CSG SRAS Report

Status, Distribution and Conservation Threats of *Gavialis gangeticus* in the Narayani River of Chitwan National Park

Basu Dev Joshi[1], Siddhartha Regmi[2], Animesh Paudel[3],

[1]Tribhuvan University, Institute of Forestry, Hetauda, Province 3, 44100, Nepal

Introduction

Gharial is the longest living of all living crocodilians is a fresh water species of the family Gavialidae (Thapaliya et al., 1970). The shape of skull and dentition is varies from other crocodile which are highly specialized for capturing the fish (Fleming et al., 2015). The pisivorous Gharial possess sexual dimorphism that the male and female can be categorized by ghara and their size. The male attained maximum size then female. Female Gharial attain sexual maturity at the age of 10 having size of 3 m and male at the age of 13 having 3.5 m and more (Rajbhandari & Acharya, 2015). Courting, mating and nesting occur generally in dry season. Mating usually occur at December-January and followed by nesting during March and May (Whitaker & members of the GMTF, 2007).

Historically, Gharial were found in the river system of India, Pakistan, Bangladesh and southern part of Bhutan and Nepal. Now, the species is confined to north India and lowland Nepal (Lang, 2019). The population of Gharial during 1950s was 5000-10,000 (Saikia, 2013). According to Maskey (1997), due to anthropogenic and natural causes the population from 1940s decline to 96% and the remaining fragmented population are also verge of extinction (Poudyal, 2018). Being the reason of rapid declination form the different geographical region, the Gharial is listed by IUCN as 'Critically Endangered. Habitat loss is the main reason for decline of Gharial in Nepal (Saikia, 2013). According to Sharma & Basu (2004), small-sized Gharial are susceptible to drowning in fishing nets (Singh & Rao, 2017) - the reason that Gharial didn't maintain its population. According to DNPWC in 2008 only 81 Gharial are survived in Nepal and 120 individual in India (Thapaliya et al., 1970).

The keystone species Gharial is important for the biodiversity conservation (Thapaliya et al., 1970). The existing knowledge about the population status, distribution and threat is applicable to many discipline to improve the conservation measure of species (Thapaliya et al., 1970). The key predator species Gharial helps in maintaining the health and biotic integrity of Narayani River. According to (DNPWC 2011) the population of Gharial in Narayani is 44. This remnant population is under continuous pressure from different human activities (Rajbhandari & Acharya, 2015). Different conservation strategies were adopted for the conservation of Gharial with the aid of Frankfurt Zoological Society in 1978, Nepal started captive breeding which helps in rehabilitating the wild population of Gharial by egg collection, captive rearing and release in the wild (Thapaliya et al., 1970). When the Gharial attained the length of 1.5 m at the age of 4-7 years they are released to the wild from the captive breeding in Nepal (Acharya et al., 2017). The population was 101 (31 adults, 54 sub-adults, 13 juveniles and 3 yearlings) in the Narayani River (Poudyal, 2018). The population increases to117 (56 adult females, 19 sub-adults, 32 immature and 9 were unidentified) (Sah et al., 2020). To understand the survival of the wild Gharial along with the release of Gharial from the captive breeding in the wild it is very necessary to conduct the periodic monitoring of Gharial about the status and distribution and conservation threat. The timely study helps to overcome the problems of Extinction of Critically Endangered Gharial by identifying the conservation threats with solutions.

Objectives

The general objective of the study is to update the existing information on Gharial in Narayani River and its tributaries in Chitwan National Park (CNP) and assess the threats in Gharial conservation. The specific objectives of the study are as follows:

1. To update the population status of Gharials in Narayani River of CNP.
2. To prepare a GIS map of distribution and habitat of Gharial.
3. To assess the threats of Gharial conservation at the local and wider context.
4. To raise the level of awareness on Gharial conservation among the local communities.

Methodology

Study Area

For this study, all potential locations in and around the Narayani River system in CNP that once had Gharial were taken into consideration. The Narayani and Rapti River system's alluvial flood plain is a part of the park. Since the river eventually passes through the CNP, the success of the overall conservation efforts in each PA will determine how well the river's wetland biodiversity is preserved. In addition to this, it also depends on the locals who live close to the Park. Consequently, the physiographic features of the site, the state of the parameters, and the mindset of the locals toward its conservation are all closely tied to the survival of Gharial in this river system. The Narayani River runs through CNP for 58 km.

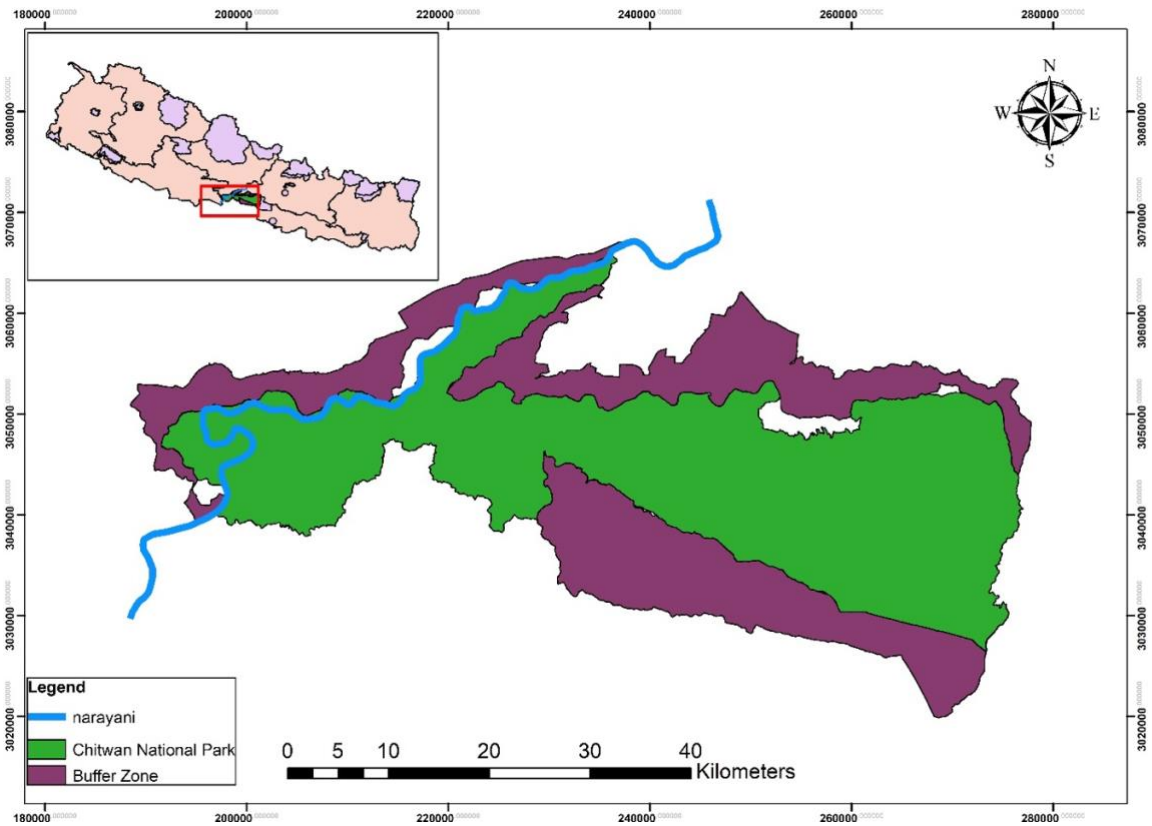


Figure 1: Study area.

Data Collection

Firstly, reconnaissance survey was carried out to understand the field more critically. It includes questionnaire survey, semi structured interview with key informant, local leader and local people.

And purposive sampling was carried out to understand the people perception and attributes about the Gharial. The population survey was carried out by dividing the Narayani River into three different segments. The river divided on the basis of accessible services such as boat, people and vehicles. The survey carried out with the dugout canoes with a team consisting of two observer (research assistant) and four boatmen, who were familiar with the habit and natural history of Gharial. Direct and indirect survey methods were used to access the Gharial status in Narayani River. Both the methods were repeated three times. Each survey takes 7 days. In direct method the basking and swimming gharial were counted. The active opportunistic method suggested by Maskey (1997) was adopted during the direct survey. Binocular (vortex optics 8*42 and Olympus 10*50) were used for the determination of gharial. The survey was carried out between 10 am and 3 pm. In the indirect method the presence or absence of Gharial is checked by 'U' shaped marked and discussion with crew on boat who were familiar with the site and species.

Age distinction and sex determination were performed according to standard procedures (Khadka, 2010)**:**

- <90 cm TL – yearling
- 90<180 cm TL – juvenile
- 180<300 cm TL - sub-adult
- TL>300 cm without ghara - mostly adult female or possibly sub-adult male
- TL>300 cm with ghara - adult male

The river's hydrological features were accessed such as sedimentation, aquatic flora and fauna, water quality, pollution, anthropogenic disturbance in the area with discussion with the residential people. The width and depth of the water are accessed by ocular method. Secondary information was collected from literature review, Crocodile Specialist Group's newsletters, other publications, personal communication with park staffs and wardens, etc.



Figure 2: Questionnaire survey.

Data Analysis

Software like Microsoft Excel, SPSS, etc., programs \were used for data analysis. Qualitative and quantitative information give total numbers; mean values, percentages and statistical information about Gharial in Narayani River of CNP which is very helpful in making conservation related decisions of Gharial.

Results and Discussion

Status

The study was conducted from the Golghat to Triveni of the Narayani River. We observed total 72 Gharial across the different section of the river. Among them 11 Gharial (2 yearling, 3 juvenile, 5 sub-adult, 1 adult) were observed in near the grass bank. 17 Gharial (4 yearling, 1 juvenile, 8 sub-adult, 4 adult) were observed in the river channel. 44 Gharial (14 yearling, 12 juvenile, 11 sub-adult, 7 adult) were observed in the sand bank. 4 Gharial are recorded by the dry marks left on the ground with discussion with the crew members of canons. The Gharial in the Narayani River are summarized in Tables 1 and 2.

River	Segment Name	Replicate 1	Replicate 2	Replicate 3
Narayani River	Golghat to Amaltari	25	26	19
	Amaltari to Arunkhola	36	22	29
	Arunkhoka to Trivrni	19	21	24
Total				

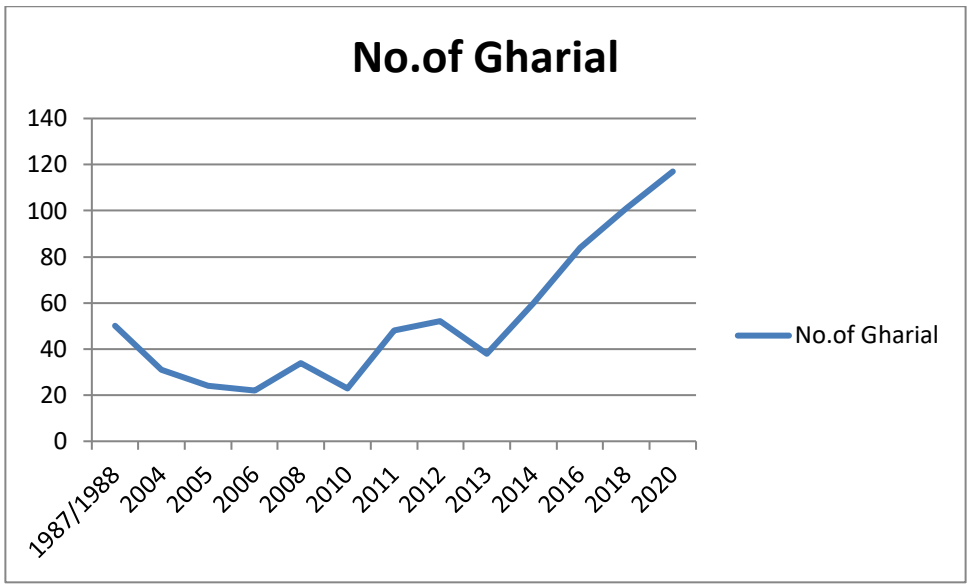
Table 1: Replication of Gharial at three different times in each segment.

S.N	Study Area	Yearling	Juvenile	Sub Adult	Adult	Total	Position	Depth(m)	Habitat	Marks	Remark
1	Golghat to Amaltari	2	4	10	3	19	2Running, 14 Basking, and 3 Gaping	20-Jan	4 in River Channel ,5 in Grass Bank and 10 were in Sand Bank	19 Fresh	1 Male
2	Amaltari to arunkhola	5	9	13	4	29	3 Running, 18Basking, and 8 Gaping	20-Jan	7 in River Channel ,3 in Grass Bank and 19 were in Sand Ban	3 Dry,26 Fresh	2 Male
3	Arunkhoka to trivrni	7	8	6	3	24	3 Running, 16Basking, and 5Gaping	20-Jan	6 in River Channel, 3 in Grass Bank and 15 were in Sand Ban	1Dry,23 fresh	1

Table 2: Status of gharial in different segment of the river.

Distribution

The Gharial were not regularly found across the Narayani River. They were found at distance. Gharial were absent near the area of human settlement. They were found nearly 2 km away from human settlement. Gharial were absent at the after death human ritual ceremony, bridge and other infrastructure, etc. More Gharials were observed at the fast-flowing river having the depth of more than 5 m having the sand bank and rock on it. The progressive increasing of Gharial in the Narayani River over time is shown below (Sah et al., 2020).



Line graph 1: Gharial population over time.



Figure 3: Gharial sighting on the Narayani River.

Conservation Threat

The conservation threat analysis is done on the basis of four scale of classification Scope, severity Threat and urgency. These scales prioritize the 10 major existing issues in the study area. These 10

major threats are categorized from 1 to 10 where 1 implies for low and least effect and 10 implies for high and serious. To analysis these value they are again categorized under a 4-scale which are Very High (VH), High (H), Medium (M) and Low (L) (Cucu et al., 2013).

S.N	Issue	Scope	Severity	Urgency	Total	Threat Classification
1	Habitat alteration	9	9	9	27	VH
2	Human and Gharial conflict	2	3	2	7	L
3	Diseases and parasites	5	7	6	18	H
4	Flash flood	9	8	9	26	VH
5	Illegal poaching	2	4	3	9	M
6	Infrastructure development	5	6	5	16	H
7	Industrial pollution	7	9	8	24	VH
8	Traditional fishing	8	9	9	26	VH
9	Human interference	8	8	8	24	VH
10	Washing clothes	3	5	5	13	M

Table 3: Conservation threats for Gharial in the Narayani River.

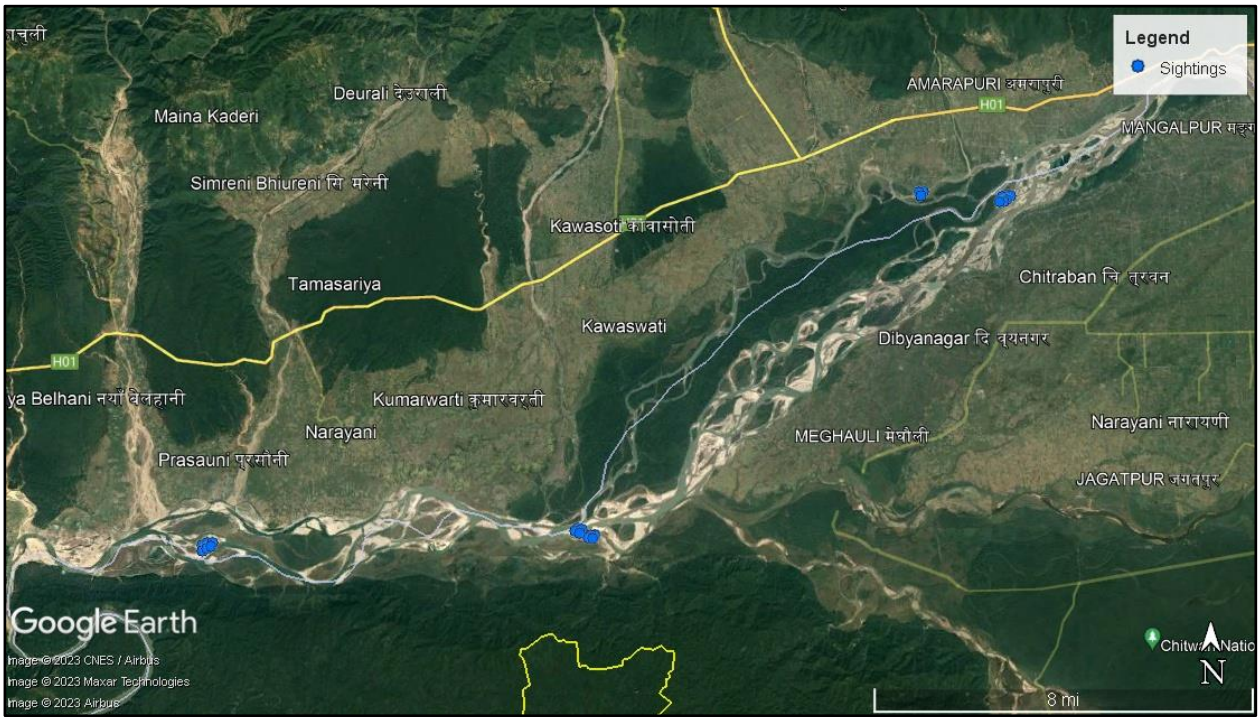


Figure 4: Map of Gharial sightings in the Narayani River.

The total of Gharials 72 were recorded in Narayani River of CNP. Out of which 14 were yearling, 21 were juvenile, 29 were sub-adult and 10 were adult. Gharial population is not constant along the river. They were less or absent in near the human habit. The different types of threat were identified for the Gharial. Habitat alteration, flash flood, industrial pollution, traditional fishing and human interference are the Very High Value Threat identified in the study area. Similarly, infrastructure development, diseases and parasite are identified as a High Threat. Washing clothes and illegal poaching are identified as the Medium threat whereas human and Gharial conflict is the least threat identified in the Narayani River. Due to the flash flood small Gharial were displace to new site where they incapable to exist in the area. Habitat alteration due to the anthropogenic effect and invasive species changes the behavior of survival of the species. The declination of ichthofauna and other water species due to the fishing activities have affected the Gharial feeding activities. Many of Gharial were

facing the problem of the fishing net that they were hooked in it. The industrial pollution, washing clothes, etc., effect in the quality of water in the river. Sand is very important for the gharial for basking and hatchling the egg. Therefore, sand mining near or far alongside the river should be stopped. They cannot migrate a long distance in search for living or food because of their modification of limbs. With the scarcity of food and anthropogenic disturbance they are dying and unable to maintain the viable population. Therefore, the conservation threats should be solved by adopting the periodic monitoring.

Conclusions

This research indicates that habitat loss, flash flood and industrial pollutions are the major threats to an established population of Gharials around Narayani River inside Chitwan National Park. The protected areas can be a good and secure site for Gharial conservation without human influence. Narayani River is one of the very important and suitable habitats for Gharials to flourish. Gharials reside far from human settlements and the availability of sand around water are making their habitat more suitable. Maintaining the Gharial population by managing habitats and other conservation efforts may not be enough unless it is supplemented with captive-reared animals. The regular updating of status of Gharial, distribution and conservation threat by adopting the same methodology helps to generate the important ideas for the conservation and increasing the number of Gharial in Narayani River of Chitwan National Park. Alternating ideas for the fishing community should be provided and anthropogenic effect on the river should be decreased that they are shy reptiles for basking and hatchling the egg. As Gharial is an endangered species in the whole world and its habitats are limited, its very important to safeguard their habitat to maintain a viable population.

Acknowledgements

I wish to express my thanks to the IUCN SSC Crocodile Specialist Group, which provided financial support for the study through its Student Research Assistance Scheme. Special thanks go to Santosh Bhattarai and Ragunath Lal Karna, Institute of Forestry Hetauda, whose guidance and constant support shaped the direction of this work. Additionally, I extend my gratitude to Bed Khadka for his motivational support and who significantly contributed to the data collection process. This project would not have been possible without the collective efforts and expertise of these individuals and organizations.

References

Acharya, K. P., Khadka, B. K., Jnawali, S. R., Malla, S., Bhattarai, S., Wikramanayake, E., & Köhl, M. (2017). Conservation and population recovery of Gharials (*Gavialis gangeticus*) in Nepal. *Herpetologica, 73*(2), 129-135. https://doi.org/10.1655/HERPETOLOGICA-D-16-00048.1

Cucu, L. A., Niculae, M.-I., & Pătroescu, M. (2013). Hierarchical analysis of the threats for Species of Community Interest in the Iron Gates Natural Park, Romania. *Forum Geografic, XII*(1), 52–58. https://doi.org/10.5775/fg.2067-4635.2013.047.i

Fleming, G. J., Fontenot, D. K., & Medicine, W. A. (2015). *Gharial Crocodilians (Crocodiles , Alligators , Caiman , Gharial) Reptiles 3*. *8*.

Lang, A. (2019). *Gavialis gangeticus*, (Vol. 8235).

Poudyal, L. P. (2018). Population Status and Distribution of Gharial in Rivers of Chitwan National Park. *Technical Report, September*.

Rajbhandari, S. L., & Acharya, P. M. (2015). Population, basking and hatching success of *Gavialis gangeticus* in Narayani River, Chitwan National Park, Nepal. *Journal of Natural History Museum*, *27*(Smith 1931), 1–11. https://doi.org/10.3126/jnhm.v27i0.14148

Sah, A. K., Gautam, B., & Bhattarai, S. (2020). *Journal of Animal Diversity*. *2*(July), 1–17. https://doi.org/10.29252/JAD.2020.2.2.2

Saikia, P. K. (2013). Indian Gharial (*Gavialis gangeticus*): Status, ecology and conservation. *Rare Animals of India, January 2013*, 76–100. https://doi.org/10.2174/978160805485511301000 7

Singh, H., & Rao, R. J. (2017). Status, threats and conservation challenges to key aquatic fauna (Crocodile and Dolphin) in National Chambal Sanctuary, India. *Aquatic Ecosystem Health and Management*, *20*(1–2), 59–70. https://doi.org/10.1080/14634988.2017.1298964

Thapaliya, B. P., Khadka, M., & Kafley, H. (1970). Population status and distribution of Gharial (*Gavialis gangeticus*) in Nepal. *The Initiation*, *3*, 1–11. https://doi.org/10.3126/init.v3i0.2422

Whitaker, R. & members of the GMTF. (2007). The Gharial: Going Extinct Again. *Iguana*, *14*(1), 24-33.