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Amphibians and Reptiles of the Royal Chitwan National Park, Nepal

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Abstract. -The Royal Chitwan National Park encompasses over 900 km^2 of grassland and forest in south-central Nepal. This mixture of habitats provides the home for 11 frog species, two crocodilians, eight turtles, ten lizards, and 24 snakes. A checklist documents species occurrences and habitat preferences; species accounts provide natural history observations for selected species of the park's herpetofauna.

Key Words: Nepal, Amphibia, Salientia, Reptilia, Crocodylia, Testudines, Lacertilia, Serpentes, checklist, natural history

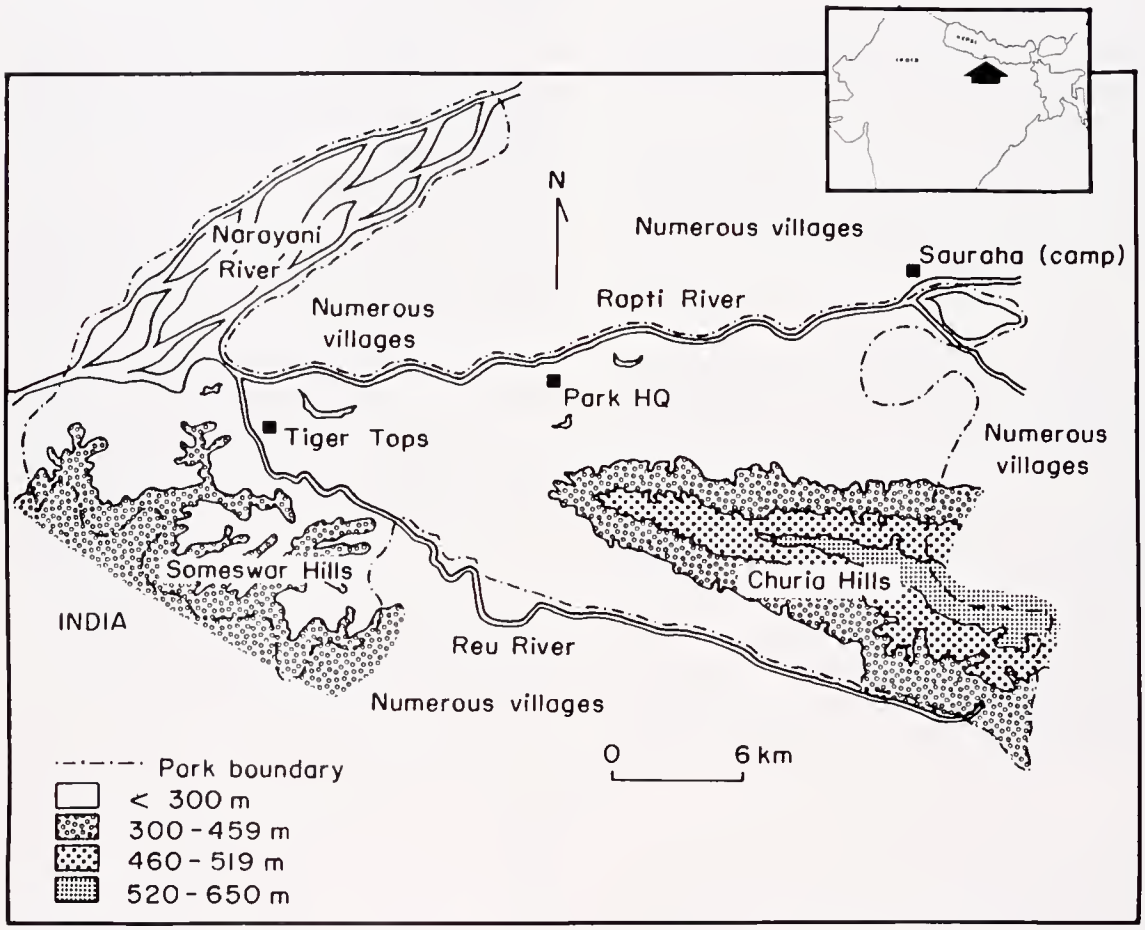

FIG. 1. Map of Royal Chitwan National Park. The Smithsonian camp was on the northeastern edge of the park and adjacent to Sauraha. After Sunquist (1988: figure 1)

Introduction

The Royal Chitwan National Park (RCNP) is a mixed grassland and forested area in south-central Nepal, centered at approximately 27°30'N 84°20'E (Fig. 1). The park lies in the Siwalik Range of low rolling hills in front of the Himalayas and along the Nepal-India border. The park is bordered to the north by the Rapti River, to the west by the Narayani River and Someswar Hills, to the south by the Reu River, and to the east by the Hasta River.

TABLE 1. A list of the known amphibians and reptiles of the Royal Chitwan National Park and neighboring areas. Habitat occurrence is noted by abbreviations within brackets and represents our observations or field notes associated with United States National Museum voucher specimens from the Chitwan area; thus, data are not available for many species and the habitats listed for a species may not encompass all habitats occupied by that species. The habitats and their abbreviations are defined in the Materials and Methods section. The type of voucher supporting each taxon's occurrence in the Chitwan area follows the habitat categories in the brackets: *, specimen in a permanent collection/museum; s, sight and/or photographic record or specimen examined in a nonpermanent collection; l, literature record.

Salientia	
Bufonidae	
Bufo melanostictus	[W/*]
Bufo stomaticus	[Ra,C,A/*]
Ranidae	
Rana crassa	[/*[1]]
Rana cyanophlyctis	[Rgh,Pfgh,Mgh/*]
Rana danieli	[Pf,F/*]
Rana limnocharis	[F/*]
Rana pierrei	[C/*]
Rana syhadrensis	[Pf,W,F,A/*]
Rana tigerina	[Pf,A/*]
Tomopterna breviceps	[/*[1,2]]
Rhacophoridae	
Polypedates maculatus	[Ra,C/*]
Crocodylia	
Crocodylidae	
Crocodylus palustris	[Rg/s[3]]
Gavialidae	
Gavialis gangeticus	[Rg/s[3]]
Testudines	
Testudinidae	
Kachuga dhongoka	[/l[4,5]]
Kachuga kachuga	[/l[4,5]]
Kachuga tecta	[/l[4,5]]
Melanochelys tricarinata	[/l[6]]
Melanochelys trijuga	[Pg/*]
Indotestudo elongata	[/*]
Trionychidae	
Aspideretes gangeticus	[/l[5]]
Chitra indica	[/l[4,5]]
Lacertilia/lizards	
Agamidae	
Calotes versicolor	[G,W,C,A/*]
Gekkonidae	
Hemidactylus brookii	[W,C/*]
Hemidactylus flaviviridis	[/l[3]]
Hemidactylus frenatus	[C/*]
Hemidactylus garnotii	[C/*]
Scincidae	
Mabuya dissimilis	[G/*]
Mabuya macularia	[W,C/*]
Scincella sikimmensis	[W,F/*]
Varanidae	
Varanus bengalensis	[/l[7]]
Varanus flavescens	[A/*]
Lacertilia/snakes	
Colubridae	
Ahaetulla nasuta	[/s[3,8]]
Amphiesma stolata	[Pgh/*]
Boiga ochracea	[/l[9]]
Boiga trigonata	[s[10]]
Chrysopelea ornata	[s[8,10]]
Dendrelaphis tristis	[W/*]
Elachistoon westermanni	[/l[9]]
Elaphe helenae	[/s[8]]
Elaphe radiata	[A/*]
Homalopsis buccata	[/s[10]]
Lycodon aulicus	[W/*]
Oligodon arnensis	[C/*]
Psammophis condanarus	[/l[9]]
Ptyas mucosus	[A/*]
Sibynophis collaris	[/l[3,11]]
Xenochrophis piscator	[Rgh/*]
Elapidae	
Bungarus caeruleus	[/l[9]]
Bungarus fasciatus	[W,A/*]
Calliophis macclellandii	[/l[11]]
Naja naja	[G/s]
Ophiophagus hannah	[/l[7]]
Leptotyphlopidae	
Ramphotyphlops braminus	[C/*]
Pythonidae	
Python molurus	[W,A/s[8,10]]
Viperidae	
Trimeresurus albolabris	[/s[8]]

Nearly a third of the park is a floodplain valley floor (150-250 m elevation; Anon., 1985) covered by a mix of grasslands, patches of hardwood forest, marshes, ponds and small streams. The Churia Hills (250-600 m), occupying the southeastern and central third of the park, are covered largely by sal forest. The climate is monsoonal with heavy rains typically from June through September, then becoming progressively drier and drought-like through April; May is a transitional month with increasingly heavier rains. Total annual precipitation averages about 230 cm. Daily temperatures generally range from 5-30° C in the cool, dry winter season (November-February) through 16-40° in the dry premonsoonal months (March-May) to 20-34° during the monsoonal rains of June-September (Bhatt, 1977; Gurung, 1983; Sunquist, 1981).

The Royal Chitwan National Park was established in the mid 1960s to provide a preserve for large mammals, particularly the Bengal tiger and the Indian rhinoceros (Sunquist, 1981; Laurie, 1982; Sunquist and Sunquist, 1988). Until the mid 1950s, the Siwalik Range and the encompassing terai area were a high malaria area and had low human density. The control of malaria-carrying mosquitoes in the 1950s allowed explosive human colonization. Fertile flood plains became pastures and farmlands, and the hill forests were cut for firewood and local building materials. The park is now totally surrounded by human settlements. The pastures and farmlands abut the park and expose it to daily incursions by an inadequately fed and fueled human population and their domestic animals.

The following observations on the species composition and natural history of the Chitwan herpetofauna derive from a report submitted to the Nepal Department of National Parks and Wildlife Conservation in 1986 (report's checklist used but uncited in Maskey and Schleich, 1992:Table 1, Schleich and Maskey, 1992:254, and Schleich, 1993). The report was designed as a field guide for park visitors and the training of park personnel; it included an identification key, which will be published separately in the Smithsonian Herpetological Information Service series.

Materials and Methods

Our visits to the park included a premonsoonal survey in April 1985 and a postmonsoonal one in November 1985. Episodic collections by the staff of the Smithsonian-Nepal Terai Ecology Project provided additional vouchers and observations. The headquarters' staff of the Royal Chitwan National Park and the guides and naturalist of Gaida Wildlife Camp maintained synoptic collections of amphibians and reptiles, especially snakes, collected in and around the park. The specimens from the preceding sources provide a primary data base for constructing the herpetofaunal list of RCNP. We also include taxa reported in the literature, although we did not confirm the specific identification of these taxa.

To document the habitat occurrence of the herpetofauna, we use the following habitat categories: Aquatic -- river (R), within and along the shore of rivers and major tributary streams; ponds and small streams (P), streams of <2 m width and temporary pools of water, modified by f, g, or h to denote location in forest/woodlands, grasslands, or human-occupied sites; marsh (M), marshes adjacent to rivers or formed in grasslands by small streams. Flood plain -- terai grasslands (G); woodlands (W), canopied forest patches on slightly elevated hummocks scattered throughout the grasslands. Hills -- sal forest (F). Human sites -- commensal (C), living on, in, or immediately adjacent to human and domestic animal buildings; agricultural areas (A), pastures, fields, and fence-row habitats. These habitat occurrences are based exclusively on our observations or field notes associated with voucher specimens. The habitat occurrences are summarized in Table 1.

The following species accounts represent those species for which we can provide new or broader based observations. Snout-vent length (SVL) in frogs, lizards, and snakes is distance (mm) from tip of the

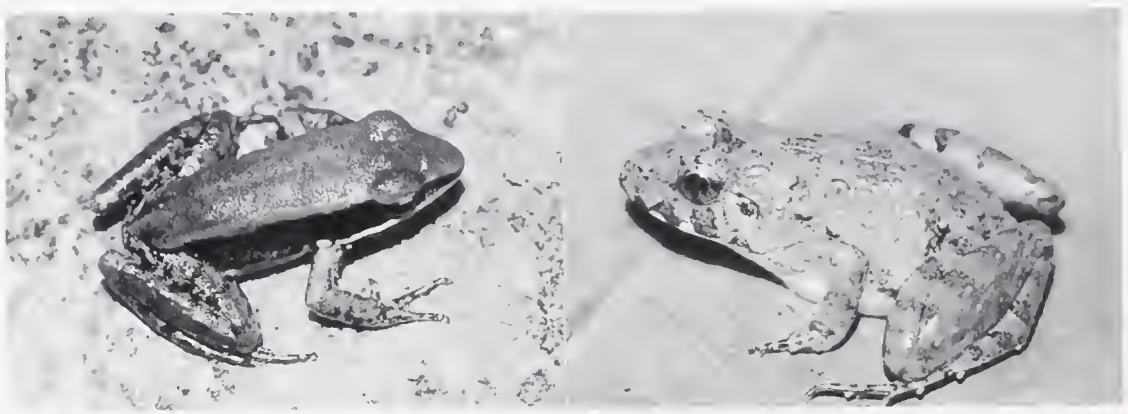

FIG. 2. The Chitwan frogs *Rana danieli* (left; USNM 266838) and *Rana syhadrensis* (right; USNM 266878).

snout to the cloacal opening; carapace length (CL) in turtles is the straight-line distance of the shell on the midline. Body weights (g) were taken with a Pesola scale. Statistics were performed by a PC version of Statistix 4.0. A priori statistical significance was set at $\alpha = 0.05$; means are followed by ± one standard deviation.

Species Accounts

The herpetofauna of the Chitwan area consists of 11 amphibians and 44 reptiles (Table 1). At this time, none of the amphibians or terrestrial reptiles are considered threatened, and only the two crocodilians are officially recognized as endangered or threatened species.

Estimates of abundance are desirable, but our field work did not coincide with the seasons of likely greatest activity for most species. Premonsoonal conditions are drought-like, and these conditions suppress the activity of most species except for a few lizards. The postmonsoonal visit occurred as day and night time temperatures were declining, and over the two week visit, lizards slowly disappeared. Nonetheless, our observations show the herpetofauna of RCNP to be rich and diverse.

Frogs

Bufo. Neither of the two toad species (*B. melanostictus, B. stomaticus*) were common. We captured nine individuals, only one of which was a *B. melanostictus* (32.1 mm SVL, 3 g). This latter individual was discovered (November) beneath a decomposing log in the forest. All *B. stomaticus* occurred in human-modified habitats. Recent metamorphs (9.4 ± 0.9 mm SVL, $n = 5$) were captured (April) on a mud bank of the Rapti River.

Rana cyanophlyctis. The skittering frogs were the most abundant of the Chitwan postmonsoonal amphibians; none were seen in April. They occurred in a wide variety of flood plain habitats from riverside to the small ponds and streams in the terai grassland and farmlands. In late afternoon and at night, numerous individuals sat at the water's edge on the bank and in the water. Human or animal movement along the shore would send the frogs skittering outward on the river in a semicircular path, some frogs landing behind the disturbance, others ahead and then repeating the escape or avoidance reaction.

Of the *R. cyanophlyctis* captured ($n = 27$), only a single female (55.2 mm SVL) was sexually mature. The immature frogs ranged 25.9 - 50.2 mm SVL; presumably they all represent young of the year, although derived from egg clutches laid at different times during the monsoon rains. This sample yields a regression, Mass = -9.0814 + 0.4184 SVL ($r = 0.90$).

Rana danieli(Fig. 2). Three juveniles (31 - 38 mm SVL) were found in the sal forest. The premonsoonal individual occurred beneath a log (with a *R. syhadrensis)* beside a small stream; the two postmonsoonal frogs were beneath logs on the forest floor 10 m or more from a small stream. These individuals represent the first *R. danieli* from Nepal and are a significant westward range extension (700 km) from the Indian type locality in the Khasi Hills, Assam (Pillai and Chanda, 1977).

Rana limnocharis. Three species (*R. limnocharis, pierrei, syhadrensis*) of the *limnocharis* complex occur in Chitwan. Our observations show *R. limnocharis* and *R. syhadrensis* to be forest-floor species and syntopic in sal forest. Two adult male *R. limnocharis* (36.2 & 44.3 mm SVL, 3.0 & 8.5 g) were captured (November) beneath logs; a few other individuals were seen in the sparse ground litter of the sal forest.

Rana pierrei. A single immature male (46.0 mm SVL, 10.8 g) was discovered (November) sitting in the "lawn" of the SI camp at night.

Rana syhadrensis(Fig. 2). Of the Chitwan frogs, *R. syhadrensis* was abundant during both the pre- and postmonsoonal surveys. Most individuals captured were juveniles (41 of 42) with SVL <31 mm (18 - 30 mm SVL). Two recent metamorphs (18 mm SVL) were captured (April) in the leaf litter along the bank of a small sal forest stream. Most individuals were captured (April & November) beneath forest-floor litter or in tree buttresses.

Rana tigerina. Two individuals, both immature (44.7 & 63.3 mm SVL), were found in or near rhino wallows within riverine forest.

Tomopterna breviceps. We saw no individuals of this species during our pre- and postmonsoonal sampling. Their absence at these time supports Schleich and Maskey's comment (1992) that *Tomopterna* are active on the surface only during the breeding season at the beginning of the monsoon.

Turtles

Turtles are uncommonly seen in the park's waters, grassland, and forest. When they are found, they become food for local inhabitants. Our turtle sightings and vouchers derive mainly from shells on kitchen middens or shells nailed to walls of local tea shops.

Indotestudo elongata. Frazier (1992) showed that this species is the only tortoise confirmed to occur in Nepal. Earlier reports of *Geochelone elegans* and *Testudo horsfieldii* are incorrect, usually misidentifications. We saw in several tea houses tortoise shells nailed to the wall as decoration. Our voucher is a shell salvaged from a dog at the Smithsonian camp. Its anterior end had been sawed off, attesting to tortoises as local food items.

Melanochelys trijuga. An adult female (215 mm CL; 1.2 kg) was found (Oct.) in the grass bordering a rhino wallow next to a patch of riverine forest. She was judged to be 7 yr old and had grown an average of 20.4 mm/yr (PL) since hatching. Dinerstein et al. (1988) provided additional information on this female and on the occurrence of this species in Nepal..

Lizards

Calotes versicolor. The garden lizard was the most common of Chitwan lizards, and the most readily observed reptile, owing to their use of elevated forage and basking sites on shrubs, trees, fence posts, etc. Adult males (87.1 ± 6.8 mm SVL, 71.3 - 97.0 mm. n = 16; 22.5 ± 5.9 g, 8.8 - 30.3 g, n = 16) averaged larger than adult females (77.9 ± 8.5 mm SVL, 66.7 - 87.0 mm, n = 7; 15.2 ± 6.2 g, 9.1 - 22.4, n = 5). Adults (21:1, adults:juveniles) predominated in the premonsoonal sample and juveniles (2:4) in the postmonsoonal one. The presence of gravid females in the premonsoon period and juveniles in the postmonsoonal suggest that most egg-laying occurs at the beginning of the monsoon in Chitwan. The postmonsoonal juveniles averaged 53.7 ± 25 mm SVL (50.0 - 55.7 mm) and presumably represent the size of the

FIG. 3. A possible defense mechanism; neural spines projecting through the median row of dorsal scales in a *Bungarus fasciatus* (USNM 267012) from the Royal Chitwan National Park.

season's cohort at the end of its first growing season.

Body temperatures of adults basking in the mid morning (0800-0950 hr; April) averaged 35.3 ± 1.64° C (33.4 - 38.2, n = 11) compared to an average ambient temperature (in shade) of 33.9 ± 0.86 (30.4 - 32.5, n = 5). The body temperature of a single juvenile, captured in the shade, was 32.2° C, identical to ambient temperature

Hemidactylus. We observed three of the four Chitwan geckos (Table 1). The rarity of *H. flaviviridis, H. frenatus,* and *H. garnotii* and their exclusive commensal occurrence suggest that these three species are exotics. In contrast, *H. brookii* is abundant both on human-made structures and in some forested sites. We provided a brief review (Mitchell and Zug, 1988) of *H. brookii* biology around the Smithsonian camp.

Female *H. brookii* mature at 43 mm SVL, males at 42 mm. They are active at night in the forest and on buildings. During the day, forest individuals hide beneath the bark of dead trees, in litter filled tree buttresses, and beneath logs. Four *H. frenatus* (37 - 53 mm SVL) and two *H. garnotii* (52 - 55 mm SVL) were captured on the camp building during the *H. brookii* survey; none were seen in the adjacent forest.

Scincella sikimmensis. Three adult *Scincella* (31 - 35 mm SVL) were found beneath logs or litter in the riverine and sal forest. The two *Mabuya* (*M. dissimilis, M. macularia*) appear to be more open-habitat denizens, e.g., at the forest edge or along trails in the grassland, although a *M. macularis* was found beneath a log with a *S. sikimmensis*.

Snakes

Snakes suffer the same level of persecution in the Chitwan area as in most rural communities, i.e., death when seen. The local population is primarily Hindu, although some of the original Chitwan residents, Tharu, remain. There is no evidence of either culture practicing tolerance of snakes, and the Tharu are

reported to eat pythons (but no other snake species) and varanid lizards.

Amphiesma stolata. Two males (387 & 440 mm SVL, 19 & 22 g) were found dead on unpaved streets in Sauraha in April. Villagers said that smaller one was found in a house and killed and the other one in a drainage ditch. Children had killed both of them and tossed them on the street.

Lycodon aulicus. A female (181 mm SVL, 2 g) was discovered in soil beneath a rotting stump in November. Possibly, she was preparing to hibernate.

Oligodon arnensis. An adult male (662 mm SVL, 17.1 g) was captured at 2100 hr (April) crossing a path in the Smithsonian camp. To avoid capture, it flattened its head by the lateral extension of the proximal ends of the jaws and struck repeatedly with the mouth open. The strike behavior was a bluff, because it did not bite even though its mouth contacted a plastic bag several times. Also it coiled several times in a three minute interval; the head was flattened and held close to the body, and it struck laterally several time from this posture. Its tail was partially coiled but never in the defensive posture described for other *Oligodon* species (Greene, 1973). Daniel (1983) reported body inflation and head flattening in this species. This individual inflated its body only slightly. Its body temperature was 27.8° C, compared to 29.2° C ambient air temperature, suggesting that it had emerged recently from its daytime retreat.

Bungarus fasciatus. An adult female (1570 mm SVL) was killed in the Smithsonian camp (April) one evening. Presumably during the human attack, she voluntarily extruded 36 neural spines through the vertebral scales (Fig. 3). Neural spines are exposed in this individual at vertebral scale 11 (counting posteriorly from the parietal scale), 136-139, 142-157, 172-178, 181, 184-189, and 190-191. Several spines protrude 3 mm above the scale surface, and in other instances, vertebral scales are slit longitudinally but the neural spines do not project presently above or through the scale.

A. H. Savitzky (personal communication & in lecture) called our attention to this novel antipredator mechanism. He has also discovered that several other species of kraits show this specialized behavior and have a specialized epaxial musculature and suture zones in the vertebral scales to effect the extrusion of the sharp neural spines when grasped by a predator.

Naja naja. A single individual was seen at midday (1300 hr) basking (approx. 1.2 m above the ground) on a large clump of elephant grass beside a game trail in the grassland.

Comments

The known Chitwan herpetofauna consists predominantly (>75%) of widespread Indian-Oriental (as defined by Leviton and Swan, 1962) taxa. The exceptions are either Himalayan or Indochinese-Himalayan taxa. *Rana danieli, R. pierri, R. syhadrensis,* and *Scincella sikimmensis* represent the Himalayan element and they are predominantly low-to moderate elevation species confined to the southern face of the Himalayas and its foothills. *Indotestudo, Elachistoon, Boiga ochracea,* and *Trimeresurus albolabris* share a similar Himalayan distribution as the preceding group, but have distributions extending into western Indochina.

One additional frog, *Microhyla ornata,* is a likely resident of Chitwan. It is reported higher in the Rapti drainage system (Nahoe and Ouboter, 1987), as well as being widespread in northern India. We excluded it from the present list, because we found no literature or specimen voucher placing it adjacent or within the RCNP.

In summary, the Chitwan herpetofauna consists of 11 frogs and 44 reptiles. With a few exceptions, the taxa represent a subset of the herpetofauna of northern India. As human population growth continues, the value of RCNP and its resident animals and plants will increase as an essential biological reserve.

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Appendix

Notes to Table 1

1. MNHN specimens, Dubois (1974: appendix).

2. Schleich and Maskey (1992) state that two species of *Tomopterna* are known from Chitwan, but they do not identify either species.

3. Schleich and Maskey (1992) report voucher specimens.

4. Iverson (1992).

5. Moll (1984) lists 14 turtle species from the Gandak River south of the Gandak Dam to Bettiah. Since the Gandak R. is a continuation of the Narayni R. in India, some of these species (*Geoclemys hamiltoni, Hardella thurji, Kachuga smithi, K. tentoria, Morenia petersi, Lissemys punctata, Aspideretes hurum*) might also occur in Chitwan.

6. Schleich and Maskey (1992) report a voucher specimen. Moll and Vijaya (1986) report a Chitwan occurrence based on a photograph.

7. Gurung (1989); we have excluded other species from Gurung's list because they appear to be misidentifications, e.g., *Enhydris enhydris, Rhapdophis subminata.*

8. Royal Chitwan National Park headquarter's synoptic collection.

9. Kramer (1977).

10. Gaida Wildlife Camp synoptic collection.

11. Swan and Leviton (1968).

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