



Herpetofauna of a Ramsar Site: Beeshazar and Associated Lakes, Chitwan National Park, Nepal

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Abstract.—The Nepalese herpetofauna has been poorly studied, and little is known about the distribution of the country's amphibians and reptiles. We surveyed the herpetofauna at Beeshazar and associated lakes, a Ramsar site situated in the buffer zone of Chitwan National Park, Nepal. We conducted surveys between June and July 2015 using line transects, and nocturnal and diurnal visual encounter surveys (VES). We recorded 47 species comprising 13 anurans, 11 lizards, 18 snakes, four turtles, and one crocodylian. This document will serve as source material for outreach activities in conservation awareness of the herpetofauna in the buffer zone of the park. The present study suggests that the species composition of Beeshazar and associated lakes is likely to increase with additional systematic inventories.

Key words: Herpetofauna, species richness, Beeshazar Lake, Chitwan National Park, Nepal

Amphibians and reptiles have received a lower conservation priority in Nepal when compared to birds and mammals (Schleich and Kästle 2002). This could be due to lack of interest by researchers or the relatively small size of the species and their cryptic nature (e.g., Vitt et al. 2003). Herpetofaunal studies in Nepal date to Hodgson's collections between 1826 and 1854 (Günther 1860, 1861). The first zoogeographic information on the herpetofauna by Swan and Levinton (1962) laid the foundation for modern Nepalese herpetology. Since then, Dubois (1974, 1984), Fleming and Fleming (1973), Kramer (1977), Nanhoe and Ouboter (1987), Zug and Mitchell (1995), Das (1998), O'Shea (1998), Shrestha (2000), Schleich and Kästle (2002), Tillack et al. (2003), Shah and Tiwari (2004), Aryal et al. (2010), Pandey (2012), and Kästle et al. (2013), among others, contributed either by describing new species or recording taxa new to the country. Most of the above-mentioned studies were limited to eastern and central Nepal and frequently omitted locality records. Although that collective work yielded records for 53 species of amphibians and 137 species of reptiles in Nepal, many habitats remain to be explored both within and outside the previously studied areas.

Beeshazar and associated lakes are the part of the Barandabhar corridor forest that connects Chitwan National

Park in the south and the Mahabharat Mountains (Pandey 2012; Lamichhane et al. 2013) to the Annapurna Himalayan range in the north. This corridor, part of the Terai Arc Landscape (TAL), is considered to be biologically important. The fringe forests of the eastern and western portions of the corridor (to 300 m from the edges) are managed and utilized by local communities as Buffer Zone Community Forests (Government of Nepal 2015). The lake systems are characterized by a mosaic of subtropical forests, grasslands, and pools of water. The vegetation has been categorized as Sal mixed forests, riverine forests, and grasslands (Verheugt 1995; Government of Nepal 2014). The lake system is bordered by the national east-west highway to the north, the Rapti River to the south, and by villages to the east and west. These lake systems are home to several endangered or threatened mammals, including the Bengal Tiger (*Panthera tigris*), One-horned Rhinoceros (*Rhinoceros unicornis*), Asian Elephant (*Elephas maximus*), and critically endangered birds like the White-rumped Vulture (*Gyps bengalensis*). Due to their global significance, these lake systems were designated as a Ramsar Site in 2003. They also have been listed as an Important Bird Area (IBA) for Nepal (Government of Nepal 2015). However, invasive exotics such as Bitter Vine (*Mikania macrantha*), Bitterbush (*Cromolima odorata*), and Common Water

Hyacinth (*Echornia crassipes*) are major threats to the habitat. This invasion of exotics could lead to the local extirpation of species, including herpetofauna, even before identification and formal documentation.

On a global scale, herpetofauna are declining more rapidly than birds and mammals (Stuart et al. 2004). Conservation strategies are planned and executed for large charismatic mammals and birds, but snakes, lizards, and frogs are often overlooked (Vasudevan et al. 2006; Chettri et al. 2011). The inclusion of such neglected species in management plans is necessary for the conservation of overall biodiversity at local and regional levels (Pawar et al. 2007; Chettri et al. 2011). Documenting the biodiversity of Beeshazar and associated lakes has been limited to mammals and birds. Hence, this paper provides the first documentation of the herpetofauna in the region.

Methods

Beeshazar and associated lakes (27°37'04.6"N, 84°26'11.3"E, area; 3,200 ha) are situated in the buffer zone of the Chitwan National Park, a World Heritage Site

(Fig. 1). This is an oxbow lake system in which water is received through direct precipitation and from the inflow of the Khageri Canal. The monsoon season extends from June to September. The lake systems provide irrigation water to nearly 60,000 farmers in western Chitwan. Selected sampling sites represented important features or habitats and are listed and described in Table 1.

From June to July 2015, we surveyed the herpetofauna along ten permanent line transects laid by Chitwan National Park and the National Trust for Nature Conservation-Biodiversity Conservation Center (NTNC-BCC) for monitoring and research activities in the Barandabhar corridor. These transects run east-to-west across the vegetational distribution gradient. We conducted line transect surveys only during the day. In addition, we conducted both diurnal and nocturnal Visual Encounter Surveys (VES; e.g., Heyer et al. 1994), searching for herpetofauna between 0600 and 1100 h and from 1800 to 2300 h. We concentrated search activity in and around the bodies of water and marshy lands where herpetofauna tend to aggregate (Naniwadekar and Vasudevan 2007). We examined microhabitats such as leaf litter, dead

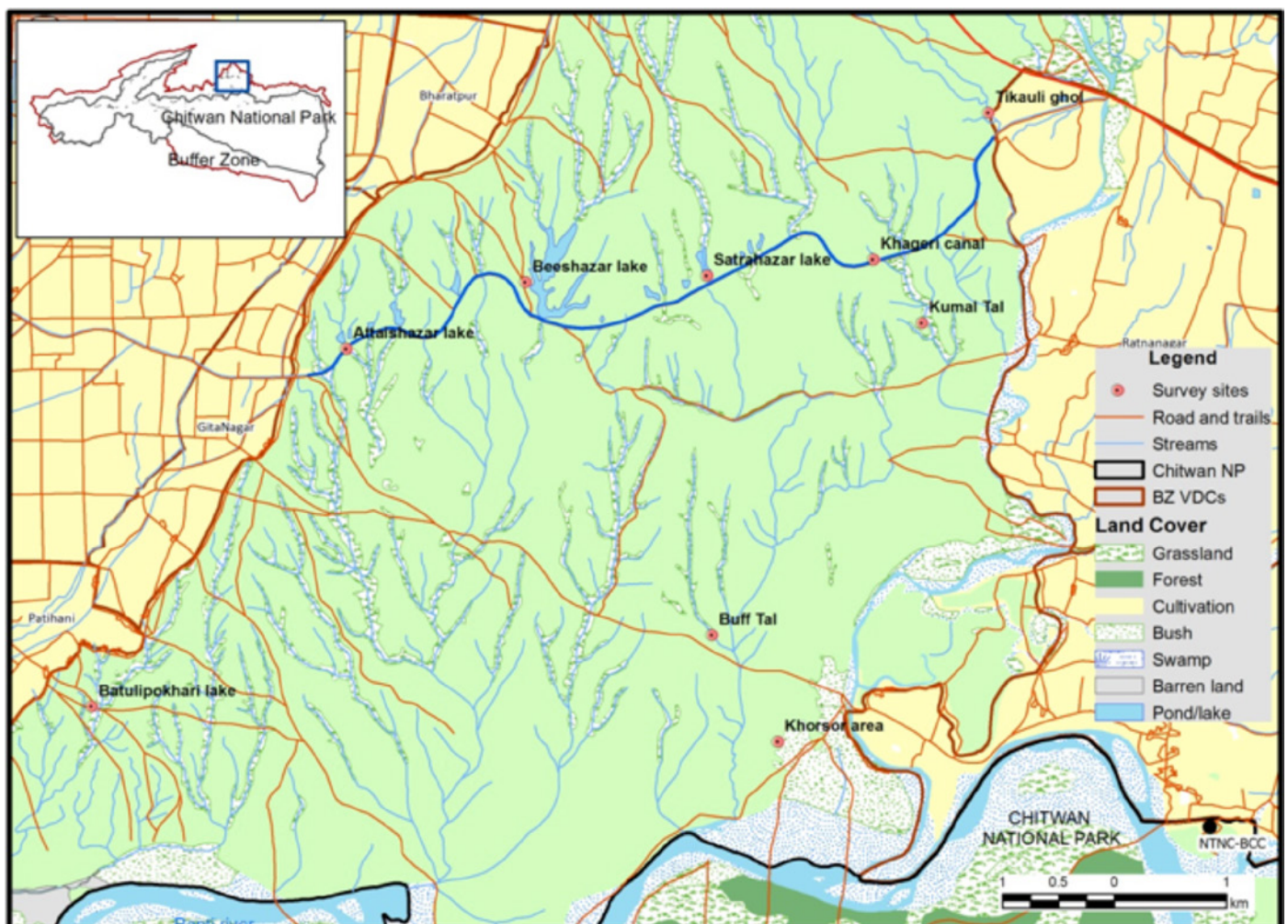


Fig. 1. Map showing survey sites at Beeshazar and associated Lakes, a Ramsar site in the buffer zone of Chitwan National Park, Nepal.

Table 1. Description of sampling sites (see also Fig. 1).

Site	GPS Coordinates	Bio-physical description of site
Beeshazar Lake	27°37'04.6"N, 84°26'11.3"E	Oxbow lake; tourist destination; forest is dominated by Sal (<i>Shorea robusta</i>); rest place for tourists available; home to >250 species of birds.
Satrahazar Lake	27°37'06.3"N, 84°27'10.4"E	Associated with Beeshazar Lake; surrounding vegetation dominated by Sal (<i>Shorea robusta</i>); lake invaded by aquatic species; situated in the core of the buffer zone.
Kumal Tal	27°36'52.3"N, 84°28'20.4"E	Managed by Milijuli Buffer Zone Community Forest.
Buff Tal	27°35'21.9"N, 84°27'11.6"E	Managed by Mrigakunj Buffer Zone User Committee; tower for tourists available; geckos are commonly seen on tower.
Attaishazar Lake	27°36'38.7"N, 84°25'03.2"E	Managed by Navajyoti Buffer Zone Community Forest; situated in western part of the corridor.
Tikauli Ghol	27°37'53.3"N, 84°28'42.5"E	Managed by Tikauli Buffer Zone Community Forest; situated in eastern part of the corridor.
Batulipokhari Lake	27°35'01.7"N, 84°23'49.3"E	Managed by Batulipokhari Buffer Zone Community Forest; local tourist destination; boating is practiced in the lake.
Khorsor area	27°34'53.3"N, 84°28'31.5"E	In the south-east corner of the Barandabhar corridor; vegetation dominated by Sal (<i>Shorea robusta</i>); elephant breeding center.
Open grasslands		Small patches and open areas dominated by species like <i>Sacchrum</i> sp., <i>Narenga</i> sp.; mainly used by ungulates.
Riverine forests		Forests on banks of streams, channels, and rivers; trees mainly dominated by <i>Trewia nudiflora</i> , <i>Syzygium cumini</i> .
Khageri Canal	27°37'10.8"N, 84°28'04.8"E	Serves as both inlet and outlet for the Beeshazar Lake system and provides irrigation water to farmers in western Chitwan.
Forests roads and trails		Nature trails, drivable roads, and fire-lines; mainly dominated by Sal (<i>Shorea robusta</i>) forest.

bark of trees, fallen logs, and pools of water, as well as artificial structures that included wooden towers in the forests and grasslands and check-posts and wooden shelters built for tourists. For arboreal herpetofauna, we carefully observed branches and bushes, using flashlights for nocturnal surveys. Upon detection of an animal, we recorded morphometric data and microhabitat before releasing it at the exact site of capture. We used a Canon Power Shot SX 60 HS digital camera for photographic documentation.

We also recorded herpetofauna encountered during regular monitoring of Barandabhar corridor forests, and amphibians and reptiles adventitiously encountered elsewhere and outside specific survey periods were annotated as opportunistic data. We pooled opportunistic records with survey data to better document the species richness of the area.

We used published literature and field guides (Smith 1935, 1943; Schleich and Kästle 2002; Das 2002; Shah and Tiwari 2004; Ahmed et al. 2009; Vasudevan and Sondhi 2010) to identify herpetofauna. Nomenclature and taxonomic arrange-

ments follow Frost (2017) and Uetz et al. (2016) for amphibians and reptiles, respectively.

Results

Combining all methods, we documented 47 species of herpetofauna (Table 2), 13 species of amphibians (Table 3; Figs. 2–3) and 34 species of reptiles (Table 4; Figs. 4–9) in the study area. All recorded species of amphibians were anurans, distributed in four families and eight genera. Among reptiles, snakes were represented by 18 species in seven families and 15 genera, lizards by 11 species in four families and six genera, turtles by four species in three families and three genera, and crocodiles by a single species. We detected more species ($n = 37$) during nocturnal VES than diurnal VES ($n = 22$), transect surveys ($n = 18$), and opportunistic records ($n = 26$). Among the sampling sites, the Khorsor area yielded the greatest species richness ($n = 29$) followed by Beeshazar Lake ($n = 28$), forest roads and trails ($n = 26$), Attaishazar Lake ($n = 24$), Khageri Canal ($n = 23$), Batulipokhari ($n = 22$), Buff Tal

(n = 21), riverine forest (n = 20), open grasslands (n = 19), Tikaulighol (n = 18), Satrahazar Lake (n = 13), and Kumal Tal (n = 10).

Thirty of the 47 species recorded (64%) have not been assessed using IUCN Red List criteria (IUCN 2012). The Burmese Python (*Python bivittatus*) and Mugger Crocodile



Fig. 2. Anurans recorded during surveys at Beeshazar and associated lakes: (A) Common Asian Toad (*Duttaphrynus melanostictus*); (B) Marbled Toad (*D. stomaticus*); (C) Skittering Frog (*Euphlyctis cyanophlyctis*); (D) Indian Bullfrog (*Hoplobatrachus tigerinus*); (E) Indian Burrowing Frog (*Sphaerotheca breviceps*); (F) Indian Painted Frog (*Uperodon taprobanicus*).

Table 2. Summary of the amphibians and reptiles recorded in each sampling site.

Sampling site	Number of Species Recorded					
	Frogs	Snakes	Lizards	Turtles	Crocodiles	Total
Beeshazar Lake	12	7	7	1	1	28 (47)
Satrahazar Lake	9	2	1	—	1	13 (47)
Kumal Tal	7	1	2	—	—	10 (47)
Buff Tal	11	1	6	2	1	21 (47)
Attaishazar Lake	10	7	7	—	—	24 (47)
Tikauli Ghol	9	2	6	—	1	18 (47)
Batuli Pokhari Lake	9	6	5	1	1	22 (47)
Khorsor	10	9	8	2	—	29 (47)
Open grasslands	12	1	6	—	—	19 (47)
Riverine forests	12	1	7	—	—	20 (47)
Khageri Canal	13	3	5	1	1	23 (47)
Forests roads and trails	13	6	6	1	—	26 (47)

Table 3. Anurans recorded during surveys at sampling sites in the Beeshazar and associated lakes region. Sampling sites: Beeshazar Lake (1), Satrahazar Lake (2), Kumal Tal (3), Buff Tal (4), Attaishazar Lake (5), Tikauli Ghol (6), Batulipokhari Lake (7), Khorsor (8), open grasslands (9), riverine forests (10), Khageri Canal (11), and forest roads and trails (12). An asterisk (*) denotes that an individual of that species was detected at that sampling site.

Species	Sampling Sites											
	1	2	3	4	5	6	7	8	9	10	11	12
BUFONIDAE Gray, 1825												
<i>Duttaphrynus melanostictus</i> (Schneider, 1799) Fig. 2A	*	*	*	*	*	*	*	*	*	*	*	*
<i>D. stomaticus</i> (Lütken, 1864) Fig. 2B	*	*	*	*	*	*	*	*	*	*	*	*
DICROGLOSSIDAE Anderson, 1871												
<i>Euphlyctis cyanophlyctis</i> (Schneider, 1799) Fig. 2C	*	*	*	*	*	*	*	*	*	*	*	*
<i>Fejervarya nepalensis</i> (Dubois, 1975)	*	*	—	*	*	—	—	—	*	*	*	*
<i>F. pierreie</i> (Dubois, 1975)	*	*	*	—	—	*	—	—	*	—	*	*
<i>F. syhadrensis</i> (Annandale, 1919)	*	*	*	*	*	*	*	*	*	*	*	*
<i>F. teraiensis</i> (Dubois, 1984) Fig. 3A	*	—	—	*	—	*	—	—	—	*	*	*
<i>Hoplobatrachus tigerinus</i> (Daudin, 1802) Fig. 2D	*	*	*	*	*	*	*	*	*	*	*	*
<i>Sphaerotheca breviceps</i> (Schneider, 1799) Fig. 2E	*	—	—	—	*	*	*	*	*	*	*	*
MICROHYLIDAE Gunther, 1858												
<i>Microhylla ornata</i> (Dumeril & Bibron, 1841) Fig. 3C	*	*	*	*	*	—	*	*	*	*	*	*
<i>Uperodon taprobanicus</i> (Parker, 1934) Fig. 2F	—	—	—	—	—	—	—	*	*	*	*	*
RHACOPHORIDAE Hoffman, 1932												
<i>Polypedates maculatus</i> (Gray, 1830) Fig. 3D	*	*	—	*	*	*	*	*	*	*	*	*
<i>P. taeniatus</i> (Boulenger, 1906) Fig. 3E	*	—	—	*	*	—	*	*	*	*	*	*



Fig. 3. Additional anurans recorded during surveys at Beeshazar and associated lakes: (A) Terai Cricket Frog (*Fejervarya teraiensis*); (B) Terrestrial Frog (*Fejervarya* sp.); (C) Ornate Narrow-mouthed Frog (*Microhyla ornata*); (D) Indian Treefrog (*Polypedates maculatus*); (E) Terai Treefrog (*P. taeniatus*).

(*Crocodylus palustris*) are listed as Vulnerable (VU) and the Elongated Tortoise (*Indotestudo elongata*) as Endangered (EN) in the IUCN Red List (IUCN 2016). *Python bivittatus* and the Yellow Monitor (*Varanus flavescens*) are legally protected reptiles and are accorded the highest degree of protection under the 1973 National Parks and Wildlife Conservation Act of Nepal.

Among amphibians, the Skittering Frog (*Euphlyctis cyanophlyctis*) was the most widely distributed, detected not only in all sampling sites but also outside the study area in agricultural fields and in small ponds, where frogs were sometimes basking on the bodies of wallowing buffaloes. We encountered calling aggregations of Terai Treefrogs (*Polypedates taeniatus*) only in open areas where they perched on and called from blades of grass. We also observed a Buff-striped Keelback (*Amphiesma stolatum*) feeding on a Common Asian Toad (*Duttaphrynus melanostictus*) and a Checkered Keelback (*Xenochropis piscator*) captured by a Crested Serpent Eagle (*Spilornis cheela*) in the Khageri Canal.

Discussion

The use of multiple methods is an effective approach for recording the cryptic species. We documented 25% of the species richness of the total herpetofauna known to occur in Nepal. The Government of Nepal (2014) approved a site management plan for Beeshazar and associated lakes. This management plan includes 18 species of amphibians and reptiles in the area. However, a list of species present in the area had not been included in the site management plan. Therefore, our results provide baseline data on the herpetofauna in the form of an annotated species checklist.

Despite sharing many habitats with Chitwan National Park, many researchers have overlooked the potential of the area. The Beeshazar and associated lakes area only became a conservation priority after its designation as a Ramsar Site and the declaration of the forest area as the Barandabhar Biological Corridor. Zug and Mitchell (1995) reported 55 species of herpetofauna from Chitwan National Park. We documented *Sphaerotheca maskeyi* (now considered a syn-

Table 4. Reptilian species recorded during surveys at sampling sites in the Beeshazar and associated lakes region. Sampling sites: Beeshazar Lake (1), Satrahazar Lake (2), Kumal Tal (3), Buff Tal (4), Attaishazar Lake (5), Tikauli Ghol (6), Batulipokhari Lake (7), Khorsor (8), open grasslands (9), riverine forests (10), Khageri Canal (11), and forest roads and trails (12). An asterisk (*) denotes that an individual of that species was detected at that sampling site.

Species	Sampling sites												
	1	2	3	4	5	6	7	8	9	10	11	12	
GEKKONIDAE Gray, 1825													
<i>Hemidactylus brookii</i> Gray, 1845 Fig. 4B	—	—	—	*	*	*	*	*	*	—	—	—	
<i>H. flaviviridis</i> Rüppell, 1835 Fig. 4A	*	—	—	*	*	*	*	—	—	—	—	—	
<i>H. frenatus</i> Dumeril & Bibron, 1836 Fig. 4C	*	—	—	*	*	*	*	*	—	—	—	—	
AGAMIDAE Gray, 1827													
<i>Calotes versicolor</i> complex (Daudin, 1802) Fig. 4D	*	*	*	*	*	*	*	*	*	*	*	*	
SCINCIDAE Gray, 1825													
<i>Eutropis carinata</i> (Schneider, 1801) Fig. 4E	*	—	*	*	*	*	—	*	*	*	*	*	
<i>E. dissimilis</i> (Hallowell, 1857)	—	—	—	—	—	—	—	—	*	*	*	*	
<i>E. macularia</i> (Blyth, 1853) Fig. 4F	*	—	—	*	—	—	—	*	*	*	*	*	
<i>Lygosoma punctata</i> (Gmelin, 1799)	—	—	—	—	—	—	—	—	*	*	—	—	
<i>Sphenomorphus maculatus</i> (Blyth, 1853)	—	—	—	—	—	—	—	*	—	*	—	—	
VARANIDAE Merrem, 1820													
<i>Varanus bengalensis</i> (Daudin, 1802) Fig. 5A	*	—	—	—	*	—	—	*	—	*	*	*	
<i>V. flavescens</i> (Hardwicke & Gray, 1827) Fig. 5B	*	—	—	—	*	*	*	*	—	—	—	*	
TYPHLOPIDAE Merrem, 1820													
<i>Indotyphlops braminus</i> (Daudin, 1803) Fig. 6A	—	—	—	—	—	*	—	*	—	—	—	—	
BOIDAE Gray 1825													
<i>Eryx conicus</i> (Schneider, 1801) Fig. 6B	—	—	—	—	—	—	—	—	—	—	—	*	
PYTHONIDAE Fitzinger, 1826													
<i>Python bivittatus</i> Kuhl, 1820 Fig. 6C	*	—	—	*	*	—	*	—	—	*	*	*	
COLUBRIDAE Oppel, 1811													
<i>Ahaetulla nasuta</i> , (Bonnaterre, 1790) Fig. 6D	—	—	—	—	*	—	—	*	*	—	—	—	
<i>Boiga trigonata</i> (Schneider, 1802) Fig. 7A	*	—	—	—	—	—	—	—	—	—	—	*	
<i>Chrysopelea ornata</i> (Shaw, 1802) Fig. 7B	—	—	—	—	—	—	—	—	—	—	—	*	
<i>Dendrelaphis tristis</i> (Daudin, 1803) Fig. 7C	*	*	—	—	*	—	*	—	—	—	*	—	
<i>Lycodon aulicus</i> (Linnaeus, 1758) Fig. 7D	—	—	—	—	—	—	—	*	—	—	—	—	
<i>L. jara</i> (Shaw, 1802) Fig. 7E	—	—	—	—	—	—	—	—	—	—	—	*	
<i>Oligodon arnensis</i> (Shaw, 1802) Fig. 7F	—	—	—	—	—	—	—	*	—	—	—	—	
<i>Ptyas mucosa</i> (Linnaeus, 1758) Fig. 8A	*	*	—	—	*	—	*	—	—	—	—	*	
ELAPIDAE F. Boie, 1827													
<i>Bungarus caeruleus</i> (Schneider, 1801)	—	—	—	—	—	*	*	—	—	—	—	—	
<i>B. fasciatus</i> (Schneider, 1801) Fig. 8B	—	—	—	—	*	—	—	*	—	—	—	—	
<i>B. lividus</i> Cantor, 1839 Fig. 8C	—	—	—	—	—	—	*	*	—	—	—	—	
<i>Naja naja</i> (Linnaeus, 1758) Fig. 9A	*	—	*	—	*	—	—	*	—	—	—	—	
NATRICIDAE Bonaparte, 1838													
<i>Amphiesma stolatum</i> (Linnaeus, 1758) Fig. 8D	*	—	—	—	—	—	—	*	—	—	—	—	
<i>Xenochropis piscator</i> (Schneider, 1799)	*	—	—	—	*	—	*	—	—	—	*	—	
VIPERIDAE Oppel, 1811													
<i>Trimeresurus septentrionalis</i> Kramer, 1977 Fig. 8E	—	—	—	—	—	—	—	*	—	—	—	—	
TRIONYCHIDAE Fitzinger, 1826													
<i>Lissemys punctata andersoni</i> Webb, 1980	*	—	—	*	—	—	*	—	—	—	*	—	
GEOEMYDIDAE Theobald, 1868													
<i>Melanocheilus trijuga indopeninsularis</i> (Annandale, 1913)	—	—	—	*	—	—	—	—	—	—	—	—	
<i>Melanocheilus tricarinata</i> (Blyth, 1856)	—	—	—	—	—	—	—	*	—	—	—	*	
TESTUDINIDAE Batsch, 1788													
<i>Indotestudo elongata</i> (Blyth, 1854) Fig. 9B	—	—	—	—	—	—	—	*	—	—	—	—	
CROCODYLIDAE Cuvier, 1806													
<i>Crocodylus palustris</i> Lesson, 1831 Fig. 9C	*	*	—	*	—	*	*	—	—	—	*	—	



Fig. 4. Lizards recorded during surveys at Beeshazar and associated lakes: (A) Yellow-bellied House Gecko (*Hemidactylus flaviviridis*); (B) Brook's House Gecko (*H. brooki*); (C) Common House Gecko (*H. frenatus*); (D) Oriental Garden Lizard (*Calotes versicolor* complex); (E) Common Indian Skink (*Eutropis carinata*); (F) Bronze Skink (*E. macularia*).

onym of *S. breviceps*; Schleich and Kästle 2002; Frost 2017) from Beeshazar and associated lakes; the type locality of that taxon is in Chitwan National Park (Schleich and Anders 1998). Shah and Tiwari (2004) reported *S. breviceps* from Chitwan National Park, and Khatiwada and Haugaasen (2015) reported it from outside the Protected Area, but our record is the first documenting the occurrence of *S. breviceps* in the Beeshazar and associated lakes area. Schleich and Kastle (2002) noted that the first record of *Polypedates taeniatus* for Nepal had been found by Schleich in 1989. We also recorded this species in the Beeshazar and associated lakes area.

During our surveys, we failed to document rare and poorly known species such as the Chitwan Frog (*Hylarana chitwanensis*) and the Nepalese Treefrog (*Polypedates zed*), both of which have type localities in Chitwan (Das 1998 and Dubois 1987, respectively). Narayanghat, the type locality for *P. zed* is now a densely populated sub-metropolitan city, and the species has been assessed as Data Deficient (DD) on the IUCN Red List (2016). No other records for this species are known. The Beeshazar and associated lakes area is less than 5 km from the type locality, and regular monitoring will be required to determine the present status of the species (i.e.,

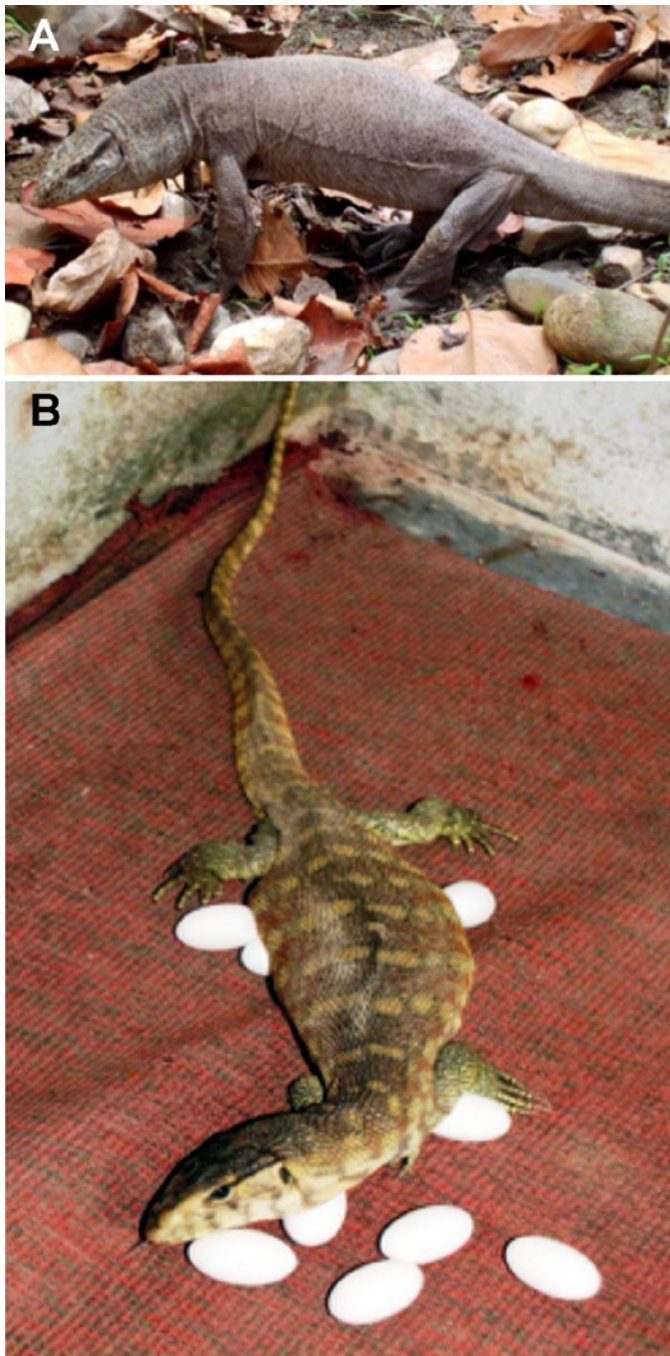


Fig. 5. Varanid lizards recorded during surveys at Beeshazar and associated lakes: (A) Bengal Monitor (*Varanus bengalensis*); (B) Yellow Monitor (*V. flavescens*). Photographs by Bishnu Lama, NTNC-BCC (A) and Babu Ram (B).

whether it is extinct, the known population has been extirpated, or it occurs in nearby suitable habitats such as those in the Beeshazar and associated lakes area).

During the survey, we also failed to record some of the reptilian species that have been encountered in the buffer villages of Chitwan National Park. Pandey (2012) reported 26 species of snakes from those surrounding villages. Of those, we did not find species such as the King Cobra (*Ophiophagus*

hannah), Copper-headed Ratsnake (*Coelognathus radiatus*), or Trinket Snake (*C. helena*) that have been rescued from villages (pers. obs.) and are likely to occur in the Beeshazar and associated lakes area.

The herpetofauna of Beeshazar and associated lakes comprises Indian genera (*Ahaetulla*, *Bungarus*, *Calotes*, *Euphlyctis*, *Hemidactylus*, *Melanocheilus*, *Sphaerotheca*), Indo-Malayan genera (*Amphiesma*, *Chrysopelea*, *Crocodylus*, *Indotyphlops*, *Lygosoma*, *Naja*, *Ptyas*, *Python*, *Varanus*, *Xenochrophis*), Indo-Chinese genera (*Kaloula*, *Microhyla*, *Polypedates*), and transitional elements (*Boiga*, *Dendrelaphis*, *Indotestudo*, *Lycodon*, *Oligodon*, *Trimeresurus*) (O’Shea 1998; Schleich and Kastle 2002). The Barandabhar Biological Corridor is connected to the Annapurna Himalayan Range in the north and to the Valmiki Tiger Reserve in India to the south. This likely facilitated the distribution of various genera. It also is part of the Terai Arc Landscape and thus is of important conservation concern. Considering the knowledge of the species richness of the herpetofauna in the area, this study is of great significance. Although current data were collected in a single season, we hope that this study will trigger additional intensive surveys that likely will record species that have not been documented to date.

The Beeshazar and associated lakes area in the buffer zone of Chitwan National Park is of considerable conservation value as a Ramsar Site, but also is a major tourist destination. The documentation of the herpetofauna from this area has immense value to help build capacity for nature guides and eco-tourism. Many youths in the area are engaged in nature tourism. Tourists across the globe visit this area throughout the year to see wildlife. The amphibians and reptiles are among the vertebrates they are most likely to observe during a visit. That nature guides are able to identify and provide accurate scientific information on the species encountered is extremely important. Moreover, as outreach material, the study has great potential for increasing the general awareness among local communities of the need for conserving the herpetofauna.

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Fig. 6. Snakes recorded during surveys at Beeshazar and associated lakes: (A) Braminy Blinksnake (*Indotyphlops braminus*); (B) Common Sandboa (*Eryx conicus*); (C) Burmese Python (*Python bivittatus*); (D) Long-nosed Treesnake (*Ahaetulla nasuta*).

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Literature Cited

- Ahmed, M.F., A. Das, and S.K. Dutta. 2009. *Amphibians and Reptiles of Northeast India — A Photographic Guide*. Aaranyak, Guwahati, India.
- Aryal, P.C., M.K. Dhamala, B.B. Bhurtel, M.K. Suwal, and B. Rijal. 2010. *Turtles of Nepal: A Field Guide for Species Accounts and Distribution*. Environmental Graduates in Himalaya, Resources Himalaya Foundation, and Companions for Amphibians and Reptiles. Kathmandu, Nepal.
- Chettri, B., B. K. Acharya, and S. Bhupathy. 2011. An overview of the herpetofauna of Sikkim with emphasis on elevational distribution pattern and threats and conservation issues, pp. 233–254. In: M.L. Arrawatia and S. Tambe (eds.), *Biodiversity of Sikkim — Exploring and Conserving a Global Hotspot*. Information and Public Relations Department, Government of Sikkim, Gangtok, India.
- Das, I. 1998. A new species of *Rana* from the Terai of Nepal. *Journal of Herpetology* 32: 223–229.
- Das, I. 2002. *A Photographic Guide to Snakes and Other Reptiles of India*. New Holland Publishers Ltd., London, UK.
- Dubois, A. 1974. Liste commentée d'Amphibiens récoltés au Nepal. *Bulletin du Muséum National d'Histoire Naturelle* (3) 213 (Zoologie 143): 341–411.
- Dubois, A. 1984. Note préliminaire sur le groupe de *Rana limnocharis* Gravenhorst, 1829 (Amphibiens, Anoures). *Alytes* 3: 143–159.
- Dubois, A. 1987. Miscellanea taxinomica batrachologica (I). *Alytes* 5: 7–95.
- Fleming, R.L. Jr. and R.L. Fleming Sr. 1973. Some snakes from Nepal. *Journal of Bombay Natural History Society*. 3: 426–437.
- Frost, D.R. 2017. Amphibian Species of the World: An Online Reference. Version 6.0. American Museum of Natural History, New York (<http://research.amnh.org/vz/herpetology/amphibia/>).
- Government of Nepal. 2014. *Site Management Plan: Beeshazar and Associated Lakes (Ramsar Site)*. Ministry of Forests and Soil Conservation, Department of National Parks and Wildlife Conservation, Chitwan National Park, Chitwan, Nepal.
- Government of Nepal. 2015. *Chitwan National Park and Its Bufferzone Management Plan 2013–2017*. Ministry of Forests and Soil Conservation, Department of National Parks and Wildlife Conservation, Chitwan National Park Office, Kasara, Nepal.
- Günther, A. 1860. Contribution to the knowledge of the reptiles of the Himalaya Mountains. *Proceedings of the Zoological Society of London* 1860: 148–175.
- Günther, A. 1861. List of the cold-blooded vertebrates collected by B. H. Hodgson Esq. in Nepal. *Proceedings of the Zoological Society of London* 1861: 213–227.
- Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L.C. Hayek, and M.S. Foster. 1994. *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians*. Smithsonian Institution Press, Washington, DC.
- IUCN (International Union for Conservation of Nature). 2012. IUCN Red List Categories and Criteria. Version 3.1. 2nd ed. IUCN, Gland, Switzerland (http://s3.amazonaws.com/iucnredlist-newcms/staging/public/attachments/3097/redlist_cats_crit_en.pdf).
- IUCN (International Union for Conservation of Nature). 2016. The IUCN Red List of Threatened Species. Version 2016.3 (<http://www.iucnredlist.org>).
- Kästle, W., K. Rai, and H.H. Schleich. 2013. *Field Guide to Amphibians and Reptiles of Nepal*. ARCO-Nepal e.V., München, Germany.
- Khatiwada, J.R. and T. Haugaasen. 2015. Anuran species richness and abundance along an elevational gradient in Chitwan, Nepal. *Zoology and Ecology* 25: 110–119.
- Kramer, U. 1977. Zur Schlangenfauna Nepals. *Revue Suisse de Zoologie* 84: 721–761.
- Lamichhane, B.R., K. Pokhrel, and A. Anderson. 2013. *Bird Monitoring in Barandabhar Corridor Forest*. Report submitted to the National Trust for Nature Conservation — Biodiversity Conservation Center, Sauraha, Chitwan, Nepal.
- Nanhoe, L.M.R. and P.E. Ouboter. 1987. The distribution of reptiles and amphibians in the Annapurna-Dhaulagiri Region (Nepal). *Zoologische Verhandlungen* 240: viii + 105 pp.
- Naniwadekar, R. and K.Vasudevan. 2007. Patterns in diversity of anurans along an elevational gradient in the Western Ghats, South India. *Journal of Biogeography* 34: 842–853.



Fig. 7. Additional snakes recorded during surveys at Beeshazar and associated lakes: (A) Common Catsnake (*Boiga trigonata*); (B) Golden Flying Snake (*Chrysopelea ornata*); (C) Common Bronze-backed Treesnake (*Dendrelaphis tristis*); (D) Indian Wolfsnake (*Lycodon aulicus*); (E) Twin-spotted Wolfsnake (*L. jara*); (F) Common Kukri Snake (*Oligodon arnensis*). Photographs D & E by Bishnu Lama (NTNC-BCC).

O'Shea, M. 1998. Herpetological results of two short field excursions to the Royal Bardia region of western Nepal, including range extensions for Assamese/ Indo- Chinese snake taxa, pp. 306–317. In: A. de Silva (ed.), *Biology and*

Conservation of the Amphibians, Reptiles, and Their Habitats in South Asia. Amphibia and Reptile Research Organization of Sri Lanka (ARROS), Peradenia, Sri Lanka.



Fig. 8. Additional snakes recorded during surveys at Beeshazar and associated lakes: (A) Oriental Ratsnake (*Ptyas mucosa*); (B) Banded Krait (*Bungarus fasciatus*); (C) Lesser Black Krait (*B. lividus*); (D) Buff-striped Keelback (*Amphiesma stolatum*); (E) Nepal Pitviper (*Trimeresurus septentrionalis*). Photographs A & B by Bishnu Lama (NTNC-BCC).



Fig. 9. Additional reptiles recorded during surveys at Beeshazar and associated lakes: (A) Indian Cobra (*Naja naja*); (B) Elongated Tortoise (*Indotestudo elongata*); (C) Mugger Crocodile (*Crocodylus palustris*). Photograph A by Tirth Lama (NTNC-BCC).

- Pandey, D.P. 2012. Snakes in the vicinity of Chitwan National Park, Nepal. *Herpetological Conservation and Biology* 7: 46–57.
- Pawar, S., M.S. Koo, C. Kelley, M.F. Ahmed, S. Chaudhuri, and S. Sarkar. 2007. Conservation assessment and prioritization of areas in Northeast India: Priorities for amphibians and reptiles. *Biological Conservation* 136: 346–361.
- Schleich, S.H. and C.C. Anders, 1998. *Tomopterna maskeyi* spec.nov. from Nepal (Amphibia, Anura), pp. 57–72. In: S.H. Schleich and W. Kästle (eds.), *Contributions to the herpetology of South Asia (Nepal, India)*. Veröffentlichungen aus dem Fuhlrott-Museum, volume 4. Wuppertal, Germany.
- Schleich, S.H. and W. Kästle (eds.). 2002. *Amphibians and Reptiles of Nepal: Biology, Systematics, Field Guide*. A.R.G. Gantner Verlag KG, Ruggell, Liechtenstein.
- Shah, K.B. and S. Tiwari. 2004. *Herpetofauna of Nepal: A Conservation Companion*. IUCN Nepal, Kathmandu.
- Shrestha, T.K. 2000. *Herpetology of Nepal: A Field Guide to Amphibians and Reptiles of Trans-Himalayan Region of Asia*. Steven Simpson Natural History Books, Hingham, U.K.
- Smith, M.A. 1935. *The Fauna of British India, Including Ceylon and Burma. Reptilia and Amphibia, Vol. 2: Sauria*. Taylor and Francis, London.
- Smith, M.A. 1943. *The Fauna of British India: Reptilia and Amphibia, Including the Whole of the Indo-Chinese Sub-region. Reptilia and Amphibia, Vol. 3: Serpentes*. Taylor and Francis, London, U.K.
- Stuart, S.N., J.S. Chanson, N.A. Cox, B.E. Young, A.S.L. Rodrigues, D.L. Fischman, and R.W. Waller. 2004. Status and trends of amphibian declines and extinctions worldwide. *Science* 306: 1783–1786.
- Swan, L.W. and A.E. Levinton 1962. The herpetology of Nepal: A history, checklist and zoogeographical analysis of the herpetofauna. *Proceedings of the California Academy of Sciences* 32: 103–147.
- Tillack, F., M. Lorenz, N.L. Orlov, N. Helfenberger, K.B. Shah, and W. Eckert. 2003. Shah's Grubenotter *Trimeresurus karanshahi* Orlov & Helfenberger, 1997 — ein Juniorsynonym von *Trimeresurus tibetanus* Huang, 1982 (Serpentes: Viperidae: Crotalinae), mit Angaben zur Verbreitung, Biologie und der Vorstellung neuer Farbvarianten aus Zentral-Nepal. *Sauria* 25(2): 3–15.
- Uetz, P., P. Freed, and J. Hošek (eds.). 2015. The Reptile Database (<http://www.reptile-database.org>).
- Vasudevan, K. and S. Sondhi 2010. *Amphibians and Reptiles of Uttarakhand, India*. Wildlife Institute of India, Dehradun.
- Vasudevan, K., A. Kumar, and R. Chellam. 2006. Species turnover: The case of stream amphibians of rainforests in the Western Ghats, southern India. *Biodiversity and Conservation* 15: 3515–3525.
- Verheugt, W.J.M. 1995. *Biodiversity Assessment of Terai Wetlands*. Biodiversity Profile Project, Nepalese Department of National Parks & Wildlife Conservation, Kathmandu.
- Vitt, L.J., E.R. Pianka, W.E. Cooper, Jr., and K. Schwenk. 2003. History and the global ecology of squamate reptiles. *American Naturalist* 162: 44–60.
- Zug, G.R. and J.C. Mitchell. 1995. Amphibians and reptiles of the Royal Chitwan National Park, Nepal. *Asiatic Herpetological Research* 6: 172–180.