

*Full Length Research Paper*

# **A survey of habitat inveterization and habitat potentiality for sustenance of Gharial in Sone (*Gavialis gangeticus*) Gharial Sanctuary**

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Accepted 10 December, 2010

The present study was carried out to find out the diversity of Gharial and potential habitat for its survival. A total of 161 km area in the Sanctuary was studied and data related with population of Gharial, habitat features, river profile, human activities and threats were collected. The Sone River apparently supports a few viable populations of Gharial. The population of Gharial shows 40% reduction since 1996 to 2010 in Sone Gharial Sanctuary. Much of the river was found sub-optimal for sustenance of viable population of Gharial for low flow conditions due to construction of Dam at upstream region. The other stretches have potentiality as good habitat for Gharial as some of them are presently used by the species for nesting. Some recommendations have been suggested on the basis of the observations to maintain those habitats for propagation, release and management of the species to raise the present population to a stabilized and viable one.

**Key words:** Gharial, population, habitat features, conservation, threats.

## **INTRODUCTION**

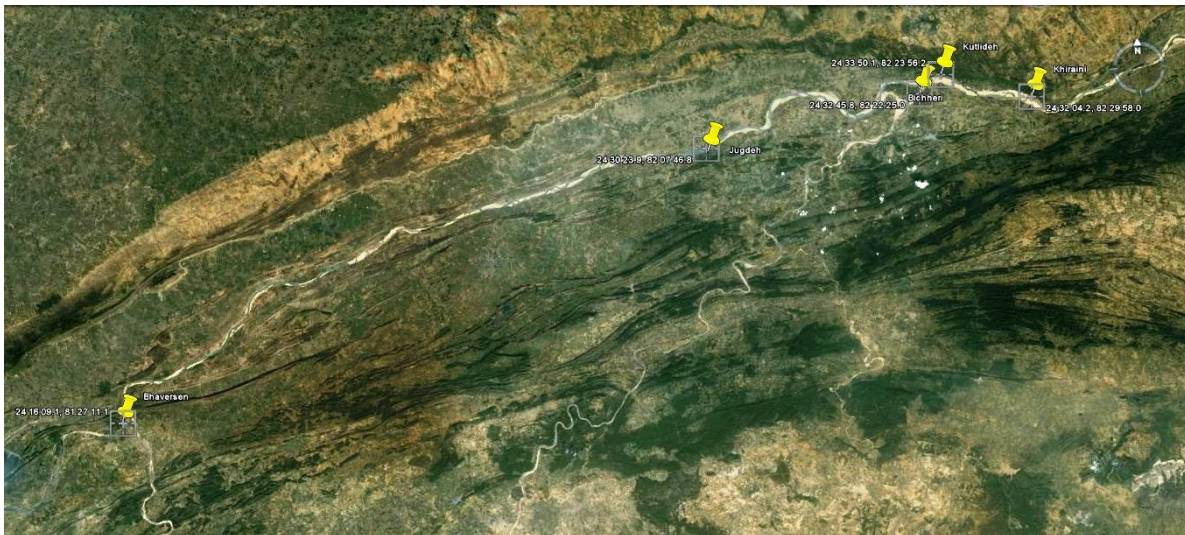
Of the 23 species of crocodylians, which inhabit a range of aquatic ecosystem, four species are critically endangered, and three are vulnerable (IUCN, 2006). The Gharial *Gavialis gangeticus* (Gmelin, 1789) is endemic to the Indian sub-continent occurring in the Indus, Ganges, Brahmaputra and Mahanadi river systems (Smith, 1939; Singh, 1978; Groombridge, 1987; Whitaker, 1987; Hussian, 1999). By the mid 1970s it was on the verge of extinction due to loss of habitat, mortality in fishing nets (Whitaker, 1987; Hussian, 1999) and poaching (Whitaker and Basu, 1983). It is believed that the Gharial is now extinct in Myanmar, Bhutan and Pakistan. The remaining

Gharial populations are restricted to India and Nepal and are highly fragmented. In India small populations are present and increasing in the rivers of the National Chambal Sanctuary, Katarniaghat Wildlife Sanctuary, Sone River Sanctuary and the rainforest biome of Mahanadi in Satkosia Gorge Sanctuary, Orissa, where they apparently do not breed.

However, since 1999 the Gharial population has shown a dramatic decline throughout its range. The total breeding population of Gharial is now estimated to be less than 200 individuals making Gharial a critically endangered species (IUCN, 2007). Such a drastic decline with the last decade is largely the result of anthropogenic pressures such as reduction in the availability of nesting beaches, encroachment on the river banks for agriculture, construction of dams and barrages, reduction

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**Figure 1.** Map depicting the study areas of Sone Gharial Sanctuary. Photo courtesy: Google map.

in water flow, siltation, channelization, and modification by river morphology by development activities and increased mortality in the fishing net (Hussian, 1999; IUCN, 2007). In 2006, the mature Gharial population in India was reported as less than 200 (Andrews, 2006; Sharma and Basu, 2004).

Khan (1993) reported 13 Gharials, varying in size between 2 m to 5 m, before the Sanctuary notification. Two hundred and sixty three head-started Gharials were released in the Sone River and the first nest in more than 30 years was found in April, 2006 (Andrews, 2006). The Chambal River holds the largest estimates at 48% of the total population. The only other large breeding population of Gharial in India is in the Katerniaghat wildlife Sanctuary. The one other known breeding population in India is the Sone Gharial Sanctuary (Andrews, 2006). With stringent management and mitigation of threats such as fishing and sand mining, the Sone, though only small parts are suitable habitat, could well provide the best opportunity for gharial survival after the Chambal. At certain points, the river varies widely in depth from 0.6 m to 15 to 20 m (Sharma and Sharma, 1997). The objective of the present survey was identification of gharial habitats, population estimation of the same and biotic pressure and threat identification and exploration of local knowledge.

### Study area

The Sone Gharial Sanctuary is primarily situated in the Sidhi district of the Central Indian State, Madhya Pradesh, with very small portions extending to the Satna

and Shahdol districts. The Sidhi district lies in the North East of the state, bordering Uttar Pradesh, and is home to four protected areas - Sanjay National Park, Sanjay-Dubari Sanctuary, Bagdara Sanctuary and Sone Gharial Sanctuary. A total of 209.21 km of river (Sone, Banas and Gopad Rivers) with a width of 200 m of the river bank on either side are protected. The Sanctuary falls within latitude 24°15' and 25°40'N and longitude 81°20' and 82°50'E (Figure 1).

### MATERIALS AND METHODS

Surveys were conducted in the years 1996, 2003 and 2010 with the help of forest officials of Sone Gharial Sanctuary. Survey localities were selected on the basis of accessibility to vehicles and boats. To determine the existence of Gharial direct and indirect methods were used in all survey years and at all the locations. In the direct method Gharial count was made by direct sightings of basking or swimming Gharials. In the indirect method, presence or absence of the species were determined by signs like trails or information from local people, forest officials and fishermen etc. The hydrological features of the river, habitat features shoreline and bank characteristics, anthropogenic activities were also analyzed. The coordinates of each of the locations during the survey were put on a GPS (Global Positioning System) domain. The river depth was estimated by depth finder (Garmin). The width was measured by range finder (BUSHNEL X 900). Secondary data have been collected from forest officials of Sone Gharial Sanctuary.

### RESULTS AND DISCUSSION

The total of 14 Gharial which comprises two adult male, six adult female, one sub-adult, one juvenile and four yearling/hatchlings were recorded. The highest number

**Table 1.** Age group of Gharial during different surveys in Sone Sanctuary.

Animal sighted	PSN	1996	2003	2010
Male	0	0	0	2
Female	4	25	11	6
Sub-adult	9	6	9	1
juvenile	0	4	8	1
Yearling/ hatchling	0	0	0	4
Total	13	35	28	14

PSN = Prior to sanctuary notification.

**Table 2.** Gharial recorded in different sites of Sone River.

Site	Area covered	Total Number of Gharial		
		1996	2003	2010
I	Bhavarsen ghat, Terideh	3	2	2
II	Jugdeh Ghat	14	11	6
III	Kherpur/Bichheri Ghat	5	4	1
IV	Kutlideh	2	2	2
V	Kheraini Ghat	11	9	5
Total		35	28	14

**Table 3.** Hydrological parameter of different study sites of Sone River during March, 2010.

Site	Name of location	GPS location		Depth (m)	Width (m)
		Latitude	Longitude		
I	Terideh/Bhavarsen ghat	24°16'09.1	81°27'11.1	1 - 3	211
II	Jugdeh Ghat	24°30'23.9	82°07'46.8	5 - 7	231
III	Kherpur/Bichheri Ghat	24°32'45.8	82°22'25.2	>1 - 3	453
IV	Kutlideh	24°33'50.1	82°23'56.2	>1 - 2	322
V	Kheraini Ghat	24°32'04.2	82°29'58.0	3 - 5	279

of Gharial 35 was recorded in year 1996, followed by 28 Gharial in 2003 and 14 in 2010. Male Gharial, yearlings/hatchlings were not observed in the previous two surveys, during, 1996 and 2003 (Table 1).

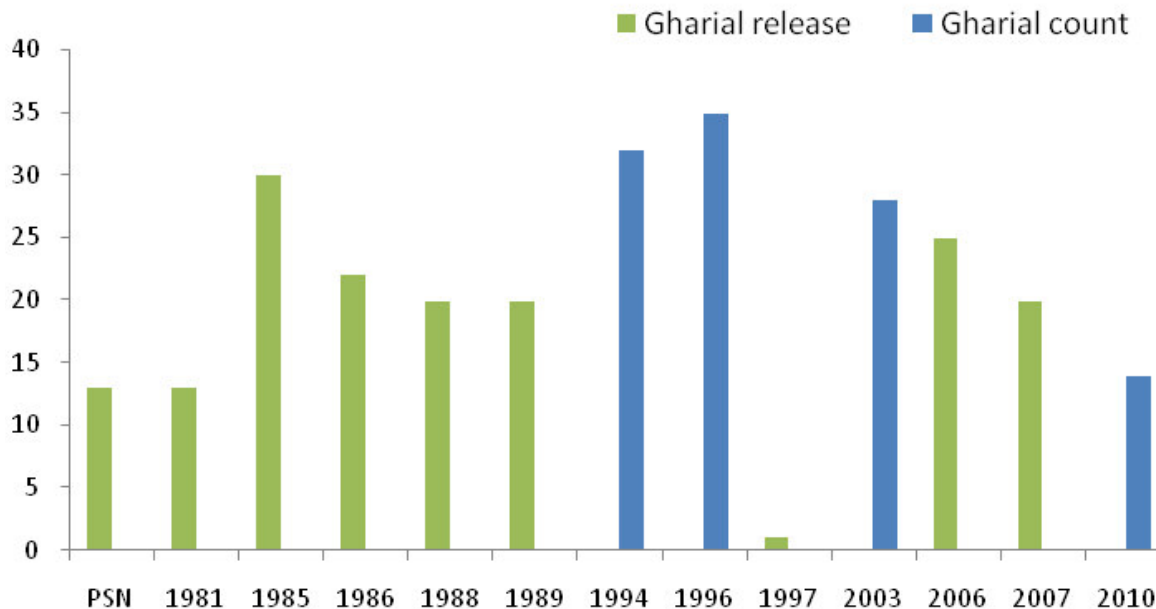
Previous result shows maximum number of Gharial was recorded at Site II in 1996 and 2003 and six Gharial including one adult male was recorded in 2010, followed by Site V which include five Gharial including one adult male (Table 2).

The maximum depth (7 m) of the river was recorded at Site II and minimum (>1 m) was recorded at Site IV. Width ranges between 211 m to 453 m at Sites I and III and the ranges of pH was 6 to 8 (Table 3).

The highest number of Gharial released in the sanctuary was 30 in 1985, followed by 25 in 2006, and 20 in 2007, which includes a total of 164. The highest count

of Gharial was reported in 1996 (35 Gharial) and the lowest (14 Gharial) was in 2010.

The survey results indicate that the Sone Gharial Sanctuary holds two breeding groups of Gharial at two sites Jugdeh Ghat (Site II) and Kharaini Ghat (Site V). A decrease in 24% of adult female, 16.7% sub-adult and 25% juvenile with an overall decrease of 40% of Gharial was reported since 1996 to 2010. Besides the releases of 164 Gharials in the sanctuary since 1981 to till date (Sharma et al., 1999) the survival rate of gharial in the Sanctuary is very low (Figure 2). However, Sharma et al. (1999) indicates that an increment rate of adult female in the sanctuary was 18.4%. Estimated reduction of Gharial in ten years (1997 to 2006) was recorded in different sanctuaries in India, example, Chambal 65%, Katarniaghat 13%, Sone 66% and other 20%. Among



**Figure 2.** Trends in population of sighted and released Gharial in Sone River.

these the highest reduction rate of Gharial was reported from Sone Gharial Sanctuary (IUCN, 2007), which is evident during the present survey. A reduction of 58% breeding adult of Gharial was reported in 10 years by IUCN (2007). The reduction of 24% adult female was assumed during the present survey. When we compare the success rate of hatchling to Chambal river, Hussian (2009) assumed that a decline of 40% in the recruitment class (<120 cm). Similar decline was evident during the present survey. Two Gharial nests were found at Site II. The clutch sizes were 27 and 31 eggs, among which only 3 and 5 hatchlings were hatched successfully (Sharma, pers comm.). However, no report of nesting at Site V was recorded due to lack of monitoring during nesting season. Our result indicates an absence of 14 Gharials from two suitable habitats Sites II and V from 1996 to 2010. The recruitment of two male Gharials and 4 yearlings/hatchlings were observed in the present survey which was not recorded in earlier surveys. The results show that a loss of 21 Gharials from 1996 to 2010 indicates the status of the Gharial in the sanctuary need to be reassessed. The addition of two male Gharials in the present survey indicates that breeding male was not reported in the earlier studies. The absence of 19 breeding female is a major setback to the success rate of Gharial in the sanctuary. Some more number may be missing because the survey was conducted in the month of March. Due to hot weather sighting of Gharial is very low.

No detailed surveys on hydrological parameter such as

depth and width were conducted previously. Sharma and Sharma (1997) recorded a depth range of less than 0.6 m to 15 m but did not mention site location and depth range. During the present survey only two stretches (Sites II and V) has a depth of 3 to 7 m. All the other stretches of the river has shallow water with a depth of below 0.6 m.

Increase in agriculture and livestock grazing, construction of Ban Sagar Dam resulted in water abstraction from the river. This lowered the water level and resulted in low flow condition in the River. Lowering of flow also enhanced siltation and farther lowered the depth. All of these phenomena synergistically affected the Gharial habitat. The grazing, agriculture and other human activities degraded the nesting and basking sandy beaches along the River bank. The local community, dependent for food upon the fishes and turtles in the River, also practices unsustainable practices of fishing with explosives and netting.

## RECOMMENDATIONS

Regular monitoring should be conducted throughout the Sanctuary. For further release of Gharial, it is recommended that a proper survey of the potential areas for habitat features and anthropogenic pressure should be analyzed. The sandy island should be managed properly and all sorts of human activities should be barred around that area. Awareness programme at community and village level may be incorporated in the

management plan. Local people should be involved in the conservation programme. An extensive survey of the total stretch of the river should be incorporated to evaluate suitable habitat for Gharial, Mugger and Turtle and probable re-introduction of these species. To maintain a near natural flow regime in the dry months, timely water release from the dam may be provided to optimize the depth and flow requirement of Gharial.

## ACKNOWLEDGEMENTS

We sincerely appreciate Director, Sanjay Tiger Reserve and field staff for providing technical and logistic support during survey and field stay. Second and third authors are thankful to their supervisor Dr. R.J. Rao and laboratory colleagues Mr. Kush Kushwah and Mrs. Bidya Lakshmi for their encouragement.

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