Study of Habitat and Population of Endangered *Gavialis gangeticus* in Narayani River of Chitwan National Park, Nepal

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Acronyms

CITES	Convention on International Trade of Endangered Species
CNP	Chitwan National Park
DNPWC	Department of National Parks and Wildlife Conservation
GBC	Gharial Breeding Center
GCA	Gharial Conservation Alliance
IUCN	International Union for the Conservation of Nature
NTNC	Nepal Trust for Nature Conservation
TAL	Terai Arc Landscape
WWF	Worldwide Fund for Nature

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Abstract

A study carried out in Narayani River of Chitwan National Park from 2012 to 2013 to investigate the habitats and abundances of the gharials has recorded the total number of 38 gharials including 3 hatchlings, 8 juveniles, 12 sub-adults and 15 adults. Only one breeding male was observed reflecting the critical condition for the breeding in the wild within Chitwan Nation Park. The abundance of the gharial was restricted in 2 areas, namely Khoria Muhan and Bhelaugi due to suitability of the habitat conditions and minimum human disturbances. The Basking activities in relation to depth showed that > 80 % of the gharials selected sandy banks. Among the 2 populations, the gharials in Khoria Muhan preferred shallow to moderate depth of water because of presence of braided channels in the area. In contrast, the gharials in Bhelaugi select deep water course of the main channel. The park management must adopt conservation measures such as ban of fishing and regular monitoring of habitats and population to maintain long term conservation of gharials in Narayani River.

Introduction

Background

The Crocodile (Family **Crocodylidae**) is a large aquatic tetrapod that lives throughout the tropics in Africa, Asia, the Americas and Australia. Lizards, snakes and crocodiles are all scaled diapsids but crocodiles are archosaurs which means they are genetically closer to birds and the extinct dinosaurs. Crocodylidae is classified as a biological family.

The term can also be used more loosely to include all extant members of the order Crocodilia which includes the crocodiles of Crocodylidae, the alligators and caimans (family Alligatoridae) and the gharials (family Gavialidae), and the rest of Crocodylomorpha, which includes prehistoric crocodile relatives and ancestors.

Crocodiles tend to congregate in freshwater habitats such as rivers, lakes, wetlands and sometimes in brackish water. They feed mostly on vertebrates (fish, reptiles, and mammals), and sometimes on invertebrates (molluscs and crustaceans), depending on species. They first appeared during the Eocene epoch, about 55 million years ago.

Ecology and Natural History

The Gharial is characterised by its extremely long, thin jaws, one of the largest of the living crocodilians (males up to 6 m, and average weight of around 160 kg). The species is the only member of the Family Gavialidae, although recent molecular evidence suggests that *Tomistoma schlegelii* also belongs to this family (Densmore 1983; Willis *et al.* 2007). The Gharial is the most thoroughly aquatic of the extant crocodilians, and adults apparently do not have the ability to walk in a semi-upright stance as other crocodilians do (Bustard and Singh 1978; Whitaker and Basu 1983). Adult males grow a bulbous nasal appendage, which resembles an Indian pot called a 'ghara', from which the species derives its name.

Historically, *G. gangeticus* was found in the northern part of the Indian subcontinent, in the Indus (Pakistan), Ganges (India and Nepal), Mahanadi (India) and Brahmaputra (Bangladesh, India and Bhutan) River systems. The presence of the species in the Irrawaddy River system in Myanmar has also been reported (Smith 1931) (Fig. 1). The Gharial is typically a resident of flowing rivers with deep pools that have high sand banks and good fish stocks (Whitaker and Basu 1983; GCA 2008). Exposed sand banks are used for nesting. Although the function of the 'ghara' is not well understood, it is apparently used as a visual sex indicator, as a sound resonator, or for bubbling or other associated sexual behaviors (Martin and Bellairs 1977).



Figure 1: Distributional range of gharial

Source: Stevenson, C. and Whitaker, R. (2010)

Gharial was previously present in all the gangetic plain in several countries of South-East Asia – Pakistan, Bhutan, Myanmar (ex-Burma), India, Nepal and Bangladesh. In the 1940's, gharial population was estimated from 5000 to 10000 individuals. It declined to 150-200 individuals in the 1960's principally due to habitat destruction and uncontrolled exploitation. It's now only present in India and Nepal, about 2000 individuals in India and 81 in Nepal.

Status of gharial in Nepal

Gharial conservation began in 1971 in Nepal with the help of the Frankfurt Zoological Society. It consists of population reintroduction by egg collection, gharial breeding and juvenile release. Until now, nearly 700 individuals were released in 4 different rivers of Nepal (Andrews and Mc Achernar, 1994; DNPWC, 2005).

The gharial crocodile (*Gavialis gangeticus*) is a globally threatened and endangered reptilian species of Nepal. It is included as endangered in IUCN red list category and Appendix I by CITES. The natural population of gharial in the world is estimated at about 200 of which remnant population of about 80 was

estimated recently by the government of Nepal. The gharials are found in the Narayani, Rapti, Babai and Karnali rivers of Nepal which are under tremendous threats from human disturbances such as overfishing, grazing, dam construction and over-exploitation of natural resources.

Objectives

The overall objectives of the study is to strengthen the gharial conservation in Nepal through the understanding of critical habitats, population, nesting ecology and in raising the public awareness with active participation of local communities to maintain viable population of gharial. The specific objectives are: 1) assess the population status of Gavialis gangeticus in Narayani river; 2) assess the habitat utilization by gharials; 3) prepare GIS maps of distribution and habitat; 4) raise the level of awareness on gharial conservation among the local communities.

Rationale

The gharial is one of the key predators of the Narayani river system which helps in maintaining the health of the river and biotic integrity. The species is protected by Nepal Government under the National Parks and Wildlife Conservation Act 1973. The population of gharial crocodile in the Narayani is estimated at 44 (DNPWC, 2011). This remnant fragmented population is under continuous pressure from different human activities. On the other hand, the construction of Gandak barrage along the international border with India has further threatened the population through rapid loss of habitats. The government of Nepal has given priority towards the conservation of gharial. Realizing the declining trend of population and loss of habitat of gharial, the government has formulated the Gharial Conservation Action Plan (DNPWC, 2012). However, detailed research studies on habitat requirement, population, reproductive success and nesting and hatching behavior are lacking, which may be one of the constraint in gharial conservation.

This research has to some extent derived valuable information on habitat requirements and hatchling success which could contribute in designing the effective conservation strategies to maintain long term conservation of gharials in the river basins of Nepal.

Study Area

The study was carried out in Narayani river of Chitwan National park (27^{0} 34' to 27^{0} 68' N and 83^{0} 87' to 84^{0} 74' E) including the buffer zones from northern boundary of park (Sikrauli) to Tribeni barrage at international border with India. Chitwan National Park is renowned for the conservation of some of the world's most endangered species, including rhinoceros, tiger, gaur, gangetic dolphin, otter and gharial in their natural habitat (CNP Management Plan 1975- 1979). The Park occupies an area of 932 km² in the Rapti Valley of the Siwalik physiographic region, while the buffer zone (27^{0} 28' N to 27^{0} 70' N and 83^{0} 83' E to 84^{0} 77' E) extends 750 km² area (Fig. 2).



Figure 2: Narayani River

The Narayani River ((also called the Gandaki) is a snow fed river, formed by the confluence of Kaligandaki and Trisuli rivers. The total length of this river is about 338 km, and the average flow ranges between 1000 to 1700 cum/s but maximum flow ranges from 10 to 700, 000 cum/s during the monsoon season from June to September (Panday, 1987; Maskey, 1989).

The Narayani river flows southwest for 30 kilometers from a gorge in the Mahabharat Range to the Rapti confluence and then flows westward for a further 25 kilometers along the base of the Someswar Hills before turning south through a very narrow gorge in the Siwaliks between the Dauney and Someswar Hills until it reaches the Nepal-India border (Laurie, 1978). The bed of the Narayani River is very broad consisting of a large number of channels and islands with a width of up to 4 kilometers. The floodplain varies with the altitude, ranging from 250 meters to 150 meters.

The climate of Chitwan is subtropical with a summer monsoon from mid-June to late September and a relatively dry winter. The average annual rainfall is about 250 cm, with the most occurring between June and September. The post-monsoon season between November and January is cool with the daily average temperature reaching 24 0 C during the day and droppings to about 7 0 C at night.

Methodology

Research design



Scoping

The scoping was conducted prior to embarking a detailed field study to collect the primary field information.

Field activities

Survey

The survey of gharial was conducted in January 2013 from Rapti-Narayani confluence area to Tribeni barrage along Nepal-India border.

The survey was conducted in two dugout canoes with four fishermen. The details of the gharial sighted with the help of Olympus binoculars were recorded with their habitat features and GPS location (Annex 1).



Figure 3: Gharial survey locations - GPS points

The gharials were classified into different size classes in 30 cm increments. The individuals < 120 cm long were considered as hatchlings, > 120-180 cm as juveniles, > 180-270 cm as sub-adults and those > 270 cm as adults (Hussain, 2009).

The sex of the sighted crocodile was also determined by presence or absence of nasal orifice.

Distribution and Abundance

The census of gharial was conducted to evaluate the population abundance in the different blocks of the study area. The details of the sighted gharials such as substrate type, river width; mid-river depth and degree of human disturbances were estimated.



Figure 4: Sightings of gharials

Basking

The study of basking activity was conducted in the two areas, namely Khoriya Muhan and Velaunji for three and two days respectively. The details of the sighted gharials on both banks of the river as well as the mid-sandbars and islands were noted. These include approximate size, basking site topography, substrate characteristics and the mid-river water depth and width.

Hatching success

Hatching success of the artificially incubated eggs in Gharial Project were studied. The details of the eggs such as the number of eggs hatched, eggs damaged, and hatchling mortality in each clutch collected from different nests were recorded.

GIS study

The field data such as GPS locations of sign survey and riverine habitat features have been visually interpreted from the Google Image 2010 after ground truthing. The data were generated by the screen digitization in Arc GIS 10.0 version.

Awareness raising

The awareness materials in the form of brochure was prepared in the native language and distributed widely among the school students adjoining the park area, buffer zone communities and information centers of the national park. This will promote awareness and develop stewardship towards conservation of aquatic fauna, particularly gharials among the different target groups.

The focal group/stakeholder meetings in collaboration with the park were conducted in Khoriya Muhan, Gharial Project Camp, Amaltari and Gharial Breeding Center, Kasara. The participants included the fishermen, nature guide, park staff and buffer zone communities representing different places adjoining the park area. These meetings were fruitful in developing strong linkage between stakeholders regarding the conservation of gharial. The meetings will also help in understanding people's perception and identifying conservation problems as well as suggestions for means of gharial conservation.

Result

S.	Egg	Location	Clutch	Hatched	Incubation	Hatchling	% of	Death	Post-	Infertile
No.	laying		size	date	period	no.	eggs	during	hatching	eggs
	date						hatched	hatching	mortality	
1	5 April	Khoriya Muhan	18	14 June	71	9	50.0	0	0	9
2	31	Hattisar, Khoriya	36	16 June	78	8	22.2	0	7	21
	March									
3	31	Bhelauji	41	16 June	NA	0	0.0	0	40	1
	March									
4	4 April	Bhelauji	33	15 June	71	12	36.3	0	19	2
5	5 April	Bhelauji	30	15 June	70	2	6.6	0	10	18
	Sub-		158			31	19.6	0	76	51
	Total									

Hatching success

Table 1: Reproductive effort of gharial in Narayani River, CNP in 2012

The average clutch size of the gharials that were collected during 2012 is 31.6 with a maximum clutch size 41 and a minimum of 18. The average percentage of eggs hatched is 19.6 with a maximum 50 percentage and a minimum 0. Almost 50 percent of the eggs that were hatched was lost due to death by various reasons.

The review of hatching success of gharial in the river system of CNP from the year 1977 to 2011 is presented in Annex 2.

Abundance and Distribution

A survey was carried out in the Narayani River from Narayani – Rapti confluence to Tribeni at the international border with India. The survey recorded a total number of 38 gharials. Among the observed gharials, 3 were hatchlings, 2 juveniles, 12 sub-adults and 15 adults. Only one breeding male was recorded. The abundance of the gharial population was mostly confined largely in three areas, namely, Khoriya, Seri and Bhelauji (Table 2 & 3). Among the gharials observed in these areas, Khoriya had the largest congregation and Seri had only few numbers of gharials.

River	Hatchlings	Juveniles	Sub-adults	Adults	Totals	Remarks		
Narayani River	3	8	12	15	38	One breeding male		
Total	3	8	12	15	38			

Table 2: Gharial survey in the Nayanari River, January 2013

Size class of gharial	2013
<120 cm	3
>120 – 180 cm	8
>180 – 270 cm	12
>270	115
Total	38

Table 3: Size classes of gharial seen in the Narayani River, CNP during 2013.

Recent monitoring survey in Narayani and Rapti rivers carried out by Chitwan National Park in November 2012 recorded altogether 87 gharials, of which 52 were recorded in the 100 km stretch of Narayani River. The census of gharial according to the age classes had maximum of sub-adults representation with a total number of 28 individuals and hatchling represents a minimum number with only 4 individuals (Tables 4 & 5).

River/Location of sightings	km	Hatchlings	Juveniles	Sub-	Adults	Totals	Remarks
				adults	(M.F)		
Rapti River	50.0	0	9	22	4 f	35	No male
Narayani River	100	4	6	28	14	52	One male
Grand Total	150	4	15	50	18	87	

 Table 4: Results of Gharial counts in the Rapti and Nayanari Rivers, November 2012 (Source: GBC, CNP, 2012)

Size class of gharial	2012
<120 cm	4
>120 – 180 cm	6
>180 – 270 cm	28
>270	14
Total	52

Table 5: Size classes of gharial sen in the Narayani River, CNP during 2012 (Source: GBC, CNP, 2012)

Habitat

In the basking areas, the water channels were from 1.2 m - 4.5 m deep. In Khoriya population, the gharials used the sand bars and rocks for basking with the river channels having 1.2 m - 2.7 m deep whereas in Bhelauji, the basking sites were only on sand with maximum water depth of 3.6 m (Figs. 5 & 6).

The field observation showed that more than 80 percent of gharials select sandy areas for basking activities followed by rocks with about 15 percent. No gharials were observed in clay (Table 6).

Basking site type	Number of gharial observed	Percentage of habitat use
Sandy	32	84.21
Rocky	6	15.78
Clay	0	0
Total	38	100

Table 6: Preference of basking types by gharials in the Narayani River, CNP during January 2013



Figure 5: Habitat utilization by gharials





Human disturbances

Despite of all the conservation actions, gharial population in Nepal is staying at a critically low level. The major threats to the gharials are identified as:

<u>Poaching</u>: it has been clearly identified by Maskey in 1998 and the last observations show that poaching still exist in Nepal. Before it was mainly aimed on males.

<u>Industrial pollution</u>: The most widespread form of pollution is organic waste from domestic and industrial sources. There is a little doubt that pollution could be the cause of gharial population decline. Increasing industrialization is leading to increase in pollution loads from factories. Discharges from the Gorkha Brewery and Bhrikuti Paper and Pulp factory and Pharmaceutical and Gill Mary were the major sources of pollution in Narayani River affecting the gharial crocodiles.

<u>Dams</u>: The large dam in Tribeni has been built between Nepal and India that allow gharials to go in India following the stream, but once in the Indian side, they can't go back in Nepal. During the monsoon season, the huge stream bring a large number of gharial to India. Thus, it's impossible for them to return to their original habitat, decreasing the Nepalese population.

<u>Overfishing</u>: The Chitwan National Park have provided the fishing license to the traditional fishermen to support their livelihood. Besides, this wetland dependent communities, others are also intensively fishing in the river on both banks resulting to scarcity of fish prey base, disturbances to the gharials and loss of habitat. The fisher men use large fishing net (gill net) which largely threatens the gharial population due to risk of being entrapped. Small sized mesh nets are often used which removes both adult breeding stock

and fingerlings from the populations reducing the possibilities of future breeding and recruitment from the areas.



Figure 7: Human disturbances in Narayani River

Awareness

A brochure in Nepali language on the importance and values of gharial was prepared and distributed to the park offices and the local communities around CNP to enhance the level of awareness on gharial conservation (Annex 3).

Discussion

The population census survey carried out in Narayani river showed the congregations of gharials, particularly in two sections of the river, Rapti confluence-Khoria Muhan and Velaungi in the downstream section. This study showed that less human disturbances because of restriction on fishing activities have resulted the presence of gharials in large numbers. In other sections of the river, the January 2012 survey did not sighted the gharials . This is due to the presence of high human disturbances such as fishing, grazing, extraction of sand and boulder and construction of Tribeni dam (Acharya & Rajbhandari, 2009; Acharya & Rajbhandari, 2012). Other studies also have indicated the threats to the gharial population by human disturbances and dam construction

(Maskey, 1987; Collares et al). The gharials from different areas tend to migrate to the habitats with sand bars and sandy islands with deep water courses for safety and availability of its prey.

The presence of main channel, braided channels with sandy bars and patches of sandy islands within the main channels reflects the availability of sites for basking and food resources. These habitat features in Narayani and Rapti river confluences where the riverine habitat is characterized by main channel with braided channels, large areas of sand bars in between these channels, moderate to deep water and regular monitoring of habitats have tended the gharials ro select these areas during the winter season.

In the downstream areas such as Velaungi, the riverine habitat is characterized by the stagnant conditions of thenriver due to Tribeni dam. The river here flows in between the foothills of Mahabharat range and churia range. The presence of single deep water channels and occurrence of elevated sandy areas on the eastern banks with low human disturbances have caused gharials to prefer these sites. Additionally, these sites are important sites for breeding of gharials where eggs are collected annually for artificial hatching. This year, 3 nests of gharial eggs were collected from the Velaungi area (personal communication, Juthe Ram and Sante Bote, 2013).

Altogether 53 nests were collected from the Narayani River during the 6 nesting seasons of 1977-81 and 1987 (Maskey, 1987). During the study, only 5 nests with a total of 158 eggs were collected from from Velaungi, Khoria Muhan and Hattisar Khoria. The significant reduction in the number of nesting sites over years is due to high fishing pressures. The fishermen use large gill nets (Tiyari) for fishing which collect many small to large fish causing reduction in the prey base. Occasionally, the gharials get entangled in these nets.

Conclusion

The gharials in Narayani are under immense pressure from anthropogenic disturbances and barrage construction. On the other hand, one of the major obstacle in the conservation of gharials in the river basins of Nepal is the wide gap in their researches. Such gaps have hindered the conservation due to the lack of basic information. The park should adopt appropriate conservation measures such as ban of fishing, promotion of prioritized researches and strengthen the policies to address the conservation of gharials so that their long term existence is ensured.

Recommendations

Conduct regular monitoring and patrolling of gharial habitats and population and ban the fishing activities in these areas.

Conduct scientific researches on the gharials in Narayani on habitat requirements, home range and reproductive activities.

The prime concern is the protection of a single breeding male in Narayani River. Use of radiotelemetry to monitor its movement and behavioral activity is necessary to ensure the maintenance of gene pool.

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		1010	D.475		River	River					
IDENI	LAI	LONG	DATE	ALIITUDE	Width	Depth	Habitat		Place	Slope	Remarks
251	27.55782872	84.12037463	20-JAN-13 11:01:15AM	145					Gharial Project		
252	27.55530065	84.12032576	20-JAN-13 11:16:21AM	139					Project-Khoriya confluence		
253	27.54867098	84.13845255	20-JAN-13 12:32:31PM	117	121	2.1	Sand	4	Khoriya	Flat	
254	27.54977672	84.13912822	20-JAN-13 1:27:13PM	120	151	2.7	Sand	8	Khoriya	30°	
255	27.5514236	84.13870996	20-JAN-13 1:42:55PM	133	242	1.2	Sand	1	Khoriya	15°	
256	27.54762417	84.1360109	20-JAN-13 1:49:31PM	118	121	2.4	Sand	3	Khoriya	20°	
257	27.54752652	84.13590873	20-JAN-13 1:49:41PM	117	121	2.4	Sand	1	Khoriya	20°	
258	27.54704791	84.13288915	20-JAN-13 1:53:22PM	143	181	1.6	water	2	Khoriya	90°	
259	27.55491718	84.12208764	21-JAN-13 11:55:36AM	116	303	2.4	Rocky		Chitwan-Nawalparasi confluence		
260	27.5507186	84.1312856	21-JAN-13 12:15:49PM	114	151	2.1	Rocky	6	Khoriya	Flat	
261	27.55213363	84.13993824	21-JAN-13 12:59:53PM	113	121	2.1	Sand	5	Khoriya	Flat	
262	27.55923947	84.14762654	21-JAN-13 1:30:09PM	116	242	1.8	Clay		Khoriya	Flat	
263	27.56112171	84.1499205	21-JAN-13 1:42:57PM	115	212	1.8	Sand	1	Rapti Dovan	Flat	
264	27.56070111	84.14194051	21-JAN-13 1:52:37PM	113	545	2.1	Sand/rock	1	Khoriya	15°	
265	27.55082002	84.1383746	21-JAN-13 2:02:46PM	111	121	2.4	Sand	14	Khoriya		
266	27.54725017	84.13319835	22-JAN-13 12:02:13PM	118	106	1.8	Rocky	2	Khoriya		
267	27.54811803	84.13612163	22-JAN-13 12:12:38PM	114	121	2.4	Rocky	3	Khoriya		
268	27.54999692	84.13741764	22-JAN-13 12:20:12PM	117	151	1.8	Sand	10	Khoriya		
269	27.55024075	84.13910609	22-JAN-13 12:45:40PM	123	181	1.5	Sand	2	Khoriya		
270	27.55515589	84.14450898	22-JAN-13 1:06:57PM	121	75	1.6	Sand	5	Khoriya		
271	27.56158146	84.15032267	22-JAN-13 1:41:28PM	119	303	1.5	Sand	1	Khoriya	Flat	
272	27.56124225	84.14322244	22-JAN-13 1:50:18PM	112	151	1.8	Sand	2	Khoriya	10°	
273	27.55310157	84.13868406	22-JAN-13 1:58:50PM	114	136	1.8	Sand	2	Khoriya		
274	27.56289952	84.12367048	22-JAN-13 2:54:46PM	117	90	2.7	Sand	2	Project area		
275	27.5511019	84.10951956	23-JAN-13 12:10:18PM	112	545	2.1	Rocky		Amaltari		Human disturbance
276	27.55389593	84.09265366	23-JAN-13 12:22:56PM	113	606	2.1	Rocky		Temple Ghat		Human disturbance

Annex 1: GPS locations of gharial survey, January 2013

27.55747542	84 08213429	22 IANI 12 12:22:24DM	110	606	1 -		1		1	
	04.00215425	23-JAN-13 12.52.54FIVI	116	606	3	Rocky		Bramahasthan		Human disturbance
27.56482928	84.06452576	23-JAN-13 12:48:55PM	122	181	1.8	Rocky	Rocky Bramahasthan-Ratanpur Kholsa			Human disturbance
27.55166014	84.04737194	23-JAN-13 1:06:12PM	112	151	1.8	Sand/rock		Ratanpur-Nandapur boundary		Human disturbance
27.5383226	84.0334465	23-JAN-13 1:23:21PM	101	136	3	Sand/rock		Nandapur		Human disturbance
27.53608983	84.02517993	23-JAN-13 1:31:29PM	100	106	4.5	Sand/rock		Laidaghat		Human disturbance
27.54222362	84.01018756	23-JAN-13 1:49:50PM	99	181	2.4	Sand	2	Lower Seri		
27.54557907	84.00443707	23-JAN-13 1:55:14PM	98	181	1.8	Sand	1	Seri		
27.54752945	84.00132855	23-JAN-13 1:57:33PM	99	121	3.9	Sand	2	Seri		Human disturbance
27.54636336	83.97532236	23-JAN-13 2:16:02PM	92	151	2.4	Rocky		Kolkatta		Human disturbance
27.54833085	83.95596134	23-JAN-13 2:39:49PM	97	545	3.3	Sand		Tamaspur		Human disturbance
27.54334822	83.93617652	23-JAN-13 2:58:41PM	92	151	3.6	Sand/rock		Tamaspur		
27.53540059	83.91938447	23-JAN-13 4:14:47PM	92	121	3.6	Sand	1	Darasingh	15°	
27.52634478	83.92097267	24-JAN-13 11:02:26AM	141	90	4.5	Sand		Malebagar	45°	
27.51412019	83.92773234	24-JAN-13 11:30:29AM	92	90	4.8	Rocky		Bhimban	70°	
27.51703391	83.94302077	24-JAN-13 11:46:08AM	92	151	3.9	Rocky		Kathana		
27.5255858	83.95968709	24-JAN-13 12:05:55PM	92	151	3.6	Sand	3	Bhelauji		
27.52465842	83.96134185	24-JAN-13 12:08:28PM	90	151	3.6	Sand		Bhelauji		
27.52358763	83.96157922	24-JAN-13 12:25:17PM	90	212	3.6	Sand	4	Bhelauji	40°	
27.51052938	83.96845917	24-JAN-13 12:49:01PM	89	181	2.7	Sand		Bhelauji		
27.50398228	83.9623154	24-JAN-13 12:59:58PM	90	212	3.6	Rocky		Simrada		
27.49328672	83.93889134	24-JAN-13 1:40:06PM	92	181	3.6	Sand		Odrandri		
	27.56482928 27.55166014 27.5383226 27.53608983 27.54222362 27.54557907 27.54752945 27.54636336 27.54833085 27.54833085 27.54334822 27.52634478 27.52634478 27.51412019 27.51703391 27.5255858 27.52465842 27.52358763 27.51052938 27.50398228 27.49328672	27.5648292884.0645257627.5516601484.0473719427.538322684.033446527.5360898384.0251799327.5422236284.0101875627.5455790784.0044370727.5475294584.0013285527.5463633683.9753223627.5433482283.9361765227.5263447883.9209726727.525585883.9596870927.5246584283.9613418527.5235876383.9615792227.5105293883.962315427.5039822883.93889134	27.5648292884.0645257623-JAN-13 12:48:55PM27.5516601484.0473719423-JAN-13 1:06:12PM27.538322684.033446523-JAN-13 1:23:21PM27.5360898384.0251799323-JAN-13 1:31:29PM27.5422236284.0101875623-JAN-13 1:49:50PM27.5455790784.0044370723-JAN-13 1:55:14PM27.5455790784.0013285523-JAN-13 1:55:14PM27.5463633683.9753223623-JAN-13 1:57:33PM27.5463633683.9753223623-JAN-13 2:16:02PM27.5483308583.9559613423-JAN-13 2:39:49PM27.5433482283.9361765223-JAN-13 2:58:41PM27.5263447883.9209726724-JAN-13 11:02:26AM27.5141201983.9277323424-JAN-13 11:30:29AM27.525585883.9596870924-JAN-13 11:46:08AM27.5235876383.9613418524-JAN-13 12:05:55PM27.5235876383.9615792224-JAN-13 12:08:28PM27.5039822883.962315424-JAN-13 12:59:58PM27.4932867283.938913424-JAN-13 12:06PM	27.5648292884.0645257623-JAN-13 12:48:55PM12227.5516601484.0473719423-JAN-13 1:06:12PM11227.538322684.033446523-JAN-13 1:23:21PM10127.5360898384.0251799323-JAN-13 1:31:29PM10027.5422236284.0101875623-JAN-13 1:49:50PM9927.5455790784.0044370723-JAN-13 1:55:14PM9827.5455790784.0044370723-JAN-13 1:57:33PM9927.546363683.9753223623-JAN-13 2:16:02PM9227.5483308583.9559613423-JAN-13 2:39:49PM9727.5433482283.9361765223-JAN-13 2:58:41PM9227.5263447883.9209726724-JAN-13 1:02:26AM14127.5141201983.9277323424-JAN-13 11:02:26AM9227.525585883.9596870924-JAN-13 12:05:55PM9227.5246584283.9613418524-JAN-13 12:05:55PM9027.5235876383.9615792224-JAN-13 12:08:28PM9027.5105293883.962315424-JAN-13 12:05:55PM9027.5039822883.962315424-JAN-13 12:05:58PM9027.5039822883.962315424-JAN-13 12:05:58PM9027.4932867283.938913424-JAN-13 12:05:58PM90	27.5648292884.0645257623-JAN-13 12:48:55PM12218127.5516601484.0473719423-JAN-13 1:06:12PM11215127.538322684.033446523-JAN-13 1:23:21PM10113627.5360898384.0251799323-JAN-13 1:31:29PM10010627.5422236284.0101875623-JAN-13 1:49:50PM9918127.5455790784.0044370723-JAN-13 1:55:14PM9818127.5455790784.0013285523-JAN-13 1:57:33PM9912127.5463633683.9753223623-JAN-13 2:16:02PM9215127.548308583.9559613423-JAN-13 2:39:49PM9754527.5433482283.9361765223-JAN-13 2:58:41PM9215127.5263447883.9209726724-JAN-13 11:02:26AM1419027.5141201983.9277323424-JAN-13 11:30:29AM929027.5170339183.9430207724-JAN-13 11:46:08AM9215127.52585883.9596870924-JAN-13 12:05:55PM9215127.5235876383.9613418524-JAN-13 12:05:55PM9215127.5105293883.9634591724-JAN-13 12:49:01PM8918127.5039822883.962315424-JAN-13 12:06:PM9021227.4932867283.938913424-JAN-13 1:40:06PM92181	27.5648292884.0645257623-JAN-13 12:48:55PM1221811.827.5516601484.0473719423-JAN-13 1:06:12PM1121511.827.538322684.033446523-JAN-13 1:23:21PM101136327.5360898384.0251799323-JAN-13 1:31:29PM1001064.527.5422236284.0101875623-JAN-13 1:31:29PM1001064.527.5455790784.0044370723-JAN-13 1:55:14PM981811.827.5463633683.9753223623-JAN-13 1:57:33PM991213.927.5463633683.9753223623-JAN-13 2:16:02PM921512.427.5433482283.9361765223-JAN-13 2:39:49PM975453.327.5263447883.9209726724-JAN-13 11:02:26AM141904.527.5141201983.9277323424-JAN-13 11:30:29AM921513.627.52585883.9613418524-JAN-13 11:20:555PM921513.627.5235876383.9613418524-JAN-13 12:05:55PM921513.627.5235876383.9615792224-JAN-13 12:05:55PM901513.627.5235876383.9615792224-JAN-13 12:25:17PM902123.627.5039822883.962315424-JAN-13 12:49:01PM891812.727.5039822883.962315424-JAN-13 12:06PM921813.627.5039822883.962315424-JAN-13 12:06PM921813.6	27.5648292884.0645257623-JAN-13 12:48:55PM1221811.8Rocky27.5516601484.0473719423-JAN-13 1:06:12PM1121511.8Sand/rock27.538322684.033446523-JAN-13 1:23:21PM1011363Sand/rock27.5360898384.0251799323-JAN-13 1:31:29PM1001064.5Sand/rock27.5422236284.0101875623-JAN-13 1:31:29PM1001064.5Sand/rock27.5455790784.0044370723-JAN-13 1:55:14PM981811.8Sand27.5475294584.0013285523-JAN-13 1:57:33PM991213.9Sand27.5463633683.9753223623-JAN-13 2:16:02PM921512.4Rocky27.543348283.9559613423-JAN-13 2:39:49PM975453.3Sand27.543348283.9193844723-JAN-13 2:39:49PM921513.6Sand/rock27.5354005983.9193844723-JAN-13 1:30:29AM921513.6Sand27.5263447883.9209726724-JAN-13 11:02:26AM141904.5Sand27.5170339183.9430207724-JAN-13 11:205:55PM921513.6Sand27.525585883.9613418524-JAN-13 12:05:55PM921513.6Sand27.525585883.9613418524-JAN-13 12:05:55PM901513.6Sand27.525585883.9613418524-JAN-13 12:05:55PM901513.6Sand	27.56482928 84.06452576 23-JAN-13 12:48:55PM 122 181 1.8 Rocky 27.55166014 84.04737194 23-JAN-13 1:06:12PM 112 151 1.8 Sand/rock 27.55360208 84.0334465 23-JAN-13 1:23:21PM 101 136 3 Sand/rock 27.53608983 84.02517993 23-JAN-13 1:31:29PM 100 106 4.5 Sand/rock 27.54222362 84.01018756 23-JAN-13 1:49:50PM 99 181 2.4 Sand 2 27.54557907 84.00443707 23-JAN-13 1:55:14PM 98 181 1.8 Sand 1 27.54557907 84.00132855 23-JAN-13 1:57:33PM 99 121 3.9 Sand 2 27.54636336 83.97532236 23-JAN-13 2:39:49PM 97 545 3.3 Sand 2 27.54334822 83.9617652 23-JAN-13 2:39:49PM 97 545 3.3 Sand 1 27.52634478 83.92097267 24-JAN-13 11:02:26AM 141 90 4.5 Sand 1 27.51703391 83.94302077 2	27.56482928 84.06452576 23-JAN-13 12:48:55PM 122 181 1.8 Rocky Bramahasthan-Ratanpur Kholsa 27.55166014 84.04737194 23-JAN-13 1:06:12PM 112 151 1.8 Sand/rock Ratanpur-Nandapur boundary 27.5383226 84.0334465 23-JAN-13 1:2:2:1PM 101 136 3 Sand/rock Nandapur 27.53608983 84.02517993 23-JAN-13 1:3:2:9PM 100 106 4.5 Sand/rock Laidaghat 27.5452926 84.0118756 23-JAN-13 1:3:2:9PM 100 106 4.5 Sand/rock Laidaghat 27.5452936 84.0043207 23-JAN-13 1:5:5:14PM 98 181 1.8 Sand 1 Seri 27.54536363 83.97532236 23-JAN-13 1:5:6:02PM 92 151 2.4 Rocky Kolkatta 27.5433682 83.9596134 23-JAN-13 2:5:8:4PM 92 151 3.6 Sand/rock Tamaspur 27.5433482 83.91938447 23-JAN-13 1:2:5:84PM 92 151 3.6 Sand 1 Darasingh 27.52634478 83.92097267	27.56482928 84.06452576 23.JAN-13 12:48:55PM 122 181 1.8 Rocky Image: stress of the stres of the stress of the stres of the stress

Year	No. of Eggs	No. of	% of	No. of Hatchling	% of Hatchling
	Collection	Hatchlings	Hatchling	Survival after 1	Survival after
				year age	1 year age
1977	592	438	73.99	NA	NA
1978	310	162	52.26	NA	NA
1979	543	294	54.14	NA	NA
1980	264	187	70.83	NA	NA
1981	259	64	24.71	NA	NA
1982	90	38	42.22	NA	NA
1983	296	124	41.89	NA	NA
1984	40	33	82.50	NA	NA
1985	158	116	73.42	NA	NA
1989	253	144	56.92	NA	NA
1990	395	237	60.00	NA	NA
1991	359	281	78.27	NA	NA
1992	490	230	46.94	NA	NA
1993	428	280	65.42	11	3.93
1994	437	144	32.95	10	6.94
1995	221	97	43.89	17	17.53
1996	577	276	47.83	17	6.16
1997	311	106	34.08	20	18.87
1998	302	19	6.29	2	10.53
1999	408	101	24.75	10	9.90
2000	244	141	57.79	30	21.28
2001	291	81	27.84	27	33.33
2002	466	229	49.14	32	13.97
2003	347	169	48.70	3	1.78
2004	521	298	57.20	157	52.68
2005	510	333	65.29	80	24.02
2006	382	262	68.59	95	36.26
2007	343	117	34.11	53	45.30
2008	369	133	36.04	32	24.06
2009	101	71	70.30	41	57.75
2010	508	355	69.88	133	37.46
2011	634	256	40.38	141	55.08
Total	11449	5816		911	

Annex 2: Trend of hatching success of gharial in the river system of CNP

Annex 3: Brochure in Nepali language

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wigness are status and all the אמאמות נורן לינוא ו אויראו שפליט אואאמינים विजीतल्वी संस्था २०० जन्मा क्रम आखी अनुमान छ । बहुदी आनंदीय चाय्ये तथी किनीजन्त्री संख्या चट्टे भोप ge mai waves theyabit such soft farmait प्रकार तीत कृतेब अवस्थाय गांधेजी छ । यनी CITES # Appendix I at earlier eval at ethes विकृत्व तथा वभ्यवान् ऐन २०२९ र जनवर बंरधन ऐन :संसोधन २०७२: में यस दुर्वन जीवनाई मरक्षम ne paper press scatters of south in पहित्यनको संस्थामा क्रमी हुँदे राजु र बाजन्वायमा बग्री सालवीय असर फसले नेपाल सरपारने पहिष्ठान संरक्षण कार्यपोलन तथार गी छ। गणिए निकृत्व तथा कवावल् त्व २०२९ व पहिषाव मंत्रीवाई बच्चाने, बावे व पाईने वनाइने व्यक्तिमाई ४०,००० स्पेवी देखे २८,००० स्पेवी जीवाना सा १ वर्ष दीव १० वर्णसम्ब वेद सा दूवे सजाव A 100000 1000

SCOTTAL DESIGN

inowar above ufgare status andra वासम्बारचाह चिंदान जालाने भीप हुन सकी प्रवस्त छ । तमचे प्रमाणे अनुमन्धान गर्म प्रमाने संघर प्रष्टापन fum, boty at itste neutrit Frankfurt Zoological Society at eminat furus rifes fear-ant anexe पहिलान प्रजनन केन्द्र स्वयंग संगत ते । यस बंग्हने हरेव का मोडीयो गुंह प्रीत्यान समि In spervace and some of anothe follower aver nu correctul dit übare per apprent women fracfing ; wont featibalt affie 2 prot पछि इस प्रभारत्वाई ग्रीहवाल प्रजन्त बंग्इम

स्वाचान्तरण गरी जरीम र डींब ६ क्षेत्रस्य तुवांई पुत प्रदर्गिक जनम्मानमा द्वीहन्छ। राजसाने फिल्कन सर्पहन feature WWF at weature weat feature अन्यमन योग्रोको छ ।

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नहीं क्षेत्रक पहुंचे साल्तीय प्रायहर अभी सॉल्फीयल भाख माने, चरियाण, जानुवा तथा दुवा निवाले, प्रावृत्तिक बोतारको बडी उपयेग गर्नु उम प्रदूषण तथा तुमा बाँव feater mails seast and strength a magnet share असर प्रभावर्षे आएको छ । ये आहेक पहिषाल तेला वचन बतारानमा फास्ट्र, बदाबी भोगे, स्थान र न्याप्री मुमा र गोगोरीबाह प्रदास हने नीवनानी एवा म-माना भइना पूनी माछ माने र बहुदी मात्रामा महाजानको प्रधान गयां पश्चिमान सोतीहरु जोविक्सा छन् ।



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घडियाल गोही



Gharial Conservation Project

Phone +6/7 1-5553 burningthands

Rufford

चरिवा

परिषयान गोरी राज पावरे तीव हो, जावड़ो युपूर्वा निवे साचे त्या पात्रजे वहाता हुन्दु । बसको सर्वत्र पं पांड सात्रारा साधानां के सित्रे सात्रात्व सर्वत्र पर निवेश गीर प्रतित्वाधांक्रील स्वतन्त इन गोरी से । परिषयान गीरी Genislisher वीत्याचा त्यापा सरमा तो । बात्रक सामको सुग्रीको दुग्वीमा पहा हुन्छ जसको जात्रमाने समयाहे प्रदियान स्तित्रको तो । ये गोरीयमधे खार्ड् ५४० वर्गलस्थाने हुन्छ । पर मगर गोरीको आप का वर्ष साथ हरा।

Sur ent

पूर्व कामग्रेविनी अहिवाल अगरीत उपमायिएको unft anat offeren unen urgebt i er und erette ure nar anneure fanners anneren fuften ein üch februr üreren nin mpige i sdark dt eistere Recease recht, errerett, aus e untilt offener unges i werner fit ebfter beim, भाषाल, तोज, केंच र बहावरीका बाह पाइन्द्र : पी sidnessit man yess afe anal seems afreat 81

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ufpun einfrat erfte und upmit maat ging i wunn nichtab erfterab nebenit ann reigt fbit epuit e adeuit ann deit nituit epuit avas i maurit यगवी लामी कुनुनेवार सींबने फिल संबिन्द । कुनुनीवी enfandt upprint tie big te e minit upprint tu the is not of satural flat stars gaug a स्त्रांशे हणीमा ६ वटा दांत हल्दन् । के संतीरन un & beer miet nie gegit i neut the aftu ६०० थे.जी, सम्ब हुन्छ i की सीतीहर दक्ष बहुतर र पुत्रकाओं सहरले कीहन सक्षान :

पहिषात होती एक स्वन्ध जलवा स्वय हर । की जीवतन कोई बालनीय चान तथा प्रहाल आहंबा General uns unberg i ft einfure aussenst eilteit, बडी बसाह अएका महाबहार नहीतन र अनिनी सृष्ठ्यो moment factor e groce se urperat diven before nige i & samesai salar as oftens mit पाने प्रयोग गर्वछन् । वयोगको सभावस की मोतीतम नहीं विकारका होड स. म. - स्टला अपुल्टारका पाराहीत् । अन्य समयक गौरने लोका वाल्याका दिव्यालया प्रस्त werdurt i

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