

## A NEW SPECIES OF WOLF SNAKE (SERPENTES: COLUBRIDAE: *LYCODON*) FROM THE CARDAMOM MOUNTAINS, SOUTHWESTERN CAMBODIA

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**ABSTRACT:** We describe a new species of wolf snake of the genus *Lycodon* from the Cardamom Mountains of southwestern Cambodia. The new species differs from other species of *Lycodon* in Southeast Asia in the following combination of characteristics: dorsal scales feebly keeled, in 17 rows at midbody; 12 well defined, broad white bands across black body and six across the tail; presence of both a single preocular and a loreal, causing absence of prefrontal-eye contact; three postoculars, two anterior temporals. Visually, the new species is most similar to *Lycodon subcinctus*, and specimens labeled as *L. subcinctus* from eastern Thailand and elsewhere in Cambodia should be checked against the diagnosis of the new species.

**Key words:** Cambodia; Cardamom Mountains; *Lycodon*; New species

ALTHOUGH the herpetofauna of Southeast Asia is currently subject to renewed, intensive research interest, this interest has been less than evenly distributed. Whereas Thailand, Malaysia (e.g., Chan-Ard et al., 1999; Cox et al., 1998; Manthey and Grossmann, 1997), Vietnam (e.g., Orlov, 1997), and even Myanmar (e.g., Slowinski and Wüster, 2000) are now receiving increasing attention from herpetologists, Cambodia has been almost entirely neglected since the work of Saint Girons (1972), for the obvious reason of political instability. Even before the 1970's, research on the herpetofauna of Cambodia was patchy.

The most remote and least known part of Cambodia is the Cardamom Mountains Range. Situated in the Southwest, this 10,000 km<sup>2</sup> range includes Cambodia's highest mountains, Mount Aural (1771 m) and Mount Samkos (1717 m). The range is largely devoid of human activity and is predominantly covered with primary lowland evergreen forest. Apart from a brief ornithological survey in 1944 (Engelbach, 1952) and a 13-d survey of birds and large mammals in 1999 (Momberg and Weiler, 1999), the fauna of the Cardamom Mountains remained essentially unknown until 2000.

The first reptilian survey of the Cardamom Mountains was carried out during the dry season from January–March 2000 as part of a broader biodiversity survey led by Fauna and Flora International, the Cambodian Department for Nature Conservation and Protection and the Department of Forestry and Wildlife (Daltry and Momberg, 2000). This survey resulted in more than a dozen records of reptilian species previously undocumented in Cambodia, as well as an important discovery of a large population of the critically endangered Siamese crocodile *Crocodylus siamensis* (Daltry and Chheang, 2000a,b).

During the reptile survey, a single specimen of *Lycodon* was collected that could not be assigned to any of the known species. Because the specimen differs in several qualitative characters from all other species of *Lycodon* known from mainland Southeast Asia, we believe it represents a hitherto undescribed species. We are acutely aware of the potential problems of describing a new species on the basis of a single specimen. However, the Cardamom Mountain specimen differs categorically from all other species of *Lycodon* in so many characters that we feel the recognition of a new species to be justified.

The genus *Lycodon* Boie, 1826 is one of the most widespread genera of Asiatic snakes, containing approximately 25 spe-

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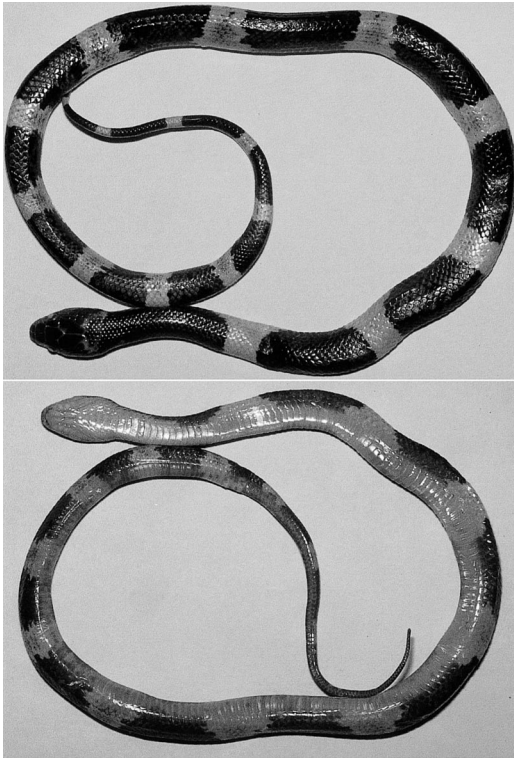


FIG. 1.—Dorsal (top) and ventral (bottom) views of holotype of *Lycodon cardamomensis*, BMNH 2000.70. Photo by W. Wüster.

cies (Lanza, 1999), which range from the Caspian Sea to the Philippines and Indonesia. Of these, eight are known from mainland Southeast Asia (i.e., Myanmar, Thailand, Laos, Vietnam, Cambodia and Peninsular Malaysia) (Lanza, 1999; Smith, 1943).

#### MATERIALS AND METHODS

The single specimen of the new species was preserved in 75% ethanol. In order to check the consistency of potentially diagnostic characters in other species from the Asian mainland, we compared aspects of color pattern and head scalation of the new species with a selection of specimens of other species of *Lycodon* from mainland Southeast Asia (particularly *L. subcinctus*) (listed in Appendix I), as well as data from the literature (Lanza, 1999; Leviton, 1955; Pope, 1935; Taylor, 1965). Additional data on specimens not examined by the authors

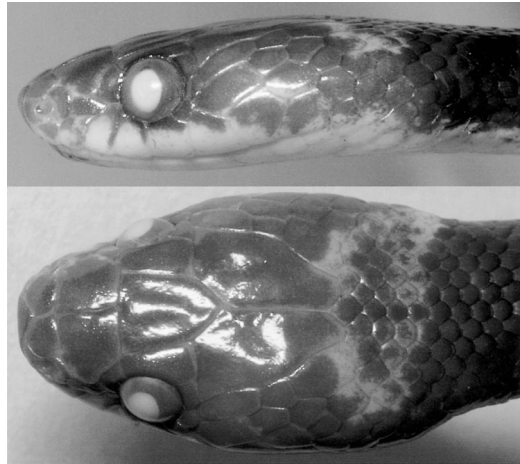


FIG. 2.—Lateral (top) and dorsal (bottom) views of head of holotype of *Lycodon cardamomensis*, BMNH 2000.70. Note in particular the presence of a loreal scale. Photo by W. Wüster.

were kindly provided by Dr. H. Ota (personal communication) and M. J. Cox (personal communication).

#### SYSTEMATIC ACCOUNT

##### *Lycodon cardamomensis* sp. nov. Cardamom Wolf Snake

*Holotype*.—BMNH 2000.70 (Figs. 1, 2), a juvenile male from 500 m above sea level at 12° 25' N; 103° 02' E in the Phnom Samkos Wildlife Sanctuary, Pursat Province, Cardamom Mountains, Southwest Cambodia (Fig. 3). Collected by J. C. Daltry on 9 February 2000.

*Diagnosis*.—The new species differs from other species of *Lycodon* in Southeast Asia in the following combination of characteristics: dorsal scales feebly keeled, in 17 rows at midbody; anal undivided; 12 well defined, broad white bands, evenly spaced along the entire length of the black body, and six white bands across the tail; presence of both a single preocular and a loreal, causing absence of prefrontal-eye contact; loreal contacts neither eye nor internasals; three postoculars, two anterior temporals. Important scalation and color pattern characters in different species of *Lycodon* are compared in Table 1 and will not be repeated in the text except in cases where elaboration is required.

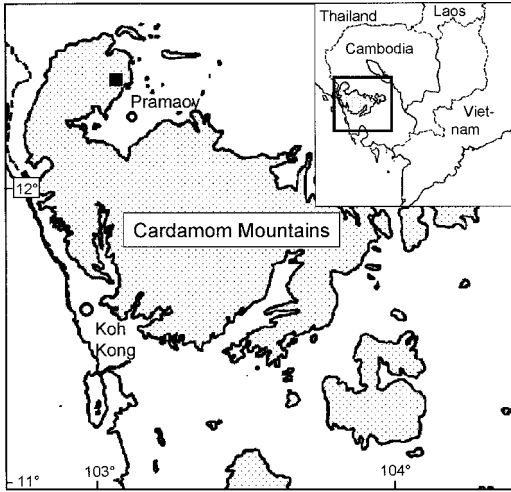


FIG. 3.—Type locality of *Lycodon cardamomensis* in southwestern Cambodia, indicated by a solid square. Shading indicates areas >300 m above mean sea level.

Visually, in terms of pattern, the type specimen is most similar to a juvenile of *L. subcinctus*. However, it differs from this species in having a preocular (absent in *L. subcinctus*, prefrontal-eye contact present instead), three postoculars, two anterior temporals (one in *L. subcinctus*, except some Bornean and Palawan specimens, Leviton, 1955; photo in Stuebing and Inger, 1999, p. 102), 93 subcaudals (91 or fewer in *L. subcinctus*, Lanza, 1999; H. Ota, personal communication), an undivided anal scale, and in lacking a contact between the loreal and the eye. Furthermore, the head of *L. cardamomensis* is largely black, whereas in *L. subcinctus* of similar size, most of the parietal region of the head is white. The characters of head scalation and pattern are invariable in the material of *L. subcinctus* observed in this study (Appendix I), from throughout the range of that species, except that the crown of *L. subcinctus* darkens with age and becomes entirely black in adults. A further 13 specimens from Thailand examined by H. Ota (personal communication) also displayed the same diagnostic character states, except for one specimen in which the anterior temporal was partially divided.

All other species of *Lycodon* differ from

TABLE 1.—Comparison of pertinent scalation and color pattern characters in mainland Southeast Asia. Exceptional values are shown in brackets. In presence/absence characters, 0 = absence, 1 = presence.

	<i>L. cardamomensis</i>	<i>L. subcinctus</i>	<i>L. effraensis</i>	<i>L. capucinus</i>	<i>L. fasciatus</i>	<i>L. laevis</i>	<i>L. butleri</i>
Ventrals	215	192-230	215-228	182-211	189-225	163-192	218-234
Subcaudals	93	61-91	72-100	59-74	66-94	60-76	82-93
Anal	single	divided, rarely entire	single	divided	single	divided	single
Preocular	1	0	1	1	1	1	1
Loreal	1	1	0	1	1	1	1
Loreal-eye contact	0	1	0	0	1 (exceptionally 0)	0	1
Loreal-intermal contact	0	0	—	1	0	0/1	1
Postoculars	3	2	(1)-2	2	2	2 (3)	2
Anterior temporals	2	1	2-3	2	2	2	1
Supralabials	8	8	9-(10)	9-10	8	9	8
Top of head in juveniles	largely dark	largely white	dark, with white canthal lines	dark	dark anteriorly, light posteriorly	dark	dark
No. of light bands on body	12	9-15	11-13	reticulate	21-49	19-36	40-50
Dorsal scales	weakly keeled	weakly keeled	smooth	smooth	weakly keeled	smooth	weakly keeled

*L. cardamomensis* in aspects of their pattern. *Lycodon effraenis* has a light canthal stripe, reminiscent of that of *Lamprophis fuliginosus*. *Lycodon butleri* has much more numerous (40–50) crossbands as a juvenile, which appear somewhat irregular and suffused with dark pigment in adults and are spaced more widely anteriorly than posteriorly (regular in *L. cardamomensis*). *Lycodon capucinus* has a reticulate body pattern, or at best indistinct bands, and *L. laoensis* differs in having a greater number of body bands, which are spaced much more widely on the anterior body. All these species also differ from *L. cardamomensis* in various scalation characters (Table 1).

In terms of scalation, *L. cardamomensis* is most similar to *L. fasciatus*. However, the latter differs in having much more numerous (>21), rather irregular crossbands on the body and tail, or a reticulate or spotted pattern, and in having only two postoculars (Zhao et al., 1998, based on 17 specimens; H. Ota, personal communication, based on four specimens), the loreal normally in contact with the internasal, the preoculars contacting the frontal, and a blotched venter.

*Dinodon septentrionalis* is another black and white banded snake that resembles *L. cardamomensis* in its scalation. It differs in having two postoculars rather than three, more numerous light body (25–35) and tail bands (11–17); the light bands in *D. septentrionalis* are approximately 1–1.5 dorsal scales wide along the vertebral row at midbody, compared to four dorsals in *L. cardamomensis*. Furthermore, the reduction from 19 to 17 scale rows is situated in a more anterior position in all *D. septentrionalis* examined (at the level of ventral scale 3–7 in *D. septentrionalis* versus 12/13 in *L. cardamomensis*).

*Description of the holotype*.—Head distinct from neck, distinctly flattened. Snout projects beyond lower jaw. Pupil slightly vertically elliptic. Body subcylindrical, rounded on dorsum, flat below.

Body dimensions: snout–vent length 252 mm, tail length 64 mm (20.3% of total length), head length (snout tip to posterior

end of mandible) 12.7 mm, total length 316 mm.

Body scalation: ventrals 215, with lateral keels, most pronounced on posterior part of body; subcaudals 93, all divided; anal entire; dorsal scales in 17 rows at midbody, median nine rows feebly keeled (invisible on neck), outer four rows on each side smooth. Dorsal scale reduction formula: 21 4+5(5/6) 19 3+4(12/13) 17 3+4(140) 15.

Head scalation: preoculars 1/1; loreal 1/1, protrudes somewhat under preocular, but excluded from eye by preocular-3<sup>rd</sup> supralabial contact, does not contact internasals; supralabials 8/8, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> in contact with eye; infralabials 10/10, first pair in contact along midline, first five contact anterior chin shields; posterior chin shields slightly shorter and narrower than anterior, in broad contact; two anterior, three posterior temporals.

Body pattern: dorsal surface of body and tail black, with 12 white bands across the body and 6 across the tail; light body bands are 3–5 dorsal scales wide along the vertebral scale row, and widen laterally to a width of 5–9 scales; anterior white bands broader and more widely spaced than posterior bands; first two white bands immaculate, the more posterior white bands with increasing black speckling, concentrated in the median part of the band; ventral surface mostly white; the first six dark bands encroach onto the outer parts of the ventral scales only, the more posterior bands increasingly invade the ventral side, and the last two cross the ventral side almost unattenuated; ventral side of the tail black, except for the light speckling at the level of the white bands.

Head pattern: crown largely black, except for slightly lighter sutures between the frontal and parietal scales; a light collar, four dorsal scales wide along the vertebral row, and heavily suffused with black pigment, separates the crown from the first black body band; sides of head black, except for most of supralabial region; underside of head white, except for black spots on mental and first three infralabials. Coloration in life: identical to coloration after preservation (Fig. 4).



FIG. 4.—Holotype of *Lycodon cardamomensis* (BMNH 2000.70) prior to preservation. Photo by J.C. Daltry/FFI.

Maxillary dentition: an anterior series consisting of six (left) or seven (right) teeth, which increase in size from front to back, followed by a short diastema, and five further teeth, which again increase in size from front to back. The anterior end of the maxilla curves inwards.

*Variation*.—Only a single specimen is known, hence we cannot provide data on variation. Given that the light bands contain some black pigment and that, in *L. subcinctus* and *L. effraenis*, the light bands become obscured by dark pigment during ontogeny, we suspect that adults of *L. cardamomensis* may also be more or less strongly melanized. Since the darkening of the light bands in *L. subcinctus* and *L. effraenis* starts at the posterior end of the snake, it is possible that adult *L. cardamomensis* may have fewer visible light bands than juveniles. However, confusion with *L. subcinctus* and *L. effraenis* can be avoided due to the numerous differences in scalation.

*Etymology*.—Named after the type lo-

cality, the Cardamom Mountains of southwestern Cambodia.

#### DISCUSSION

The interrelationships of the new species with other species of *Lycodon* are unclear. Although *L. cardamomensis* is most similar to *L. subcinctus* in terms of color pattern, it differs from that species in numerous scalation characters. Its scalation is most similar to that of *L. ruhstrati* and *L. fasciatus*, but it differs from those species in many aspects of color pattern (particularly the much lower number of light body and tail bands).

In the key of Lanza (1999), *L. cardamomensis* would key out as *L. ruhstrati* at point nine. It differs from that species in having three rather than two postoculars, and 12 body bands and 6 tail bands rather than 22 or more and 11 or more, respectively. Its distribution is separated by a considerable gap from that of *L. ruhstrati*, which is confined to southern China, Tai-

wan, and the Ryukyu Islands of southern Japan (Lanza, 1999).

It is important to elucidate the distribution and status of *L. cardamomensis* for the purposes of conservation management. Although the holotype was collected within a nominally protected area, the Phnom Samkos Wildlife Sanctuary is not marked on the ground, has no management plan, and is currently the target of international aid organizations for human settlement. Outside of the sanctuary, similar lowland evergreen forest habitats in the Cardamom Mountains have been parceled into commercial logging concessions. Thus, the habitat of this species is far from secure.

Because *L. cardamomensis* is superficially similar to a juvenile of *L. subcinctus*, it is possible that further specimens may masquerade under that name in museum collections. Specimens labeled as *L. subcinctus* from eastern Thailand and Cambodia in particular should be checked against the diagnosis of *L. cardamomensis*.

#### Natural History Notes

The holotype was found by J. C. Daltry at 1900 h (1 h after sunset) on 9 February 2000. The snake was located on a smooth boulder approximately 1 m from the edge of a fast flowing stream (the headwaters of the River Tumpor) at 500 m above sea level. Ambient temperature was 20 C (relatively warm for this elevation at this time of year), and ambient relative humidity was 75%. Surrounding the stream was a large expanse of primary lowland evergreen forest, dominated by dipterocarps such as *Shorea hypochra*, *Anisoptera costata*, *A. glabra*, *Dipterocarpus costatus*, and *Hopea odorata*. The tree canopy was well developed and exceeded 30 m in height. Epiphytes and hemi-epiphytes were abundant, as were lichens, mosses, and ferns, whereas palms and bamboo were uncommon (Meng et al., 2000).

The holotype showed no inclination to bite when handled, but local people expressed fear of the snake and considered it venomous, perhaps owing to its superficial similarity to the elapid *Bungarus candidus*. The latter has also been documented in the Phnom Samkos Wildlife Sanc-

tuary (Daltry and Chheang, 2000a). The nearest settlement to the type locality is Tumpor village, 6.5 km to the southwest. Other species of herpetofauna documented from the same locality on the same night were *Rana cubitalis*, *Bufo macrotis*, *B. parvus*, *Fejervarya limnocharis*, and *Limnonectes kohchangae*.

Three anurans collected from the Cardamom Mountains during 2000 and 2001 also appear to be new to science (personal communication from Annemarie Ohler, Muséum National d'Histoire Naturelle, Paris). The herpetofaunal inventory of this mountain range is still far from complete, however, and further work is needed to determine whether the Cardamom Mountains form a globally significant area of reptilian and amphibian endemism.

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## APPENDIX I

### Specimens Examined

- Lycodon cardamomensis*.—CAMBODIA: Pursat: Phnom Samkos Wildlife Sanctuary (BMNH 2000.70)
- Lycodon butleri*.—MALAYSIA: Perak: Larut Hills (BMNH 1940.1.2.1)
- Lycodon effraenis*.—INDONESIA: Sumatera Utara: Deli (Medan) (BMNH 89.11.12.1). MALAYSIA: Johor: Johor Baharu (BMNH 1971.790); Kelantan: no further data (BMNH 1905.2.7.4); Pahang: Kuala Lompat (BMNH 1974.3890); Sabah: Baram (BMNH 1902.11.15.14); Tawau District (FMNH 249760); Tenom District (FMNH 243940) Sarawak: Niah Caves (BMNH 1974.2436); 4<sup>th</sup> Division (FMNH 128434); Kapit District (FMNH 148901); Bintulu District (FMNH 148902)
- Lycodon fasciatus*.—CHINA: Sichuan: Monping District (FMNH 15148). THAILAND: No data (TNRC 395, 1372, 9630); Chiang Mai (FMNH 178369); Nakhon Ratchasima (FMNH 180144–6)
- Lycodon subcinctus*.—CHINA: Hainan Dao: Kachek (BMNH 1937.2.1.4); Hong Kong: Happy Valley (BMNH 1983.204); Mt. Butler (BMNH 1983.205). INDONESIA: Java: no further data (BMNH 79.10.20.23); Salak (BMNH 91.5.1.8); Sumatera Utara: Deli (Medan) (BMNH 89.11.12.18). MALAYSIA: Johor: Johor Baharu (BMNH 97.12.28.53); Kelantan: no further data (BMNH 1912.2.22.5–6); Kuala Krai (BMNH 1983.964); Pahang: Kuala Teku (BMNH 1906.2.28.20); Perak: Kuala Legap, Headwaters of River Plus, 1000 ft. (BMNH 1934.5.21.71); Taiping (BMNH 1902.5.28.28); Sabah: Sandakan (BMNH 95.9.11.22); Sarawak: Gunung Mulu (BMNH 1978.1867). THAILAND: Kuan Nieng, Setal Road (possibly Khuan Niang, Satun Province) (BMNH 1968.761); Nakhon Si Thammarat: Ban Rong Lek (unvouchered specimen photographed in the field by W. Wüster); Patani: Patani (BMNH 1968.763); Tak: northwest of Tak (BMNH 1937.2.1.6). VIETNAM: Quang Nam Da Nang: Tourane (now Da Nang) (BMNH 1937.2.3.5)
- Dinodon septentrionalis*.—BURMA: no further data (BMNH 1908.6.23.101); Sargaing: Mogok (BMNH 1904.4.26.5–6). INDIA: Meghalaya: Khasi Hills (BMNH 1946.1.14.96). THAILAND: Pa Meang (BMNH 1968.40); Chiang Mai: Chiang Mai Hills (BMNH 1937.2.1.11)

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