FINAL PROJECT REPORT

**ON**

# CONSERVATION OF GHARIAL (*GAVIALIS GANGETICUS)* IN MAHANADI RIVER SYSTEM OF ORISSA, INDIA

**SUBMITTED TO**

RUFFORD FOUNDATION

FOR NATURE CONSERVATION

UK

# CONTENTS

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**TITLE OF THE PROJECT: - CONSERVATION OF GHARIAL (***GAVIALIS GANGETICUS)* **IN THE MAHANADI RIVER SYSTEM OF ORISSA, INDIA.**

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**Duration of the Period**- One Year

**Place of Work**- The entire length and breadth of Mahanadi river, Orissa.

**Geographical location-** 26º.00' N & 94º20' E

**Name of the nodal agency**: World Wide Fund for Nature

Orissa State office

3rd floor, Pakruti Bhawan, Bhubaneswar,

Orissa

## 1. INTRODUCTION

### 1.0 Background

Gharial (*Gavialis gangeticus)*, 65 million years old crocodilian is one of the largest riverine crocodile. This reptile belongs to the family gavialidae and the genus gavialis. The name "Gavialis" is believed to be misinterpreted Hindi word Ghariyal means ghara / pot with a long neck. The word gangeticus is derived from river Ganga or "Ganges" as it is called in English.

This animal is known by several names like fish eating crocodile, long nosed gharial, gavial, chomta in Nepal, sansar in Pakistan, Thantia in Orissa, India etc. The animal is more adapted to aquatic life style in calmer areas of deep and fast moving rivers. Though the animal is poorly equipped for locomotion on land yet, it basks and nests in the sandbanks. Once they reach to a length of 1 mts, they are believed to have no natural enemies other than human beings. But this animal, which is one of the largest living crocodilians, is now fighting for its own existence and sadly enough, this species is heading towards extinction.

**1.1 Need for conservation**

With the shrinking habitats due to the human encroachments, wanton killing and other anthropogenic pressures, the species reached a catastrophic low prompting an urgent and massive rescue campaign to save the species and bring them back from the danger of getting extinct, forcing the conservationist to adopt a species oriented conservation strategy. By the mid 1970's, all the three species of Indian crocodilians-gharial (*Gavialis gangeticus)*, mugger (*Crocodylus palustris*) and saltwater crocodile (*Crocodylus porosus*) were on the verge of extinction. Out of three existing Indian crocodilians, gharial (*Gavialis gangeticus)* is the most threatened one. In 1975, the Govt. of India initiated a project to save these crocodilians from the brink of extinction by collecting eggs from the wild, incubating them before release of yearlings & breeding the animal in captivity and to release them again to the wild. Various agencies like UNDP, FAO, and Ministry of

Environment and Forests, State Governments and other wildlife management agencies provided a right mix of management and scientific inputs with a strong research base, a well planned strategy, extending the network over 12 States to bring back this animal to an improved status.

**1.3 Status in Orissa**

In India, Orissa has the distinction of having all three species of crocodiles. Many rivers in Orissa were inhabited by this species. Gharial once inhabited all the major river systems of Orissa, namely, the Mahanadi, Brahmani and Baitarani besides some tributaries of Godavari system. But, by mid 70's they were restricted to Mahanadi only. The conservation of gharials was initiated at Tikarpara in Satkosia Gorge Sanctuary (Orissa), under the supervision of Dr. H. R. Bustard along with other scientists. In the process, the Orissa state programme developed three research and conservation units at Tikarpara, Dangmal and Ramatirtha for captive rearing of gharial, estuarine crocodile and the mugger respectively. It included the management of three crocodilian sanctuaries at Satkosia Gorge, Bhitarkanika and Hadgarh, and management of mugger crocodiles in the Similipal Tiger Reserve. Apart from these, captive breeding facilities were also developed for all the three species at Nandankanan Zoological Park. Conservation measures with captive breeding and release into the river started. Despite the state initiative and successes in first ever-captive breeding, their status in the wild has declined and the status remain endangered, though individuals have been found straying out to different

tributaries, canals, lagoon and beaches. Looking at the precarious condition of the gharial, this project was initiated to study the entire Mahanadi river system to assess the exact status of this species, causes of its depletion in the wild and suggest remedial measures.

**1.4 Conservation initiatives**

The Gharial Research and Conservation Unit (GRACU) at Tikarpada, first of its kind, were established to augment the conservation measures. Since then, 700 numbers of gharials have been released in Satkosia Gorge sanctuary in the river Mahanadi which virtually brought back the species from extinction of by 1981. The increase sightings of this species spoke the success story of the crocodile conservation project. Subsequent natural breeding at some of the restocked locations were also observed. But astonishingly the population of gharial dipped to a dwindling number since then. This is evident from their rare sighting and no nesting in the sanctuary area.

Certain significant management actions were taken up with an intention to manage gharial as the “flagship species” in the Mahanadi. Regulation of fishing in Mahanadi was done by issuing permits to authorized fisherman only. Fishing camps on the river banks were banned and the fisherman were suggested alternatives replacing the open cast fishing techniques with inland fish farming to make them independent of river-fishing. In spite of all these efforts initiated to conserve gharial, the status of gharial is still precarious. After a long time, crocodile census was carried out

to find only one gharial within the designated sanctuary area. Unfortunately, no systematic monitoring of releases was carried out and their numbers declined leaving the reasons for decline unnoticed, pushing these animals again to danger level in the river system. Hence, the present investigation was proposed with the following objectives

- To make a status survey of gharial in the entire Mahanadi river system and in different released sites.
- To compile all scattered information about gharial sightings, captures and death reports.
- To identify the causes for which the gharial species is in danger and threats to known habitat.
- To suggest measures to protect the remaining population of gharial in their natural habitat.
- To identify suitable habitat for reintroduction of gharial.
- To take up study to improve management by

  -Interpretation of various types of data collected during survey and census.

  -Study of habitat features and population structure.

  -Identifying the possible course or path of movement of gharial from the sanctuary area.
- To involve the local people in the project intimately through

  -Strong level of acceptance of the project by the local people.

-Protecting the immediate and long-term interest of fishermen who live within the sanctuaries.

- To make a long-term monitoring plan.
- To collect all available literatures.

## 2. METHODOLOGY

**2.0** The survey was conducted in the entire length and breadth of Mahanadi river system, starting from the Hrakud reservoir, in Sambalpur district of Orissa, 20º 44'N & 82 º 39'E till to its mouth in the Bay of Bengal near false point 20 º 18' N & 86 º 43' E. The study was conducted over a period of one year and two months from 10.12.05 till date involving two winter survey in the biennium 2005-06 to know the habitat, remaining population and limiting factors. The Map of the area of Mahanadi river system were studied in detail by procuring the 1:1,000, 000 topo-sheet and then the sites were divided into strategic segments and decision was taken as to which part shall be ideally covered by water route and the rest to be covered by land.

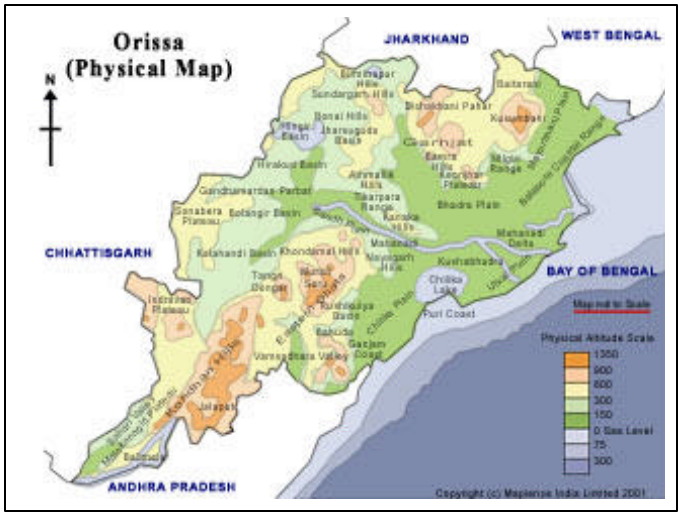
**2.1** Before conducting the survey and reconnaissance field visits, literatures was collected from different libraries of Orissa like state library, Orissa state archives, OUAT, Suchana Bhawan, as well as from other libraries of India. Apart from library collection, literatures were also collected from internet and personal articles collection of Dr. L. N. Acharjyo, Mr. S.K.Pattnaik., Dr. A. Patra, and other crocodile experts.

**2.2** The entire water route system was divided into three groups

1. Satkosia gorge (starting midpoint).

2. Upstream of the gorge (to the staring point at Sambalpur)

3. Down stream of the gorge (to the end point upto Munduli)




A. **Satkosia gorge**: The entire gorge was covered by water. We first surveyed the northern bank of the river covering Angul, Athamalik, and Atthagarh followed by southern bank of the side Boudh and Nayagarh district.

**View of Satkosia gorge**

B. **Upstream** (Binkei to Huma: Dist- Atthagarh) the outer periphery of the Satkosia gorge was chosen as the starting point for the upstream survey and reached up to Hirakud reservoir (Dist- Sambalpur).

C. **Downstream** (Barmul: dist- Nayagarh to Naraj: dist- Cuttack) Just down stream the sanctuary periphery was chosen as the starting point and from that point we moved down the stream to reach Munduli bridge near Naraj.

**2.3** We reached both the starting point i.e., Tikarpara, Barmul and Binkei by land and from there we started our operation. Local boats were hired and both sides of riverbank were covered during the investigation. The survey was conducted from 8am to 5 pm. Binoculars were used to sight gharials in water/sand banks during their sun basking, imprints on the mud while basking etc. During evening time, meetings with the local people were arranged and all the information available with them regarding gharial and mugger sighting, nesting, last seen, availability of suitable habitat, threats, etc were discussed and documented in a prepared questionnaire. During survey, almost all the villages on either bank of the river were covered for collecting data.

**Interaction with forest official and village elders**

### 2.3 Area covered by land

View of a roadway to Sonpur

Villages on either side of the river were also surveyed covering more than 1000km. by land route. The survey was conducted by road from Sambalpur to Boudh via Sonpur and Manmunda. Data pertaining to available information on gharial sighting or death in last two decades from local people were collected in details. The Tel river system, from Manmunda to Bamini was covered by road and surveys were made from village to village in a similar manner as done by water route.

View of a roadway to Bamini


Puri main canal near Madhusudhanpur from where the gharial was caught

Puri canal, the main canal system of Mahanadi river, starting from Munduli Bridge was covered by road. Similarly, from Munduli bridge to Paradip (where the river drains to sea) was also covered by road. Interactive studies

were made by visiting different government offices involving research officers, students, scientists, wild life expertise, forest officials, foresters, range officers, watchman, etc. The photographic evidences of different crocodiles (Gharial/Muggers), their imprints, interview with local people, fishermen, fish, other river flora and fauna was documented.

Apart from gharials, they were also asked about their idea on conservation issue, type of fishing methodology, types of fish available, decline or increase in fisheries, livelihood, socio-economic status of the community etc. Finally, data from the district fishery offices were collected to support our investigation.

**View of river draining to sea**

**Fishing by cane cage**

**Use of zero mesh size net**

## 3. INSTUMENTS USED

All the necessary and documented requirements are procured from Orissa as well as different parts of India.

1. GPS: Garmin make, USA.
2. Binocular: - Nikon make,
3. Camping kits, sleeping begs, sleeping mattress.
4. Camera: - Digital Kodak camera with 10X Optical Zoom,
5. Torches: Two 4-celled focusing torch
6. Maps: - Both physical as well as political maps of Orissa and entire Mahanadi river system were procured from State Govt. office of different Topo- sheet.
7. pH meter.

## 4 OBSERVATIONS

### 4.0 Origin

Mahanadi, the largest river of Orissa, originates from hills of Amarkantak, (state of Chattishgarh) enters Orissa from the Sambalpur district (20º4'N & 84º23'E). The river covers approx.832kms before draining into Bay of Bengal in Jagatsinghpur district in the false point 20º18'N & 86º43'E. In the upper stream near

**Rocky river bed near Huma**

**Reservoir formed by Hirakud dam**

Sambalpur a huge reservoir named as Hirakud reservoir of 288 Sq Kms with 52 gates spreading over three districts (Sambalpur, Jharsuguda and Baragarh) has been constructed way back in 1956 for irrigation, controlling flood and generating hydroelectric power. Approx.4000 people directly or indirectly are dependent on the reservoir for their livelihood through fisheries. Similarly

**View of Mahanadi down the dam**

**View of the Hirakud dam**

at the lower end of Mahanadi a weir has been made near Munduli (Cuttack District) and just before the bridge there exists a big canal system known as Puri main canal.

**4.1 Ambience**

The river is surrounded by beautiful scenic places with rocky mountains, hills, dense forests, creeks, canals, temples and hundreds of villages on either side of the river side with millions of people directly or indirectly dependent on the river for their livelihood through fisheries. Several small and large streams and tributaries like Tel, Ong, Jira, Jawan, Malti Jor, Salki, etc are the major contributors on the upper hilly area while in the lower stream before the river forms a deltaic head in Cuttack district, giving rise to a number of distributaries. The river near Tikarpara (Angul District) at 20º35' N & 84º47'

E, forms a picturesque Satkosia gorge spreading over 5 districts such as Cuttack and Angul in north and Nayagarh and Boudh in south. The original gorge area is approx. 24 Kms. This gorge forms a part of Satkosia gorge wildlife Sanctuary and is controlled by Satkosia and Mahanadi Wildlife Forest Division.

**Scenic views along the river on its upstream**

**4.2** More than 120 licensed boats are plying daily in the river for fishing in the gorge area. The common fishing methodologies include gill nets, disco nets, nylon nets of zero mesh size (banned) and varieties of bamboo caned traps. More than 60 villages on either side of the gorge area were covered for survey and collection of data.

**4.3** The water is usually clear during summer and turns muddy during rainy season through out the length of the river system. This is because the river covers a large area, draining through an extensive flood plain and river basin

carrying with it huge volume of water along with silt and sediments to the down stream thereby raising the water level to an incredibly high, which goes more than 100fts near the gorge area. This immense water volume brings with it high current which erodes both the side of the river edges on, washing off the banks and bringing down the many forest trees.

**Low water level in Mahanadi during winter season**

**High water level in Mahanadi during flood**

**Heavy wash-off in the creek within forest zone**

**Eroded bank due to water current near Barmul**

**4.4** Extensive sand banks are available in the sanctuary area as well as both in upper and lower stream of the river. The upper stream often experience less water depth and the fish population was less. In the up- stream the river from Atthamalik tends to flow over a more uneven rocky bed.

**Sand bank within the river**

**Sand bank near Binkei**

**Rocky bed near Atthamalik**

**Mugger on a sand bank near Binkei**

**4.5** Very often, people in these adjoining villages are reported to employ several objectionable methodologies for fishing which may have directly affected the aquatic flora and fauna. Similarly, in the lower stream, the river takes an irregular course passing through hilly areas, where human activities increases immensely with large number of developmental structures which has come up on the river banks. Moreover of late, the sanctuary has become a highly disturbed area due to increase in human activities for their domestic purposes, high fishing activities, plying large number of boats, playing of loud speaker and dumping garbage by the picnicking groups and pollution etc. The condition of Satkosia Research Center is equally very deplorable. Now there are three female gharial and one captured gharial from Rajnagar along

with three mugger juveniles which are maintained with great difficulty due to paucity of funds.

The facilities in the hatchery are in dilapidated condition or damaged due to poor maintenance and the manpower is in acute shortage. Since long, there has been no fresh injection of funds to bring it back to its past glory. The Govt. of India is no more providing support for the crocodile project.

**A young gharial inside the hatchery**

**Govt hatchery established during 1975**

**4.6** The mugger population is quite high in the Mahanadi river system. They are frequently observed in between Majhipara to Baramul and on rare occasion it's been reported beyond Majhipara to Binkei and Baramul upto Naraj bridge.


**A full grown mugger sun basking near Majhipara**

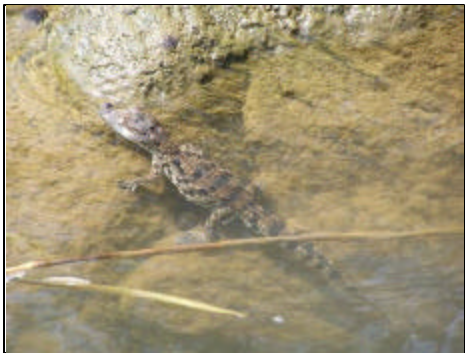

**Extensive sand banks available near Baramul**

**4.7** During our investigation typical mugger trailing marks on the mud and sands were seen. The mugger population was found in between 30-35 during our winter survey of 2005, while the number slightly varied in between 40-45 during the 2006 winter survey. During the survey, we succeeded in tracing 6-7 nesting sites of mugger with good number of mugger hatchlings in the river bank of Binkei to Baramul. Apart from the hatchlings, we also found dead hatchling in the nesting sites of mugger near Majhipara. The reason for the death seems to be a malnutrition one, even though we could not ascertain the

**Trail marking on the bank**

**Nest showing hatched eggs**

exact cause of death. But, lots of death does appear to occur due to parasitic infestation and predation. During our study, we could sight muggers only in the gorge area where, the water depth is pretty high. We never came across a single mugger, where water depth was low.



**Mugger juvenile near Majhipara**

**View of a dead hatchling**

On the contrary to mugger, we could hardly trace any trailing mark of gharials on either side of the mud or sand bank excepting a direct sighting.


**Courtship of a male and female gharial**

**4.8** During the winter survey of 2005, a pair of mature and full grown gharials was sighted near Binkei. The water depth around the Binkei varied from 4 to 6 mts. Water was clear and was flowing. pH of water varied between 7.2 - 7.4. The male and the female were approximately 4 mts and 3.5mts long respectively. The couple was constantly seen moving together from one bank to another in the same area for 3-4 days and shared the same sandy bank. This finding was in agreement with the findings of Forest Dept. census program, which had carried out their own census in parallel with us during January 13th to 17th 2005.

**4.9** The gharials were always reported to be in the middle sandbanks of Majhipara to Binkei where the conditions were very conducive for crocodiles to bask and nest without much human interference. They were never reported in the rocky riverbank. The sand bank was just on the opposite bank of the Binkei temple. However, there is only one drawback observed during

the study near Binkei. Thousands of people are found to use the water route for transport as well as to visit famous Binkei and Kankei temple. During the


Male gharial with its snout out


Male gharial scouting through water

winter survey of 2006, we succeeded in tracing the same pair of gharial but they were never seen moving around together. This year, though the male was found in the same area near Binkei to Majhipara, the female was sighted towards more upstream near Tiradaghata. The water condition and depth is more or less similar to that of Binkei. During the survey, not a single young gharial was seen.

**4.10** Other aquatic fauna seen included were a wide range of fish population in the entire Mahanadi river system. Apart from the Indian Major Carps (IMC, i.e., rohu, catla, mrigal), the fishes we encountered were, calbasu, mystus, chitla, bata, puntius, pangassius, etc. Similarly, in the reservoir, chitala, grass carps, singi, magur, etc are found more often.

Variety of fishes available in the river

**4.11** A 15 years (1990 to 2004) data collected from the Dept. of Fisheries showed a sharp decline in the fish catch from 332.80 Metric Ton (MT) to 151.54 MT during the year 1990/ 91 to 2004/05, respectively. A similar trend was also observed in the sanctuary area. The fish capture in Mahanadi river from Tikarpara was found to be declining from 65.6MT during 1995 to 36.37 (with 26.25 MT of IMC and 10.12 MT of other fishes) in 2001 while a sharp decline was recorded in 2004/05 of 15.59 MT (including 11.69 and 3.9 MT of IMC and other fishes). Along with fish, several varieties of freshwater prawns were also found in the river system. Besides fish and prawns, some freshwater turtles were frequently encountered in the entire river system with more abundance in between Athamalik to Naraj. However, their intensity was

**Catch of a river prawn**


**View of a basking turtle near Binkei**

high in the gorge area where they are usually observed in the rocky surfaces for basking and also near lower stream. Suitable nesting sites are found near Munduli bridge. During the survey in the lower stream we could able to record a good number of turtle's population belonging Roofed turtle(Kachuga sp.) and Narrow headed Softshell turtles (Chitra indica).

**4.12** On the other hand, though we could not directly sight the freshwater stingray, we get sufficient evidence from the local people of its existence in the sanctuary area. They are predominantly restricted to the gorge area. The nearby village people showed us the tails and the spines of the ray which they are using for traditional medicine. As per the fishermen's description it was round shaped with darkish grey upper with whitish under surface weighing around 100 kg. and is thought to be river stingray. Snakes are also observed on the river dykes of the river. The avifauna varied widely in the river. Due to several native along with migratory birds' graces the river stretch increases the scenic beauty of the river and birds like Rudy shellduck, river tern, plover, river lapwing, stilt, kingfisher, dove, egrets are common in the winter season.


**River lapwing on a rocky platform**

**Egret flying over the water surface**

## 5. AWARNESS PROGRAMME

**5.0** We had organized several awareness campaigns in and around the Tikarpara, Binkei, Barmul, Kankei areas targeting different groups of people. We tried to include every segment of the population i.e. children, student, youth, and adults. Awareness program were held in various primary schools

and high schools in various villages. Quiz competitions and question answer sessions were held there and prizes and chocolates were distributed at the end as a token of appreciation.

Special attention was given to the youth by involving them in the program by mobilizing them. Interactive session and meetings were organized in many villages by involving many village heads and adult people to find out their knowledge about the gharial, reason of their depletion and how could they be protected. We also made an effort to find out their perceptions towards the conservation efforts of gharial, and to discuss the reasons for decline of gharials population and how these animals could be protected by garnering the support of village heads and elders.

**Awareness campaign in a school at Tikarpada**


**Prize distribution by State Director, WWF-India**


**Interaction with village people at Nayagarh district**

State Director of WWF-India, Mr. Micheal Peter very often accompanied us to join in for the conservation program.

**Handing over of Hoarding to Forester of the sanctuary**


**Interaction with fishermen during evening time at Tikarpara**


**Awareness program in a village of Nayagarh district**


**Campaigning at Tikarpada**

Apart from this as per the suggestion of Mr. Suresh Mohanty, I.F.S, Principal Chief Conservator of Forest (PCCF), State Wildlife Warden, we prepared hoarding, citing the importance of gharials, their status and necessity for their conservation. The hoardings were installed at various public and sensitive places of Tikarpara, Baliput and Binkei.

However, during the survey and awareness campaign we didn't get that appreciating response from the fishermen folks and adults. This was because they consider both gharial and mugger living in the gorge area as a competitor to them and they believe that, their population in the river may deprived them of their livelihood which is dependent on fishing. Moreover,

the authority forces them to depend on sustenance fishing and they are also worried about legal action from the Forest Dept. for fishing within the sanctuary.

## 6. HISTORY OF CONSERVATION BASED ON PUBLISHED LITERATURE

**6.0** *Gavialis gangeticus* is listed as endangered and the present status is EN C2a, E. The species once inhabited in Bangladesh, Nepal, Pakistan, Burma, and India is now in grave danger and has already been extinct from few countries. The species is listed as endangered by Groombridge, 1982, 94, IUCN, conservation monitoring centre (86, 88, 90).

1. Bangaladesh- close to extirpated.
2. Bhutan- Possibly extirpated
3. Nepal: Ganga river, close to extirpated
4. Pakistan: The Indus river and close to extirpated
5. Myanmar: Small population exists in Irrawady and Kaladan.
6. India: Ganga, Chambal,Mahanadi

**6.1** The native range of gharials extended throughout the Gangetic plain, on the west upto the Indus River in Pakistan, in the north and north-east upto Nepal and Bhutan, in the east to Myanmar and in the south upto Orissa in India (Neill 1971). Gharial was abundant in all the large river systems of the Indian sub-continent and was commonly found in the river systems of Indus, The Bramhaputra, Ganges, Mahanadi etc. Until the early 1960s, Gharials were found in all the major river systems of Nepal, including the Mahakali, Karnali, Babai, and Rapti rivers in western Nepal, the Kali Gandaki and

Narayani rivers in central Nepal and the Koshi river in eastern Nepal. By the late 1970s, there had been a drastic depletion in their abundance and distribution. In fact, the wild gharial had become extinct in the Mahakali and Rapti rivers in western Nepal and Koshi river in eastern Nepal.

Approximately, 55 wild and about 50 released gharials were existing in Nepal in 1997 whereas there were about 58 wild and 70 released ones released in 1993. The largest single population of wild gharials, consisting of 36 adult was found in the Narayani and Kali rivers. A mere two wild gharials were observed from Rapti (west) river in western Nepal. Similarly, among the released gharials, 21 were recorded from Narayani and 4 from the Koshi River. The estimate of gharial population in the wild was 53, 60, 57, 56, and 51was found out from the surveys done in 1980, 1983, 1984, 1986, and 1987 respectively, in the Narayani and Kali rivers (Maskey, 1989). A survey carried out by Cadi, et.al., in 2001 encountered around 50 individuals in solitary or in small groups revealing a poor health of the wild population in the wild in Nepal.

The species is virtually extinct in Pakistan. Only one has so far been sighted in the Sind region of Pakistan. The government of Pakistan is interested in implementing a restocking program similar to the ones in Nepal and India and is currently planning a restocking effort with assistance from Indian institutions.

Although the gharial is considered to be extinct in Myanmar, small populations may still exist in the Irrawaddy and Kaladan river systems in

Myanmar. The Norgay crocodile breeding center of Bhutan was established sometime in 1970s with seven gharials. The center at present has four gharials, among which three are female and one is male. The gharials are also heading towards extinction in Bangladesh, with only two pairs believed to have survived in the wild now.

**6.2** The gharial, the only crocodilian species which exhibit sexual dimorphism, is the most critically threatened. However, unlike other seven most endangered crocodilians of the world, gharial conservation programs are in place over much of its range. The species was literally brought back from the brink of extinction by restocking programs initiated in India (1975) and in Nepal (1978). Gharial eggs were collected from wild nests for captive raising and releasing them back into the main rivers of India and Nepal. In Nepal, gharials are restricted to remnant populations in the Karnali, Babai and Narayani rivers (all the tributaries of the Ganges). Despite the captive breeding programs which has released more than 500 juveniles gharials since 1978 in different rivers , the present population is expected to stand at about 50 (Cadi. et.al., 2001). In India, over 4000 juveniles have been released through these programs at 12 sites mainly in Ganges drainage (Chambal, Ramganga, Girwa and Sarada) and Mahanadi river. By 1994, wild population in India was estimated at around 1500 of which about 1000 are found in Chambal river alone (Rao and Singh, 1994).

**6.3** Captive breeding facilities were also developed for all the three species of Indian crocodilians at Nandankanan Zoological Park. Out of these, gharial

was most endangered with only three river systems holding them in the wild, forcing the scientists to focus more serious attention to this species than the other two. Realising the grave situation the gharial conservation program was started during the same time extending the conservational activities to other states like; Madhya Pradesh, Rajasthan, Uttar Pradesh and neighboring country like Nepal.

Conservation measures have started in Indian states of Madhya Pradesh, Uttar Pradesh and Rajasthan, besides the neighboring country Nepal in the different rivers like Ganga, Chambal, Kali, Sindh, Parvati, Ken, Son, Girwa, Mahakali, Karnali, Babai, Rapti, Kali Gandaki, Narayani and Koshi. All these rivers are a part of Ganga river system. There are 10 sanctuaries (Protected Areas) in both the countries, where legal protection is provided to the species. Collection of eggs, hatchling and release was done at different times through FAO / UNDP project starting from 1975. Besides Orissa, captive breeding was taken up in Jaipur Zoo in Rajasthan and rearing was also done in Kota, in the same State. There is also a research center in Kukrail in Uttar Pradesh, which has done excellent work in hatching, rearing and release. In Orissa very few data are available on the crocodiles prior to 70's in general and gharial in particular. Prior to the start of the crocodile project at Tikarpara, no concrete data or evidences were recorded on the gharials. Different district gazetteers of Puri, Dhenkanal, Sambalpur, Boudh, Cuttack were referred. However, prior to 1907's only little thantia and fish eating gharials were reported in large rivers of Mahanadi, Brahmani while

large size crocodiles were frequently reported in the rivers near Cuttack (Senapati and Tripathy, 1972). Omalley (1932) cited that, in Sambalpur the crocodile and gharials were not common while Senapati and Mahanti (1971) cited that crocodiles and alligators are common in Hirakud lake. Perhaps gharial was mistakenly called as alligator. Omalley (1932) on the other hand recorded killing of 178 persons excluding domestic animals by the snub nosed or man eating crocodiles (estuarine crocodile) in between 1926 to 1930. However, they have reported the abundance of long sized crocodiles, gharials, and alligators before the year 1933 in the tidal river and creeks of the various rivers of Orissa. Similarly, Behuria (1996) cited the increase in number of crocodiles and alligators, turtles, terrapins, in the large rivulets, nallahas, and creeks of major river system.

On the otherhand, in river Devi, a branch of Mahanadi, gharial and muggers are commonly observed (Senapati and Kuanr, 1977). Another citation made by Pattnaik who for the last time reported the killing of gharial by Zaminder ( Chieftain) brother from Brahmani river and made an extravagant display of his kill as a trophy by taking it all around villages.

Gharial once inhabited all the major river systems of Orissa, namely, the Mahanadi, Brahmani and Baitarani besides some tributaries of Godavari system. Occurrence of the gharial *(Gavialis gangeticus*) in the Mahanadi river was often thought to be an exception. However, by 1975, only Mahanadi was left with some adults and juveniles of gharials. It should be kept in mind that

apart from gangetic river system, the gharial holds its best chance of survival in the Mahanadi river in Orissa.

Realising that, the gharial Research and Conservation Unit (GRACU) at Tikarpada, first of its kind, was established to augment the conservation measures. At one time there was only 5 gharials left in the Mahanadi, 2 males and 3 females and 3 sub adults were in Nadankanan (FAO, 1974) along with four juveniles during the start of the project (Mishra et al. 1996).


**Map of the designated Tikarpada sanctuary**


**Gharial Research and Conservation Unit at Tikarpada**

Since then, 700 numbers of gharials have been released in Satkosia Gorge sanctuary in the river Mahanadi in between Boudh and Katarang (Mishra et al. 1996, Kar et al. 1998) including 381 from captive rearing from Nadankanan which virtually brought back the animal from the verge of extinction by 1981. The increase sightings of this species spoke the success story of the crocodile conservation project. Subsequent, natural breeding at some of the restocked locations were also observed. But astonishingly, the population of gharial came to a dwindling number since then. This is evident from their rare sighting and no nesting in the sanctuary area. During Dec,

1987 to Jan, 1988 assessment, only 25 gharials were reported in the total length of the river from Hirakud reservoir to tidal limit (Mishra et al., 1996).

## 7. MAJOR CONTRAINTS

1. The duration of the investigation is too short.
2. Manpower was inadequate.
3. Little involvement and support from local fishing communities in the gorge area.
4. Connectivity to certain remote areas is very poor especially during rainy season.
5. Fisherman folks are very reluctant to give any information irrespective of the species.
6. Canals and creeks are present in large number particularly in the deltaic region.
6. Limited resources and infrastructure to carry out night survey.

## 8. CONCLUSIONS

The present investigation was conducted to know the status of gharial in the Mahanadi river system for a period of more than one year involving two winter survey in the biennium 2005-06. During the study, approx. 40-45 numbers of full grown muggers with 6-7 nesting sites and hundreds of mugger hatchlings were recorded in between Binkei to Barmul. On the contrary, only one pair of full grown gharial was sighted in the sand banks near Binkei. The water depth around the Binkei varied from 4 to 6 mts. Water was clear and in flowing condition. pH of water was slightly alkaline i.e. 7. 4.

The male and the female were approximately 4 mts and 3.5mts long respectively. The couple was constantly reported in that area for 3-4 days and was seen to share the same sandy beach and they were also observed to move together from one beach to another.

In the year 2006 winter survey, the male was reported near the same area as that of previous year while the female was found to be moving slightly upward in the upstream direction near Tiradaghata.

Due to pollution caused by picnic party and noise especially during the winter season in and around the Tikarpara research station, gharials were never observed in this area. However, the male was reported occasionally.

The extensive sand banks, suitable nesting sites, rocky banks, with abundant fish, the area in between Majhipara to Binkei is most suitable for the gharials as evident from the two consecutive winter survey.

Finally, the decline of fish catch over the years, objectionable fishing methodologies, active trade business, increased populations of the better adapted muggers and routine natural calamities like heavy floods are the limiting factors for the survival of gharials in the Mahanadi river system.

**9. SUGGESTIVE MEASURES AND RECOMENDATIONS:**

**a)** Since there is every possibility of the couple mating as both are mature; constant monitoring of the couple, their path of movement, breeding, nesting and other behaviors as well as activities is necessary in order to protect the couple and their progeny.

**b)** There is an urgent need to promote pisciculture and freshwater prawn culture especially among the unemployed youths, since fisheries is the only source of income for a large section of people in the near by villages.

**c)** Indiscriminate fishing, uncontrolled collection of fish seed, siltation of river banks, objectionable fishing methodologies like secret blasting, poisoning and pollution need to be kept under control in order to increase the gharial population.

**d)** The fishing activity is intense in the entire Mahanadi river system and the fishing activity should be stopped or minimized at least 10km on either side of the Satkosia gorge wildlife sanctuary.

**e)** The fishing methodology is often objectionable. Constant vigil in the form of surprise visit to the fishermen villages should be carried out by state forest as well as fisheries department so as to keep a check on their unscrupulous acts and thereby reduce any adverse impact on gharials.

**f)** In order to achieve strong level of acceptance of the conservation efforts, local people especially youth have to be involved in the mission by providing them some alternate way of income generation in the form of eco-development. This can't be possible without the help of concerned Govt. agencies so as to improve the livelihood of the villagers in these areas. During since during the course of our

investigation we found both livelihood and conservation are interrelated with each other.

**g)** High level of human activities should be minimized on either side of river bank, which has increased immensely due to their daily domestic activities, boats plying for fishing, excessive noise made by loud speaker of picnic groups and dumping garbage in the water in the sanctuary, etc.

**h)** Fishermen should be encouraged and educated not to catch/kill the gravid female fishes. Other fauna like turtles, etc, should also be taken care of by the fishermen and make them understand that, every animals are equally necessary for a healthy ecosystem. Some short of fishing ban may be implemented during the breeding season with close cooperation of the people.

**i)** Govt. agency along with other NGO's, researchers, scientists, wildlife experts should jointly work to save the animal from extinction.

**j)** The Gharial Research Project is urgently needed to restart before all the gharials get extinct from the wild. However, before release of any juvenile gharials into the water, proper pre-release acclimatization process should be carried out in an enclosed space, for preparing them to better adapt to wild conditions.

**k)** Despite of several limiting factors, upstream of the gorge area especially i.e., Majhipara, Binkei and more upper stream spots like Tiradaghat is better suited for these docile animals. Care should be taken not to

disturb this stretch of river bank and sand bars where these animal frequent to bask. Special attention is required to maintain and protect the forests, flora, fauna, sand banks etc in these areas.

**l)** The platform made for landing and boarding of the people near Binkei bank and the route of navigation should be changed since both the gharials are very often sighted there.

**m)** Communications through land routes has to be developed in order to minimize the transportation through the water routes, since during the festivals lakhs of people from nearby villages flock to Binkei and Kankei to visit temples through the water way.

**n)** Extensive sandbanks suitable for basking and nesting are available outside gorge area both in upstream as well as in downstream but water depth, increase of human activities, declining of fish density, disturbances from plying of boats both for fishing and for transportation, pollution, destruction of sand banks due to human activities are the major hindrances for a better nesting ground. Less disturbed areas can be chosen for the development of the basking banks for gharials. Hirakud reservoir is a more conducive place for the crocodiles but the major drawback it suffers is due to lack of sufficient suitable nesting sites and sandbanks for basking.

**o)** Considerable attention is needed to develop and preserve the serenity and biodiversity of the wildlife resources of Satkosia gorge and urge the

Govt. to pay as much importance as been given to Bhitarakanika, Similipal, Gahirmatha and Chilika.

**p)** In order to achieve a healthy gharial population in the Mahanadi there is an urgent need to readdress the fishing activities in the river. There should be regulation on indiscriminate catch, seed collection, fishing in monsoon season as well as fishing methodology.

**q)** Facilities are needed to carry out night survey since the existing methodologies are not adequate to trace the crocodiles since juveniles possibly can be traced during a night census.

**r)** The awareness programs in these areas need to be intensified since the fisherman, adult and youth showed a lukewarm response. Fishermen are very threatened with the increasing number of muggers as well as scared about the govt. control and regulation.

**s)** There is an urgent need to control and stabilize the muggers in the river in order to provide suitable habitat for gharials without being overwhelmed by the competition from mugger crocodiles, which are much more aggressive in nature. A mugger management group to maintain the number of muggers in the river is needed. The increasing hatchlings can be suitably transferred to other suitable mugger habitats so that a optimum number can be maintained there for facilitating the gharial population to multiply in the river.

**t)** Finally, the Satkosia gorge should be under one administrative control for better implementation of objectives.

## 8. FINANCIAL INFORMATION

Remittance amount (INR) - Rs. 374645.04

Bank processing fees - Rs.575.00

**Total amount deposited in my account** - **Rs.374070.04**

A. Recurring expenses

Compensation for:-

1. Self- ( Rs.10,000 x12) -Rs. 1,20,000
2. Research Assistant- ( Rs. 6000x12) -Rs. 72,000
3. Labour -Rs. 8,800
4. Expenses for sustenance or consumable -Rs. 13,800
5. Logistic expenses (traveling, boat, boarding, lodging) -Rs. 25,750
6. Secretarial expenses- ( computer works, xerox, printing, CDs, cassettes, photo films, development) - -Rs. 17,300
7. Awareness programmes expenses (Hoardings, banners, gifts, chocolates) -Rs. 6,600
8. Cost of final Report -Rs. 7,600

B. Nonrecurring expenses

1. Institutional fees to WWF-India, state office -Rs. 30,000
2. Equipments:

| | | |
|---|---|---|
| GPS: | | -Rs.15, 000 |
| Binocular (Nikon action series) | x 1 | -Rs. 6,400 |
| Camping kit (tents, sleeping bags, mats) | x 2 | -Rs. 16,000 |
| Camera (Kodak digital + memory card+ extra battery) | | -Rs. 31,000 |
| Torches (4-celled) | x 2 | -Rs. 600 |
| Maps (different topos) | | -Rs. 600 |
| Lantern | | -Rs. 1,200 |

## 9. ACKNOWLEDGEMENT

The team is highly indebted to Mr. S. K. Pattnaik, Chairman of WWF-India, Orissa State office, for his tireless efforts, patient and constant guidance in carrying out the project successfully. He had always been a guiding force, teaching us through fruitful discussion and knowledge dissemination, which gave us the opportunities of learning a lot from him. We are also grateful to Dr. L. N. Acharjyo for his valuable advice, guidance and involvement during the investigation. The research team is also thankful to Mr. Michael Peters for his help, co-operation and timely help in the entire course of investigation which enabled us for the smooth execution of the project.

The research team is also thankful to the P.C.C.F and Chief Wildlife Warden Mr. S. C. Mohanty (I.F.S) for giving us permission to carry out the investigation. We are also thankful to Dr. LAK Singh, Dr. S. K. Kar and Dr. C.S. Kar, Senior Research officer for their valuable suggestions and help.

We acknowledge our sincere gratitude to the D.F.O, Satakosia Wildlife Division, Mr. A. Mishra (A.C.F), Angul, Mr. Sahu, Range officer, Tikarapara, Mr. Sahu, Forester Tikarapara, Mr. D. Mohapatra, JFO, Sambalpur, for their help and co-operation. We also express our gratitude to Mrs. Meeta Biswal, (D.F.O) Hirakud Division, for her kind assistance and support during our survey in Hirakud.

The research team is also thankful to Mr. Sovan Sahu, Mrs and Mr. Rajendra. N.Sahu and Mr. Amar Bikram Nayak for their kind help.

Last but not the least the research team is highly indebted and thankful to the Rufford foundation for funding the project.

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## 11. ANNEXURE

| Sl.no | Local name | Scientific name |
|---|---|---|
| **1**. | Rohu | *Labeo rohita* |
| **2**. | Mrigal | *Cirrihnus mrigala* |
| **3**. | Catla | *Catla catla* |
| **4**. | Calbasu | *Labeo calbasu* |
| **5**. | Mystus | *Mystus singhala* |
| **6**. | Chitala | *Chitla chitla* |
| **7**. | Bata | *Labeo bata* |
| **8**. | Puntius | *Puntius ticto* |
| **9**. | Pangassius | *Pangassius pangassius* |
| **10**. | Grass carp | *Ctenopharyngodon idella* |
| **11**. | Singhi | *Heteropneustes fossilis* |
| **12**. | Magur | *Clarias batrachus* |
| **13**. | Ruddy Shellduck | *Aadorna ferruginea* |
| **14**. | River turns | *Sterna aurantia* |
| **15**. | Plover | *Pluvialis squatarola* |
| **16**. | River lapwing | *Vanellus duvaucelli* |
| **17**. | Stilt | *Himantopus himantopus* |
| **18**. | Kingfisher | *Alcedo atthis* |
| **19**. | Dove | *Streptopelia chinensis* |
| **20**. | Egret | *Bubulcus ibis* |
| **21.** | Roofed turtle | *Kachuga sp.* |
| **22**. | Narrow head softshell turtle | *Chitra indica* |