

## Identification and a new record from Penang Island of the rare red-bellied reed snake (*Calamaria albiventer*) (Gray, 1835) (Serpentes: Calamariinae)

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**Abstract.** *Calamaria albiventer* (Gray, 1835) is rediscovered at its type locality on Penang Hill on Penang Island, Malaysia after a six-decade absence of recorded sightings in the country. The species is known from only six locations in Peninsular Malaysia, Singapore, and Sumatra. A description of the new specimen is provided along with the first ever illustrations of the species in life and observations of its natural history. An updated taxonomic key to the *Calamaria* species of Peninsular Malaysia is included.

**Key words.** Squamata, Colubridae, historical, taxonomy, systematics, herpetofauna, taxonomic key

### INTRODUCTION

Snakes of the genus *Calamaria* are a group of generally small, terrestrial, semifossorial snakes that are commonly referred to as reed snakes—probably due to their cylindrical, non-tapered body shape (Inger & Marx, 1965; Stuebing et al., 2014). The genus currently contains 61 recognised species (Uetz et al., 2018) and are found from Myanmar through southern China, Taiwan, and the Ryukyu archipelago; south through the Sunda area (including Sumatra, Java, and Borneo), the Philippines, Sulawesi, and as far east as Seram (Inger & Marx, 1965).

Six *Calamaria* species are known from Peninsular Malaysia: the red-bellied reed snake (*C. albiventer*), Inger's reed snake (*C. ingeri*), Low's reed snake (*C. lovii gimletti*), variable reed snake (*C. lumbricoidea*), collared reed snake (*C. pavimentata*), and the pink-headed reed snake (*C. schlegeli*) (Inger & Marx, 1965; Grismer et al., 2004). All species are widely distributed in Peninsular Malaysia (Inger & Marx, 1965; Tweedie, 1983; Lim et al., 2002; Leong & Lim, 2003; Grismer et al., 2010; Grismer, 2011b) except *C. ingeri* that is endemic to Tioman Island (Grismer et al., 2004). Due to their secretive, semi-fossorial nature, they often go unnoticed

and some species are very rarely encountered (Stuebing et al., 2014). One such species is *C. albiventer* that was first described from Penang Island (Gray, 1835) and has only been recorded a few times from a few scattered locations on the Malay peninsula and Sumatra (Inger & Marx, 1965; Tweedie, 1983). Inger & Marx (1965) synonymised *C. indragirica* Schenkel, 1901 and *C. ornata* Werner, 1909 that were both described from Indragiri, Sumatra, with *C. albiventer*. *Calamaria albiventer* was last reported from Asahan, Malacca, six decades ago (Batchelor, 1958). Here we report on a new specimen from the type locality on Penang Island. We present a description of it because the original description of the species was based on illustrations of material with colours that had faded due to preservation and present additional variation for the species previously unreported (Table 1). This is accompanied by the first photos of a live specimen and an updated key to the *Calamaria* species of Peninsular Malaysia.

### MATERIAL AND METHODS

**Material examined.** Adult female (USMHC 2390) found by Eric H.H. Leong on 17 May 2018 at Penang Hill, Penang Island, Peninsular Malaysia (N 5.415633, E 100.259966; approximately 716 m in elevation); Adult of undetermined sex (ZRC 2.2688) found by H.M. Pendlebury in February 1932 at Larut Hills, Perak, Peninsular Malaysia at approximately 1,370m in elevation; Adult of undetermined sex (ZRC 2.3920) found in May 1917 at Penang Hill, Penang Island, Peninsular Malaysia. Collector unknown. The museum abbreviations ZRC refers to the Zoological Reference Collection of the Lee Kong Chian Natural History Museum (LKCNHM), Singapore, and USMHC refers to Universiti Sains Malaysia Herpetological Collection.

**Morphological analysis.** Colour pattern characters were noted during examination of the specimen in life and taken

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Fig. 1. A, Dorsum of *Calamaria albiventer* (USMHC 2390) in life from Penang Hill, Penang Island; B, Venter of *C. albiventer* (USMHC 2390) in life from Penang Hill, Penang Island; C, Dorsum of *C. albiventer* (ZRC 2.3920) from Penang Hill, Penang Island; D, Venter of *C. albiventer* (ZRC 2.3920) from Penang Hill, Penang Island (Photographs by Evan Quah [A–B], Kevin T.Y. Chiang [C–D]).

from digital images of the living specimen. Scale counts and scale nomenclature follow Inger & Marx (1965) and Grismer et al. (2004). The number of ventral scales was counted according to Dowling (1951). The cloacal plate was not included in the number of ventrals and the terminal scute was not included in the number of subcaudals. The values for paired head scales are listed in left/right order. See Table 1 for list of characters examined.

## RESULTS

**Description of USMHC 2390 (Fig. 1A, B; Table 1).** Head rounded, blunt and indistinct from neck. Eyes small, laterally oriented, pupils round, diameter of eye greater than eye-mouth distance and nearly equal to eye-nostril distance. Snout short, blunt and rounded in dorsal profile, rostrum convex and curves downwards. Rostral scale triangular, broader than tall, visible from above. Nasals undivided, bordered anteriorly by rostral, dorsally by prefrontal and ventrally by first supralabial, nares in the middle. Internasal absent, loreal absent. Preocular 1/1, small; supraocular 1/1, large, approximately half the width of the frontal; postoculars 1/1, small. Prefrontals two, large, approximately as long as wide, in broad contact with each other, and touching the frontal, supraocular, preocular, rostral, dorsal edge of nasal, and supralabials 1 and 2. Frontal hexagonal, large, longer than wide, longer than prefrontals but slightly shorter than parietals, in contact with prefrontals anteriorly, supraoculars laterally and parietals posteriorly. Parietals elongate, longer than wide, slightly longer than frontal, in broad contact with each other, and touching the frontal, supraocular, postocular, fifth supralabial, paraparietal and dorsal scales on the nape. Paraparietal surrounded by five scales, the parietal, fifth supralabial, post-labial and two dorsal scales of the nape. Supralabials 5/5, largest supralabials 5<sup>th</sup>/5<sup>th</sup>, supralabial entering orbit 3+4/3+4. Infralabials 5/5, first three in contact with anterior pair of chin shields. Mental triangular, touching anterior pair of chin shields. Dorsal scales smooth, 13 anterior dorsal scale rows at neck, 13 dorsal scale rows at midbody, 13 posterior dorsal scale rows anterior to vent, reduced to four rows on tail opposite 3<sup>rd</sup> to 11<sup>th</sup> subcaudal anterior to terminal scute. There are 146 ventrals; an undivided anal scale, and 21 divided subcaudal scales. Body elongated, slender, somewhat cylindrical in cross-section. Tail short, tappers gradually from base then abruptly at tip to a sharp point. Snout-vent length 153 mm, tail length 15 mm, and total length 168 mm.

**Colouration in life of USMHC 2390 (Figs. 1A, B).** The ground colour of the dorsum is reddish brown and there is a pair of narrow, bright red stripes on either side of the vertebral scale row from the nape to the tip of the tail. The red stripes are edged in black. Along the lower flank is a light, silvery-grey stripe on the 1<sup>st</sup> and 2<sup>nd</sup> dorsal scale rows which runs the length of the body from the neck to the tip of the tail. The silvery-grey stripe is also bordered by black stripes. The top of the head is reddish brown like the dorsum with dark brown speckles and spots on the rostral, prefrontals, frontal, preoculars, supraoculars, postoculars, parietals, paraparietals and supralabials. The supralabials are yellow and edged in



Fig. 2. A, Hill dipterocarp forest habitat of *C. albiventer* on Penang Hill, Penang Island (Photograph by Evan Quah); B, Original illustrations of *C. albiventer* from Gray (1835).

dark brown. Dark spots are present on the dorsal halves of the fifth supralabial and the post-labial. The mental and infralabials are yellow with dark spots along the corners of the mental and anterior corners of the infralabials. The chin shields and throat are lemon yellow and gradually shades to salmon on the neck. The ventrals and subcaudals are bright, orange-red with a black border along their outer edges that is confluent with the dark stripe bordering the silvery-grey stripe on the lower flanks. A dark median stripe is present on the underside of the tail.

**Intraspecific variation (Table 1).** Specimen USMHC 2390 is generally similar in pholidosis to the two ZRC specimens examined and that reported for the species reported by Inger & Marx (1965). Some slight differences noted between USMHC 2390 and females of *C. albiventer* reported by Inger & Marx (1965) were the lower number ventral scales (146 vs 147–162) but higher number of subcaudals (21 vs 15–19). USMHC 2390 and ZRC 2.3920 also displayed differences in their reduction of dorsal scales to four rows on tail opposite subcaudals anterior to terminal scute, ranging from the 3<sup>rd</sup>–17<sup>th</sup> vs 5<sup>th</sup>–8<sup>th</sup> subcaudals reported by Inger and Marx (1965). ZRC 2.2688 is in a poor state of preservation and some characters could not be assessed. Scale characters of USMHC 2390, ZRC 2.3920 and ZRC 2.2688 are presented in Table 1.

**Interspecific comparisons.** The colouration of *C. albiventer* readily distinguishes it from all other members of the genus in Peninsular Malaysia. It can be further differentiated from *C. schlegeli* and *C. ingeri* by its mental scale being in contact with the anterior pair of chin shields versus separated in

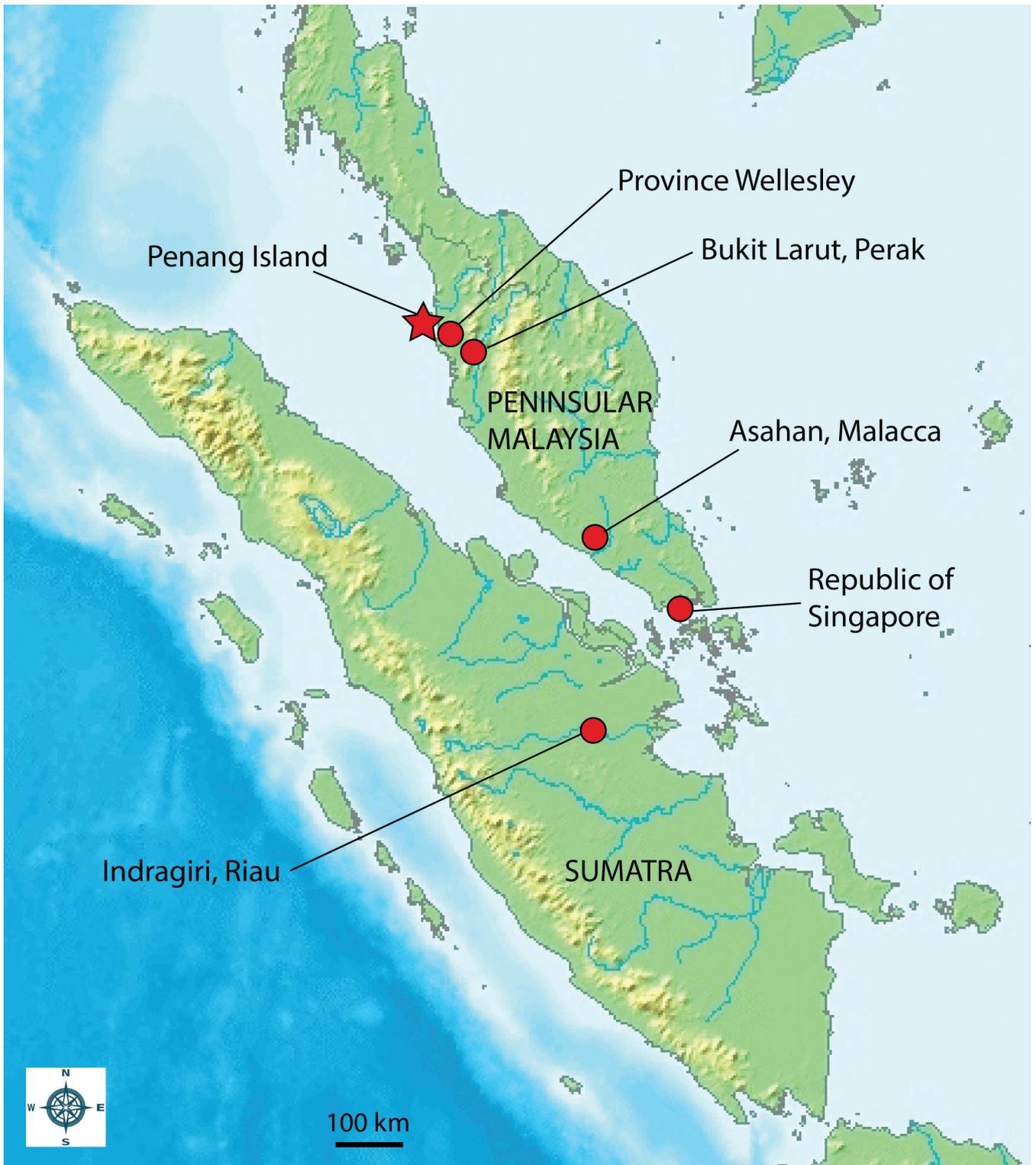


Fig. 3. Distribution of *Calamaria albiventer*. Star indicates type locality and circles indicate reported localities.

Table 1. Morphological characters of *Calamaria albiventer* specimens from Penang Hill, Penang Island and Bukit Larut, Perak. Paired values in left/right order. NA = no data available.

Characteristics	USMHC 2390 Penang Hill	ZRC 2.3920 Penang Hill	ZRC 2.2688 Bukit Larut, Perak
Sex	Female	NA	NA
Number of ventral scales	146	152	155
Number of subcaudal scales	21	22	18
Anal scale single or divided	Single	Single	Single
Anterior dorsal scale rows on neck	13	13	13
Scale rows at mid-body	13	13	13
Posterior dorsal scale rows anterior to vent	13	13	13
Subcaudals anterior to terminal scute with dorsal scale row reduction to 4 rows on tail	3 <sup>rd</sup> –11 <sup>th</sup>	4 <sup>th</sup> –17 <sup>th</sup>	NA
Internasals present or absent	Absent	Absent	Absent
Loreal present or absent	Absent	Absent	Absent
Number of supralabials	5/5	5/5	5/5
Largest supralabial	5 <sup>th</sup> /5 <sup>th</sup>	5 <sup>th</sup> /5 <sup>th</sup>	5 <sup>th</sup> /5 <sup>th</sup>
Supralabials contacting eye	3–4/3–4	3–4/3–4	3–4/3–4
Number of infralabials	5/5	5/5	5/5
Number of infralabials in contact with the anterior chin shield	1–3/1–3	1–3/1–3	1–3/1–3
Number of preoculars	1/1	1/1	1/1
Number of postoculars	1/1	1/1	1/1
Number of supraoculars	1/1	1/1	1/1
Number of scales surrounding paraparietal	5/5	5/5	5/5
Snout vent length (SVL)	153 mm	205 mm	168 mm
Tail length (TaL)	15 mm	23 mm	15 mm
Total length (TL)	168 mm	228 mm	183 mm
Relative snout vent length (SVL/TL)	0.91	0.90	0.92
Relative tail length (TaL/TL)	0.09	0.10	0.08

those two species. It can be distinguished from both *C. loyii gimletti* and *C. pavimentata* by its higher number of supralabials (5 vs 4) and supralabials in contact with the eye (3<sup>rd</sup> & 4<sup>th</sup> vs 2<sup>nd</sup> & 3<sup>rd</sup>). *Calamaria albiventer* can be separated from *C. lumbricoidea* by its dorsal (pair of red stripes present vs red stripes absent) and ventral patterns (immaculate red vs banded black and white) (Inger & Marx, 1965; Tweedie, 1983; Grismer et al., 2004). An updated key to the *Calamaria* of Peninsular Malaysia is presented below.

**Distribution (Fig. 3).** This species is known from scattered locations in Peninsular Malaysia (n = 9), Singapore (n = 1), and Sumatra (n = 2). From Peninsular Malaysia it is known from Penang Island (n = 6); Province Wellesley, Penang mainland (n = 1); Bukit Larut, Perak (n = 1), and Asahan, Malacca (n = 1). In Sumatra, it has been recorded

from Indragiri at Riau province (Batchelor, 1958; David & Vogel, 1996; Inger & Marx, 1965; Tweedie, 1983).

**Natural history.** Almost nothing is known about the natural history of this species across its range (David & Vogel, 1996). In Peninsular Malaysia, *C. albiventer* is found in the lowlands as well as at higher elevations. Batchelor's (1958) specimen from Asahan, Malacca, was collected in secondary forest near a reservoir. Flower (1899) collected a specimen on Penang Hill at 2,000 ft in the month of March 1898. The new specimen was found in hill dipterocarp forest (Fig. 2A) and it was crawling on the forest floor among the leaf litter at approximately 1700 hours, three hours before sunset. Conditions were damp from rains the night before. At the time of collection, USMHC 2390 had captured an earthworm, but it released the prey when it became startled

when approached. This vermivorous diet is similar to that of other *Calamaria* species such as *C. lumbricoidea*, *C. pavimentata*, and *C. schlegeli* that have been observed feeding on earthworms as well (Malkmus et al., 2002; Tan & Yeo, 2013; Baker, 2014; Stuebing et al., 2014; Evan S.H. Quah, pers. obs.). *Calamaria albiventer* is expected to behave similarly to other species of *Calamaria* in being a secretive, terrestrial snake that hides beneath surface objects and leaf litter during the day and predominantly active at night (Malkmus et al., 2002; Stuebing et al., 2014). Nothing is known about the breeding biology of this species but it likely lays eggs like other members of the genus (Malkmus et al., 2002; Stuebing et al., 2014). On Penang Hill it occurs in sympatry with *C. lumbricoidea*, *C. pavimentata*, *C. schlegeli*, and *Pseudorabdion longiceps* (Evan S.H. Quah, pers. obs.). Based on a published checklist, this species would also occur with those same three *Calamaria* species on Bukit Larut along with other fossorial snakes including *Collorhabdium williamsoni*, *P. longiceps*, and *Macrocalamus chanardi* (Grismer et al., 2010).

## DISCUSSION

Prior to this new record, the colouration of *C. albiventer* in life was only known from the report by Flower (1899) who wrote; “Above rich red-brown, with a pair of black-edged bright red vertebral lines; on each side a black-edged bluish-white line. Upper surface of head rich red-brown, finely speckled with black. Under surface of head rich lemon-yellow, which gradually shades into red on the neck; remainder of lower surface bright coral-red. A median black line under the tail”. Specimen USMHC 2390 closely matches his report on the colouration of this species in life. The specific epithet of the species, *albiventer* is misleading as it is derived from the Latin word ‘*albus*, -a, -um’ which means white and ‘*venter*’ in reference to the belly of specimens that turn white after long periods in preservation (Uetz et al., 2018). Similar to other species described in the 19<sup>th</sup> century, *C. albiventer* was described from a preserved specimen in which colours had presumably long faded (Figs. 1C, D, 2B). Smith (1943:166) wrote; “It is difficult to realise from the museum specimens the extreme beauty and brilliancy of colouring of many snakes in life”, and this illustrates the importance of documenting new material found with new and improved technology such as through the use of digital colour photography. New images of unprecedented quality can provide accurate illustrations and depictions of the important characteristics of the animal to aid in identification.

The colouration of *C. albiventer* also suggest that it might possibly be mimicking venomous coral snakes of the genus *Calliophis* similar to other species of *Calamaria* such as *C. lumbricoidea* and *C. schlegeli* that are supposed mimics (Tweedie, 1953, 1957; Baker & Lim, 2008; Stuebing et al., 2014). The red dorsal stripes that are outlined in black in *C. albiventer* are reminiscent of the dorsal pattern observed in *Calliophis intestinalis* and the bright orange-red venter suggest it might also be mimicking *Calliophis bivirgatus* which has a similarly bright red venter. Coincidentally, ZRC 2.3920 was actually discovered in the collection of the

LKCNHM previously misidentified and mislabelled as *C. bivirgatus*. The bright orange-red venter is a characteristic that is also observed in other species of semi-fossorial calamariid snakes such as *Macrocalamus chanardi* and *M. lateralis* (Vogel & David, 1999; David & Pauwels, 2004; Evan S.H. Quah, pers. obs.).

The rediscovery of *C. albiventer* at its type locality on Penang Island is noteworthy as it has been a century since it was last recorded on the island. This finding follows that of *Ansonia penangensis* that was also rediscovered on Penang Hill only in 2011 after close to a century and a half of not being reported (Quah et al., 2011). We speculate that the secretive and semi-fossorial nature of these snakes have kept them hidden. Other species of *Calamaria* have also been unearthed after a long absence in sightings, such as *C. loyii gimletti* in Singapore (Serin et al., 2017). The rediscovery of *C. albiventer* and *A. penangensis* on Penang Hill echoes that of other rare reptile species have turned up in recent years from around Peninsular Malaysia, especially from montane areas such as *Cyrtodactylus sworderi*, *Lygosoma peninsulare*, *Pseudocalotes flavigula*, *Sphenomorphus senja*, and *Xenophidion schaeferi* (Grismer et al., 2007, 2016, 2018; Grismer & Quah, 2015; Quah et al., 2018). Penang Hill is the type locality for many species that were described in the 19<sup>th</sup> century such as *Calliophis gracilis*, *Ovophis convictus* and *Sphenomorphus anomalopus* that have also not been collected on the hill since their descriptions (Cantor, 1847; Boulenger, 1912; Grismer, 2011a). Nevertheless, continued herpetofaunal surveys on the hill have resulted in discoveries such as two new species of lizards, *Hemiphyllodactylus cicak* (Cobos et al., 2016) and *Larutia penangensis* (Grismer et al., 2011), and a new record of *Tytthoscincus butleri* for Penang Island (Grismer et al., 2017). Thus, efforts should be sustained to study the herpetofauna of Penang Hill, with focus on semi-fossorial taxa as there is great potential for other notable discoveries to be made in the future.

## An updated key to the genus *Calamaria* of Peninsular Malaysia, modified from Tweedie (1983) with additional data from Inger & Marx (1965) and Grismer et al., (2004)

1. Five or six supralabials ..... 2
  - Four supralabials ..... 5
2. First pair of infralabials in contact behind the mental; mental separated from anterior pair of chin shields; supraocular less than half the width of the frontal ..... 3
  - First pair of infralabials not in contact; mental touches anterior pair of chin shields; supraocular approximately half the width of the frontal ..... 4
3. 129–180 ventrals; 19–44 subcaudals; dorsum immaculate grey or brown; head in varying degrees of pink and/or yellow and brown ..... *C. schlegeli*
  - 213–228 ventrals; 10–11 subcaudals; dorsum brown with 20–26 light transverse bands one scale wide; head dark brown ..... *C. ingeri*
4. Presence of a pair of red dorsal stripes in life; venter red in life (white in preservation) ..... *C. albiventer*
  - Absence of a pair of red dorsal stripes; venter usually banded black and white ..... *C. lumbricoidea*
5. Preocular present; tip of tail pointed; dorsum orange to dark brown with five dark, parallel stripes running the length of

- the body, starting behind a dark brown and yellow collar on the neck; a pair of light spots sometimes present on the tail; venter bright yellow ..... *C. pavimentata*
- Preocular absent; tip of tail rounded; dorsum grey to brown with/without a pair of cream blotches on either side of the neck; venter whitish ..... *C. lovii gimletti*

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