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Population Status and Distribution of Gharial in Rapti River of Chitwan National Park, Nepal

Shyam Kumar Pun[1*], Jagar Nath Adhikari[2], Pabina Neupane[1], Smriti Pariyar[1] and Pawan Paudel[3]
[1]Humanitarian and Biodiversity Conservation Society, Bharatpur 10, Chitwan, Nepal
[2]Birendra Multiple Campus, Tribhuvan University, Bharatpur, Chitwan, Nepal
[3]Balkumari College, Tribhuvan University, Bharatpur, Chitwan, Nepal
rauyan.pun2@gmail.com

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Abstract

The critically endangered Gharial (Gavialis gangeticus) facing rapid decline. This study suryed the population status and distribution of the species along a 68 km stretch of the Rapti River in Chitwan National Park, Nepal. Surveys were conducted between September 2024 and April 2025 in two rounds across three river segments: Lothar - Sauraha, Sauraha - Kasara and Kasara - Golaghat by direct visual observation through boat. A total of 161 individuals were recorded with the highest number (77) in the upstream section followed by 54 in the midstream and only 30 in the downstream section. Gharial density was also highest upstream (2.71 individuals/km) indicating better habitat conditions such as deeper pools, sandbanks and lower human disturbance. In contrast, the downstream section exhibited reduced density (1.52 individuals / km) likely due to increased fishing, sand mining, and habitat degradation.

Keywords: Chitwan National Park, Distribution, Gharial, Population, Rapti River. GLS: Gharial Lothar-Sauraha, GSK: Gharial Sauraha- Kasara, GKM: Gharial Kasara- Golaghat

Introduction

Nepal's freshwater biodiversity has suffered greatly over the past five decades with aquatic species declining at nearly twice the rate of terrestrial ones[1]. Among the most at-risk species is the Gharial (*Gavialis gangeticus*), a fish-eating reptile that plays a crucial role as both a flagship and keystone species in maintaining healthy river ecosystems[2]. As the sole surviving member of the Gavialidae family, the Gharial is considered one of the most evolutionarily unique and globally endangered reptiles[3] and it is classified as Critically Endangered by the IUCN, listed in Appendix I of CITES[4] and protected under Schedule I of Nepal's National Parks and Wildlife Conservation Act[5]. This species is easily recognized by its long, narrow snout and distinctive sexual dimorphism, with mature males developing a hollow snout projection called a "ghara." Gharials prefer calm, deep, fast-flowing rivers with sandy banks for basking and nesting and rely heavily on abundant fish populations[2,6].

Once widespread across Nepal's major rivers, current populations are now largely restricted to the Rapti and Narayani Rivers in Chitwan National Park and the Babai and Karnali Rivers in Bardia National Park[7] having suffered steep declines due to habitat destruction, human disturbances, fishing net entanglement, dam construction and climate-driven impacts on freshwater habitats[8,9]. To address these declines, the Government of Nepal, alongside the Frankfurt Zoological Society has implemented breeding and conservation programs in Chitwan and Bardia, releasing over 661 individuals to bolster wild populations[10]. Despite these efforts, ongoing threats including pollution, overfishing, changes in river morphology and loss of nesting sites continue to challenge population recovery[7] underscoring the importance of understanding Gharial distribution, abundance, and habitat preferences to guide effective conservation strategies, particularly in rivers such as the Rapti that support key populations of this critically endangered species.

Materials and Methods

Study Area: Chitwan National Park (CNP, Figure-1) covers 952.63 km², lying between 27°34′N to 27°68′N latitude and 83°87′E to 84°74′E longitude. Surrounding the park is a legally designated Buffer Zone of 729.37 km² (Figure-1), which extends approximately between 27°21′N to 27°41′N latitude and 83°78′E to 84°77′E longitude. The central GPS coordinate of CNP is about 27.53°N to 84.33°E. CNP encompasses diverse habitats including tropical Sal (*Shorea robusta*) forests, riverine woodlands, floodplain grasslands and the Churia hills[11]. The Rapti River, one of the park's major freshwater systems along with the Narayani and Reu Rivers, plays a vital role in sustaining biodiversity[12]. For this study, a 68 km stretch of the Rapti River is divided into three sections Lothar-Sauraha, Sauraha-Kasara, and Kasara-Golaghat each differing in vegetation, land use and river morphology[12]. These habitats serve as ecological corridors that maintain connectivity and support endangered species such as the Gharial.

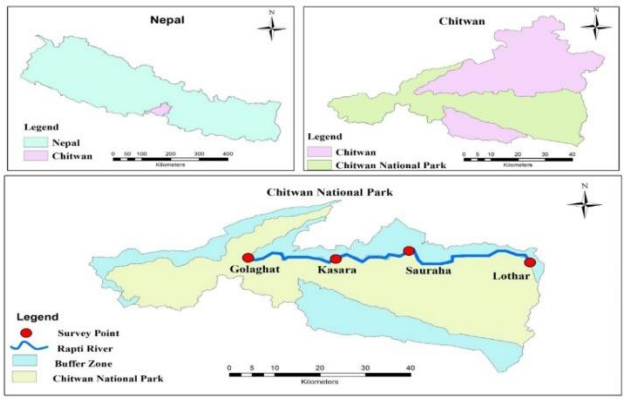


Figure- 1: Map of Study Area.

Methods: The survey period from September 2024 to April 2025. Gharial monitoring survey was conducted in 4 times (2 round x 2 times) carried out in Rapti River of Park in two Round in the whole research period. The work divided into three sections of Golaghat to Lothar (approx. 68 km) - First section: Golaghat-Kasara (19.68 km), Second section: Kasara-Sauraha (19.91km) and Third section: Sauraha-Lothar (28.41 km). The geographic location of site are Golaghat (27°33'47.58N 84°09'35.95E), Kasara (27°33'02.12N 84°19'32.60E), Sauraha (27°34'25.58N 84°29'36.51E) and Lothar (27°35'08.02N 84°43'56.12E). The survey were conducted in morning and day through wooden and rubber boat by direct visual observation with the team had spent 6-7 hours per day (between 08:00 am – 05:40 pm) and consisting of five observers and two boatmen or/and a guide who belonged to the local ethnic group. The use of point count sighting of 20 minutes in each spot within the three sections along the paths or rivers with line transect. Binoculars (Nikon Aculon A211 10 x 42, Bushnell coated optics 20 x50), Camera (Canon EOS 600D, Canon Power shot SX 540 HS, Sony α A6400), Lens Tamron HA022 150-600mm and GPS Etrex 10 were used to count, capture photographs and locate the gharial. The data were analyzed analytical tool. The map were produced using Arc GIS 10.8.

Results and Discussion

Results: Population: The distribution of Gharials along the Rapti River showed a clear upstream dominance with 77 individuals recorded in the upper segment i.e. Lothar - Sauraha, 54 in the middle segment i.e. Sauraha - Kasara and 30 in the downstream stretch i.e. Kasara - Golaghat. This trend likely reflects habitat suitability with the upper reaches offering deeper pools, sandbanks and lower human disturbance, all critical for basking and nesting. In contrast, the downstream segment appears impacted by habitat degradation, increased fishing and sand mining which may reduce its suitability for sustaining gharial populations. (Figure-2,3, Table-1).

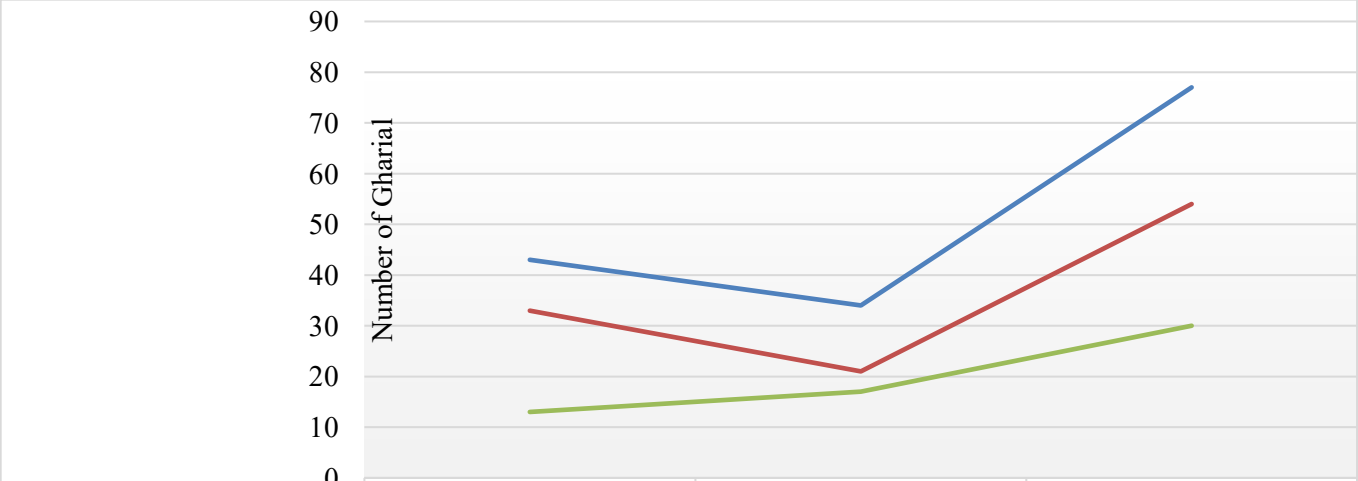
Distribution: Population distribution was determined using the this formula, D = n/A

Where, D- Density of Gharials (individuals per km river length), n- Total number of Gharial observed at each segment, A- Total area of each river segment in square/km.

Equal number of Gharial were found in the streamside of river i.e. Lothar – Sauraha and Sauraha – Kasara with a density of 2.71 individuals while the Kasara - Golaghat section had a lower density of 1.52 individuals / km. During the first survey round, gharial density was 1.2 individuals / km in the Lothar - Sauraha section and 1.05 individuals / km in the Sauraha - Kasara section. By the second survey round, the density increased slightly to 1.51 and 1.66 individuals / km, showing a modest increase in both areas. On the downstream side of river, i.e. Kasara - Golaghat section supported fewer gharials, with density of 0.86 individuals / km in the first round and 0.66 individuals/km in the second. Therefore, gharials are more concentrated in the upstream section of Lothar - Sauraha and Sauraha - Kasara, while their presence tapers off downstream toward Kasara - Golaghat. Figure-4, Figure-5, Table- 1.

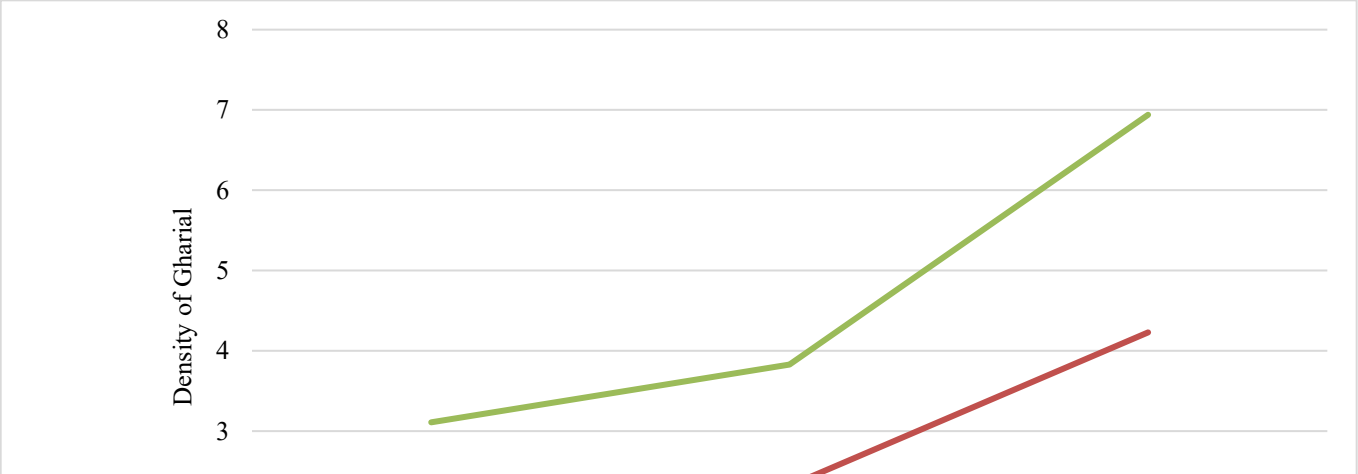


Figure- 2: Gharial: A-B. Adult, C. Sub-adult.



	Round 1	Round 2	Both round
Lothar to Sauraha	43	34	77
Sauraha to Kasara	33	21	54
Kasara to Golaghat	13	17	30

Figure- 3: Section wise comparison of Gharial Population.



	Round 1	Round 2	Both Round
Lothar - Sauraha	1.2	1.51	2.71
Sauraha - Kasara	1.05	1.66	2.71
Kasara - Golaghat	0.86	0.66	1.52

Figure-4: Section wise comparison of Gharial Distribution.

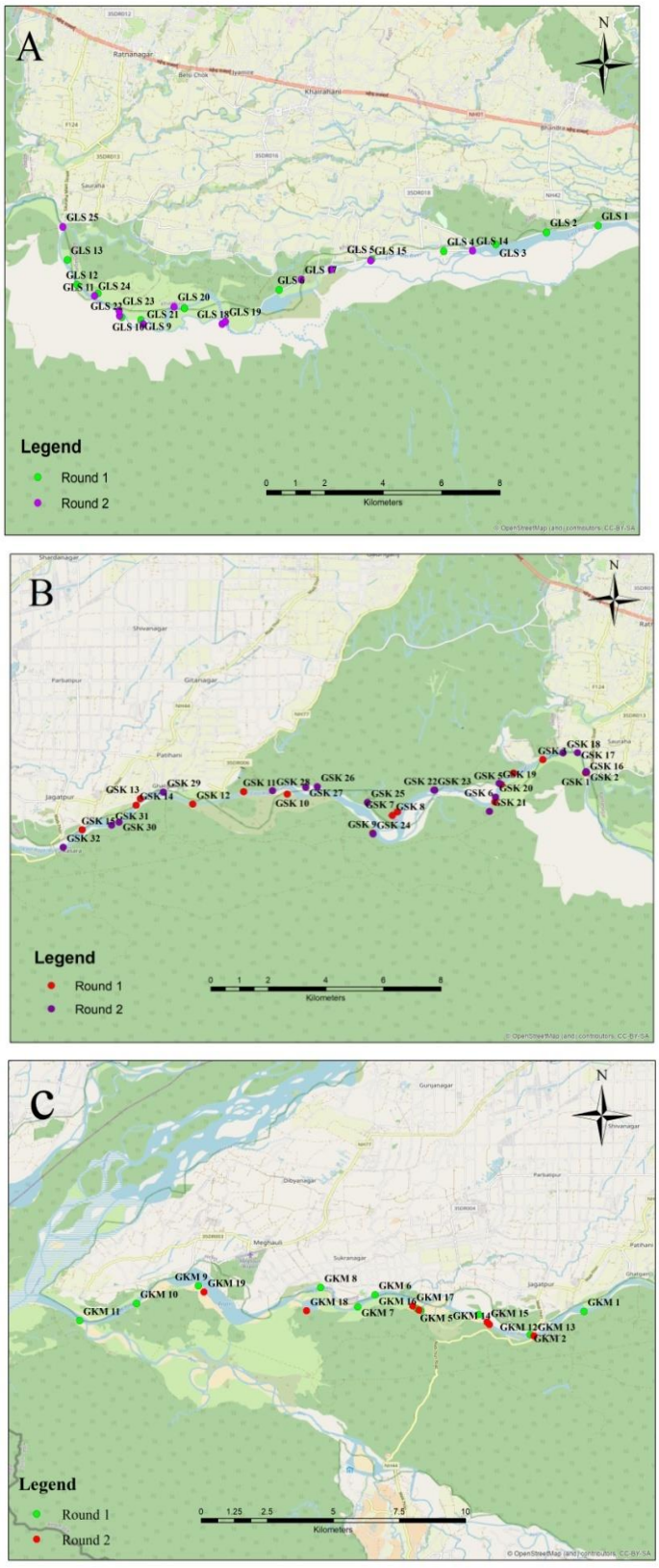


Figure- 5: Distribution Map of Gharial: A. Lothar- Sauraha (GLS), B. Sauraha-Kasara (GSK), C. Kasara-Golaghat (GKM).

Discussion: According to this study, 161 gharials were recorded along a 68 km river stretch of the Rapti River. The number increased from 72 in the first round to 89 in the second round due to seasonal changes or gharials moving between areas with the highest number observed in the upper segment i.e. Lothar-Sauraha, n = 77, followed by middle segment i.e. Sauraha - Kasara; n = 54 and the downstream segment i.e. Kasara - Golaghat, n= 30.

The spatial pattern reveals a strong upstream dominance, with equal densities in the upper and middle segments i.e. 2.71 individuals per km but a significantly lower density in the downstream stretch i.e.1.52 individuals per km.

This trend likely reflects habitat suitability with the upper reaches offering deeper pools, sandbanks, and lower human disturbance. In contrast, the downstream segment appears impacted by habitat degradation, increased fishing, and sand mining which may reduce its suitability for sustaining gharial populations. As compared to other studies, the total number of gharials observed in the survey (161) is higher than the 118 individuals reported[13,14] and along a similar 72 km stretch of the Rapti River.

The population increased from 64 in 2018 to 84 in 2022[15]. The reported 96 gharials[16] and estimated 118[13]. The recorded 53 gharials although their survey was limited to a 29 km section of the river[17].

The population distribution of gharial was density of 2.71 individuals / km in both Lothar - Sauraha and Sauraha – Kasara section, which were reported[13]. The core population of gharial is confined to the Rapti and Narayani Rivers in CNP and the Babai and Karnali Rivers in BNP in Nepal[18,19]. There were also records from Koshi River but they are disappeared from this river system[20].

These aforementioned studies surveyed the entire length (74 km) of the Rapti River Since Gharial are ectothermic in nature, they often bask in the sun during cooler winter months while remain in the water during warmer summer months in order to regulate their body temperature, which similar to the present survey.

Gharials have been released into the river from breeding centers, only a smaller number are seen in the wild. This may be due to threats like illegal fishing, habitat damage, and sand and stone removal[15,17].

Conclusion

Gharial populations are highest in the upstream sections of the Rapti River due to favorable habitat conditions and low human disturbance. In contrast, numbers decline downstream where habitat degradation, fishing and sand mining reduce suitability.

Table-1: Gharial Monitoring Survey.

Spot No.	Geographic Location Lothar to Sauraha				Spot No.	Geographic Location Sauraha to Kasara				Spot No.	Geographic Location Kasara to Golaghat			
Round 1	No.	N	E	Elevation (m)	Round 1	No.	N	E	Elevation (m)	Round 1	No.	N	E	Elevation (m)
GLS 1	2	27°33.9645	084°36.64	197	GSK 1	1	27°34.483	84°29.524	316	GKM 1	2	27°33.4760	84°20.5420	158
GLS 2	2	27°33.832	84°35.313	186	GSK 2	1	27°34.491	84°29.544	179	GKM 2	1	27°33.0083	84°19.4429	157
GLS 3	3	27°33.313	84°33.60	179	GSK 3	2	27°34.7319	84°28.7263	182	GKM 3	2	27°33.4144	84°18.3952	152
GLS 4	1	27°33.001	84°31.847	177	GSK 4	1	27°34.4756	84°28.1728	173	GKM 4	3	27°33.496	84°17.215	144
GLS 5	5	27°33.001	84°31.847	177	GSK 5	1	27°34.2595	84°27.9480	166	GKM 5	1	27°33.534	84°17.130	152
GLS 6	3	27°32.802	84°31.043	174	GSK 6	1	27°33.934	84°27.827	166	GKM 6	1	27°33.8131	84°16.2809	147
GLS 7	1	27°33.254	84°30.250	182	GSK 7	3	27°33.744	84°26.003	170	GKM 7	1	27°33.565	84°15.928	143
GLS 8	2	27°33.818	84°29.683	173	GSK 8	1	27°33.6752	84°25.9028	164	GKM 8	1	27°33.959	84°15.170	137
GLS 9	8	27°34.2856	084°38.54	206	GSK 9	2	27°33.338	84°25.538	177	GKM 9	2	27°33.9913	84°12.6747	137
GLS 10	2	27°34.399	84°39.497	209	GSK 10	2	27°34.079	84°23.932	156	GKM 10	2	27°33.636	84°11.412	133
GLS 11	1	27°34.081	84°37.607	194	GSK 11	1	27°34.125	84°23.116	159	GKM 11	1	27°33.292	84°10.250	127
GLS 12	2	27°32.849	84°30.689	162	GSK 12	1	27°33.890	84°22.160	158					
GLS 13	2	27°33.400	84°29.865	168	GSK 13	2	27°33.993	84°21.178	162					
					GSK 14	1	27°33.868	84°21.097	155					
					GSK 15	1	27°33.402	84°20.086	145					
Total= 72	**34**					**21**					**17**			
Round 2					**Round 2**					**Round 2**				
GLS 14	6	27°32.7751	084°32.6105	180	GSK 16	3	27°34.5054	84°29.5378	167	GKM 12	1	27°32.9768	84°19.5230	154
GLS 15	1	27°32.7335	084°31.0889	171	GSK 17	3	27°34.8665	84°29.3765	160	GKM 13	1	27°32.9768	84°19.5230	154
GLS 16	6	27°32.9560	084°30.6412	174	GSK 18	2	27°34.8604	84°29.1037	171	GKM 14	1	27°33.2093	84°18.6127	150
GLS 17	3	27°34.3800	084°29.6000	171	GSK 19	1	27°34.2844	84°27.9043	166	GKM 15	2	27°33.2554	84°18.5651	154
GLS 18	2	27°33.9759	084°37.1790	197	GSK 20	3	27°34.0238	84°27.8386	183	GKM 16	1	27°33.4988'	84°17.1751	143
GLS 19	2	27°33.8071	084°35.2943	189	GSK 21	2	27°33.7509	84°27.7228	165	GKM 17	1	27°33.5825	84°17.0501	146
GLS 20	6	27°33.6584	084°34.5639	189	GSK 22	1	27°34.1536	84°26.6959	171	GKM 18	5	27°33.4874	84°14.8813	140
GLS 21	2	27°33.4885	084°34.0098	182	GSK 23	1	27°33.3236	84°25.5404	158	GKM 19	1	27°33.8642	84°12.7919	136
GLS 22	2	27°32.7352	084°32.5449	170	GSK 24	1	27°33.9216	84°25.4348	170					
GLS 23	2	27°33.0258	084°31.6601	168	GSK 25	2	27°34.1546	84°26.6819	176					
GLS 24	7	27°32.8741	084°30.6487	178	GSK 26	1	27°34.2197	84°24.4943	166					
GLS 25	4	27°33.2145	084°30.1898	178	GSK 27	2	27°34.2067	84°24.2769	166					
					GSK 28	1	27°34.1432	84°23.6561	164					
					GSK 29	1	27°34.1179	84°21.6094	163					
					GSK 30	1	27°33.5471	84°20.7766	171					
					GSK 31	5	27°33.4918	84°20.6380	165					
					GSK 32	3	27°33.0719	84°19.7287	170					
Total= 89	**43**					**33**					**13**			
All Total= 161	**77**					**54**					**30**			

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