

**ON THE OCCURRENCE OF *TRIMERESURUS MEDOENSIS*
DJAO IN: DJAO & JIANG, 1977 (SERPENTES, VIPERIDAE,
CROTALINAE) IN INDIA, WITH A REDESCRIPTION
OF THIS SPECIES AND NOTES ON ITS BIOLOGY**

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(with eight text-figures)

ABSTRACT.— Twenty-six specimens of a green pitviper of the genus *Trimeresurus* observed in eastern Changlang District, State of Arunachal Pradesh, north-eastern India, proved to belong to the species *Trimeresurus medoensis* Djao in: Djao & Jiang, 1977, hitherto definitely known only from south-western China and Myanmar. The morphology of these specimens is described in detail. The Indian specimens are described and compared with the types of the species, which are also redescribed in detail, and with two specimens from northern Myanmar. An expanded description of the species, based on a total of 30 specimens, notes on its biology, and comparisons with some other green pitvipers occurring in the Eastern Himalayas are provided.

KEY WORDS.— *Trimeresurus*, *Trimeresurus medoensis*, Viperidae, Crotalinae, India, Arunachal Pradesh, Myanmar, China.

INTRODUCTION

The region of the Eastern Himalayas, a large and complex area of wet, forest covered hills, high mountain ranges and deep valleys spanning over south-western China (Xizang Autonomous Region and Yunnan Province), north-eastern India, Bhutan and northern Myanmar, is one of the richest in Asia for the pitvipers of the genus *Trimeresurus* sensu lato (David and Ineich, 1999). It is the home of at least six or seven species of predominantly green pitvipers of the genus *Trimeresurus*, namely *T. albolabris*, with the subspecies *albolabris* (Gray, 1842) and *septentrionalis* Kramer, 1977 (this latter probably a distinct species, see Malhotra and Thorpe, 2000), *T. erythrurus* (Cantor, 1839), *T. medoensis* Djao in: Djao and Jiang, 1977, *T. popeiorum* Smith, 1937, *T. stejnegeri* Schmidt, 1925, and *T. yunnanensis* Schmidt, 1925.

In the course of herpetological investigations in Changlang District, State of Arunachal

Pradesh, north-eastern India, the second author examined 26 specimens of a green pitviper of the genus *Trimeresurus*, with only 17 dorsal scale rows at midbody. On the basis of recent literature on the genus *Trimeresurus* of this area (for example David and Tong, 1997), these specimens were identified as *Trimeresurus medoensis*. One of them was illustrated in colour in Anonymous (1999), a mention which was the first confirmed record of this species in India.

Trimeresurus medoensis Djao in: Djao and Jiang, 1977 is a poorly known species which was described from only two specimens collected in south-eastern Xizang Autonomous Region. Its validity has been accepted by subsequent authors (Anonymous, 1977; Hu and Zhao, 1979; Hoge and Romano Hoge, 1981; Tian et al., 1986; Yang and Inger, 1986; Zhao et al., 1986, 1998, 2000a, 2000b; Hu et al., 1987a, 1987b; Welch, 1988, 1994; Zhao, 1990, 1993, 1998; Zhao and Adler, 1993; Golay et al., 1993; David and Tong, 1997;

Ma and Xu, 1998; David and Ineich, 1999; McDiarmid et al., 1999; Zhu and Tan, 1999; Lu and Li, 2000; Rao, 2000), although it was not included in Regeness and Kramer's review (1981). A third specimen from the vicinity of Myitkyina, northern Myanmar was recently formally referred to this species by Zhao et al. (1998). Previously, Djao in: Djao and Jiang (1977) had only tentatively referred to this new species three female specimens from northern Myanmar cited by Smith (1943: 518), on the basis of their dorsal scale row formula. Hoge and Romano Hoge (1981) included also India in the range of this species, in citing Taji Lin, better known as Darjeeling, State of West Bengal, but the basis of this statement was not specified. Lastly, Welch (1988) and Das (1997), also without comments, included this species in the Indian snake fauna.

We provide in this paper a detailed description of these Indian specimens, with notes on their biology. The description of *Trimeresurus medoensis*, originally published in Chinese, was translated by David and Tong (1997). Although accurate, it was rather brief. A more thorough description of the type specimens was published in Zhao et al. (1998), but this was also in Chinese. Consequently, we take the opportunity of this paper to publish in English a full description of the type specimens based on our own data, and not on the text appearing in Zhao et al. (1998), which may explain the slight differences in some scale counts, such as the ventral and supralabial scales. We also give the description of one of the three specimens cited by Smith (1943) and of the specimen from Myitkyina. The Indian and Burmese specimens are compared with the types and their identification is discussed.

As a conclusion, variation of major morphological characters in *Trimeresurus medoensis* and its distribution are summarised, and a short discussion on the relationships of this species is provided. This species is also compared with *T. popeiorum* Smith, 1937 and *T. yunnanensis* Schmidt, 1925, both present in north-eastern India and northern Myanmar. A summary of data on *T. medoensis* concludes this paper.

MATERIALS AND METHODS

All data pertinent to the 26 Indian specimens were obtained from living animals. Our investigations were conducted in a protected area, in which we were not allowed to kill and preserve any specimen. Consequently, there is no voucher specimen for this population, although most specimens were photographed.

The snakes were examined during two field trips, in March-June 1999 (14 specimens) and November 1999-January 2000 (12 specimens), respectively. Habitats suitable for pitvipers were identified with the help of Lisu guides and searched thoroughly. Once the snakes were located, they were collected and transferred into snake bags. Examination and scale counts were made early in the morning when the temperatures were low and the snakes were sluggish. Their heads were restrained by a noose on a nylon cord ca. 3 mm diameter that passed through a hole in a bamboo (referred to as 'musa' by the Lisus), ca. 20 mm diameter x 600 mm long. The noose was placed behind the widest part of the head. The cord was then pulled tight and a spring loaded toggle from a windcheater prevented the noose from loosening. A LenseL L111B head loupe (2.75 x magnification) was used to facilitate counts. Scales were counted with the help of a 'uni-ball eye fine' black waterproof pen. Each scale was marked for dorsal body scale row counts; and every 10th ventral and subcaudal was marked for ventral and subcaudal counts. All counts were made at least twice. The snout-vent length and tail measurements were made by marking off corresponding lengths on a wooden railing and are consequently approximate; at best they indicate the rough size of the snake. This was done to avoid stressing the snakes more than absolutely necessary. Most specimens were photographed; record photographs were taken with a Nikon F5 body mated to a 105 mm 2.8 AFD Micro Nikkor lens. Illumination was with a SB 21B ring flash. The snakes were then released within 48 hours of capture close to their respective site of capture. Photographs are deposited both in the collections of the MNHN (Paris) and the Centre for Herpetology, Madras Crocodile Bank Trust, Vadanemmeli, India.

For the Indian snakes, we recorded data on the sex, colouration, head and dorsal patterns, and the following meristic characters: numbers of dorsal scale rows (behind head, midbody and before the vent, respectively), ventrals, subcaudals, supralabials, and cephalic scales between supraoculars. Other characters were not accessible on living specimens, but all characters regarded as diagnostic of *T. medoensis* could be recorded. On preserved specimens, such as the types of *Trimeresurus medoensis* and other specimens referred to this species, measurements were taken with a slide caliper to the nearest 0.1 mm. Throughout this paper, the number of ventral scales is counted after Dowling's (1951) method. The number of subcaudals excludes the terminal scute. The numbers of dorsal scale rows are given at two head lengths behind head (values counted at one head length are given in square brackets), at midbody (i.e. at the level of the ventral plate corresponding to a half number of the total ventrals; approximate midbody for the Indian examples), and at one head length before vent (ca. two head lengths for all the Indian examples), respectively. Values for symmetric head characters are given in left/right order.

Abbreviation of measures (all in mm) and other meristic characters are:

SVL: snout-vent length.- TaL: tail length.- TL: total length.- TaL/TL: ratio tail length/total length.- HL: head length.

Ven: number of ventrals.- SubC: number of subcaudals.- InNas: number of scale(s) separating the internasals.- SupL: number of supralabials (l/r).- Cep: number of cephalic scales on a line separating the supraoculars.- InfL: number of infralabials (l/r).

Museum abbreviations:

AMNH: American Museum of Natural History, New York.

BMNH: British Museum (Natural History), now the Natural History Museum, London.

CIB: Chengdu Institute of Biology, Academia Sinica, Chengdu, Sichuan, People's Republic of China.

MNHN: Museum National d'Histoire Naturelle, Paris.

RESULTS

Description of Indian specimens (Figs. 1-4).- All snakes were found within 3 km of Gandhigram village (also known as Shidi), at 27° 26' 27" N, 96° 54' 55" E, in Changlang District, Arunachal Pradesh, elevation 1,040 m a.s.l., although the surrounding mountains are much higher (Anonymous, 1990). This village is located in the north-eastern-most fingertip of India, on the upper reaches of the Noa Dihing River close to Chaukan Pass just next to the border with Myanmar. All specimens from both trips were found in an area just outside the upper limit of Namdapha National Park. A description of the physiogeography, climate and flora of Arunachal Pradesh appears in Hajra et al. (1996).

As there is no voucher for this series, we give in Table 1 the detailed raw morphological characters recorded from these specimens. Specific comments are provided below the table when necessary. General characters conclude our description of this series. As these snakes have no collection number, they are identified by their respective date of collection; when more than one specimen was collected on a single day, a number is associated with the date.

General morphology.- These specimens present a typical morphology of the green, arboreal pitvipers of the *Trimeresurus* group (see Malhotra and Thorpe, 2000), with a rather elongated body; a wide, flat, triangular head, well distinct from the neck; and a strongly prehensile tail. Uniformly dark grass green or dark bamboo-leaf green dorsal background colour, some scales sometimes edged with turquoise blue.

General characters.- These 26 specimens share the following meristic characters: Dorsal scale rows in 17 rows at midbody, more or less keeled with obtuse keels on flanks and upper rows, sometimes nearly entirely smooth, 1st row always smooth; anal single; subcaudals paired, unless otherwise stated below; canthus rostralis sharply defined; tail rather long for a pitviper.

Nasal undivided; internasals large, kidney shaped, separated by a single smaller triangular downward pointing scale, unless otherwise mentioned below; usually 1 small triangular scale separating the internasal from the 2nd



FIGURE 1: General view of an Indian specimen of *Trimeresurus medoensis*.

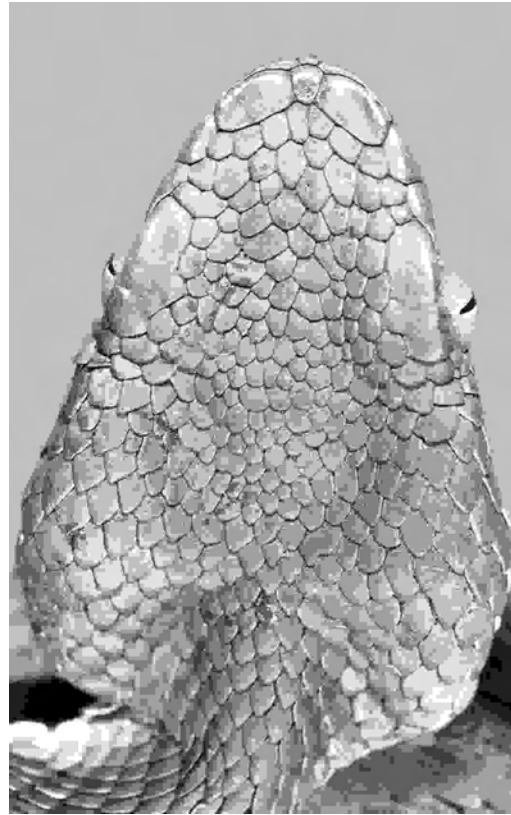


FIGURE 2: Dorsal view of head an Indian specimen of *Trimeresurus medoensis*.

supralabial; scales on the snout not numerous, large, larger than cephalic scales; 1 loreal between the internasal and the upper preocular, just below the canthus rostralis; 3 preoculars; 2 or 3 postoculars; 1 supraocular on each side, large, wide, with its inner margin sometimes indented; 1 elongate subocular; first supralabial completely separated from the nasal; supralabials 3 to 5 in contact with the subocular or sometimes separated by a single small scale; temporals: smooth.

Body uniformly dark grass green or dark bamboo-leaf green, interstitial skin between scales dark blue, some scales sometimes edged with turquoise blue, with, in all specimens, a bicoloured coral red and white ventrolateral stripe from behind the head to tail base on the first and second dorsal scale rows, red on its lower half, namely on lower half of 1st dorsal scale row, white on upper half, on upper half of 1st and

lower third of second dorsal scale rows respectively; top of head same colour as dorsum, without postocular streaks in all specimens, with paler, yellowish green (“paddy field” green) supralabials and infralabials, the latter scales sometimes with pale turquoise margin, and with a pale brown, sometimes blue-black temporal interstitial skin; venter mostly “paddy field” green; tail more or less entirely rusty reddish-brown above, with the midline, namely the sutures between the subcaudals being more or less turquoise blue or speckled with the same colour; eye green or yellowish green with a black pupil; tongue ranging from black to pale brown.

Although the bicoloured ventrolateral stripes are consistently present both in males and females, as in most Chinese specimens of *Trimeresurus stejnegeri*, sometimes white only in females, the postocular streak is totally lacking in all specimens.

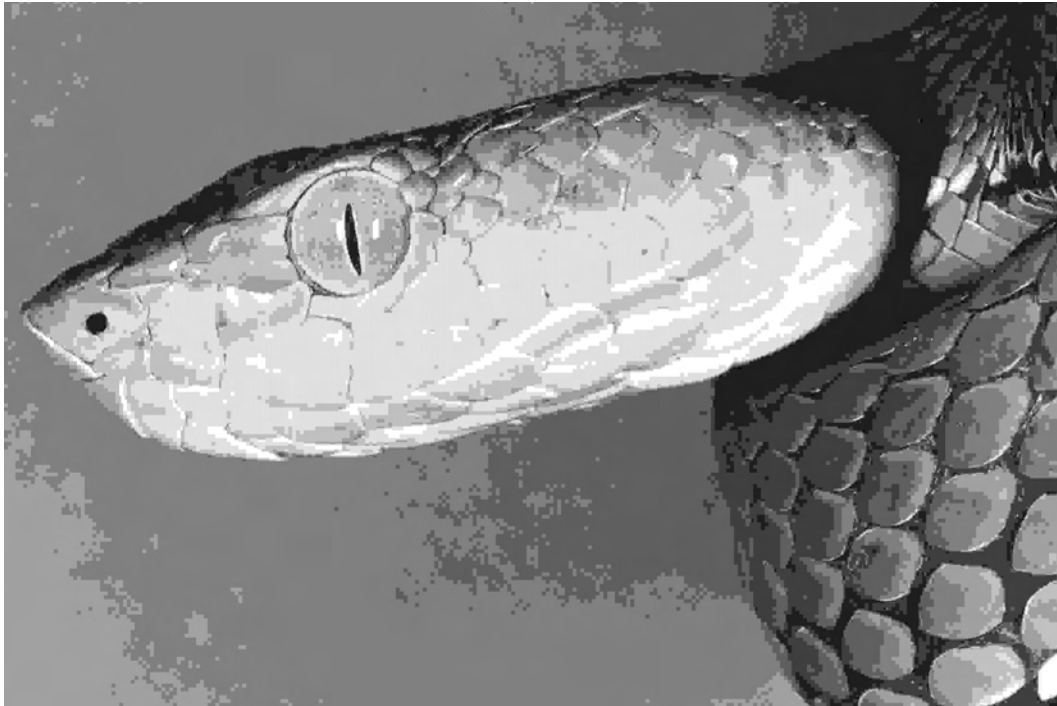


FIGURE 3: Left side of head of an Indian specimen of *Trimeresurus medoensis*.

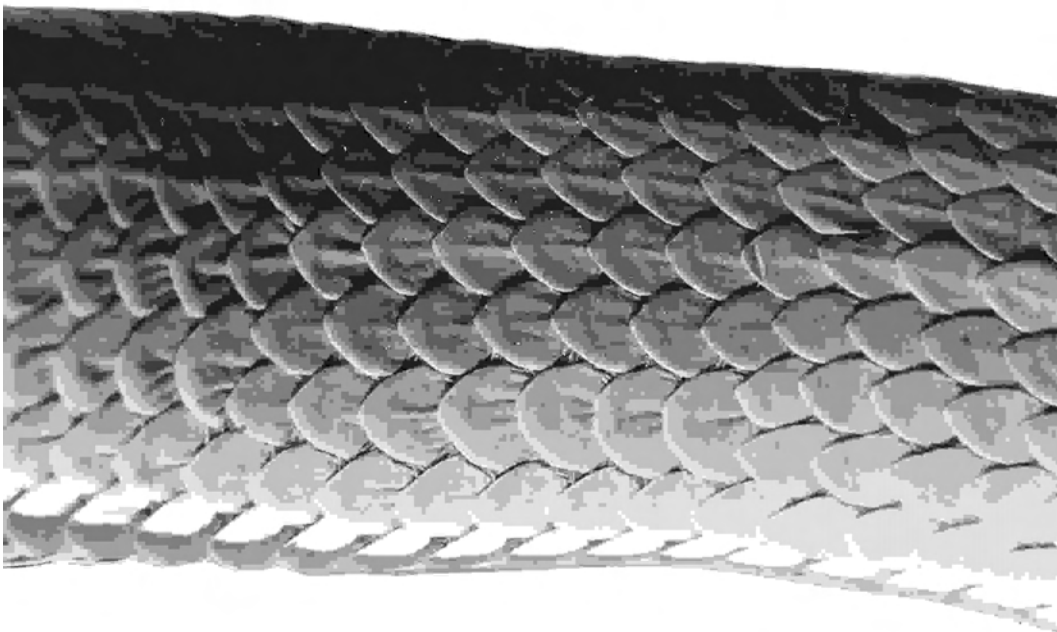


FIGURE 4: Dorsal scales of an Indian specimen of *Trimeresurus medoensis*. Note the bicoloured ventrolateral stripe.

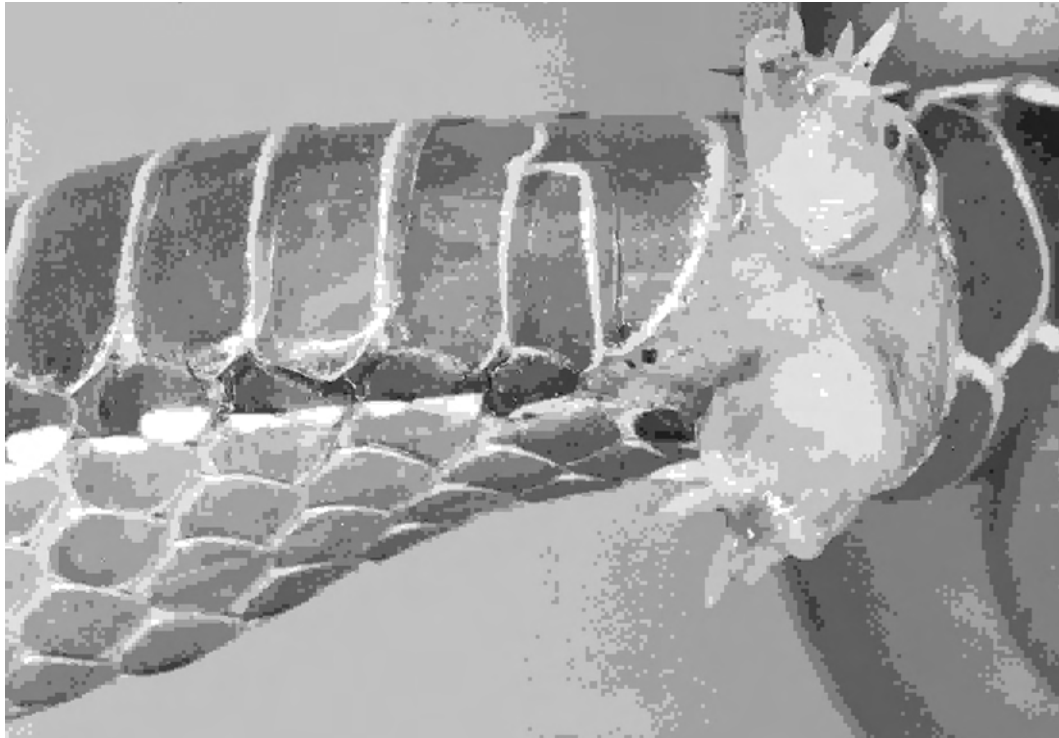


FIGURE 5: Hemipenis of an Indian specimen of *Trimeresurus medoensis* (specimen 14.xii.99[1]).



FIGURE 6: General view of the holotype of *Trimeresurus medoensis*.



FIGURE 7: Close-up of left side of head of the holotype of *Trimeresurus medoensis*.

Individual characters.- Description of hemipenis (Fig. 5). The organs are short and thick, deeply divided and rounded at extremity. The proximal two thirds of the organ are spinous, furnished with about 12 spines of irregular size, of which four or five are much enlarged and two or three are shorter but much more developed than the other spines. Its distal third is calyculate. The shallow sulcus spermaticus divides at the base of the organ, near the first two large spines,

and extends to the distal end of each lobe. In Fig. 5, we provide the first photograph of the hemipenes of this species.

Biology.- The surveyed area has steep slopes that are largely covered with wet montane forests and bamboo thickets. The sub-alpine zone merges with the tropical rain forest around the Noa-Dehing valley; there is such a floral diversity that no single plant species can be said to be dominant. The climate is cool and wet, with

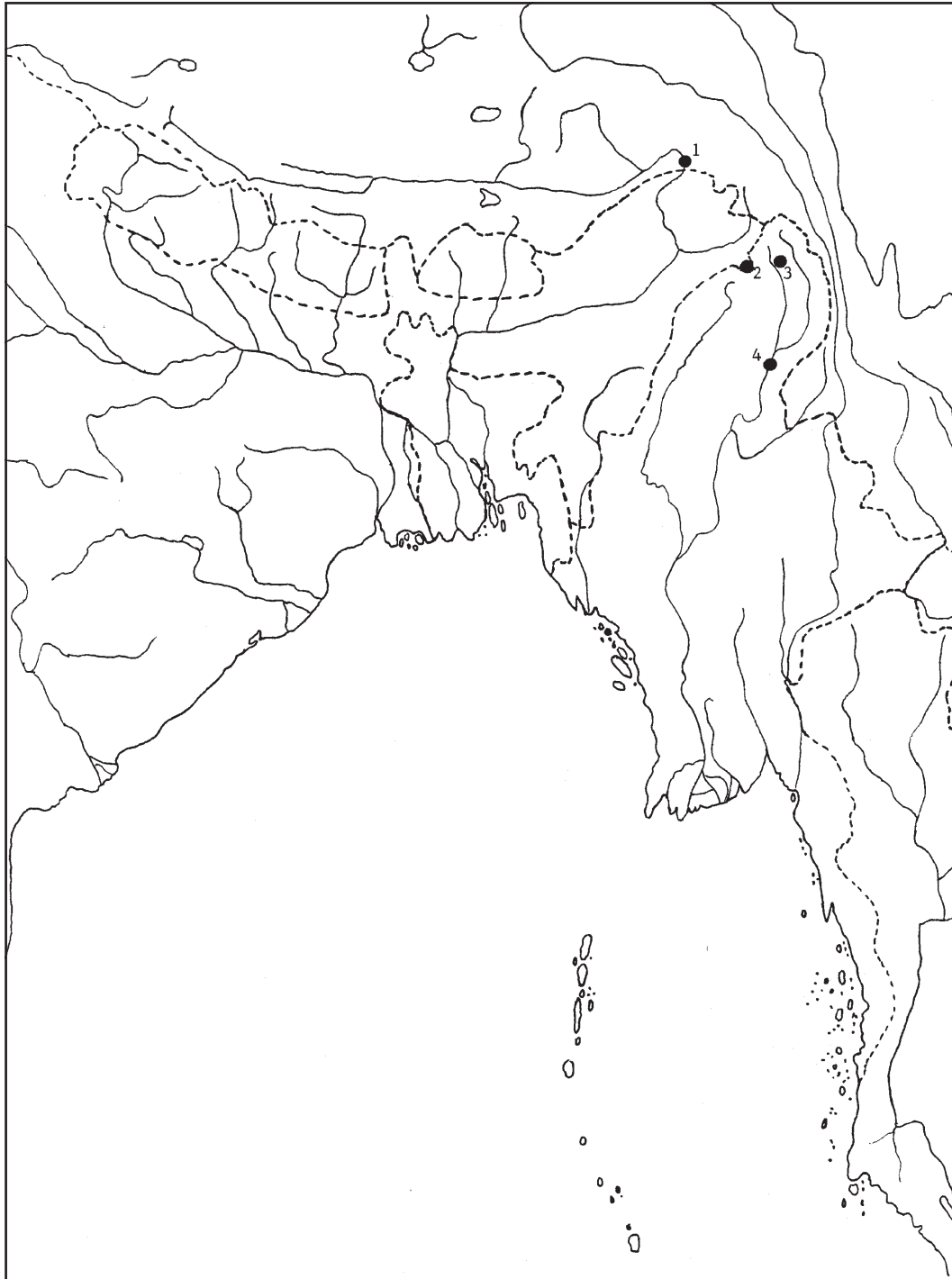


FIGURE 8: Map of north-eastern India and adjacent regions, showing the distribution of *Trimeresurus medoensis*. References: 1. Motuo (type locality), People's Republic of China; 2. Gandhigram, India; 3. Nam Ti Valley, Myanmar; and 4. Myitkina, Myanmar.

TABLE 1 : Main morphological and meristic characters of *Trimeresurus medoensis* from India. **Abbreviations:** See under Materials and Methods, except: Keels: keels of dorsal scales at midbody: 0 smooth; + keeled (in brackets, keeling of the first dorsal scale row). **Notes:** 19.iii.99: Umbilical scar at Ven 19-21 from anal; supraoculars large; 20.iii.99: The keels are like loose folds of skin; dark blue interscalar skin visible; distal few subcaudals had turquoise blue flecks near their mid sutures; tongue pale brown; 30.iii.99(1): Upper 8 dorsal scale rows weakly keeled; only the tail tip is reddish brown; 30.iii.99(2): Upper 8 dorsal scale rows weakly keeled; 22.v.99: Eye green; some subcaudal sutures near tail tip speckled with turquoise; 26.v.99(1): 21 scale rows counted from immediately behind neck, some irregular reductions happening to 19 then 17 rows two head lengths behind neck; 13 rows two head lengths before vent; dorsal scales edged with turquoise; subcaudals paired, except subcaudals 2 to 11 and 58-59 single; eye greenish yellow; tail tip rust red above, turquoise below (till 24th subcaudal from tip), then yellowish green; terminal scute totally rust reddish brown. This individual has blue-black temporal interscalar skin instead of the usual pale brown colour; 26.v.99(2): 21 scale rows counted from immediately behind neck, 17 rows two head lengths behind neck, 17 rows at midbody, and 13 rows two head lengths before vent; head at widest 22 mm, head length 28 mm, body diameter about 25 mm. The elongate subocular touches SupLab 3-5; eye green; 28.v.99: Ventrals 2, 134 and 141 (counted from the anal end) stretched only ½ way across the 'belly'; tail entirely dorsally rust reddish brown; infralabials yellowish green with upper pale turquoise margin; temporal skin pale brown; 2.vi.99(1): 19 scale rows behind head, reduced to 17 rows at 2 head lengths behind the head, 17 at midbody up to two head lengths before vent, then reduced to 13 rows two head lengths before vent; 3.vi.99(1): 19 scale rows behind head, all more or less smooth; internasals separated by 2 small triangular scales; a single row of scales between elongate subocular and supralabials; eye green; 3.vi.99(2): 19 scales behind head, reduced to 17 rows at 2 head lengths behind the head, 17 at midbody, reduced to 13 rows two head lengths before vent; 4.vi.99: The secretion of the anal glands was colourless, watery and smells of crushed leaves. This specimen slithered off smartly upon release; 14.xii.99(1): 19 rows at one head length behind neck, reducing to 17 at 2 head lengths, 13 rows at 2 head lengths before vent; dorsum and upper head beautifully coloured dark bamboo or grass green with cobalt/prussian blue skin in between; the bicoloured ventrolateral stripe runs along most of the outermost scale row on either side, but, in this specimen, the stripe continues 5 scales past the vent, then, after a gap of 2 scales, it carries on for 2 more scales on the tail; tail dorsally reddish-brown, ventrally mostly yellowish green with some turquoise patches; ventrals yellowish green, bounded anteriorly and posteriorly by grey, or perhaps a lighter shade of the cobalt/prussian blue that is present between the dorsal scales; eye yellowish green; pupil black, area surrounding it slightly orange; 14.xii.99(2): Tongue black with light tips; 14.xii.99(4): 18 scale rows at one head length behind head, reducing to 17 at two head lengths, 17 at midbody, and 13 rows at two head lengths before vent; 2 postocular scales on each side; 28.xii.99(1): 21 scale rows at one head length behind head, reducing to 17 at two head lengths, 17 at midbody, and 13 rows at two head lengths before vent; 28.xii.99(2): First subcaudal paired, SubC 2-4 single, all others paired; 28.xii.99(3): Pressing the tailbase yielded a thin stream of fluid (like from a syringe), which smell of crushed leaves.

| Specimen | Sex | SVL | TaL | TaL/TL | Ven | SubC | Dorsal rows | Keels | InNas | SupL | Cep | InfL | Pos |
|---------------|-----|-----|------|--------|-----|------|-------------|---------|--------|------|------|-------|-----|
| 19.iii.99 | F | 305 | > 35 | — | 144 | 54 | 17-17-13 | 0 | 1 | 9/9 | 8 | — | — |
| 20.iii.99 | M | 525 | 105 | 0.17 | 138 | 54 | 17-17-13 | + (0) | 1 | 9/9 | 7-8 | 10/10 | — |
| 30.iii.99 (1) | F | 530 | 103 | 0.16 | 143 | 52 | 17-17-13 | 0/+ (0) | 1 | 9/9 | — | 10/11 | — |
| 30.iii.99 (2) | ? | 470 | 102 | 0.18 | 141 | 58 | 17-17-13 | 0/+ (0) | 1 | 9/9 | — | 10/10 | — |
| 30.iii.99 (3) | M | — | — | — | 148 | 65 | 17-17-13 | 0 | 2 | 9/9 | 8 | — | — |
| 22.v.99 | M | 460 | 117 | 0.20 | 142 | 55 | 17-17-13 | + (0) | 1 | 9/9 | — | — | — |
| 26.v.99 (1) | ? | — | — | — | 146 | 61 | 17-17-13 | + (0) | 1 | 9/9 | 8 | 10/11 | — |
| 26.v.99 (2) | ? | 500 | 109 | 0.18 | 146 | 56 | 17-17-13 | + (0) | 2 | 8/9 | 8-10 | 11/11 | — |
| 28.v.99 | F | 485 | 95 | 0.16 | 149 | 54 | 17-17-13 | + (0) | 1 | 8/8 | 7-8 | 10/10 | — |
| 2.vi.99(1) | M | 475 | 115 | 0.20 | 144 | 61 | 17-17-13 | + (0) | 1 | 8/8 | 8 | 10/10 | — |
| 2.vi.99(2) | M | 400 | 105 | 0.21 | 143 | 61 | 17-17-13 | + (0) | 2 | 8/8 | 8 | 10/10 | — |
| 3.vi.99(1) | M | 490 | 97 | 0.16 | 143 | 54 | 17-17-13 | + (0) | 2 | 8/9 | 8 | 10/9 | — |
| 3.vi.99(2) | M | 467 | 122 | 0.21 | 142 | 63 | 17-17-13 | + (0) | 2 | 8/8 | 9 | 10/10 | — |
| 4.vi.99 | M | 490 | 123 | 0.20 | 141 | 61 | 17-17-13 | 0 | 1 | 8/9 | 9 | 11/10 | — |
| 14.xii.99(1) | M | 455 | 105 | 0.19 | 144 | 61 | 17-17-13 | + (0) | 1 | 9/9 | 7 | 10/10 | 3/2 |
| 14.xii.99(2) | F | 480 | 98 | 0.17 | 143 | 57 | 17-17-13 | + (0) | 1 | 9/8 | 7-9 | 9/10 | 3/3 |
| 14.xii.99(3) | M | 455 | 55 + | — | 145 | 26+ | 17-17-13 | + (0) | 1 | 8/9 | 6-8 | 10/9 | — |
| 14.xii.99(4) | M | 433 | 100 | 0.19 | 147 | 59 | 17-17-13 | + (0) | 1 | 9/9 | 8-9 | 10/10 | 2/2 |
| 14.xii.99(5) | F | 385 | 82 | 0.18 | 143 | 53 | 17-17-13 | + (0) | 3 | 8/8 | 8 | 10/11 | 2/2 |
| 14.xii.99(6) | F | 365 | 79 | 0.18 | 142 | 55 | 17-17-13 | + (0) | 1 | 9/8 | 9 | 10/10 | 2/3 |
| 28.xii.99(1) | F | 555 | 122 | 0.18 | 146 | 56 | 17-17-13 | + (0) | 1 (+1) | 9/9 | 7 | 10/10 | — |

(TABLE 1, continued)

| | | | | | | | | | | | | | |
|--------------|---|-----|-----|------|-----|----|----------|------|---|-----|---|-------|-----|
| 28.xii.99(2) | M | 350 | 83 | 0.19 | 144 | 58 | 17-17-13 | +(0) | 1 | 9/9 | 8 | 10/10 | 3/2 |
| 28.xii.99(3) | F | 490 | 98 | 0.17 | 142 | 56 | 17-17-13 | +(0) | 1 | 8/9 | 8 | 9/9 | 2/2 |
| 28.xii.99(4) | M | 490 | 123 | 0.20 | 144 | 59 | 17-17-13 | +(0) | 1 | 8/8 | 8 | 10/10 | 2/3 |
| 28.xii.99(5) | M | 455 | 112 | 0.20 | 145 | 59 | 17-17-13 | +(0) | 1 | 8/7 | 6 | 10/9 | 2/3 |

TABLE 2: Main morphological characters of *Trimeresurus medoensis*. Key: (1): green in life according to the description; green also in preservative; (2): the red pigment may have disappeared in AMNH 58532 after more than 60 years in preservative. The poor condition of the latter specimen may also be responsible for this fact. In BMNH 1936.7.4.43, the red pigment turned brownish grey, but is still visible.

| Specimen | Dorsal colour (alive) | Ventrolateral stripe | Postocular streak | Red tail | TaL/TL | SnL/HL | dO/DOL |
|---------------------------|-----------------------|----------------------|-------------------|----------|-----------------------|--------|-------------|
| CIB 73II5208 | grass green | Bicoloured | none | yes | 0.19 | 0.292 | 1.25 |
| CIB 73II5209 | grass green | Bicoloured | faint | yes | 0.18 | 0.280 | 1.18 |
| BMNH 1936.7.4. 43 | green (1) | Bicoloured | none | yes | 0.18 | 0.26 | 1.87 (juv.) |
| AMNH 58532 | green | White ? (2) | none | yes | 0.18 | 0.28 | 0.81 |
| Indian specimens (n = 26) | grass or dark green | Bicoloured | none | yes | 0.17-0.20 (0.16-0.22) | — | — |

TABLE 3 : Main meristic characters of *Trimeresurus medoensis*. Key: (1): the two other specimens of this series, not examined here, but described by Smith (1943), present the following values respectively: 17 : 17 : 13 rows; 143- 149 ventrals; 57-60 subcaudals; (2): from 6 photographed specimens.

| Specimen | Ven | SubC | Dorsal rows | Keels | InNas | Snout scales | SupL | SupL/ sobOc | Pos | Cep | InFL |
|---------------------------|--------------------|-------------------|--------------|-------|---------|--------------------|---------|-------------|-----|-----|-----------|
| CIB 73II5208 | 149 | 59 | 17 : 17 : 13 | 0/+ | 1 | 3 | 8 | 0 | 2 | 9 | 8-9 |
| CIB 73II5209 | 146 | 55 | 17 : 17 : 13 | 0/+ | 0 | 4 | 8 | 0 | 2 | 9 | 8-9 |
| BMNH 1936.7.43 | 142 ⁽¹⁾ | 57 ⁽¹⁾ | 17 : 17 : 13 | 0 | 1 | 4 | 8 | 0 | 2-3 | 8 | 9-10 |
| AMNH 58532 | 141 | 52 | 17 : 17 : 15 | 0/+ | 1 | 4 | 8-9 | 0 | 2 | 9 | 10-11 |
| Indian specimens (n = 26) | 138-149 | 52-65 | 17 : 17 : 13 | 0/+ | 1-2 (3) | 4-5 ⁽²⁾ | (7) 8-9 | 0-1 | 2-3 | 6-9 | (9) 10-11 |

TABLE 4 : Comparison between some green pitvipers (genus *Trimeresurus*) of the Eastern Himalayas and China. Key: (1): for specimens from China only, excluding Hainan Island; based on Zhao et al. (1998) and our data; (2): based on Zhao et al. (1998) and our data; (3): values for specimens from this area, from Regeness & Kramer (1981).

| Species | Co (m) | Ven | SubC | SupL | Ventrolateral stripe (M/F) | Hemipenis |
|--------------------------------------|---------|---------|-------|---------------|--------------------------------|-----------------------|
| <i>T. medoensis</i> | 17 | 138-149 | 52-65 | (7) 8-9 | Bicoloured/bicoloured | short, thick, spinose |
| <i>T. stejnegeri</i> ⁽¹⁾ | 21 | 154-172 | 43-75 | (8) 9-11 (12) | Bicoloured/bicoloured or white | short, thick, spinose |
| <i>T. yunnanensis</i> ⁽²⁾ | 19 (21) | 150-172 | 52-71 | 9-10 (11) | Bicoloured/white or absent | short, thick, spinose |
| <i>T. popeiorum</i> ⁽³⁾ | 21 | 155-169 | 52-76 | 9-11 | Bicoloured/white | long, thin, smooth |

heavy rains from March-November, however winter rains are not uncommon. Annual rainfall is 3,500 - 4,000 mm and average winter temperatures- 15-21°C, in March-October they vary between 22-30°C, maximum being in June - August where temperatures go up to 40 - 42°C (fide an unpublished paper produced by the State Forest Department Officers at Namdapha National Park).

Most specimens were discovered among bamboos. According to two Lisus who were interviewed separately, these particular "funiche" (green snakes) are often found "sleeping in bamboo" in groups of two or three. The Lisus say that they "sit" in standing bamboos which have worm (?) holes, where they eat frogs and mice. All the specimens that we found in March, and some in early/mid April were found in standing bamboos,

in which we found also small frogs and one mouse. Later in the season, from mid- to late May, depending on the climate, specimens are found on bushes and trees. A Lisu reported us that “if the snakes continue to get food inside the bamboo, they won’t come out or will do so much later”. According to the Lisu, this species is active at night, when they can be found on the ground hunting for frogs.

This species is rather common in this area, where the second author collected six specimens within two hours in a single day. In another instance, three animals were observed inside two adjacent internodes of the same bamboo.

The specimen 22.v.99 was found outside a bamboo internode, while the 26.v.99 was discovered resting on a tree. It appears that hibernation in this mountainous, relatively cold area ends between March and May. These snakes are active at least till October, the Lisu even claiming to see them out till November. During our trip conducted from November 1999 to January 2000, all collected snakes were found hibernating (dates on which the snakes were found have been incorporated into the assigned field numbers). They were found inside internodes of a species of bamboo called by the Lisu “wachu alyuh” (wachu meaning bamboo). This is a relatively thin-walled species, often with holes made by rats which sometimes live inside. Frogs and centipedes were also found in these holed internodes. Three of the snakes (28.xii.99[3] to [5]) were found in adjacent internodes of the same “rat-holed” bamboo (two together and one in the next internode).

A reliable source has seen these snakes eating frogs. Another specimen was found dead with a mouse in its stomach.

Juveniles were aggressive and delicate to handle, whereas adults were of a more even disposition, unless irritated, but were found to be noticeably more alert and trickier to handle in the late evenings. The bites of *Trimeresurus medoensis* does not appear to be fatal. Several Lisu have been bitten by this species, including children, and no fatal case was reported. Bites produce pain and swelling, which lasts from 3- 4 days up to 2 weeks. When pressure was applied

to the tail base, to sex the snakes, several adults ejected a thin stream of fluid, probably the anal gland secretion, which was colourless, watery and smells like crushed leaves.

DISCUSSION

The systematics of the genus *Trimeresurus* remain controversial, especially among species with an overall green colouration, and all specimens of this group likely to present a taxonomic or distributional interest should be carefully compared either with type specimens of relevant species, or with soundly identified vouchers. Within the frame of an ongoing project on the *Trimeresurus* group, the senior author examined the type specimens of *Trimeresurus medoensis*, which are here redescribed. We also provide a comparison between the types and both our Indian specimens and two specimens from Myanmar which were referred to this taxon. These data are presented below.

Redescription of the types of *Trimeresurus medoensis* (Figs. 6-7).

Holotype.- CIB 73II5208, male, from “Ani bridge, Motuo, Xizang, alt. 1200m”, Motuo County, Xizang Autonomous Region, People’s Republic of China, collected by Zhao Ermi and Gao Yuan, 3 August, 1973.

Paratype.- CIB 73II5209, male, from the same locality, 1400 m, collected by Zhao Ermi and Wu Xueen, 3 August, 1973.

In the following description, the first and second values given for each character refer to those in CIB 73II5208 and CIB 73II5209, respectively. Values for symmetric head characters are given in left- right order. When unspecified, the state of a given character is shared by both specimens.

Holotype:

SVL: 546 mm; TaL: 125 mm; TL: 671 mm; HL: 26.25 mm; ratio TaL/TL: 0.186.

Ven: 149 (no prefrontals); SubC: 59, paired, plus one terminal scale; anal entire.

Co: [18 at IHL] : 17 : 17 : 13 scales, rhomboid, moderately keeled, with the exception of those in outermost row which are smooth.

Dorsal scale rows reduction, from 17 to 13 rows (17 rows at Ven 30; reductions before Ven 30 were not considered), see formula 1.

Dorsal scale row formula 1:

| | | | | | |
|----|---|----|---|----|---------|
| 17 | $\frac{3+4 \rightarrow 3 \text{ (Ven 100)}}{\quad}$ | 15 | $\frac{3+4 \rightarrow 3 \text{ (Ven 107)}}{\quad}$ | 13 | (right) |
| | $\frac{3+4 \rightarrow 3 \text{ (Ven 101)}}{\quad}$ | | $\frac{3+4 \rightarrow 3 \text{ (Ven 113)}}{\quad}$ | | (left) |

Dorsal scale row formula 2:

| | | | | | |
|----|--|----|---|----|---------|
| 17 | $\frac{3+4 \rightarrow 3 \text{ (Ven 95)}}{\quad}$ | 15 | $\frac{3+4 \rightarrow 3 \text{ (Ven 101)}}{\quad}$ | 13 | (right) |
| | $\frac{3+4 \rightarrow 3 \text{ (Ven 95)}}{\quad}$ | | $\frac{3+4 \rightarrow 3 \text{ (Ven 103)}}{\quad}$ | | (left) |

Paratype:

SVL: 496 mm; TaL: 111 mm; TL: 607 mm; HL: 25.87 mm; ratio TaL/TL: 0.183.

Ven: 146 (+ 1 preventral); SubC: 55, paired, plus one terminal scale; anal entire.

Co: [18 at 1HL] : 17 : 17 : 13 scales, rhomboid, moderately keeled like holotype, smooth on first row.

Dorsal scale rows reduction, from 17 to 13 rows (17 rows at Ven 30; reductions before Ven 30 were not considered), see formula 2.

Body rather elongated for members of the genus *Trimeresurus*, cylindrical but slightly laterally compressed; head triangular, distinctly flattened, rather short, 1.4/1.5 times as long as wide, wide at its base, clearly distinct from a thin neck; snout long, accounting for 29.2/28.0% of total head length, 1.8/1.8 times as long as diameter of eye, flattened, rounded when seen from above, obliquely truncated when seen from lateral side, with a distinct and sharp canthus rostralis; eye very large for a pitviper, eye diameter/distance lower margin of eye- upper lip border ratio 1.25/1.18 (mean values of both sides); nostril-loreal pit distance/nostril-eye distance ratio 0.56/0.58 (mean values of both sides); tail long, cylindrical, tapering, distinctly prehensile.

The hemipenes of the holotype were recently described and illustrated by Guo and Zhang (2001). It is about 15.6 mm long, short and thick, deeply divided and rounded at the extremity of each lobe. The proximal two thirds of the organ bear about 15 spines, with four or five ones distinctly enlarged and two or three shorter but much more developed than the other spines covering the organ; its distal third is calyculate. The shallow sulcus spermaticus divides at the base of the organ and extends to the distal end of each lobe.

Rostral visible from above, 1.4/1.5 times broader than high, triangular; nasal subrectangular, 1.7/1.7 times as long as high, undivided, with nostril in its middle; one pair of enlarged, bean-shaped internasals, 1.6/1.8 times as wide as deep, being about 1.3/1.5 times as long as and about 1.1/1.0 times as wide as adjacent upper snout scales, separated by a small, triangular scale in the holotype, in contact in the paratype; 3- 3/3- 3 canthal scales bordering the canthus rostralis between internasal and corresponding supraocular, of similar size or even smaller than adjacent snout scales; a triangular loreal between upper preocular and nasal; two upper preoculars above loreal pit, both elongated and in contact with loreal; lower preocular forming lower margin of loreal pit; 2-2/2-2 postoculars; one large supraocular on each side, long and wide, about 2.3/2.2 times as long as wide, much wider than the adjacent upper head scales and about 0.9/0.7 time as wide as internasals, strongly indented by upper head scales; scales on upper snout surface enlarged, smooth, juxtaposed, irregular in shape, at the number of 3/4 on a line between the internasals and a line connecting the anterior margins of eyes, slightly larger than scales of the frontal-parietal region; cephalic scales irregular, juxtaposed, smooth on upper head, slightly keeled backwards on occipital region; 9/9 cephalic scales on a line between supraoculars; temporals large, unequal, in 2 or 3 rows, smooth, the lower row much larger than others; one thin, elongated, crescent-like subocular; 8- 8/8- 8 supralabials (SupL); first SupL small and short, totally separated from the corresponding nasal; 2nd SupL high, forming the anterior border of loreal pit, separated from nasal by 1/1 small triangular scale; 3rd SupL largest, pentagonal, approximately 1.3- 1.4/1.4- 1.4 times as long as

high, placed in front of the subocular with which it is in contact in both specimens; 4th SupL nearly as high but smaller than 3rd, in contact with subocular in both specimens; 5th and other posterior supralabials distinctly smaller than 4th one, 5th separated from subocular by one scale of similar size, others in contact with first row of temporals; 8-9/8-9 infralabials, first pair in contact with each other, first, second and third pairs in contact with chin shields; 6/5 rows of smooth gular scales; chin shields irregularly arranged.

In preservative, dorsal and upper tail surfaces are very dark brown, nearly black, with a bicoured ventrolateral stripe, orange-red below, white above, running from the neck up to the beginning of the tail on first and second rows of dorsal scales; tail like body, with upper part of posterior half rusty red; upper head surface and temporal regions of same colour than dorsal surface; a faint, whitish yellow postocular streak in holotype, absent in the paratype; venter, chin and throat blackish-brown.

For colouration in life of the types specimens, we refer to Djao and Jiang (1977) and Zhao et al. (1998). It is identical to the Indian specimens described in this paper.

Comparison of available material.- It seems that no further specimens were collected within the People's Republic of China since the discovery of the types, but four specimens, all from Myanmar, have previously been implicitly or explicitly referred to *Trimeresurus medoensis*.

Smith (1943: 518) tentatively, and rather reluctantly, identified three specimens of pitvipers from Myanmar as *Trimeresurus stejnegeri*. In fact, Smith noted the unusual low number of dorsal scale rows, 17 at midbody and 13 before vent, whereas *T. stejnegeri* and *T. yunnanensis* (formerly *T. s. yunnanensis*, see Zhao, 1995) have 21 and 19 (or seldom 21) rows at midbody, respectively, and 15 or 13 rows before vent. These specimens were collected by Mr. R. Kaulback in "Ratnamhti", at 27° 35' N - 97° 47' E (Smith, 1940) and "Nam Ti Valley" (Smith, 1943), Upper Burma, in the area then known as "The Triangle", a region located between the Nmai or Laung Pit River and Mali Kha River. Nam Ti Valley or Ratnamhti is located north of the vil-

lage of Alangdunhku, at about middistance between Langtao and Nogmung, in northern Kachin State, Myanmar (Finlay, 1995). Djao and Jiang (1977) tentatively referred these specimens to their newly described species *Trimeresurus medoensis* (see the translation in David and Tong, 1977). Of these three specimens, we examined only BMNH 1936.7.4.43. The two other specimens, cited by Smith (1940, 1943), are by all evidence BMNH 1940.6.5.73-74, according to C. J. McCarthy (pers. comm., March 2000). We also examined the specimen of *T. medoensis* cited by Zhao et al. (1998), AMNH 58532, from "Burma: (Myitkyina): Gora", collected on 24 January, 1935 by H. C. Raven. Besides the Chinese types, this specimen was thus the third ever mentioned specimen of *T. medoensis* and confirmed the occurrence of this species in northern Myanmar.

These two Burmese specimens are succinctly described below, in the order BMNH 1936.7.4.43 then AMNH 58532. (Values for symmetric head characters are given in left/right order. When nothing is mentioned, state of a given character is shared by both specimens).

BMNH 1936.7.4.43 (female):

SVL: 214 mm; TaL: 46 mm; TL: 260 mm; HL: 13.50 mm; ratio TaL/TL: 0.177; Ven: 142 (+ 1 preventral); SubC: 57, all paired; Co: [19 at 1 HL] : 17 : 17 : 13 scales, all smooth.

AMNH 58532 (female):

SVL: 535 mm; TaL: 115 mm; TL: 650 mm; HL: 27.85 mm; ratio TaL/TL: 0.177; Ven: 141 (+ 2 preventrals); SubC: 52, all paired; Co: [21 at 1 HL] : 17 : 17 : 15 scales, nearly all smooth.

Body and head shapes as in the types, head 1.7 times as long as wide in BMNH 1936.7.4.43; snout accounting for 25.9/28.3 % of total head length, 1.6/2.0 times as long as diameter of eye; eye diameter/distance lower margin of eye- upper lip border ratio 1.9/1.2 (mean values of both sides); nostril-loreal pit distance/nostril-eye distance ratio 0.59/0.55 (mean values of both sides); tail long, cylindrical and distinctly prehensile.

Head scalation as in the type specimens, with one pair of bean shaped, enlarged internasals, separated by 1/1 small, triangular scale; 1 triangular loreal; 2- 3/2- 2 postoculars; one large

supraocular on each side, long and wide, about 1.6 (measure approximate)/2.3 times as long as wide, much wider than the adjacent upper head scales and about 0.9/0.9 time as wide as the internasals, strongly indented by upper head scales; scales on upper snout surface enlarged, slightly larger than cephalic scales; cephalic scales irregular, juxtaposed, smooth on upper head, weakly keeled backwards on occipital region, at the number of 8/9 on a line between supraoculars; temporals large and smooth; 8-8/8- 9 supralabials (SupL); 1st SupL short and totally separated from the corresponding nasal; 2nd SupL high, in contact with nasal in BMNH 1936.7.4.43, separated by 1 small scale in AMNH 58532; 3rd SupL largest, pentagonal; 4th SupL nearly as high but smaller than 3rd, both in contact with subocular on each side in both specimens; 9- 10/11- 10 infralabials, in contact with chin shields as in the types; 6/6 rows of smooth gular scales.

Dorsal surfaces are dark bluish green, with a ventrolateral stripe, bicoloured in BMNH 1936.7.4.43 (although the red hue has turned to a brownish grey), white, although possibly bicoloured in life in AMNH 58532, running from the neck up to the beginning of the tail on first and second rows of dorsal scales; tail like body, with upper part of posterior half rusty red; upper head surface and temporal regions of same colour than dorsal surface; no postocular streak; venter, chin and throat slightly paler green.

The comparison of the main morphological data appear in Tables 2 and 3 (see Table 1 for abbreviations; other abbreviations are: SnL/HL: snout length/head length ratio.- do/DOL: diameter of eye/distance eye- lower margin of lip.- SupL/SubOc: number of scales between the 3rd and 4th supraoculars and the subocular).

The great morphological similarities of all these specimens allow us to regard them unambiguously as conspecific, thus confirming the presence of *T. medoensis* in north-eastern India and northern Myanmar.

CONCLUSIONS

The examination of 30 specimens, namely a 10-fold increase compared with the number of

specimens previously reported in the literature, allow us to present a new definition of this species, and a summary of our knowledge on this species.

Trimeresurus medoensis Djao in: Djao and Jiang, 1977

Trimeresurus medoensis Djao in Djao and Djiang, 1977: 66, Pl. 2, fig. 9-1 to 9-5.- Type locality. "Ani bridge, Motuo, Xizang, alt. 1200m", Motuo County, Xizang Autonomous Region (Tibet), People's Republic of China.- Holotype. CIB 73II5208 (male); paratype CIB 73II5209 (male).

Note.- We give above the type locality as it appears in the Chinese text. In the English summary, the type locality reads as: "Near A-nie bridge, Medo Xian, Xizang, alt. 1200m." Motuo, a large city of south-eastern Xizang Autonomous Region, chief of the county of the same name, is often spelt as Medôg or Medo.

Diagnosis and variation.- A species of the *Trimeresurus* group, referable to the informal subgroup of *Trimeresurus stejnegeri* on the basis of the morphology of short and spinose hemipenes (see below), characterized by an overall bright green dorsum, a first supralabial distinct from nasal, a number of 17 weakly keeled dorsal scale rows at about two head-lengths behind neck and at midbody, 8 or 9 (rarely 7) supralabials, upper-snout scales enlarged, wide supraoculars, and a bicoloured white/red ventrolateral stripe present in both males and females.

The largest known specimen for this species is a female from India, with a snout vent length and total length of 555 mm and 677 mm respectively. The largest male is the holotype from China, with a total length of 671 mm (SVL 546 mm).

Dorsal scale rows: [17-19, rarely 18 or 21, at 1 HL] : 17 [at 2 HL] : 17 : 13 (rarely 15), weakly keeled on upper rows or nearly wholly smooth; Ventrals 138- 149, subcaudals 52- 65.

Hemipenes.- The organs of the holotype were recently described in detail by Guo and Zhang (2001). For a general description of the hemipenes of this species, we refer to the descriptions given above for both the holotype and the Indian specimens, which are very similar.

Guo and Zhang (2001) put emphasis on a difference in the morphology of the hemipenes of *T. stejnegeri* and *T. medoensis*, and placed the two species in two different groups. If the hemipenes of *T. medoensis* are indeed more elongated and divided than those of *T. stejnegeri*, we do not regard this difference as warranting such a distinction. On the basis of the hemipenial morphology, Guo and Zhang (2001) also referred to their *medoensis*-type the species *Protobothrops kaulbacki* and *P. xiangchengensis*, which are otherwise morphologically very distinct. We here still regard the hemipenes of *T. medoensis* and *T. stejnegeri* as closely related, and these species as belonging to the same subgroup within the genus *Trimeresurus*.

Similar species.- This species is the only one in the *Trimeresurus stejnegeri* subgroup to have 17 rows at midbody. However, it may be superficially confused with any other green species of *Trimeresurus*. It differs immediately from *T. albolabris* and *T. erythrurus* by its flat head, elongated body, a first supralabial distinct from the nasal, a much lower number of dorsal scale rows (at least 21 for *T. albolabris* and *T. erythrurus*), and the presence of the bicoloured ventrolateral stripe.

However, it could be confused with green species which have the first supralabial totally separated from nasal, namely *T. gramineus*, *T. popeiorum*, *T. stejnegeri*, *T. tibetanus* and *T. yunnanensis*. From all these species, *T. medoensis* differs by the lower number of dorsal scale rows, 17 vs. 19 (rarely 21) in *T. yunnanensis* and 21 in other taxa. Furthermore, it is separated from *T. gramineus* by the presence of the bicoloured ventrolateral stripe. From *T. tibetanus*, it is distinguished by the absence of the reddish brown vertebral and cephalic markings of this species, a much flatter head and a much higher number of subcaudals. From *T. popeiorum*, it is also separated by the totally different shape of the hemipenes, long, thin and not spinose in *T. popeiorum*.

In its range, *T. medoensis* could be confused only with *T. popeiorum*, if hemipenes are not available, and *T. yunnanensis*. Main characters allowing to distinguish these species, as well as

T. stejnegeri, occurring as far west as Yunnan Province in China, are given in Table 4.

T. medoensis shows also some similarities, such as the enlarged upper snout scales, with some specimens from Thailand currently referred to as *T. stejnegeri*. The systematics of the *stejnegeri*-group is extremely confused and is still provisional, but the validity of *T. medoensis* cannot be questioned.

Sexual dimorphism.- The base of the tail in the adult male is distinctly swollen. The numbers of ventrals show little conclusive variation correlated to the sex. There are only few differences in the relative size of the tail and the average number of subcaudals, with the following values:

Ventrals:males: 138- 149 (x = 144.0) females: 141-149 (x = 143.5)

Subcaudals:males: 54- 65 (x = 59.1) females: 52-60 (x = 54.6)

Ratio TaL/TL males: 0.17- 0.21 (x = 0.193) females: 0.16- 0.19 (x = 0.172)

Lastly, the sexual dimorphism is not marked by the presence of the bicoloured ventrolateral stripe, which occurs in both males and females, as usually in Chinese specimens of *T. stejnegeri*, but to the contrary of the southern Indochinese populations currently referred to *T. stejnegeri*, in which the ventrolateral stripe in females is either white or absent (David et al, unpublished).

Distribution (Map 1).- This species inhabits mountainous areas under wet tropical and subtropical climates. Up to now, it is known from a few scattered localities of the three following countries:

India: Definitely known only from the vicinity of Gandhigram, Upper valley of the Noa Dihing River, State of Arunachal Pradesh, as reported here.

Myanmar: It is only known only from two localities in the north of this country, namely Nam Ti Valley, in the north of Kachin State, and an unidentified place in the vicinity of Myitkyina, southern Kachin State.

People's Republic of China: It is currently known only from Xizang Autonomous Region (Tibet), in the vicinity of Motuo (or Medôg), which is the type locality.

Natural history.- This species inhabits wet, forest-covered hills and mountains between 1000 and 1400 m a.s.l. Data for Indian specimens were provided above, and represent as yet most of our knowledge of this species. Most specimens were associated with a local species of bamboo, having been collected either hidden inside nodes of bamboos or perched on these bamboos. The types were collected on a mountain path crossing a forest on a wet slope. *Trimeresurus medoensis* is mainly an arboreal species, but also forages on the ground, as the type specimens were collected in day time while they were crossing a path bordered with vegetation in a rainy day. Other data on its biology are very limited. The known preys include frogs and mammals. Lastly, the reproduction of this species is still entirely unknown.

Further surveys of the herpetofauna of remote, montane areas of Eastern Himalaya will undoubtedly reveal a wider range for *T. medoensis*. Its occurrence may be expected in the Yunnan Province of China, and in other mountain ranges of India and northern Myanmar. Also, the examination of preserved specimens registered as *Trimeresurus stejnegeri* might show up more specimens.

The herpetological biodiversity of this area is high. The list of reptiles observed in the region of Gandhigram will be published elsewhere, but, as far as pitvipers are concerned, two species are already known besides *T. medoensis*, namely *Ovophis monticola* and *Protobothrops jerdonii*. The addition of *T. medoensis* to the Indian snake fauna increases to 37 the number of venomous landsnakes (Elapidae, Viperidae and Crotalinae) and to 18 pitvipers, respectively, in this country, of which 15 belong to the *Trimeresurus* group (David and Ineich, 1999).

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