্য বা কোন জায়গায় ঘড়িয়াল দেখা গেলে নিম্নের ঠিকানায় যোগাযোগের জন্য অনুরোধ করা হল।



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Strengthening Regional Cooperation for Wildlife Protection Project

4.6 Proposal for Gharial Exchange Program

A Gharial exchange program was initiated for the establishment of breeding facilities of captive Gharials among Bangladesh National Zoo (Dhaka Zoo), Rangpur Zoo, Rajshahi Zoo, and Bangabandhu Sheikh Mujib Safari Park, Gazipur (Table 7).



Table 7. Proposed Gharial exchange program among different zoos and safari parks.

Sl. No.	Name of zoo/ safari park	No. of existing Gharial	Exchangeable individuals	Destination of outgoing Gharials	Proposed sex ratio (M:F)	Source of incoming Gharials
1	Dhaka Zoo	4 M	2 M	Rangpur-1 M Rajshahi-1 M	2:3	2 F from Rangpur Zoo and 1 F from Rajshahi Zoo
2	Rajshahi Zoo	3 F	2 F	Dhaka-1 F Safari Park-1F	1:1	1 M from Dhaka Zoo
3	Rangpur Zoo	4 F	3 F	Dhaka Zoo-2 F Safari Park-1F	1:1	1 M from Dhaka Zoo
4	Banga-bandhu Safari Park, Gazipur	1 M	0	-	1:2	1 M from Rangpur Zoo 1 F (juvenile) from Rajshahi Zoo

* M = Male; F = Female



4.6.1 Tasks to Improve the Existing Facilities in Zoos and Safari Park

Dhaka Zoo

- Improved basking and nesting area in captivity.
- Maximum time of the year sand basking and nesting place sink about 3 feet under water. It is needed to be lifted up with sand about 2 feet above the water level. This will facilitate Gharials for easy basking and will also be visible to the visitors.
- When exchange work will start, it is necessary to pump-out all water from captivity for easy capturing.



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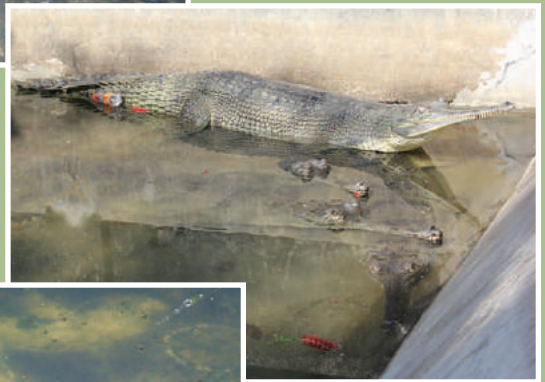
Rajshahi Zoo

- Gharial enclosure is round in shape; there is no basking and nesting sand bank.
- For the interest of proper breeding and display, in west side of the enclosure, about $\frac{1}{3}$ of the water body should be filled up with sand about 2 feet high from water level. Gharial will get basking and nesting site at the same time. It will also ensure Gharials to be visible to the visitors.
- When exchange work will start, it is necessary to pump-out all water from captivity for easy capturing.



Rangpur Zoo

- Gharial enclosure is too small.
- There is no proper basking and nesting area.
- Need to build up basking and nesting sites.
- Minimum 4 feet depth of water should always be maintained in the enclosure to facilitate easy mating.



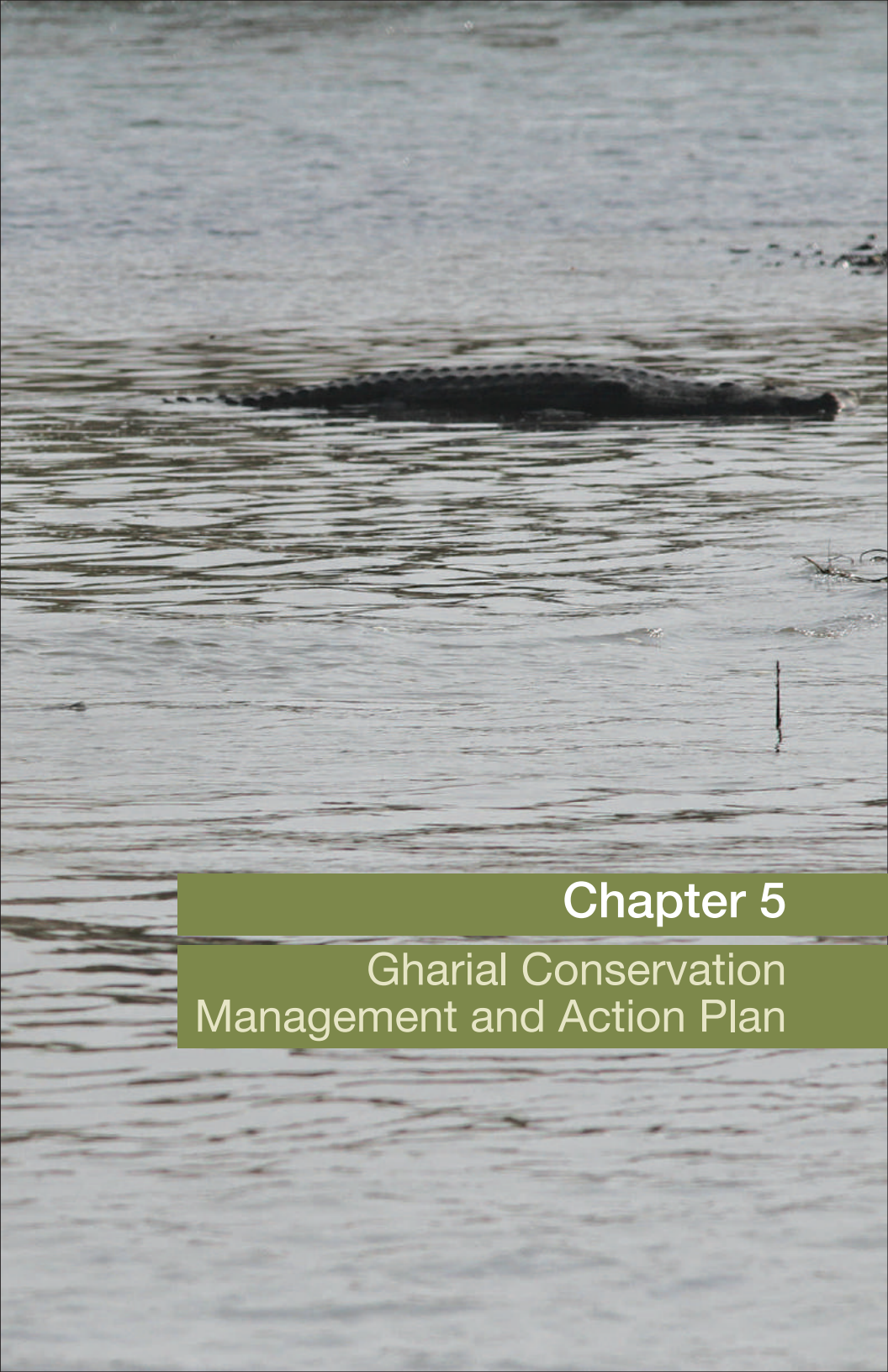
Bangabandhu Sheikh Mujib Safari Park, Gazipur

- Present stock of one Gharial is in juvenile stage; exchange program is needed to facilitate breeding.
- One male from Dhaka Zoo and one female from Rangpur Zoo can be brought together for future breeding program.
- Need to improve basking and nesting facilities.



Gharial enclosure at Bangabandhu Safari Park, Gazipur (top), and the Gharial individual there (bottom).





Chapter 5

Gharial Conservation Management and Action Plan

Gharial Conservation Management and Action Plan (2016-2025) will facilitate the management and conservation of Gharials in Bangladesh. It is based on the available relevant information and inputs provided by the stakeholders and experts. The *Gharial Conservation Management and Action Plan (2016-2025)* preparation team reviewed all the available secondary information on Gharials of Bangladesh. Moreover, the team physically visited potential Gharial habitats and interviewed to local stakeholders. The draft of the management and action plan was presented in the national workshop (Section 4.2). The feedback came from the stakeholders were considered carefully for finalizing the plan.

Vision

Protect habitats for Gharial where, all threats will be minimized to recover Gharial population in Bangladesh and where Gharial will provide essential ecological services.

Goals

- To recover Gharial population and ensure safe habitats in Gharial hotspots.
- To facilitate captive breeding programs for possible reintroduction.

Objectives

1. Minimize threats to Gharials.
2. Capacity building to ensure protection of Gharials hotspots.
3. Facilitate captive breeding and reintroduction programs.
4. Research and monitoring.



Table 8. Objectives and Strategic Actions

Task	Time Frame	Responsible Body/ Organization	Strategic Actions	Indicators
A. Minimize threats to Gharials				
1. Minimize death of Gharials in fishing gears	10 years	BFD, DoF	Determine types and frequency of fishing gear use and scale of Gharial death	Number and types of gears; Number of Gharial death
	10 years	BFD, DoF, Law enforcing agencies	Implementation of law to stop use of harmful fishing gears	Showing zero tolerance
	5 years	BFD, DoF, NGOs	Provide training to the fishermen on safe release of Gharials from fishing gears	Assessing the skill of Gharial release from fishing gears
	10 years	BFD	Provide incentive to the fishermen for safe release of Gharials from the fishing nets	Number of Gharial release from fishing net
	5 years	BFD, NGOs	Raise awareness among fishermen, boatmen and local communities about legal protection and importance of Gharials in river ecosystem	Perception of target group about Gharial and level of awareness
	2 years	BFD, NGOs	Clarify the misconceptions on Gharials through the establishment of bill boards, circulation of posters, leaflets and incorporation of local educational institutions in this process of Awareness among related people	Level of awareness and attitude of the target group

* BFD = Bangladesh Forest Department; DoF = Department of Fisheries; NGO = Non-governmental Organization.

Task	Time Frame	Responsible Body/ Organization	Strategic Actions	Indicators
2. Control human activities in Gharial hotspots	5 years	BFD, DoF, Law enforcing agencies	Control agricultural practices in newly accreted lands	Frequency of agricultural crop cultivation
	10 years	BFD, DoF, Law enforcing agencies	Control the establishment of boat station in Gharial sensitive areas	Zero number of boat station
3. Raising awareness in from national to local levels	5 years	BFD, Zoos, Safari parks, wildlife centre and NGOs,	Development and dissemination of IEC (information, education and communication) materials for mass awareness from national to local levels	Number, participants and area of programe
	10 years	BFD, Zoos, Safari parks, Wildlife centre and NGOs	Education and outreach programs	Scientific and comparative study
	10 years	BFD	Observation of national/ international day highlighting Gharials	Rally, seminar and awareness programs
	10 years	BFD, Zoos, Safari parks and NGOs	Film/ documentary on Gharials in mass media	Number of documentary and frequency of exhibition
B. Capacity building to ensure protection of Gharial hotspots				
1. Improve institutional capacity of BFD	5 years	BFD, MoEF	Training to carry out conservation work including rescuing and handling Gharials	Number of trained person
	10 years	BFD	Incorporation of conservation task in the training curriculum of BFD	Reflection in the curriculum

Task	Time Frame	Responsible Body/ Organization	Strategic Actions	Indicators
2. Logistic support	10 years	BFD	Patrol boat with fuel support and arms	Number of patrol boats and arms
3. Collaboration with other agencies	5 years	BFD, NGOs	Development of a platform to coordinate among different agencies especially with BGB	Number of collaboration with other agencies
4. Development of trans-boundary programs	2 years	BFD	Meeting, awareness and development of conservation plan by the related countries	Condition of Gharial population in the wild
C. Facilitate captive breeding and reintroduction programs				
1. Gharial exchange program	5 years	Zoos, Safari parks and BFD	Establish collaboration among different zoos and safari parks to initiate Gharial exchange and sharing captive breeding experience	Exchange of male and female Gharials. Confirming combined stay in zoo or safari park
2. Develop captive breeding facilities	10 years	Zoos, Safari parks and BFD	Modification and extension of Gharial enclosure ensuring basking and breeding facilities	Quality of captive breeding facilities in zoos and safari parks
3. Development of skilled manpower	10 years	Universities, Zoos, Safari parks, wildlife centre and BFD	Hire expert for the training of zoo keepers to facilitate captive breeding	Scientific study and number of training
4. Coordination of captive breeding and reintroduction programs	10 years	BFD	Wildlife Division of BFD will coordinate captive breeding programs among the experts, Zoos, Safari Parks and BFD.	Coordination among BFD, Zoos, Safari parks, Wildlife centre, Experts and NGOs

Task	Time Frame	Responsible Body/ Organization	Strategic Actions	Indicators
5. Assessment of reintroduction feasibilities	5 years	An expert team of BFD, universities, research organization	The expert team will assess reintroduction possibilities by evaluating captive bred Gharials and suitable habitats	Report from the expert team
D. Research and monitoring				
1. Monitoring population trend and habitat quality	10 years	BFD, universities, research organizations, Wildlife Center	Periodic survey every year to assess population trend and habitat quality	Assessment of population trend
2. Research on ecology and breeding biology	10 years	BFD, universities, research organization s, Wildlife Center	Study on habitat and ecological requirements, essential breeding facilities both in wild and captivity	Number of studies / research done/ number of scientific publications
3. Monitoring of Gharial hotspots	10 years	Trained BFD personnel incorporatio n with local people	Regular survey, data keeping, monitoring and interpretation	Number of Gharial spotted and quality of hotspots



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Implementation

Bangladesh Forest Department will implement the *Gharial Conservation Management and Action Plan (2016-2025)* with the assistance of other concerned agencies. Engagement of NGOs, law enforcing agencies, media and civil societies will be crucial for the Gharial management and action plan implementation in Bangladesh. Partnership will be developed with concerned NGOs and the Government of neighboring countries for the technical supports.

Monitoring and Evaluation

Monitoring and evaluation is necessary to assess the accomplishment of the management and action plan. Bangladesh Forest Department will monitor and evaluate the plan after the end of the short-term and medium-term periods. Specific and measureable indicator is proposed in log-frame relating to implement the plan, which will form the basis of monitoring and evaluation. Final review and update of the plan will be conducted in the 10th year for a new or updated plan.



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