

NEW FINDINGS ON THE DISTRIBUTION, MORPHOLOGY, AND NATURAL HISTORY OF *TRICERATOLEPIDOPHIS SIEVERSORUM* (SERPENTES: VIPERIDAE)

Hans-Werner Herrmann¹

Zoologischer Garten Köln, Riehler Straße 173, 50735 Köln, Germany
Email: hwherrmann@sandiegozoo.org

Thomas Ziegler²

Zoologisches Forschungsinstitut und Museum Alexander Koenig,
Adenauerallee 160, 53113 Bonn, Germany
Email: dr.th.ziegler@t-online.de

Bryan L. Stuart³

Wildlife Conservation Society, PO Box 6712, Vientiane, Laos
Email: bstuart@fieldmuseum.org

Nikolai L. Orlov

Zoological Institute, Russian Academy of Sciences,
Universitetskaya nab. 1, St. Petersburg 199034, Russia
Email: agama@na4755.spb.edu

The Phong Nha-Ke Bang National Park (PKNP) in central Vietnam and the Hin Namno National Biodiversity Conservation Area (NBCA) in central Laos border each other and form part of the largest continuous limestone ecosystem in Indochina. This limestone ecosystem consists of vast areas of sparsely vegetated karst limestone outcrops with forested limestone hills and valleys (Fig. 1), and represents a considerable part of the central Annamite Mountains. These mountains run along the border of Vietnam and Laos, and extend over a range of approximately 700 km in north–south and 60–100 km in east–west direction. The endemism and faunal importance of the Annamite Mountain range is illustrated by a number of recent discoveries and rediscoveries of large mammal species, such as a bovid (*Pseudoryx nghetinhensis*; Schaller and Rabinowitz 1995), cervids (*Megamuntiacus*

vuquangensis, *Muntiacus truongsongensis*; Pham Mong Giao et al. 1998; Timmins et al. 1999), a suid (*Sus bucculentus*; Grooves et al. 1997), and a lagomorph (*Nesolagus timminsi*; SurrIDGE et al. 1999; Averianov et al. 2000). Ziegler and Herrmann (2000) reported up to 100 amphibian and reptile species for PKNP alone.

The monotypic pitviper genus *Triceratolepidophis* was recently described based on a single specimen from the vicinity of PKNP in the Quang Binh Province in central Vietnam (Ziegler et al. 2000). The holotype, an adult male placed in the species *T. sieversorum*, was discovered preserved in rice liquor in a traditional medicine man's animal collection.

A recent herpetological survey conducted within the framework of a Cologne Zoo Nature Conservation Project in PKNP allowed the capture of one living adult specimen of *T. sieversorum*. Similarly, during a herpetological survey by the Wildlife Conservation Society (WCS) in Hin Namno NBCA (Laos), an additional living specimen was found. With these two additional specimens, we here supplement the original description (Ziegler et al. 2000) and present for the first time ecological and ethological data on *T. sieversorum*.

¹Present address: CRES Cameroon, Zoological Society of San Diego, PO Box 3055, Messa, Yaounde, Cameroon

²Please use for correspondence.

³Present address: Field Museum of Natural History, Division of Amphibians and Reptiles, 1400 S. Lake Shore Dr., Chicago, Illinois 60605-2496, and University of Illinois at Chicago, Department of Biological Sciences (M/C 066), 845 W. Taylor, Chicago, Illinois 60607-7060, USA.



Figure 1. Habitat of *Triceratolepidophis sieversorum* in a limestone karst region of the central Annamite Mountains, Phong Nha-Ke Bang National Park. Photograph by Hans-Werner Herrmann.

MATERIAL AND METHODS

Three specimens of *Triceratolepidophis sieversorum* are known, two in the collection of the Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK) and one at the Field Museum of Natural History, Chicago, USA (FMNH). The holotype (ZFMK 71262) is an adult male from Phong Nha (village), PKNP, Quang Binh Province, Vietnam, that was collected by a local medicine man during the first half of 1999. The second (ZFMK 75066) is an adult female from 17°30'N 106°16'E, elevation approximately 150 m, PKNP, Quang Binh Province, Vietnam, that was collected on 1 September 2001 by HWH and TZ. The third specimen (FMNH 255258) is incomplete, consisting of the head and the anterior part of the body only (the body spoiled and was discarded shortly after preservation owing to insufficient injection of formalin into the body cavity) and was captured at coordinates 17°34' N and 105°51' E, at an elevation of 210 m, in Hin Namno NBCA, Boualapha District, Khammouan Province, Laos, on 13 February 1998 by BLS.

Specimens were fixed in 98% ethanol (ZFMK 75066) or in 10% buffered formalin (FMNH 255258) and then transferred to 70% ethanol. Snout-vent length (SVL) and tail length (TL) were measured in the preserved specimens to the nearest mm using a meter stick. Other standard measurements were taken to the nearest mm using digital calipers. Scalation features were observed under a dissecting microscope. Scale terminology follows Klauber (1956) except for circumoculars, which are all scales around the eye, and prefrontals, which are

scales wider than long but not in contact with the first row of dorsals. Ventral scales were counted following Dowling (1951). Anterior dorsal scale row counts were made approximately one head-length posterior to the head. Posterior dorsal scale row counts were made approximately one head-length anterior to the vent. Values for symmetric head characters are presented as left/right. Coloration in life is based on photographs of living and freshly preserved specimens. X-ray examinations of the skull of FMNH 255258 were made using a CBM (Japan) soft ray X-ray machine.

Locality coordinates were obtained by handheld Garmin® GPS instruments. Climate data in Vietnam were collected by a Hobo® 08 data logger recording temperature and relative humidity every hour. The data logger was mounted on a tree trunk at 2 m height within a closed forest in close proximity to the locality of specimen ZFMK 75066. Logger data was processed with the computer program BoxCar version 4.0. Temperature data in Laos were collected with a minimum/maximum thermometer.

RESULTS

Both ZFMK 75066 and FMNH 255258 clearly show the diagnostic characters of *T. sieversorum* as described by Ziegler et al. (2000), namely the supraocular horns, and the dorsal and lateral scales with keels consisting of three consecutive horn-like structures. Characters corresponded well with the description of the holotype (Table 1), unless stated otherwise below.

The female (ZFMK 75066, Fig. 2) has a SVL of 887 mm, a TL of 165 cm, and a SVL/TL ratio of 5.4, the same as the male holotype. The ventral count is 235, plus two prefrontals. Dorsal scale rows in the species range from 23–24 anterior rows to 21–23 midbody rows, to 17 posterior rows (note that in the original holotype description 33 anterior dorsal scale rows were reported instead of the actual value of 23 anterior rows due to a typographical error). The head length/head width ratio of ZFMK 75066 and FMNH 255258 is 1.6 and 1.7, respectively, versus 1.5 in the holotype. This indicates the two new specimens have slightly more elongated heads than the holotype. All specimens have 8–10/8–10 supralabials, 14/13 infralabials, and eye diameters of 4–5 mm. Supralabials, numbering 5–8 when counted from the corner of the mouth for-

TABLE 1. Measurements (in mm) and pholidosis of the three known specimens of *Triceratolepidophis sieversorum*. Enlarged supralabial numbers indicate the position when counted toward the snout tip on the left side of the head. Values for symmetric head characters are presented as left/right. ZFMK 71262 is the adult male holotype, ZFMK 75066 is an adult female specimen, and FMNH 255258 is an incomplete specimen of unknown sex.

Character	ZFMK 71262	ZFMK 75066	FMNH 255258
Snout-vent length	1060	887	no data
Tail length	197	165	no data
Ventrals	228	235	no data
Preventrals	2	2	2
Subcaudals	82	79	no data
Anterior-body dorsals	24	24	23
Midbody dorsals	23	22	21
Posterior-body dorsals	17	17	no data
Head length	40	37	39
Head width	26	23	23
Head height	15	14	15
Eye diameter	5/5	4/4	5/5
Supralabials	9/9	8/8	10/10
Infralabials	14/13	14/13	14/13
Enlarged supralabials	6,7,8	5,6,7	6,7,8
Circumoculars	11/11	11/10	10/10
Intersupraoculars	15	15	16
Internasals	2	3	4

ward, may be enlarged. The circumoculars range from 10–11, and intersupraoculars from 15–16. There are two scales between the circumoculars and supralabials. The “horns” in all specimens consist of two enlarged supraoculars that raise upwards and outwards at a 45° angle from the head (Fig. 3).

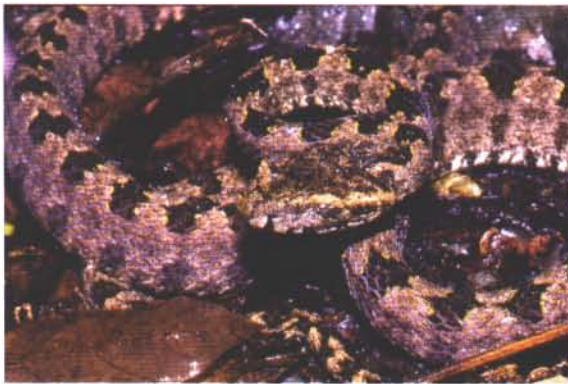


Figure 2. Live female *Triceratolepidophis sieversorum* (ZFMK 75066) from Phong Nha-Ke Bang National Park. (Left) The specimen in situ. Photographs by Thomas Ziegler.

The posterior of these two enlarged supraocular scales is considerably larger than the anterior. The large nasal is divided into two scales. The length of the fangs is 12 mm.

The premaxilla of FMNH 255258 has very slender and relatively long processes; the length is 3.5 times the width. Nasals are short and rhomboid. Prefrontals are short, rounded, and broad, with their lateral “planes” nearly equivalent to the lateral processes of the parietal. Maxillae are short, solid and broad, with their lateral “planes” nearly equivalent to the lateral processes of the prefrontals. Frontals are almost square-formed and slightly concave in the center. The parietal is 1.4 times as long as wide. Supratemporals are slender and prolonged. The anterior part of the slender pterygoids bears 7 teeth, and the posterior part is expanded laterally. The dentaries bear nine teeth that decrease in size posteriorly. The quadrates are slender and long, composing one third of the length of the lower jaw. In general, the skull characters resemble the states found in members of the genus *Protobothrops*, particularly *P. mucrosquamatus* and *P. elegans*.

The distinctive coloration of the living female (ZFMK 75066) is as follows. The dark brown dorsal blotches are bordered by a fine yellow line anteriorly and posteriorly. The upper head surface is dark beige mottled with dark brown markings. The lateral head surface is light creme colored with dark brown mottling and some larger dark brown blotches on the upper and lower lip. A dark postocular stripe is composed of two large and connected dark brown blotches. This stripe is separated from the dorsal dark mottled areas of the head by a beige stripe. Gular scales show a slightly pink coloration. The coloration of the Laos specimen is in accor-

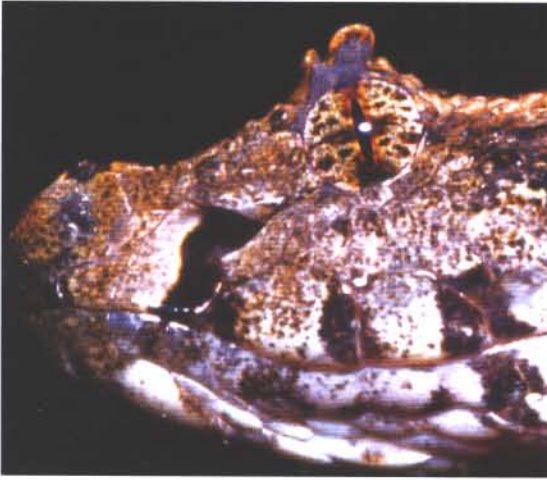


Figure 3. Eye region of a live female *Triceratolepidophis sieversorum* (ZFMK 75066) showing the characteristic raised supraoculars. Photograph by Thomas Ziegler.

dance with the living female from Vietnam, based on photographs of the Laos specimen taken shortly after fixation. The eye is light beige with dark brown spots and has a central vertical orange-yellow stripe surrounding the pupil. The coloration and pattern makes *T. sieversorum* appear cryptic on limestone which is partly overgrown by algae, lichens or moss. Compared to living specimens of *P. mucrosquamatus* from Ha Tinh Province to the south, *T. sieversorum* differs by dark brown mottling on the head and various parts of the body, a rough appearance due to the unusual scale keels, hornlike supraoculars, and a less pointed snout.

The digestive tract of ZFMK 75066 was empty. The ovaries contained 11/19 follicles of which the largest had dimensions of 5 x 3 mm.

Both new specimens were collected at night (2000 and 2330 h) in dry semi-evergreen forest (< 50% deciduous) in a limestone karst area (Fig. 1). In both cases the snakes were found close to limestone outcroppings. The localities have a linear distance of approximately 70 km from each other. The specimen from Laos was found on leaf litter whereas the specimen from Vietnam was found coiled on a forest path. The latter had not been there 2 h prior to capture, meaning that the snake must have been active during that time. When captured it showed very aggressive behavior, striking vigorously and exhibiting defensive tail vibrating. According to local hunters, *T. sieversorum* is not rare and inhabits the forest floor of the Phong Nha

area where it can often be found in dry leaf litter. Ranger staff of the nature reserve reported a large horned pitviper in one of the larger caves in the area which is densely populated by bats (predominantly the species *Hipposideros armiger*).

On the day of collection, the Laos locality had a minimum/maximum temperature of 17.0/29.5°C and some rainfall in the morning. Likewise, the Vietnam locality had slight rainfall in the morning, hot and sunny weather during noon and afternoon, and overcast skies at night. Steady rain followed the next day. The Vietnam locality ranged in temperature from 12–35°C, and in relative humidity from 54–104% (Fig. 4). Values over 100% resulted from condensation of water on the humidity sensor of the data logger.

Local villagers in the Phong Nha area use the Vietnamese name Ran luc gam for *T. sieversorum*, meaning “clouded snake.” The name relates to the clouded and mottled color pattern. Local villagers in the Hin Namno area used the name “ngou kaba” (written phonetically from the Lao language) for the specimen of *Triceratolepidophis*, but this is a general name used in Laos for brown vipers.

DISCUSSION

Triceratolepidophis sieversorum appears endemic to tropical semi-evergreen forest at low and possibly middle elevations in the limestone areas of the Annamite Mountains of Laos and Vietnam. It is presently known only from the karst of PKNP and the Hin Namno NBCA, which are part the largest continuous limestone karst formation in Indochina. The cryptic coloration and pattern of the snakes, especially on limestone with its typical overgrowth, can be interpreted as evidence for a life among limestone. Reports of *T. sieversorum* being seen in large caves are possible, as bat populations might provide for abundant prey in such karst areas.

Defensive tail vibrating was observed in the female encountered in PKNP. This is a common behavior in most pitvipers, as well as in their sister group *Azemiops* (Greene 1988, 1992). This behavior, and the non-prehensile tail, suggests *Triceratolepidophis* is predominantly terrestrial. Defensive behavior related to the unique serration of the dorsal and lateral scale keels in *T. sieversorum* was not observed (see Ziegler et al. 2000 for discussion).

The maximum size of the 30 follicles in ZFMK 75066 corresponds well with that described by

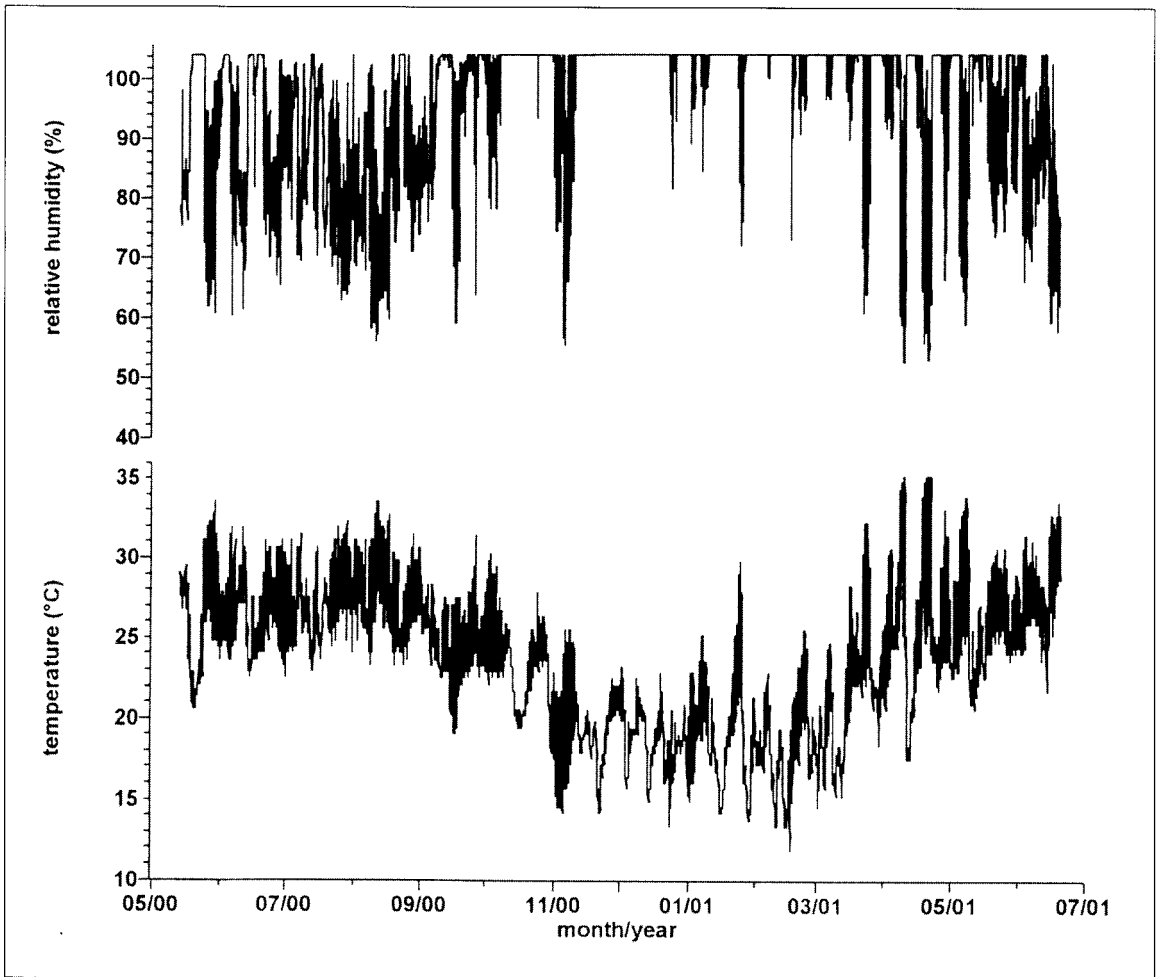


Figure 4. Temperature ($^{\circ}\text{C}$) and relative humidity (%) recorded by a data logger in close proximity to the locality of specimen ZFMK 75066. Relative humidity values greater than 100 % resulted from condensation of water on the sensor of the data logger.

Ziegler (2002) for a specimen of *Protobothrops mucrosquamatus* from Ha Tinh Province that was also found in the beginning of September. This suggests these two species have similar timing of reproduction. *Protobothrops mucrosquamatus* is known to produce clutches of 5–13 eggs (Pope 1929; Orlov 1997; Ziegler 2002).

The conservation status of *Triceratolepidophis* is uncertain. At present, it is considered to have a very restricted distribution. Potential threats are habitat destruction by logging, human encroachment, and, more recently, the construction of roads in PKNP. Although wildlife in both the localities where *Triceratolepidophis* has been found are under legal protection, poaching is a major threat in Laos and Vietnam. Reptiles, including snakes, are

widely hunted with dogs and utilized for food and in traditional medicine in great numbers (Jenkins 1995; Stuart 1999).

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