

A Preliminary Report on the Reptile Fauna of the Kingdom of Bhutan with the Description of a New Species of Scincid Lizard (Reptilia: Scincidae)

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Abstract. -The herpetofauna of the Kingdom of Bhutan has been poorly studied and few collections of Bhutanese reptiles have been made. Reptiles collected by the 1972 expedition of the Naturhistorisches Museum Basel (Switzerland) are presented as a basis for a preliminary species list for this eastern Himalayan country. Specimens representing seven families and 18 species were examined. Included is a new species of scincid lizard of the genus *Mabuya*. An additional five species have been reported from Bhutan and numerous other taxa are known from adjacent regions of Sikkim and Assam. Most of the fauna is pan-oriental in derivation and is widespread to the east, west and south. A number of species, however, are primarily Indo-Chinese in their affinities and extend only as far west as eastern Nepal. Collections from eastern Bhutan and from elevations over 1500 m are particularly small and additional field work will be required to provide a complete picture of the reptiles of the country.

Key words: Reptilia, Sauria, Scincidae, *Mabuya*, Bhutan, Himalayas, biogeography, zoogeography.

Introduction

Acharji and Kripilani (1951) reported that the herpetofauna of the western Himalayas was poorly researched in comparison with that of the eastern portion of the range. Since the time of their publication this condition may be said to have reversed, with several major and many minor expeditions reporting on the herpetofauna of the Kingdom of Nepal, particularly the region from Annapurna to the west (Cox, 1985; Dubois, 1974a, 1974b; Leviton et al., 1962; Mrsic, 1980; Nanhoë and Ouboter, 1987; Sura, 1987, 1989; Swan and Leviton, 1958). In the eastern Himalayas, numerous workers have reported on the reptiles of Sikkim and West Bengal (e.g., Annandale 1912; Günther, 1864; Inglis et al., 1920) reviewed the herpetofauna of the Abor district (= central Arunchal Pradesh), some 225 km east of Bhutan. Nonetheless, no comprehensive works on the region have been compiled.

The Kingdom of Bhutan has long remained a gap in the knowledge of eastern Himalayan zoology, especially that of the herpetofauna (Annandale, 1912; Ouboter 1986; Swan and Leviton, 1962). Bhutan occupies approximately 47000 km² in the

eastern Himalayas (Fig. 1). To the north it is bordered by Tibet (Xizang Zizhiqu), to the east by Arunchal Pradesh, to the south by Assam, and to the west by Sikkim and the Darjeeling district of West Bengal. Government policy severely limiting foreign travel and research in the Kingdom has, until quite recently, left Bhutan as a zoological terra incognita in south central Asia. Fortunately, a great deal of Bhutan lies within national parks, sanctuaries or reserves (Hawkins, 1986) so that there may yet be opportunities to study its fauna in a relatively undisturbed state.

To date only four papers have been published on the herpetofauna of Bhutan. Bustard (1979, 1980a, 1980b) published a conservation document and two short notes on the status of the gaviial (*Gavialis gangeticus*) in Bhutan. Biswas (1975) reported on a small collection of reptiles from Bhutan and described a new taxon, *Calotes bhutanensis*. We here report on a much more extensive collection of reptiles and amphibians from Bhutan collected by the Zoologische Expedition des Naturhistorischen Museums Basel (NMBA) in 1972. This material is supplemented by additional information from literature sources.



FIG. 1. Map of the eastern Himalayas and adjacent regions showing the position of Bhutan. Closed circles indicate the capital cities of each country.

Methods

Specimens were collected in the Kingdom of Bhutan in April-May 1972 by the Zoologische Expedition des Naturhistorischen Museums Basel (NMBA), primarily by Drs. O. Stemmler and M. Würmli. Specimens were examined while on loan at the Museum für Naturkunde, Berlin. Other material referred to is from the collections of the Academy of Natural Sciences of Philadelphia (ANSP), the U.S. National Museum (USNM) and the Zoological Survey of India (ZSI). Live weights for some specimens were obtained from the field notes of the collectors. The following abbreviations are used throughout this paper: LW = live weight, SC = subcaudal

scales, SVL = snout-vent length, TL = tail length, V = ventral scales. Measurements were taken only from representative specimens of each taxon and samples generally reflect typical individuals from each series.

All of the localities represented by the NMBA expedition are in southwestern Bhutan. Literature records from other collections also include several localities in the central and eastern regions of the country. Localities of the NMBA expedition have already been characterized in the literature (Baroni-Urbani et al., 1973). To avoid repetition only the latitudes, longitudes, and elevations of those localities at which reptiles were collected are provided below, along

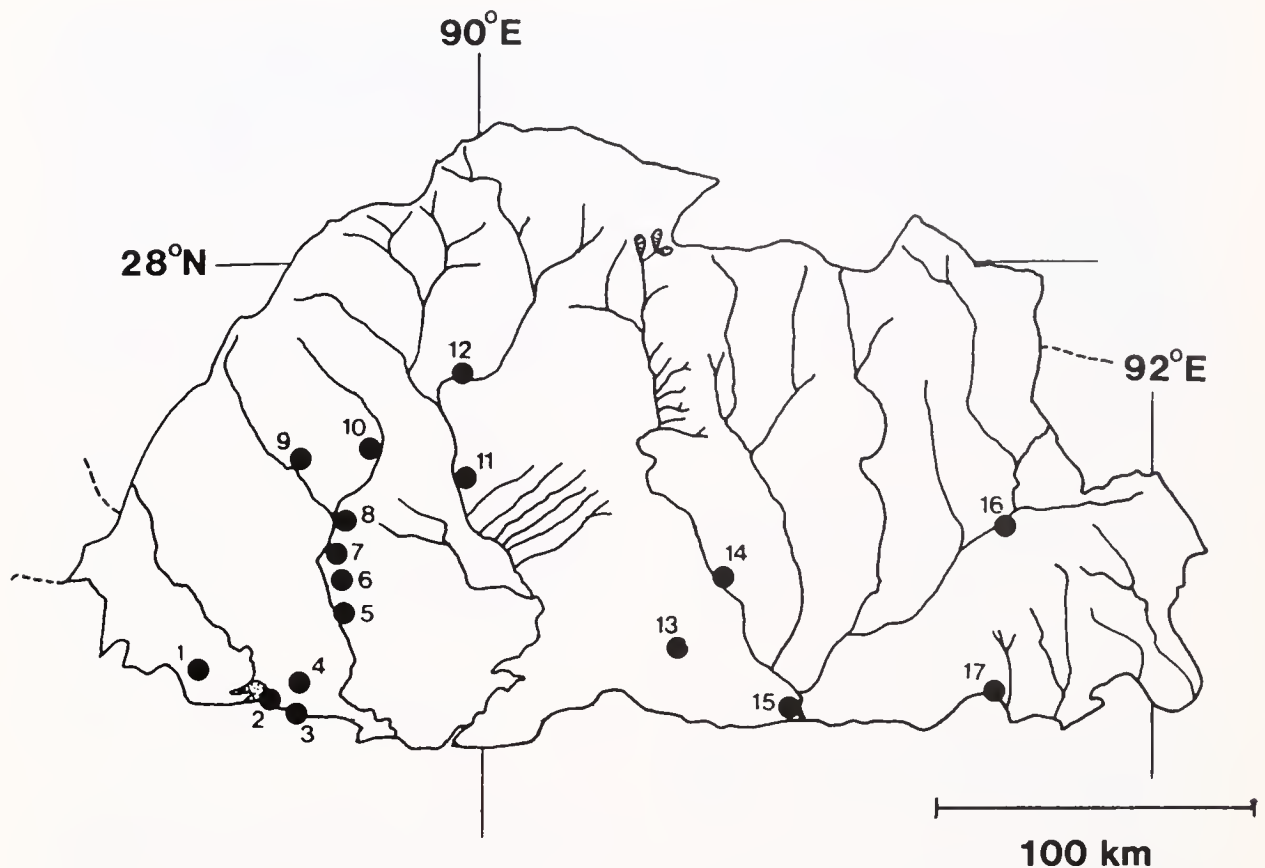


FIG. 2. Map of the Kingdom of Bhutan showing the localities referred to in the text. See **Methods** for names, elevations and coordinates of numbered localities.

with the same information for literature and other specimen localities. Latitudes and longitudes are approximate as no adequate gazetteer exists for Bhutan and several localities not appearing on any available maps could only be bracketed between known places by reference to collectors field notes. The following numbered localities are marked on Figure 2:

1. Samchi (400 m),
26° 54' N 89° 14' E.

2. Phuntsholing (200-400 m),
26° 51' N 89° 26' E.

3. Khala and Balu Jhura (200 m),
26° 50' N 89° 26' E.

4. 14 km N of Phuntsholing,
(850-950 m), 26° 53' N 89° 27' E.

5. 87 km N of Phuntsholing (1700 m),
27° 05' N, 89° 35' E.

6. Chimakothi (2200 m),
27° 10' N 89° 34' E.

7. 110 km N of Phuntsholing (2000 m),
27° 12' N 89° 34' E.

8. 125 km N of Phuntsholing (2100 m),
27° 15' N 89° 35' E.

9. Paro (2300 m),
27° 26' N 89° 25' E.

10. Thimphu (2300-2500 m),
27° 29' N 89° 37' E.

11. Wangdi Phodrang (1400 m),
27° 29' N 89° 54' E.

12. Tamji (2450 m),
27° 40' N 89° 54' E.

13. Batase (1500 m),
27° 00' N 90° 37' E.

14. Panjurmane (1525 m),
27° 10' N 90° 43' E.

15. Manas River,
26° 50' N 90° 59' E.

16. Rongtong (2042 m),
27° 16' N 91° 32' E.

17. Samdrup Jhongkhar (300 m),
26° 52' N 91° 28' E.

Species Recorded from the Kingdom of Bhutan

Reptilia

Crocodylia

Family Gavialidae

Gavialis gangeticus (Gmelin, 1789)

Ross (1989) included Bhutan in his list of the recent distribution of the gharial. Bustard (1979, 1980a, 1980b) reported that this species had recently been extirpated from its primary habitat in the Kingdom of Bhutan, the Manas River. The last specimens were seen in the 1960's. Bustard (1980a, 1980b) and Groombridge (1987) have suggested reintroducing the species into suitable habitat. At present a small population survives in the Indian portion of the Manas River (Whitaker, 1987).

Sauria

Family Agamidae

Calotes bhutanensis Biswas, 1975

Biswas (1975) described this endemic species on the basis of a single specimen (ZSI 22480) from Panjurmane (listed as Janjurmane by Biswas). Although he provided mensural characters to distinguish *C. bhutanensis* from the very similar *C. versicolor*, the validity of this taxon must remain in doubt. The values provided by

Biswas (1975) suggest that the single specimen falls within the range of variation displayed by *C. versicolor*. Moody (1980) in his systematic revision of the Agamidae was apparently unaware of this description and did not recognize the species either as distinct or as a junior synonym. Until such time as *C. bhutanensis* is reevaluated in the context of the genus *Calotes* as a whole we tentatively recognize it a taxon distinguishable from *C. versicolor* on the basis of the minor scalation and color features delineated by its describer.

Calotes versicolor (Daudin, 1802)

(17 specimens examined): Phuntsholing NMBA 22582-92, ZMB 48784-85; Balu Jhura NMBA 22593; Wangdi Phodrang NMBA 22594-6.

LW adult males 27.0-36.4 g (\bar{x} = 31.68 g, n = 4), LW females and juveniles 5.8-21.1 g (\bar{x} = 9.96 g, n = 8).

In addition to the specimens examined, Biswas (1975) reported a specimen from Samdrup Jhongkhar, Bhutan. *Calotes versicolor* is widespread throughout the Oriental region, including all of the southern slopes of the Himalayas. Smith (1935) and Cox (1985) recorded the species as common up to 1980 m in the Himalayas. It is widespread in most of Nepal and in adjacent regions of Sikkim and the Darjeeling District (Acharji, 1961; Acharji and Kripilani, 1951; Leviton et al., 1956; Mursic, 1980; Nanhoe and Ouboter, 1987; Rendahl, 1937; Sura, 1987, 1989; Swan and Leviton, 1962). Barbour (1912) recorded this species from the Tista Valley near the Bhutanese frontier of Sikkim.

Japalura variegata Gray, 1853

(2 specimens examined): 87 km N of Phuntsholing NMBA 22597-8. Biswas (1980) obtained a specimen from Batase, Bhutan. Günther (1865) recorded this taxon from Sikkim, and Hora (1926) and Smith (1935) reported that this species was common throughout the eastern Himalayas at elevations of 330-2970 m. Annandale (1906) initially reported *J. yunnanensis*



FIG. 3. Holotype of *Mabuya quadratolobus* Baur and Günther (NMBA 10275). Note general coloration pattern.

from Buksa (=Buxa), near the Bengalese/Bhutan frontier, but later described the same specimen as *J. bengalensis*, now regarded as a synonym of *J. variegata*.

Family Gekkonidae

Hemidactylus brookii Gray, 1845

(1 specimen examined): Samchi NMBA 22599.

Swan and Leviton (1962) did not record this species among the fauna of Nepal, but it has since been reported as locally common at lower altitudes (Mrsic, 1980; Nanhoe and Ouboter, 1987). Mitchell and Zug (1988) found it to be the most abundant gecko at their locality in the Terai of Nepal as did Cox (1985) at his central Nepalese sites.

Hemidactylus frenatus
Duméril and Bibron, 1836

(39 specimens examined): Samchi NMBA 22600-7; Phuntsholing NMBA 22608-34; ZMB 48786-89.

LW 1.0-6+.2 g (\bar{x} = 3.16 g, n = 32), LW males (\bar{x} = 3.43 g, n = 13), LW females (\bar{x} = 2.97 g, n = 19).

Leviton et al. (1956) and Swan and Leviton (1962) recorded this species from Dharan (ca. 330 m) in Eastern Nepal and Cox (1985) found it common in Tharu, in

central Nepal. Annandale (1912) regarded the species as common at low altitude throughout the eastern Himalayas.

Platyurus platyurus (Schneider, 1797)

(5 specimens examined): Phuntsholing NMBA 22635; Wangdi Phodrang NMBA 22636-7; no precise locality NMBA 22638-9.

LW 2.5-5.2 g (\bar{x} = 3.63 g, n = 3).

Annandale (1912), Cox (1985), Leviton et al. (1956), Mrsic (1980), and Swan and Leviton (1962) recorded this species from central and eastern Nepal at elevations up to 1500 m and Smith (1935) and Taylor (1962) recorded it from Sikkim. The species is also known from southeastern Tibet (Kraig Adler, pers. comm.).

Family Scincidae

Mabuya quadratolobus
Bauer and Günther, n. sp.
Figs. 3 and 4.

Holotype.—NMBA 22681, lowest terrace on the right bank of river valley west of Samchi, Bhutan (26°54'N, 89°14'E), elevation 450 m. Collected by M. Würmli and C. Baroni-Urbani, 12 May 1972.

Paratypes.—(11 specimens): NMBA 22682-87, ZMB 48769, 48775-78 all from Samchi, Bhutan. Collected 8 May 1972 by

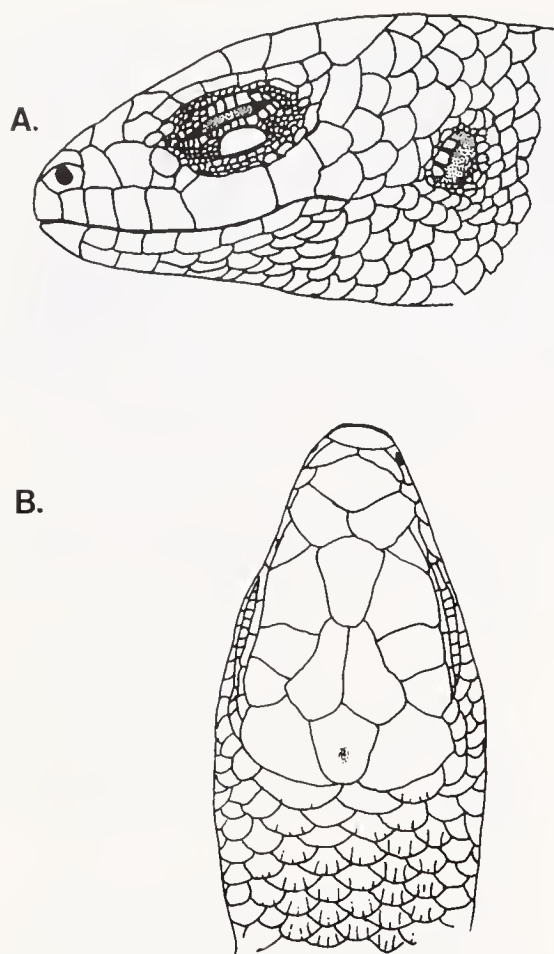


Fig. 4. A) Lateral and B) dorsal views of the head of *Mabuya quadratolobus* (NMBA 10275). Note the ear lobules, enlarged fifth supralabial and carinate dorsal scales.

O. Stemmler (NMBA 22682, 22688) and 11 May 1972 by O. Stemmler and M. Würmli (NMBA 22683-87, ZMB 10281-84).

Diagnosis.—*Mabuya quadratolobus* is distinguished from all other Asian members of the genus by the following combination of characters: lower eyelid with transparent disk; three large, squared lobules at anterior margin of ear; seven supralabials with fifth approximately 2.5 x length of first; dorsal scales tricarinate.

Description of holotype.—A juvenile, 36.0 mm SVL, LW 1.3 g. TL (incomplete) 25.8 mm (TL of intact paratype NMBA

48777 = 130% SVL). Axilla-groin length 14.2 mm. Hindlimb length 13.8 mm.

Scalation (Fig. 4).—Frontonasal broader than long; prefrontals large, in broad contact; frontoparietals large, paired; distinct interparietal; parietals each bordered posteriorly by a single nuchal (unilaterally fragmented in holotype); nostril entirely within nasal; small supranasals present, in narrow contact dorsally; two loreals, anterior larger than posterior; lower eyelid with central transparent disk (diameter approximately 50% of eye); four supraoculars, decreasing in size in the order $2 > 3 > 4 > 1$; six supraciliaries; seven supralabials, fifth and sixth under eye; sixth supralabial separated from orbit by series of small suboculars; fifth supralabial 2.5 x length of anteriormost supralabials; seven or eight infralabials, roughly equal in size; first and second infralabials contact postmental; two enlarged pairs of chin shields, first pair in narrow contact.

Ears moderately large; tympanum sunken; anterior margin of ear with three flattened, distinctly squarish lobules; remainder of scales on anterior margin of ear slightly raised.

Dorsal scales tricarinate, with lateral carinations more well developed than medial; medial ridge limited to posterior scale edge on many lateral and posterior scales; carinated scales continue on to proximal region of tail; dorsal scales approximately equal in size, decreasing slightly on flanks; 35 scale rows around mid-body.

Limbs pentadactyl; scales on dorsal surface of limbs weakly tricarinate; palmar scales spinose; 14 unkeeled lamellae under fourth toe.

Color (in preservative).—Dorsum olive brown with series of dark brown marks on distal edges of scales, forming irregular spots on nape and broken transverse bands at every second scale row on body. Light dorsolateral stripe, one and one half scale rows wide, from level of ear to tail. Dark brown stripe beneath light stripe, extending

from anterior corner of eye on to tail, passing beneath eye as a narrow dark line, disrupted and diffuse through ear, flecked with blue-white scales ventrally and fading towards flanks. Venter white. Dorsal surfaces of limbs brown, scales edged with dark brown, forming a diffuse, irregular reticulate pattern.

Variation.—The paratypes resemble the holotype in all major features. All specimens appear to be juveniles and possess yolk scars. Some specimens show minor fragmentation of some head scales. LW 0.5–1.3 g (\bar{x} = 0.85 g, n = 11); SVL 28.9–36.0 mm (\bar{x} = 32.1 mm, n = 8).

Etymology.—The name derives from the Latin lobus (lobe) and quadratus (square) and is in reference to the striking ear lobules characteristic of this species.

Unfortunately the phylogeny of the lygosomine skinks in general, and *Mabuya* in particular, is not well resolved. Greer (1974, 1979) regarded *Mabuya* as ancestral to other skink lineages and suggested that the south-east Asian species of the genus exhibited the greatest number of plesiomorphic features. If this is true, then this group must also be paraphyletic. The only comprehensive treatment of *Mabuya* as a whole has been that of Horton (1973), who provided a key to the species and an overview of the evolution and biogeography of the numerous species groups by geographic region. More than 20 Asian *Mabuya* were recognized by Horton (1973), but no unified picture of relationships among these taxa was presented. In most existing keys to the herpetofauna of the greater Indian region (e.g., Smith, 1935) the new species falls out most closely with *Mabuya dissimilis*, a species from the western Himalayan region. Comparison with the types (ANSP 9537–8) and other specimens of the latter taxon, however, reveal major differences and the two taxa are clearly distinct, if closely related at all. With the material at hand we are unable to offer any meaningful suggestion as to the close relationship of *Mabuya quadratilobus*.

Scincella sikkimensis (Blyth, 1853)

(45 specimens examined): Phuntsholing NMBA 22640; 87 km N of Phuntsholing NMBA 22641; Chimakothi NMBA 22642–51, ZMB 48779–83; 110 km N of Phuntsholing NMBA 22652–60; 125 km N of Phuntsholing NMBA 22661; Paro NMBA 22662–67; Thimphu NMBA 22668–76; Tamji USNM 166443; no specific locality NMBA 22667–80.

LW 0.6–3.5 g (\bar{x} = 1.62 g, n = 35), SVL (larger specimens only) 45.8–55.8 mm (\bar{x} = 49.48 mm, n = 6), TL 144–148% SVL (n = 3).

Ouboter (1986) reported a maximum SVL of 55.7 mm and an average of 39.1 mm. Although only larger individuals of the Bhutanese sample were measured, it appears that populations from the northeastern extent of the range may be slightly larger than average. Specimens examined in detail revealed at least three different head scale patterns, reflecting fusions and fragmentation of the standard pattern reported by Ouboter (1986). For example, NMBA 22668 possessed a fragmented frontonasal, NMBA 22663 had both prefrontals fused to the frontal, and NMBA 22662 had unilateral prefrontal-frontal fusion.

Hora (1927) recorded the species from Sikkim and other neighboring areas of India, and Cox (1985), Mursic (1980), Sura (1987), and Swan and Leviton (1962) reported specimens from central Nepal. Gruber (1981) and Ouboter (1986) highlighted the confusion surrounding the identity of the Himalayan species of *Scincella* in general, but demonstrated that *S. sikkimensis* is the characteristic species of eastern Himalayas. As defined by Ouboter (1986) it appears to be limited chiefly to mesic oak forest regions on the southern flanks of the range. Nanhoë and Ouboter (1987) characterized this species as a common inhabitant of forest clearings or edges, generally below 3000 m throughout the Himalayan region to the east of Jaljala Pass in central Nepal. Ouboter (1986)

stated that the species was not known from localities below 1200 m. However, M^{rs}ic (1980) recorded specimens below 1000 m in Nepal and the Bhutanese localities reported here, especially Phuntsholing, clearly indicate that the species may occupy the entire elevational range of the tropical-subtropical belt of the foothills. The presence of such low altitude specimens give some credence to occurrence of *Scincella sikkimensis* at Parasnath Hill, south of the Gangetic Plain in Bihar, the type locality of *Mococa sacra*, a junior synonym of *S. sikkimensis*.

Sphenomorphus indicus (Gray, 1853)

(5 specimens examined): 87 km N of Phuntsholing NMBA 22689-92, ZMB 48768.

LW 9.4-26.5g (\bar{x} = 17.58, n = 5), Maximum SVL 104.7 mm (NMBA 22689, a large female containing embryos), TL 128-130% SVL (n = 2)

Hora (1927) reported this species from "the eastern Himalayas below Darjeeling" and Smith (1935) and Taylor (1962) mentioned material from Sikkim. Although literature records in the region are few, the species is widespread in the eastern Himalayas (Annandale, 1912; Rendahl, 1937).

Sphenomorphus maculatus
(Blyth, 1853)

(4 specimens examined): Samchi NMBA 22693; Phuntsholing NMBA 22694. In addition the Basel Expedition collected two specimens, NMBA 22695-6, from 23 km N of Siliguri (ca. 150 m) in the Jaipalguri District of India.

LW 3.0-4.0 g (\bar{x} = 3.5 g, n = 2), SVL 45.0-58.8 mm (\bar{x} = 50.6 mm, n = 4), TL 144-200% SVL, n = 4).

Nanhoe and Ouboter (1987) concluded that this Indo-Chinese species was limited in its distribution to low altitude riverine

forests. The Bhutanese localities reported here support this. Smith (1935) mentioned specimens from Sikkim.

Family Varanidae

Varanus bengalensis (Daudin, 1802)

(3 specimens examined): Phuntsholing NMBA 22697-8, 22740. Specimens were also sighted at Samchi.

This species is common throughout much of the eastern Himalayas as well as Assam (Annandale, 1912). Cox (1985) reported a specimen from central Nepal at Patan.

Serpentes

Family Typhlopidae

Ramphotyphlops braminus
(Daudin, 1803)

(24 specimens examined): Samchi NMBA 22699-713; Phuntsholing NMBA 22714-17, ZMB 48770-74, 48774.

LW 0.3-1.0 g (\bar{x} = 0.72 g, n = 21). Largest specimen ZNB 48771, SVL 146.0 mm, TL 2.0 mm. All specimens have 20 scale rows around mid-body and show the head scale suture pattern typical of this species.

This widespread and easily transported snake has also been recorded from Nepal (Kramer, 1977; M^{rs}ic, 1980; Nanhoe and Ouboter, 1987) and Sikkim (Rendahl, 1937).

Family Pythonidae

Python molurus (Linnaeus, 1758)

Although we know of no Bhutanese specimens in collections, the statement of Harris et al. (1964) that "pythons" were common inhabitants of the Duars Plains of Bhutan, must surely refer to this species. It has been recorded from comparable habitats

in Nepal (Kramer, 1977).

Family Colubridae

Amphiesma platyceps (Blyth, 1854)

(1 specimen examined): Wangdi Phodrang NMBA 22741 (475 + 184 mm, 186 V, 98 SC).

This species has previously been recorded from Sikkim, Assam and Nepal (Kramer, 1977; Masic, 1980; Nanho and Ouboter, 1987; Smith, 1943; Swan and Leviton, 1962) and is widely distributed in the Himalayas.

Amphiesma stolata (Linnaeus 1758)

Biswas (1975) collected a single specimen from Samdrup Jongkhari in eastern Bhutan. This is a widely distributed pan-oriental species that appears to thrive in disturbed areas (Nanho and Ouboter, 1987).

Boiga ochracea ochracea
(Günther, 1868)

(2 specimens examined): Phuntsholing NMBA 22730, juvenile (280.5 + 73.8 mm, 4 g, 234 V, 108 SC); NMBA 22731, adult male, badly damaged (925 + 284 mm, 241 V, 118 SC).

This species is common in the eastern Himalayas and is known from the Buksa Duars along the southern boundary of Bhutan (Smith, 1937).

Pseudoxenodon macrops (Blyth, 1854)

(2 specimens examined): 125 km N of Phuntsholing NMBA 22738, male, head and neck severely damaged (975 + 227 mm, 164 V, 63 SC); Wangdi Phodrang NMBA 22739 (710 + 183 mm, 169 V, 67 SC).

Nanho and Ouboter (1987) regarded this species as an Indo-Chinese form, extending through the eastern Himalayas as far west as Jaljala Pass in west central Nepal.

Trachischium guentheri Boulenger, 1890

(4 specimens examined): 87 km N Phuntsholing NMBA 22732-35. Largest specimen (NMBA 22735), 226.3 + 38.6 mm.

Kramer (1977) and Swan and Leviton (1962) reported this species from Nepal, and Smith (1943) from Sikkim and Darjeeling.

Xenochrophis piscator
(Schneider, 1799)

(12 specimens examined): Phuntsholing NMBA 22718-29. The specimens are all neonates (typical individuals 140.5 + 64.8 mm) and were collected along with 16 egg shells. Smith (1943) reported clutch sizes of 8-87 in this species. Nanho and Ouboter (1987) reported this species as common at low altitudes in association with water and Annandale (1912) reported its presence at elevations as high as 1450 m in the western Himalayas. The species range extends throughout the Oriental region. Kramer (1977) and Swan and Leviton (1962) reported Nepalese localities.

Zaocys nigromarginatus (Blyth, 1854)

(1 specimen examined): 87 km N Phuntsholing NMBA-Field Number 10258, total length 1980 mm, badly damaged.

This large snake is an eastern form, ranging from Yunnan to the eastern Himalayas (Smith, 1943). It is known from elevations of up to 2500 m.

Family Elapidae

Bungarus niger Wall, 1908

(1 specimen examined): Phuntsholing NMBA 22736 (667 + 120 mm, 221 V, 56 SC).

Although this taxon has long been known from the eastern Himalayas and Assam (Smith, 1943), it has not been recorded from eastern Nepal by any of the

recent reviewers of the fauna of that region.

Ophiophagus hannah (Cantor, 1836)

Biswas (1975) reported a juvenile specimen from Rongtong in the Manas Valley. This species has recently been recorded from as far west as eastern Nepal (Nanhoe and Ouboter, 1987).

Species Likely to Occur in Bhutan

In addition to the 23 species listed above, it is certain that a great many more reptile species are yet to be found in Bhutan, both in the more well-known, but richer lowlands, and the less-well collected higher elevations. No turtles have been reported from Bhutan, but several species are likely to occur. Among the batagurine emydids the range of *Kachuga tecta* brackets Bhutan, with records from Sikkim in the west (Moll, 1987) and the Dihang River in the east (Annandale, 1912). *Kachuga drongoka* has been collected in the Brahmaputra River in the Kamrup District of Assam (Moll, 1986) and was illustrated in a distribution map as occurring in Bhutan by Tikader and Sharma (1985). *Cuora amboinensis*, *Melanochelys tricarinata*, *M. trijuga*, *Kachuga smithii*, *K. tentoria* and *K. sylhetensis* have been reported from the Manas Tiger Reserve in Assam (Das, 1988) and *Hardella thutjii*, *Indotestudo elongata* and *Lissemys punctata* also approach the borders of Bhutan. The freshwater turtles are known either from the Tista to the west or the Brahmaputra to the south (Das, 1985; Iverson, 1986; Smith, 1933; Tikader and Sharma, 1985) and might be expected to occur at lower elevations in the Torsa, Wong Chu, Sankosh, and Manas drainages of southwestern and south central Bhutan.

It is highly probable that additional lizard species may also be found in Bhutan. The gekkonid *Hemidactylus flaviviridis* occurs in Nepal (Cox, 1985; Sura, 1987, 1989) but apparently does not reach the eastern Himalayas. *Hemidactylus garnotii*, on the other hand, extends only as far west as central Nepal (Cox, 1985; Nanhoe and Ouboter, 1987; Sura, 1989), where it has only recently become established. The

latter species almost certainly occurs at lower elevations in Bhutan. *Hemidactylus bowringii* was recorded by Barbour (1912) from the Tista Valley near the Bhutanese frontier with Sikkim, but no more recent remarks on this species in the area in question have appeared in the literature. Among agamids, *Japalura tricarinata* occurs in eastern Nepal, Sikkim, and the Darjeeling area, it may be expected to occur in the southwestern corner of Bhutan, although the Basel expedition found no specimens despite their intense collecting effort in and around Phuntsholing. *Japalura andersoniana* was described from the Dafla Hills, near the eastern border of Bhutan and is another potentially indigenous agamid. Annandale (1906) suggested that *Ptyctolaemus gularis* might be found in the Buksa Duars along the southern frontier of Bhutan. There are a great many snake taxa that might be expected to occur in Bhutan. Over 40 species have been recorded from Nepal (Kramer, 1977). In the family Typhlopidae at least *Ramphotyphlops jerdoni* and *R. oligolepis* and possibly *R. diardi* extend to the border regions of Bhutan. The colubrid fauna of adjacent Sikkim and Assam is exceptionally rich (Smith, 1943). Welch (1988) listed *Ahaetulla p. prasina*, *Boiga gokool*, *Boiga multifasciata* and *Rhabdophis himalayana* as well as *Boiga o. ochracea* as taxa occurring in Bhutan. However, these records were purportedly derived from Smith (1943), who, in fact, listed no material from Bhutan. Welch's (1988) apparent criterion for inclusion in the Bhutanese fauna was Smith's (1943) mention of the "eastern Himalayas" in his distributional comments. In addition, at least four species of *Oligodon* occur in Sikkim or the Jaipalguri District of India and may also be found in Bhutan. Additional specimens and species almost certainly exist in museum collections, but have never been reported in the literature. It is also likely that the cobra, *Naja naja kaouthia*, occurs in Bhutan. Smith (1943:434) presented a distribution map showing most of Bhutan within the range of the subspecies. The nominate subspecies is illustrated as just reaching the southwest corner of the country. The true

status of these forms relative to one another remains unclear. They occur in sympatry in a number of areas and are probably specifically distinct (Wüster and Thorpe, 1989). To date, however, there have been no specimens to confirm the presence of either form in Bhutan, although there are records from Nepal (Acharji, 1961; Kramer, 1977).

Discussion

Himalayan zoogeography has been reviewed extensively by previous authors (e.g., Annandale, 1912; Blanford, 1901; Dubois, 1981; Hora, 1948; Nanhoë and Ouboter, 1987; Smith, 1933; Swan and Leviton, 1962). All have used approximately the same divisions in identifying the affinities of the faunal elements of the region. Bhutan lies primarily within the Eastern Himalayan province of the Indo-Chinese subregion of the classically-defined Oriental region. The herpetology of the eastern Himalayas in general is known from a number of faunal reports from eastern Nepal (e.g., Leviton et al., 1956) and northeastern Bengal (Annandale, 1912), as well as from descriptions of new species, especially amphibians (see Dubois, 1974a). Swan and Leviton (1962) recorded 85 snake and lizard species from Sikkim and the adjacent Darjeeling area of India. As yet material is insufficient to compare the similarity and richness of the Bhutanese fauna with these figures. Bhutan is characterized by north-south flowing rivers that ultimately drain into the Brahmaputra and thence to the Bay of Bengal. To the north the higher peaks of the Himalayas form a barrier to reptile movement. Mountain ridges also form partial barriers to the west and east. Only to the south is there low altitude access to Bhutan. The mountains further subdivide the country into a series of valleys between which communication is likely only in the subtropical south. As a consequence, the majority of the species recorded are pan-oriental in their distribution or, like *Platyurus platyurus*, *Sphenomorphus maculatus*, and *Pseudoxenodon macrops*, are primarily Indo-Chinese species that extend only as far west as eastern or central

Nepal. Eastern Himalayan endemics include *Trachischium guentheri* and *Scincella sikkimensis*. The distribution of the two putatively endemic forms described from Bhutan, *Calotes bhutanensis* and *Mabuya quadratilobus* n. sp., remains poorly known, but it is probable that at least the latter may be found in adjacent Sikkim or Assam. None of the taxa reported here reflect Tibetan or Mediterranean influences as reported for the Nepalese reptile fauna by Swan and Leviton (1962) and Nanhoë and Ouboter (1987). At least in part, this is a reflection of the limitation of previous collecting efforts to the valleys and lower elevations of Bhutan. This same factor precludes a meaningful elevational analysis of herpetofaunal distribution at this time. In Bhutan, as elsewhere in the Himalayas, there appears to be a strong correlation between zonation of vegetation and that of amphibians and reptiles (Dubois, 1974a, 1974b, 1981; Nanhoë and Ouboter, 1987). The elevational profiles provided by Baroni-Urbani et al. (1973) characterized the native vegetation of the lower elevations of Bhutan as: moist sal forest (200-800 m), evergreen montane forest (700-1600 m), evergreen deciduous forest (1600-2800 m), and Rhododendron - conifer forest (2800-3500 m). Dubois (1974b) regarded elevations below 1000 m in neighboring Nepal as tropical, those to 2000 m as subtropical and those to 3000 m as temperate, with higher elevations subalpine or alpine in their climate and floral characteristics. Although each of the vegetation types is represented by at least one collecting site, all are within the tropical or subtropical zones, biasing the fauna sampled against Tibetan or Mediterranean taxa which would be expected to occur at higher, more temperate elevations (Swan et al., 1962). On the basis of the known fauna of other areas of the Eastern Himalayas only a fraction of the expected species have as yet been recorded. Further, phylogenies have not been proposed for the majority of the known taxa, precluding the application of cladistic biogeographic methods (Humphries and Parenti, 1986) in the analysis of pattern. It would thus be premature to speculate about long-term

historical biogeographical patterns of the Bhutanese reptile fauna and a more detailed analysis is deferred to a later date.

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