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A new species of the genus *Lycodon* (Boie, 1826) from Yunnan Province, China (Serpentes: Colubridae)

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Abstract. A new species of the genus *Lycodon* is described from Yunnan Province, People's Republic of China. It differs from the superficially similar *Lycodon fasciatus* by the fact that the loreal is not entering orbit, in colouration, and lower numbers of subcaudals and infralabials. From the *Lycodon ruhstrati* group it differs by the colouration of the venter and the dorsal bands. This new species is only known from the Chinese province of Yunnan.

Keywords. Oriental Region, China, Colubrinae, *Lycodon fasciatus*, taxonomy, *Lycodon synaptor* sp. n.

INTRODUCTION

Snakes of the species rich genus *Lycodon* Boie, 1826 received considerable attention in most regions of Asia. Six new species were described from the Philippines (Ota & Ross 1994; Lanza 1999; Gaulke 2002) and new species were discovered in Cambodia (Daltry & Wüster 2002), India (Mukherjee & Bhupathy 2007) and Myanmar (Slowinski et al., 2001). The taxonomy of the Chinese part of the genus remained unattended until recently. Pope (1935) listed five species, namely *Lycodon capucinus* Boie, 1827, *Lycodon fasciatus* (Anderson, 1879), *Lycodon laoensis* Günther, 1864, *Lycodon ruhstrati* (Fischer, 1886) and *Lycodon subcinctus* Boie, 1827. This arrangement has not changed for the next 75 years. Vogel et al. (2010) reviewed the *Lycodon ruhstrati* complex and described *Lycodon ruhstrati abditus* as a new subspecies from China, and revalidated *Lycodon futsingensis* (Pope, 1928). Detailed examination of banded specimens of the genus led us to the conclusion, that the diversity is much higher in this region and that several species await description.

In the course of our ongoing review of the *Lycodon fasciatus* complex, we came upon two specimens of the genus *Lycodon* from Yunnan, China, which seemed to be different from *L. fasciatus*. A detailed examination showed clear morphological differences which lead us to describe them as new species.

MATERIAL & METHODS

This revision is based on a total of 67 preserved specimens of *Lycodon fasciatus* auctorum examined for their external morphological characters and on several photographed specimens. They are listed in the Appendix I. Comparative material of the *L. ruhstrati* complex is listed under Vogel et al. (2010).

A total of 53 morphological characters were recorded for each specimen. The characters and their abbreviations are listed in Table 1. Not all of these characters have been used for this study, but all of them were compared.

Measurements, except body and tail lengths, were taken with a slide-caliper to the nearest 0.1 mm; all body measurements were made to the nearest millimetre. The number of ventral scales was counted according to Dowling (1951). Half ventrals were not counted except they were present on both sides (divided ventrals). The terminal scute is not included in the number of subcaudals. The dorsal scale row counts are given at one head length behind head, at midbody (i.e., at the level of the ventral plate corresponding to a half of the total number of ventrals), and at one head length before vent. We considered being sublabials those shields that were completely below a supralabial. Values for paired head characters are given in left / right order.

Table 1. List of morphological characters used in this study and their abbreviation.

N°	Abbreviation	Characters
<i>Morphometry</i>		
1	SVL	Snout-vent length (mm)
2	TaL	Tail length (mm)
3	TL	Total length (mm)
4	Rel TL	Relative tail length TaL/TL
<i>Anatomy</i>		
5	TEETH	Number of upper maxill. teeth (one side)
<i>Scalation</i>		
6	DSR	Dorsal scale rows
7	ASR	Dorsal scale rows at neck
8	MSR	Dorsal scale rows at midbody
9	PSR	Dorsal scale rows before vent
10	Keel	Number of keeled dorsal rows
11	VEN	Ventral plates
12	PreVEN	Number of preventrals
13	VEN not	Ventrals notched or not
14	VEN keel	Ventrals keeled
15	SC	Subcaudal plates
16	ANA	Anal plate: 1: single – 2: divided
17	Lor-l	Number of loreal scale (0 or 1) at left
18	Lor-r	Number of loreal scale (0 or 1) at right
19	Lo touch-l	Loreal scale touches eye at left
20	Lo touch-r	Loreal scale touches eye at right
21	SL-l	Number of supralabials at left
22	SL-r	Number of supralabials at right
23	SL/Eye-l	Numbers of the SL entering orbit at left
24	SL/Eye-r	Numbers of the SL entering orbit at right
25	Larg SL-l	Largest SL left
26	Larg SLr	Largest SL right
27	IL-l	Number of infralabials at left
28	IL-r	Number of infralabials at right
29	IL-tot	Total number of infralabials
30	IL/1st child	Number of IL in contact with anterior chin shield
31	PreOc-l	Number of preoculars at left
32	PreOc-r	Number of preoculars at right
33	PostOc-l	Number of postoculars at left
34	PostOc-r	Number of postoculars at right
35	ATem-l	Number of anterior temporals at left
36	ATem-r	Number of anterior temporals at right
37	PTem-l	Number of posterior temporals at left
38	PTem-r	Number of posterior temporals at right
39	ParaR	Temporal row containing paraparietals
40	Paras	Plates surrounding paraparietals, see Inger & Marx (1965)
41	Parab	Scales between the paraparietals
<i>Pattern</i>		
42	BODCOL	Body colour 1: grey; 2: brown or ochre
43	Bands	Number of bands on body
44	Tail bands	Number of bands on tail
45	Tail venter	Colouration of tail venter
46	Bellycol	Colouration of belly
47	Bellyspeck	Speckling of belly
48	First band	Number of VEN before the first band starts, counted left side
49	Broad base	Number of VEN that are covered at the base of the first band
50	Broad vert	Numbers of vertebral scales that are covered by the first band
51	Edged	Dorsal bands with light margins
52	Coul throat	Colour of the throat
53	Ve throat	Dark VEN on the throat before the first band

The white or light bands on the body and tail were counted on one side. Hardly visible or incomplete bands were counted as one, bands that were fused were counted as two. The collar on the neck was not counted and bands covering the anal shield were added to the bands of the body.

Museum abbreviations

BMNH: The Natural History Museum, London, UK. – BNHS: Bombay Natural History Society, Mumbai, India. – CAS: California Academy of Sciences, San Francisco, USA. – CIB: Chengdu Institute of Biology, Chengdu, People's Republic of China. – FMNH: Field Museum of Natural History, Chicago, USA. – KIZ: Kunming Institute of Zoology, Kunming, People's Republic of China. – MNHN: Muséum national d'Histoire naturelle, Paris, France. – NMW: Naturhistorisches Museum Wien, Austria. – ZFMK: Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany. – ZMB: Zoologisches Museum für Naturkunde der Humboldt-Universität zu Berlin, Berlin, Germany. – ZSM: Zoologische Staatssammlung, München, Germany.

RESULTS

Lycodon synaptor sp. n.

Holotype. BMNH 1905.1.30.63 adult female (tail dissected), from “Tongchuan, Yunnan”, today Dongchuan, 100 km north of Kunming, Yunnan Province, People's Republic of China (Figs 1–3). Collected by the J. Graham Expedition, unknown date.



Fig. 1. Dorsal view of preserved holotype of *Lycodon synaptor* sp. n., BMNH 1905.1.30.63 from Dongchuan, 100 km north of Kunming, Yunnan Province, People's Republic of China. Photograph by Gernot Vogel.

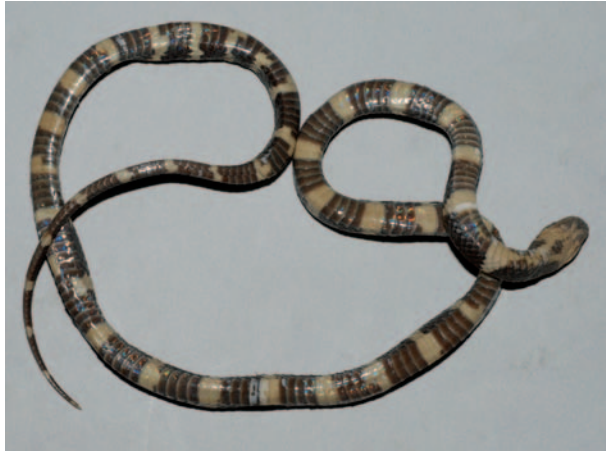


Fig. 2. Ventral view of preserved holotype of *Lycodon synaptor* sp. n., BMNH 1905.1.30.63 from Dongchuan, 100 km north of Kunming, Yunnan Province, People's Republic of China. Photograph by Gernot Vogel.

Paratype. MNHN 1905.0283, adult female (tail dissected), from “Tongchuan Fu, Chine”, at present Dongchuan, Yunnan Province, People's Republic of China. Collected by W. F. H. Rosenberg on 21st July 1905.

Diagnosis. A species of the genus *Lycodon* characterized by: (1) loreal scale not entering orbit; (2) 15–17 dorsal scale rows at the forepart of the body and 17 dorsal scale rows at midbody; (3) upper and vertebral dorsal rows (6–7) keeled; (4) 201–203 ventrals in females, males unknown; (5) 68–69 Sc in females, males unknown; (6) a relative tail length of about 0.189–0.192 in females, males unknown; (7) 8 supralabials with SL 4–6 touching the orbit (7) 30–31 narrow white bands on a dark body; (8) width of the first band vertebral 0.5–1.0 scales, on the base 3 ventrals; and (9) the belly with discreet bands throughout.



Fig. 3. Lateral view of the right side of the head of preserved holotype of *Lycodon synaptor* sp. n., BMNH 1905.1.30.63 from Dongchuan, 100 km north of Kunming, Yunnan Province, People's Republic of China. Photograph by Gernot Vogel.

The new species can be recognized by the combination of the loreal scale not entering orbit (entering in *L. fasciatus* sensu stricto), its narrow dorsal bands, with the first band starting at ventral 5–9 (more irregular in *L. fasciatus* [Fig. 4] and species of the *L. ruhstrati* group, where they usually start later) and the dark throat, which usually is light in other species of the *L. fasciatus* group and the *L. ruhstrati* group. Most other characters match with *Lycodon fasciatus*.

Detailed comparisons with other species of the genus *Lycodon* appear below in the Discussion.



Fig. 4. Dorsal view of *Lycodon fasciatus*. CIB 9804, from Ruili City, Yunnan. Note the irregular bands. Photograph by Gernot Vogel.

Etymology. This species is indirectly named in honour of Dr. Wolfgang Böhme. It was always a publicized aim of Wolfgang Böhme to unite professional and amateur herpetologists. We, both authors have always been amateur herpetologists, so it is a delight for us to dignify his efforts towards this aim. The specific name *synaptor*, a noun in apposition, stems from the Greek word “συναψις” meaning “a connection”. In this case, this noun underlines the connection of these two kinds of herpetologists.

We suggest the following common names: *Boehme's wolf Snake* (English), *Böhmes Wolfszahnnatter* (German).

Description of the holotype. *Habitus.* Body elongate, somewhat laterally compressed; head flattened anteriorly, well distinct from the neck; snout depressed and elongate; nostril oval, large, in the middle of the nasal. Eye moderate, with a vertically elliptic pupil.

SVL 374 mm; TaL 89 mm; TL 463 mm.



Fig. 5. Ventral view of *Lycodon fasciatus*. CIB 9804, from Ruili City, Yunnan. Note the whitish colouration of the anterior part and the speckling of the posterior part. Photograph by Gernot Vogel.

Dentition. A total of 10 maxillary teeth, with the following formula: 4 small anterior teeth + 2 strongly enlarged teeth + a wide gap + 2 small teeth + a small gap + 2 strongly enlarged, posterior teeth.

Body scalation. 201 VEN (+ 2 preventrals), 68 SC, all paired. Anal single. Dorsal scales in 17–17–15 rows, the 7 upper rows feebly keeled. Vertebral row not enlarged. No apical pit detected.

Head scalation. Rostral, triangular, hardly visible from above; nasal vertically divided by a furrow below and above the nostril; two small, trapezoidal internasals, widely in contact each with the other and with prefrontals; two large prefrontals, longer and wider than internasals; a rather small ogive-shaped frontal, about 1.3 times longer than wide and about 0.8 times as long as the suture between the parietals; 2 large parietals, each edged with three large scales, 2 upper temporals and a larger paraparietal poste-

riorly; 1 / 1 wide, triangular supraocular; 1 / 1 small preocular, located above the posterior part of loreal; 2 / 2 postoculars, about the same size; 1 / 1 subrectangular loreal, elongate and narrow, not entering orbit, in contact with SL 2 and 3, the large preocular, the prefrontal (long contact) and the posterior part of nasal; 8 / 8 SL, of which the first four are higher than long, SL 1–2 in contact with nasal, SL 3–5 entering orbit, 6th and 7th SL largest; 2+2 / 2+2 temporals, lower anterior temporal a bit broader than upper one, posterior temporals smaller; 8 / 8 infralabials, IL 1–4 in contact with the first pair of sublinguals; anterior and posterior pair of sublinguals of about same length, but anterior pair wider.

Coloration in preservation. Body and tail dark blackish-brown, with 31 crossbands on body and 9 on tail, narrow and cream, not speckled; these crossbands, about 1 dorsal scale long, widen at their ventrolateral limit, up to about 5–7 dorsal scale long; the first crossband, beginning at the level of VEN 9; the second crossband is 8 scale rows behind the first one; 9 cream crossbands on the tail, also not speckled.

The head is uniformly blackish-brown, a broad nuchal collar extends from the 6th and 7th supralabial across the lower posterior temporal across the posterior half of the parietals. The underside of the head is dark in the anterior half and cream in the posterior one; the throat is cream, with a dark cloudy spot on the preventrals and the first ventral.

The venter is dark, with faint cream bands rather regular, 2 ventrals wide and with 3–4 ventrals in between. Within these bands some ventrals are dark on one half and cream on the other, especially in the posterior part of the body. The under surface of the tail is banded as the venter with the cream bands about 1.5 SC wide.

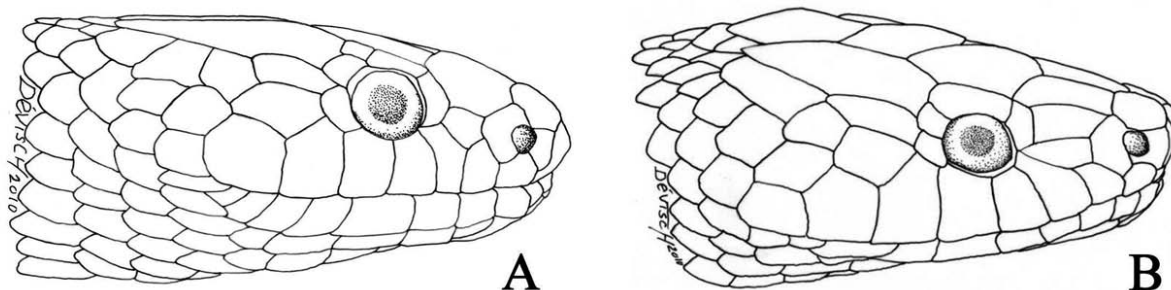


Fig. 6. Comparison of lateral head scalation of *Lycodon synaptor* sp. n. (BM 1905.1.30.63 Holotype) and one *L. fasciatus* (BNHS 1223) where the Lo touches the eye. This is the case only in 6.3% of all cases seen by us. Please note that in *L. synaptor* sp. n. the Lo is well separate from the eye by the preocular scale, whereas it is tapering and narrow in the *L. fasciatus*, where it is more or less inserted between 2 scales and falls short from the eye. Drawings by Dick Visser.

Table 2. Pholidosis of the two type specimens of *Lycodon synaptor* sp. n.

Characters	BMNH 1905.1.30.63 holotype	MNHN 1905.0283 paratype
Sex	Female	Female
SVL	374	395
TaL	87	92
Rel TL	0.192	0.189
ASR	17	15
MSR	17	17
VEN	201	203
SC	68	69
Lo enters eye	no	no
Dorsal bands	31	30
Tail bands	9	9
First band at VEN no	9	5
Broad base [VEN]	7	3
Broad vertebral [Dorsals]	2	1

Variation. The paratype, MNHN 1905.0283, agrees in most respects with the description of the holotype with the throat being dark instead of light. The maxilla are missing in the paratype. A comparison of the most important morphological characters is summarized in Table 2.

Distribution. China. *Lycodon synaptor* sp. n. is currently only known from the region of Dongchuan, Dongchuan County, in the province of Yunnan, China.

Biology. There is no information available on the biology of this species. However, the region of Dongchuan is highly mountainous. Dongchuan is located between high mountains of the ranges known as Gongwang Shan and Liangwang Shan. In the area, the highest point is 4.344 meters high, and lowest is 695 meters asl.

DISCUSSION

Lycodon synaptor sp. n. is superficially similar to *L. fasciatus* but differs from the whole *L. fasciatus* group (including *L. butleri*) by the loreal, which does not enter orbit in *L. synaptor*. We have examined six specimens (out of 35) of *Lycodon fasciatus* sensu stricto in which the loreal does not enter orbit (eight occurrence, three times on both sides [4.7 %]), but the morphology of the anterior region of the eye is different. In specimens of *L. fasciatus* in which the loreal does not enter orbit, the posterior region of this narrow scale is very tapering (Fig. 6). Its apex is more or less inserted between the preocular and the 4th SL and falls short from the eye. In contrast, in *L.*

synaptor, the loreal scale is well separated from the orbit by a broad preocular. The tail is a bit shorter in *L. synaptor* sp. n. (0.189–0.192 vs. 0.190–0.219 in 29 females of *L. fasciatus*). There are also differences in the shape of the bands and the colouration of the belly (compare Figs 2 and 5). *L. synaptor* sp. n. has eight infralabials, whereas only one specimen out of 60 specimens of *L. fasciatus* had eight infralabials on both sides and rarely that character is seen on one side (5 %) in *L. fasciatus*. *L. synaptor* sp. n. has less subcaudals than *L. fasciatus* (68–69, $x = 68.5$, versus 70–88, $x = 79.9$ with one outlier having 67 subcaudals). For a complete comparison of scale counts see Table 3.

L. synaptor sp. n. differs from the other Chinese and Indochinese species as follows: from *L. subcinctus* by the fact that in *L. synaptor* sp. n. both a loreal and a preocular are present. From *L. laoensis*, *L. zawi* and *L. capucinus* it differs by the anal shield which is single in *L. synaptor* sp. n. but divided in the latter two species. Furthermore the colouration is much different. From the *L. ruhstrati* group it differs by the colouration of the bands (small, regular, completely light in *L. synaptor* sp. n., getting broader posteriorly, irregular and partly speckled with brown in the *L. ruhstrati* complex), by the number of infralabials (eight in *L. synaptor*, nine to ten in the *L. ruhstrati* group) and by the colour of the belly, which is speckled or uniform light in the *L. ruhstrati* group, but clearly banded in *L. synaptor* sp. n. From *L. paucifasciatus* Rendahl, 1943, occurring in Vietnam, *L. synaptor* sp. n. differs by the number of anterior dorsal scale rows (15–17 in *L. synaptor* sp. n. and 19 in *L. paucifasciatus*).

Table 2. Important characters in the *Lycodon fasciatus* / *ruhstrati* groups.

<i>Lycodon</i>	<i>fasciatus</i>	<i>synaptor</i> sp. n.	<i>ruhstrati</i>	<i>futsingensis</i>	<i>cardamomensis</i>
n females	35	2	23	6	1
TL, females	N=29 679	N=2 487	N=22 876	N=5 773	N=1 545
Rel TL, females	0.190–0.219 N=29	0.189–0.192 N=2	0.207–0.237 N=22	0.205–0.217 N=11	0.25 N=1
VEN, females	180–219 N=35	201–203 N=2	217–229 N=23	198–208 N=13	223 N=1
SC, females	(67) 70–88 N=29	68–69 N=2	90–108 N=21	78–85 N=5	92 N=1
IL both sexes	9–10 (8)* N=120	8 N=2	10 (9.11) N=86	9–10 (11) N=44	10 N=4
Bands	19–43 N=60	30–31 N=2	19–46 N=45	19–33 N=22	12–13 N=4
Tail bands	7–21 N=62	9 N=2	10–23 N=43	9–18 N=21	6 N=4
First band	5–18 N=51	5–9 N=2	8–17 N=34	13–23 N=18	unknown
Broad base	3–12 N=51	3 N=2	5–9 (12) N=34	5–8.5 N=18	unknown
Lo enters orbit	Yes (rarely not**) N=126	No N=4	No (rarely yes***) N=86	No N=44	No N=4
Belly banded	Yes N=63	Yes N=2	No N=25****	No N=22	No N=4

* 8 in 6 cases (5 %), in one specimen from Shillong on both sides (1.6 %)

** not entering in 8 occurrences (6.3 %), three times on both sides (4.7 %) (see above)

*** in 6 specimens, all from Fujian the Lo touched the eye.

**** banded in juveniles only

Werner (1922) described *Dinodon yunnanensis* from Yunnanfu, now Kunming, Yunnan Province. This species was synonymised with *Lycodon fasciatus* by Pope (1935: 188), but according to our unpublished data, this taxon might be valid. In any way this name is available, so we compared *Lycodon synaptor* sp. n. with *Dinodon yunnanensis* Werner, 1922 for which we re-examined the holotype (NMW 23417; adult female). *Lycodon synaptor* sp. n. dif-

fers from *D. yunnanensis* mainly by the loreal which is touching the eye in *D. yunnanensis*, but also by the number of ventrals (201–203 against 193) and the number of bands on the body (30–31 vs. 23) and the number of infralabials (eight vs. nine in *D. yunnanensis*).

While preparing a review for the *Lycodon fasciatus* group, we found quite a lot of obviously independent lineages,

which seem to constitute distinct species. Some of them are restricted to small areas. A discussion of these lineages will follow in the main review (Vogel & David in prep.). *Lycodon synaptor* sp. n. differs so much from other members of the group that we decided to describe it separately. The closest localities we got from *Lycodon fasciatus* are from the vicinity of Kunming in Yunnan province, which lies about 100 km south of Dongchuan. This latter place (previously Tongchuan or Tongchuan Fu) is the type locality for several reptile species, as *Cuora yunnanensis* (Boulenger 1906), *Nanorana yunnanensis* (Anderson, 1879), *Odorrana grahami* (Boulenger 1917) and *Bombina maxima* (Boulenger 1905). It is a relatively small city that had about 300.000 inhabitants in 2006.

Revised Key for the genus *Lycodon* in China

According to our data, there are several unnamed species of the genus *Lycodon* living in China. So this should be regarded as preliminary key.

1. Both a loreal and a preocular scales present 2
 Either loreal or preocular absent *L. subcinctus*
2. Anal divided 3
 Anal single 4
3. Anterior chinshields not more than 1.5 times longer than posterior ones; loreal in extensive contact with internasal, when adult no crossbands on body *L. capucinus*
 Anterior chinshields 2 to 3 times longer than posterior ones; loreal not, or barely in contact with internasal (very rarely a strong contact), when adult yellow crossbands on forepart of body *L. laoensis*
4. Belly banded 5
 Belly not banded 6
5. Lo not touching the eye, 8 lower labials .. *L. synaptor* sp. n.
 Lo usually touching the eye, usually 9–10 lower labials *L. fasciatus*
6. Dorsal rows keeled *L. ruhstrati abditus*
 Dorsal rows smooth *L. futsingensis*

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APPENDIX I

Additional comparative material of *Lycodon fasciatus*

India. Shillong, Assam, BMNH 92.1.25.1; BMNH 1908.6.23.6; BMNH 1908.6.23.8; BMNH 1907.12.16.28–29; BMNH 94.10.4.2; BNHS 1219–20, 1229.

Laos. Xieng-Khouang, Laos, MNHN 1928.69.

Myanmar. Maymyo, Burma, BMNH 1925.12.22.15–16; Mogok, Burma, BMNH 1900.9.20.5–7; BMNH 1901.4.26.1Mogkok, Burma, BNHS 1221 “Burma”, BMNH 1908.6.23.9–11 ; Burma, BNHS 1218; Toungyi, Shan State, Myanmar, BMNH 91.11.26.31; Bhamo, Burma, BMNH 1925.4.2.28; Kachin Hills, Burma, BMNH 1925.9.17.10–11; South Shan State, BMNH 1908.6.23.14; Burma-Siam Border, BMNH 1937.2.1.12; Rangoon, Burma, BMNH 1940.3.3.3; Maymyo, Burma, BNHS 1222–24; Thandung Hills, BNHS 1228.

People’s Republic of China. Western China CAS 55147; Yunnan, MNHN 1919.148; “Yunnan Fu” (holotype of *Dinodon yunnanensis*), NMW 23417; Kuantun, ZSM 75/1938; Kunming, Yunnan, BMNH 1930.11.16.4; Ruili City, Yunnan, CIB 9804; RuiLi, Yunnan, CIB 9805; XiShuangBanNa, Yunnan, CIB 9806, CIB 9808, CIB 9809; LongChuan GongWa, Yunnan, KIZ 74 I 0035; LongChuan HuSa, Yunnan, KIZ 74 I 0145; Tengchong County, Yunnan KIZ 74 II 0262; Menglian, Yunnan, KIZ 75 I 473; TengChong TuanTian, Yunnan, KIZ 74 II 0263; Kunming, Yunnan, KIZ 73009; Kunming, Yunnan, KIZ 77004; Kunming city, Yunnan, KIZ 83007; Yunnan, KIZ 83017; FMNH 15148; Tibet; MNHN 1921.0465 Tibet; Yunnan,; ZMB 65453

Thailand. Chiang Mai, Thailand, FMNH 178369; CAS 172715, Southern Thailand ? FMNH 178368, Nan province Thailand FMNH 270716.

Vietnam. Phong Nha, Vietnam, ZFMK 86448–50 (GenBank: EU999214-215); ZFMK 80665; Ziegler unreg.