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A new species of coralsnake of the genus *Calliophis* (Squamata: Elapidae) from the Central Province of Sri Lanka

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Abstract

We describe a new species of coralsnake, *Calliophis haematoetron*, from central Sri Lanka. This is the second species of coralsnake known from the island country, after *Calliophis melanurus*. It differs from *C. melanurus* in coloration, possessing a relatively unpigmented head (vs. capped with black from rostrum to nuchal collar), no light spots posterolateral to the parietal plates (vs. one at each side), a banded body dorsum (vs. unicolored), a bright red body venter (vs. orange or yellow through most of the length), and red pigment lateral to the blue under-tail color (vs. no red on tail). It also differs from *C. melanurus* in aspects of lepidosis, in having a frontal that is shorter or equal in size (vs. longer) than the interparietal suture and a first sublabial that does not touch the second pair of chin-shields (vs. first sublabial broadly touching second pair of chin-shields). The new species is easily distinguished from all other *Calliophis* species in nearby India and Southeast Asia by characters of external morphology and coloration.

Sinhala Abstract

ශ්‍රී ලංකාවේ මධ්‍යම ප්‍රදේශයෙන් සොයාගත් *Calliophis haematoetron* නම්වූ නව සර්පයින් විශේෂයක් මෙම ලිපියෙන් විද්‍යාත්මකව නම් කෙරේ. ශ්‍රී ලංකා දෙපත් කළුවාට (විද්‍යාත්මක නාමය *Calliophis melanurus sinhaleyus*) පසුව මෙරටින් වාර්තා වන මෙම ගණයේ දෙවැනි සාමාජිකයා මොහු වේ. මෙම නව විශේෂයේ සහ *C. melanurus* විශේෂයේ වර්ණ රටාවෙන් සැසඳිමේදි: නව විශේෂයේ හිස කැපී පෙනෙන වර්ණ රටාවකින් තොරය (අනෙක් විශේෂයේ හොඹ කෙලවර සිට ගෙල දක්වා තනි කළු පැහැතිය), නව විශේෂයේ පාර්ශ්ව කොරල වලට අපරව සහ පාර්ශ්විකව ලා පැහැති ලප රහිතය (අනෙක් විශේෂයේ එවැනි ලප එක් පසක එක බැගින් පිහිටයි), නව විශේෂයේ පෘෂ්ඨීය දේහය හරස් පටි සහිතය (අනෙක් විශේෂයේ තනි පැහැතිය), නව විශේෂයේ දේහය උදරියව තද රතු පැහැතිය (අනෙක් විශේෂයේ තැඹිලි හෝ කහ පැහැතිය), නව විශේෂයේ උදරියව නිල් පැහැ වලිගයේ රතු පැහැ පාර්ශ්වික සළකුණු පිහිටයි (අනෙක් විශේෂයේ උදරියව වලිගයේ රතු පැහැ සළකුණු නොපිහිටයි). කොරල සැකැස්ම සැසඳිමේදි: නව විශේෂයේ ලලාට කොරලය පාර්ශ්ව කොරල අතර සිහුමට දිගින් සමාන හෝ ඊට කෙටි හෝ වේ (අනෙක් විශේෂයේ එය දිගින් වැඩිය), නව විශේෂයේ පළමු යටිතොල කොරලය දෙවන නිකට කොරල යුගලය හා ස්පර්ශ නොවේ (අනෙක් විශේෂයේ එම කොරල පළල්ව ස්පර්ශ වේ). මෙම නව විශේෂය ඉන්දියානු සහ අන් දකුණු ආසියාතික *Calliophis* විශේෂයන්ගෙන්ද පහසුවෙන් වෙන් කොට හඳුනා ගත හැක.

Key words: *Calliophis haematoetron* new species, *Calliophis melanurus*, *Calliophis melanurus sinhaleyus*, India, Wasgomuwa National Park

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Introduction

In June of 1997 two researchers from the Wildlife Heritage Trust of Sri Lanka, Mohomed M. Bahir and Sampath Nanayakkara, were conducting field work in Wasgomuwa National Park. While searching through leaf-litter, M. Bahir collected a very strange-looking coralsnake. The coralsnake was somewhat different from *Calliophis melanurus sinhaleyus* Deraniyagala, 1951, the only named coralsnake known from Sri Lanka. Bahir (1999) reported on this peculiar snake as *Calliophis melanurus* (Shaw, 1802), published a color photograph, and compared the specimen briefly with a typical specimen. Bahir (1999) realized the possibility of this being an undescribed species but never described it formally, probably due to the lack of more specimens. During examination of coralsnake specimens in the collection of the Smithsonian Institution (USNM) we found two additional specimens of this interesting new species, collected by Herbert G. Deignan near Rattota, Sri Lanka. Taylor (1950) reported these two specimens as *C. melanurus*. He had noticed some differences between these specimens and typical *C. melanurus* as described from India by Wall (1921) and Smith (1943), and suggested that there could be subspecific differentiation. It seems, however, that Taylor never realized the possibility of two species of *Calliophis* existing in Sri Lanka because he apparently never examined other specimens from the island. He was also seemingly confused by the fact that the variation given by Wall (1921) for *C. melanurus* in Sri Lanka did not fully encompass the specimens he reported. Taylor's report of the differences and possibility of a different subspecies of coralsnake for Sri Lanka prompted Deraniyagala (1951) to describe the Sri Lankan *C. melanurus* as a new form. Deraniyagala (1951) apparently did not recognize any of the differences seen by Taylor and provided a very short description of a new taxon, *Calliophis melanurus sinhaleyus*, based on material that is actually more similar to the nominotypical form. In the diagnosis Deraniyagala (1951) states that the nostril is "usually between two scales" in *C. m. sinhaleyus* and that it has "an enlarged pair of temporals" and is larger than the nominate subspecies, which has a "nostril usually in one scale" and "usually no enlarged temporals." Deraniyagala (1951) apparently examined only Sri Lankan material, and his information on Indian specimens seems to have been based on published descriptions and illustrations only. In fact, most Indian specimens of *C. melanurus* observed by us have long temporals and a divided nasal (two scales). The question of whether or not different populations within *C. melanurus* deserve taxonomic recognition requires detailed phylogeographic studies. Deraniyagala (1951: Table 2) described some specimens of *C. m. sinhaleyus* as having dorsal spots, but we have not seen specimens like these, and those examined by him might be lost. Later, Das & De Silva (2005) also recognized the banded form as a distinct population of *C. m. sinhaleyus*, and illustrated this population with a picture of the specimen collected by Bahir. Herein we provide a detailed description of the banded taxon recognized by Taylor (1950) and Bahir (1999) and formally introduce it as a new species.

Material and methods

We examined preserved specimens of coralsnakes from the collections of the Bombay Natural History Society (BNHS), the Natural History Museum, London (BMNH), the Madras Museum (MAD), the Madras Snake Park (MSP), the National Museum of Sri Lanka (NMSL), the National Museum of Natural History, Smithsonian Institution (USNM), the Wildlife Heritage Trust of Sri Lanka (WHT), and the Zoological Survey of India (ZSI) Kolkata (Calcutta) and Kozhikode (Calicut) collections (see Appendix). Information on some morphological characters were also obtained from written accounts and/or illustrations from Bahir (1999), Boulenger (1890, 1896), Cox (2000), Das & De Silva (2005), Deraniyagala (1951, 1955), De Silva (1980), Phelps (1981), Slowinski *et al.* (2001), Smith (1943), Taylor (1950), Vogel (2006), Wall (1913, 1921), and Whitaker & Captain (2004).

Measurements of external morphology were taken from digital images using the software ImageJ (Rasband, 2004). Photographs were taken with high resolution digital cameras (> 8 megapixels), placing the sub-

ject at right angles with respect to the lens of the camera. External dimensions are given to the nearest 0.1 mm. Measurements of internal features were taken using a stereoscope (40x) with an ocular micrometer, to the nearest 0.01 mm. Fang length was measured, at each side, from upper lumen to tip. Snout-vent length (SVL), tail length, and total length (TL) were taken to the nearest mm using the imaging software or a measuring ruler or tape.

Terminology for scales follows standard colubroid terminology (e.g., Smith & Campbell 1994). The method of counting ventrals is that of Dowling (1951). The terminal scute (tip) is excluded from the number of subcaudals. A preanal scale is a small single or divided scale present before the anal plate but not associated to dorsal scales or vertebral segments. The numbers of dorsal scale rows are counted at one head length behind the head, at midbody, and at one head length before the vent. Values for asymmetric head characters are given in left/right order.

The color description of the holotype in life is based on an electronic image obtained from a color transparency. This image is deposited at the Image Collection of the UTA Amphibian and Reptile Diversity Research Center (UTA Image-1928). Colors are taken from the Naturalist's Color Guide (Smithe 1975-1981) and numbers in parentheses correspond to the ones in this guide.

Terminology for cephalic glands follows Taub (1966), McDowell (1986), and Slowinski *et al.* (2001); hemipenial terminology follows the works of Dowling & Savage (1960), Savage (2002) and Castoe *et al.* (2007).

***Calliophis haematoetron* sp. nov.**
(Figs. 1–3)

Calliophis melanurus (Taylor 1950: 583–585, in part, described specimens) (Bahir 1999: 22–24, in part)
Calliophis melanurus sinhaleyus (Deraniyagala 1951: 147–148, in part, referred specimens of new taxon, at least specimens 12–13 on table 2) (Das & De Silva 2005: 57, in part)
Calliophis sp. (Somaweera 2006: 154–155)

English name: Blood-bellied coralsnake

FIGURE 1. *Calliophis haematoetron*, adult female holotype, 371 mm TL, WHT 1621. Photo by M. M. Bahir, courtesy of WHT (UTA Image-1928).

Holotype—WHT (The Wildlife Heritage Trust of Sri Lanka, Colombo, Sri Lanka) 1621, an adult female from Wasgomuwa National Park, [Central Province], Sri Lanka, ca. 90 m (ca. 7.648056° N 80.93583° E), collected 7 June 1997 by Mohomed M. Bahir and Sampath Nanayakkara (figs. 1–3).

Paratypes (2)—USNM (National Museum of Natural History, Smithsonian Institution, Washington D.C., United States of America) 120334–120335, young male and adult female, respectively, from Clodagh Estate, Rattota, Matale [Central Province], Sri Lanka, ca. 570 m (ca. 7.521667° N 80.68472° E), collected on 2 July 1944 by Herbert G. Deignan (fig. 2).

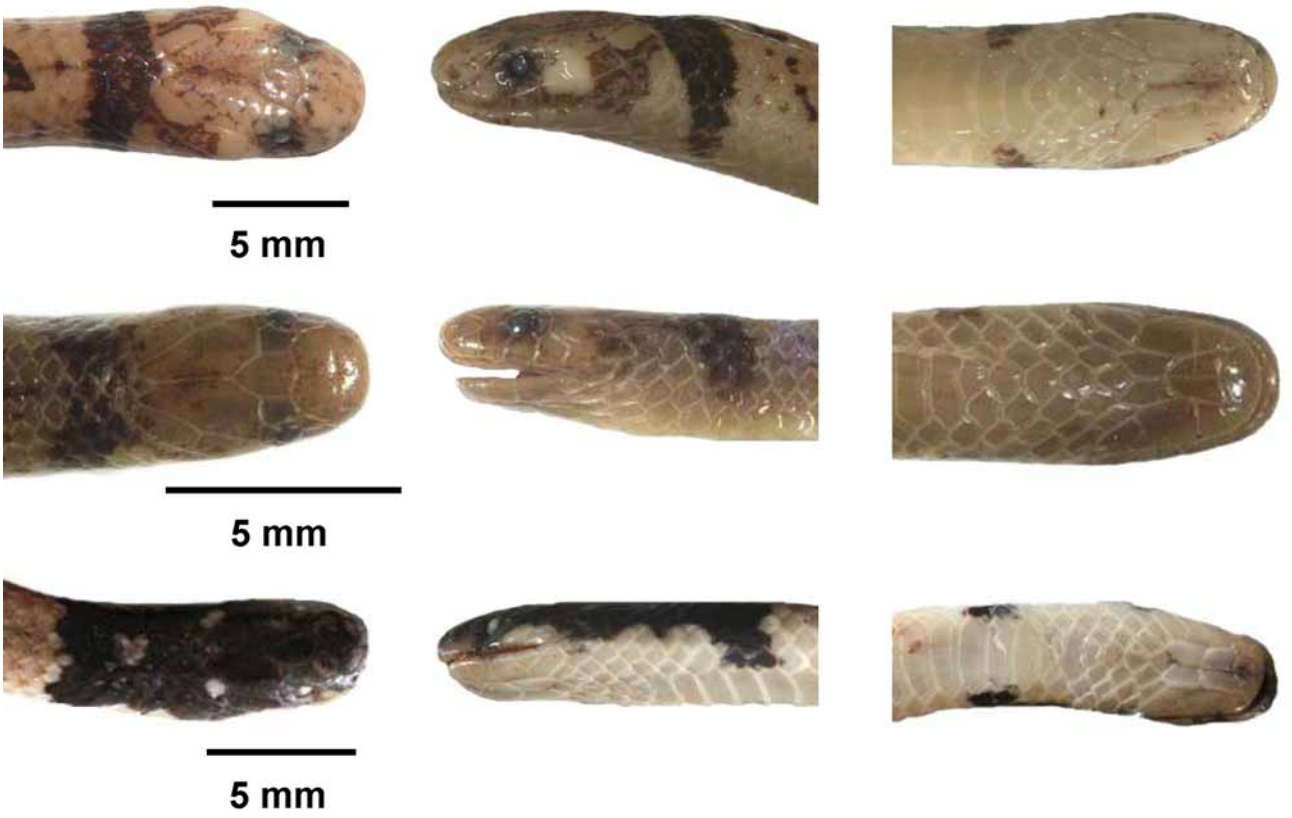

FIGURE 2. Dorsal, lateral and ventral aspects of heads of *Calliophis haematoetron*, adult female holotype, WHT 1621 (Top), *C. haematoetron*, young male paratype, USNM 120334 (Middle), and *Calliophis melanurus*, adult male from Sooriyawewa, Sri Lanka, NMSL-01 (Bottom).

Diagnosis—A small (152–414 mm TL, young male and mature female, respectively), brownish, terrestrial coralsnake in which the tail comprises 10.5% of the TL in the known male and 8.0–8.6% in the two known females. It has no sublabial-chin-shield contact, 6 supralabials, 6 infralabials, 2 postoculars, 225–239 ventrals, a divided anal, 29–35 divided subcaudals, dorsal scale rows arranged in 13 rows along entire body, and a color pattern consisting of 13–22 lateral body blotches and 2–3 tail bands (including one band in the cloacal region).

The new species can be distinguished from the only other known Sri Lankan *Calliophis*, *C. melanurus*, in having a frontal that is about equal in length or slightly shorter (vs. longer) than the interparietal suture, a first sublabial that does not touch the second pair of chin-shields (vs. broad contact with second pair of chin-shields), a relatively unpigmented head (vs. capped with black from rostrum to nuchal collar), no light spots posterolateral to the parietals, numerous bands on the dorsum of the body (13–22 vs. none; excluding nuchal collar and cloacal and tail bands), a blood-red body venter (vs. orange or yellow through most of the length), and in having red pigment lateral to blue coloration under the tail (vs. no red on tail).

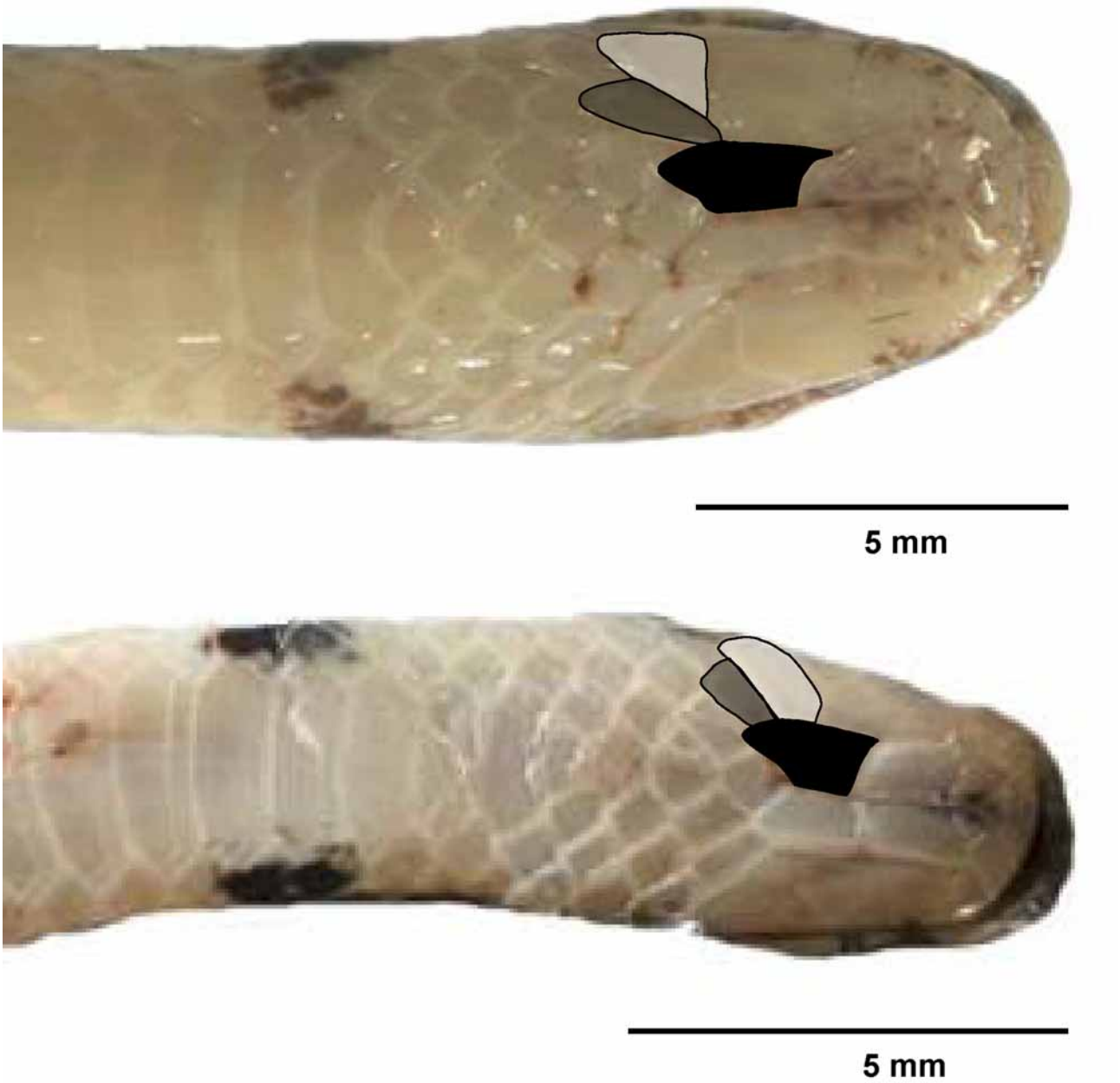

FIGURE 3. Ventral aspects of heads of *Calliophis haematoetron*, adult female holotype, WHT 1621 (Top) and *Calliophis melanurus*, adult male from Sooriyawewa, Sri Lanka, NMSL-01 (Bottom), showing distinct arrangement of scales in *C. haematoetron* with first sublabial scale (white) not touching the second pair of chin-shields (black) because of interruption of gular scale (gray). In *C. melanurus* the sublabial touches the chin-shield.

The new species can be distinguished from all other coralsnakes, except *C. melanurus* and *Calliophis maculiceps* (Günther, 1858), by its melanized tail base internal musculature, hypaxial, and associated epimysial and perimysial tissues (i.e., asulcate layer of hemipenis, *m. propulsor*, *m. retractor penis magnus*, and homologous muscles in females). The new species can be distinguished from all other *Calliophis* species in nearby India, *C. beddomei* (Smith, 1943), *C. bibroni* (Jan, 1858), *C. melanurus*, and *C. nigrescens* (Günther, 1862). From *C. beddomei* it differs in having fewer supralabials (6 vs. 7), first sublabials not touching the second pair of chin-shields, a pale head with light-brown subocular and cheek blotches (vs. head with melanic color, covering the snout and continuing caudally as a narrow interparietal line joining the dark collar and as lateral stripes from above the eye to the corner of the mouth), a body pattern of complete and incomplete bands and a few lateral anterior blotches (vs. pattern of paradorsal and lateral blotches separated by faint and

broken medial stripe), a colorful venter (vs. immaculate light colored, including tail), and tail bands (vs. no bands, only small blotches). From *C. bibroni* it differs in having fewer supralabials (6 vs. 7), a light colored (vs. dark) snout, a preocular (vs. no preocular), two postoculars (vs. 1), 2 or 3 tail bands (vs. 4–6), thin dark bands on the body that are up to 2 scales wide (vs. usually 3–4 scales wide), a divided anal (vs. single), and higher ventral scute counts (males 225 vs. 219; females 232–239 vs. 222–227). It differs from *C. nigrescens* in having a first sublabial that does not contact the second pair of chin-shields (vs. broad contact), having 6 supralabials (vs. 7), dark subcaudal markings (vs. unmarked), and a dorsal pattern of bands (vs. striped, with longitudinal blotches, or unicolored). The new species differs from *Calliophis gracilis* Gray, 1835 in possessing fewer ventral scales (225–239 vs. 303–320), more subcaudals (29–35 vs. 21–23), 2 maxillary teeth posterior to fangs (vs. none), a dorsal pattern of narrow bands (vs. large and paired paravertebral spots and 5–7 well-defined stripes), and a venter with no bands (vs. numerous regularly spaced wide bands). From *C. maculiceps* it can be distinguished by its high number of ventrals (225–239 vs. 169–222), more subcaudals (29–35 vs. 20–31), lack of postocular stripes, the first sublabial not touching the second pair of chin-shields (vs. broadly touching), and a frontal that is shorter or about equal to the length of the interparietal suture (vs. longer).

From the long-glanded coralsnakes *Calliophis bivirgata* (Boie, 1827) and *Calliophis intestinalis* (Laurenti, 1768), previously known as members of a the genus *Maticora* Gray, 1834 (see Slowinski *et al*. 2001), the new species differs in having a venom gland that is confined to the temporal region (vs. extending behind the head), a Harderian gland with a moderately developed posterior extension (vs. enlarged posterior extension, larger than the eyeball), pterygoids of moderate size and with 4 teeth (vs. reduced in size and with 2, 1, or no teeth), and a dorsal pattern of bands (vs. stripes). Additionally, the new species can be distinguished from *C. bivirgata* in lacking a bright red venter, head and tail dorsum, and from *C. intestinalis* in lacking a venter without bars and a blue (vs. red) subcaudal coloration.

From species in the genus *Sinomicrurus* Slowinski, Boundy & Lawson, 2001, i.e., *S. hatori* (Takahashi, 1930), *S. japonicus* (Günther, 1868), *S. kelloggi* (Pope, 1928), *S. macclellandi* (Reinhardt, 1844), and *S. sauteri* (Steindachner, 1913) (*sensu* Slowinski *et al*. 2001), the new taxon differs in possessing no protuberant sclerified tail tip, 6 (vs. 7) supralabials, and a Harderian gland with a moderately developed posterior extension (vs. no extension). It can further be distinguished from *S. hatori*, *S. japonicus*, and *S. sauteri* in having no pattern of stripes, and from *S. kelloggi* and *S. macclellandi* in having no white band anterior to the nuchal band. From snakes in the genus *Hemibungarus* Peters, 1862, namely *Hemibungarus calligaster* (Wiegmann, 1834), that had previously been considered coralsnakes (e.g., Slowinski *et al*. 2001), the new species differs in having 13 dorsal scale rows (vs. 15), 1+2 temporals (vs. 2+2 or 2+3), more subcaudals (32–35 vs. <25), a divided anal plate (vs. single), and a Harderian gland with a moderately developed posterior extension (vs. no extension). *Hemibungarus calligaster* is now placed in the tribe Hemibungarini, and the genus *Calliophis* and the rest of the Asian and American coralsnakes in the tribe Calliophini, based on hemipenial and molecular data (Castoe *et al*. 2007).

Etymology—The specific name, *haematoetron*, is derived from the Greek adjective *haematodes* (bloody), and the Greek noun *etron* (belly) meaning "bloody belly" in reference to the bright-red venter of this "beautiful snake" (= *Calliophis*).

Description of holotype and variation—Features of the adult female holotype are followed in parentheses by variation of the young male and the mature female paratypes, respectively. Total length 371 mm (152, 414); tail length 32 mm (16, 33); head length 6.9 mm (4.8, 9.5) from anterior edge of rostral to posterior end of mandible; head width 5.8 mm (3.1, 5.3) at broadest point; head slightly distinct from neck; snout 2.0 mm (1.5, 2.7) from front of rostral to anterior edge of eye; eye 0.3 (0.4, 0.4) times length of snout; pupil round; rostral 1.4 (1.3, 1.8) times wider than high; internasals 2.0 (1.2, 1.3) times wider than long, contacting only the nasals laterally; length of internasal suture slightly more than half diameter of eye (half in female paratype); prefrontals as wide as long, in contact laterally with nasal, preocular, and supraocular; prefrontal suture 1.4

(1.0, 1.3) times diameter of eye; frontal 1.3 (1.5, 1.5) times longer than wide; supraoculars 1.4 (1.3, 1.8) times longer than wide; parietals twice as long as wide (2.0, 1.8); parietal suture 0.6 times length of parietals, 1.2 (1.1, 0.9) times longer than frontal; 1+0 temporals and one posttemporal, shields touching parietal laterally large and elongated; temporal 1.9 (2.2, 1.9) times longer than wide; single preocular, 1.6 (1.5, 1.4) times longer than wide, triangular, with apex rostrally, located above line between center of eye and posterior border of naris; two postoculars, upper slightly wider than lower, reaching beyond upper and lower borders of eye, respectively; no loreal, preocular and nasal in contact; 6/6 supralabials, sixth largest and longest, first in contact with anterior nasal, second in contact with both nasal plates; third in contact with posterior nasal, preocular, and one sixth of orbit; fourth below orbit and contacting lower postocular, fifth in contact with lower postocular and temporal, and sixth in contact with temporal; mental 1.7 (1.9, 1.7) times as broad as long; anterior chin-shields 2.1 (2.1, 2.0) times longer than wide; posterior chin-shields 2.3 (1.9, 2.0) times longer than wide; 6/6 infralabials, first pair in contact behind mental, second small, second and third touching anterior chin-shields, fourth largest and contacting anterior and posterior chin-shields, fifth and sixth contacting sublabials; first sublabial not touching chin-shields; 2 (2, 1) gulars and 2 (3, 4) preventrals at midline between posterior chin-shields and first ventral; with few tubercles on head scales, concentrated anteriorly; dorsals in 13 rows, smooth, unreduced; apical pits absent; ventrals 239 (225, 232); anal divided; preanal single; subcaudals 32 (35, 29), paired; tail complete, tip round; no anal ridges or tubercles; male with umbilical scar on ventrals 161–163.

Dentition of paratypes examined, characteristics of male followed by variation of female, in parentheses: maxillae bearing one fang 0.50 mm long (1.1 mm), arising below suture of supralabials 2 and 3, slanted backward; two posterior maxillary teeth on each side, first largest, 0.13 mm long (0.15 mm), close to each other (0.13, 0.10 mm), slanted backward, below suture of supralabials 4 and 5, first at 1 mm from base of fang (1.2 mm); 6/6 palatine teeth (7/6); 4/4 pterygoid teeth (6/5); 9/9 dentary teeth, decreasing in size from front to rear. Head glands visible through transparent head shields of young male and when reflecting head skin of female paratype (skin detached prior to our examination; characteristics of male followed by variation of female, in parentheses): salivary gland developed under supralabials 1–3; nasal gland occupying area below prefrontal shields (prefrontal shields, posterior nasal, and preocular); Harderian gland under anterolateral portion of parietal (and posterior supraocular and upper postocular), 0.68 mm long (1.00 mm), 0.60 mm wide (0.90 mm), triangular, apex caudal, with a moderate posterior extension; venom gland triangular (rounded posteriorly), corners at middle of fourth supralabial (middle of third supralabial), middle of sixth supralabial (tip of temporal), and middle of temporal at border with parietal, 0.78 mm wide (1.95 mm), 1.88 mm long (4.85 mm), not inflected ventrally and confined to head; infralabial gland bordering mouth under lateral tips of mental to fifth infralabial, area differentiated, darker and more granular under fourth infralabial; in male, salivary, nasal, Harderian and infralabial glands yellowish and of irregular texture (granular), venom gland whitish and smooth; *m. adductor mandibulae externus superficialis* (AES) forming continuous loop, from upper parietal surface above Harderian gland to insertion on compound bone; in both specimens, granular glands situated under the rostral; in female, slender gland evident under lower edge of supralabials five and six.

Hemipenes of male exposed *in situ* but not dissected or cut, single (unbifurcated), relatively smooth, reaching level of subcaudal 10; each hemipenis and associated *m. retractor penis magnus* covered in a melanic *epimysium*, asulcate layer; *m. retractor penis magnus* inserts first to vertebrae at level of subcaudal 32; *m. propulsor* also with external melanized epymisium; no spines or papillae evident through transluscent tissue (after removing the melanic sheath); subvertebral and medial hypaxial musculature in tail with melanized internal epymisial covering; cloacal scent glands oval, ending at levels of subcaudals 3 (left) and 4 (right). In female paratype, tail subvertebral and medial hypaxial musculature and associated epimysial and perimysial connective tissues melanized; external epymisial tissue covering *m. propulsor* and basal and medial section of *m. constrictor sacculi ani* melanized.

Color (Fig. 1)—Holotype in life: Dorsum of head and body Burnt Sienna (132), turning Drab-Gray (119D) towards venter; Jet Black (89) dorsal bands and blotches, those anterior finely edged with Pale Pinkish Buff (121D); Jet Black irregular diffuse reticulation on top of head and suborbital and cheek markings; dark cheek marking covering almost all sixth supralabial and continuing through lower edge of temporal and post-temporal towards black collar; eye surrounded by dark pigment; 22 primary bands on body (crossing midline or not), about 1.5–2 scales wide; five small middorsal blotches anteriorly and small diffuse and scattered blotches posteriorly; three dorsal bands on tail; scales on second dorsolateral row with dark centers; tip of tail light colored; no spots on ventral scales; venter of body to anal plate and first row of dorsal scales on tail Gem Ruby (110) red; underside of tail True Blue (168A), except for last two subcaudals which are Gem Ruby and Pearl Gray (81); 19 subcaudals blotched with Jet Black.

Holotype in preservative: Drab Gray dorsally and ventrally; head markings Warm Sepia (221A) to Sepia (119); nuchal band and dorsal body and tail bands and blotches Sepia; faint middorsal stripe Warm Sepia; dark subcaudals Jet Black.

Male paratype in preservative similar to holotype, differs in having 13 body dorsal bands, two tail dorsal bands, a Light Drab (119C) overall coloration, Dark Drab (119B) chin, Sepia (219) bands and blotches, 12 subcaudals with dark lateral coloration (tail ventrally almost immaculate), and only faint suborbital and cheek blotches.

Female paratype in preservative more similar in color and pattern to preserved holotype than to male paratype; differs from holotype in possessing 17 body dorsal bands and two tail dorsal bands.

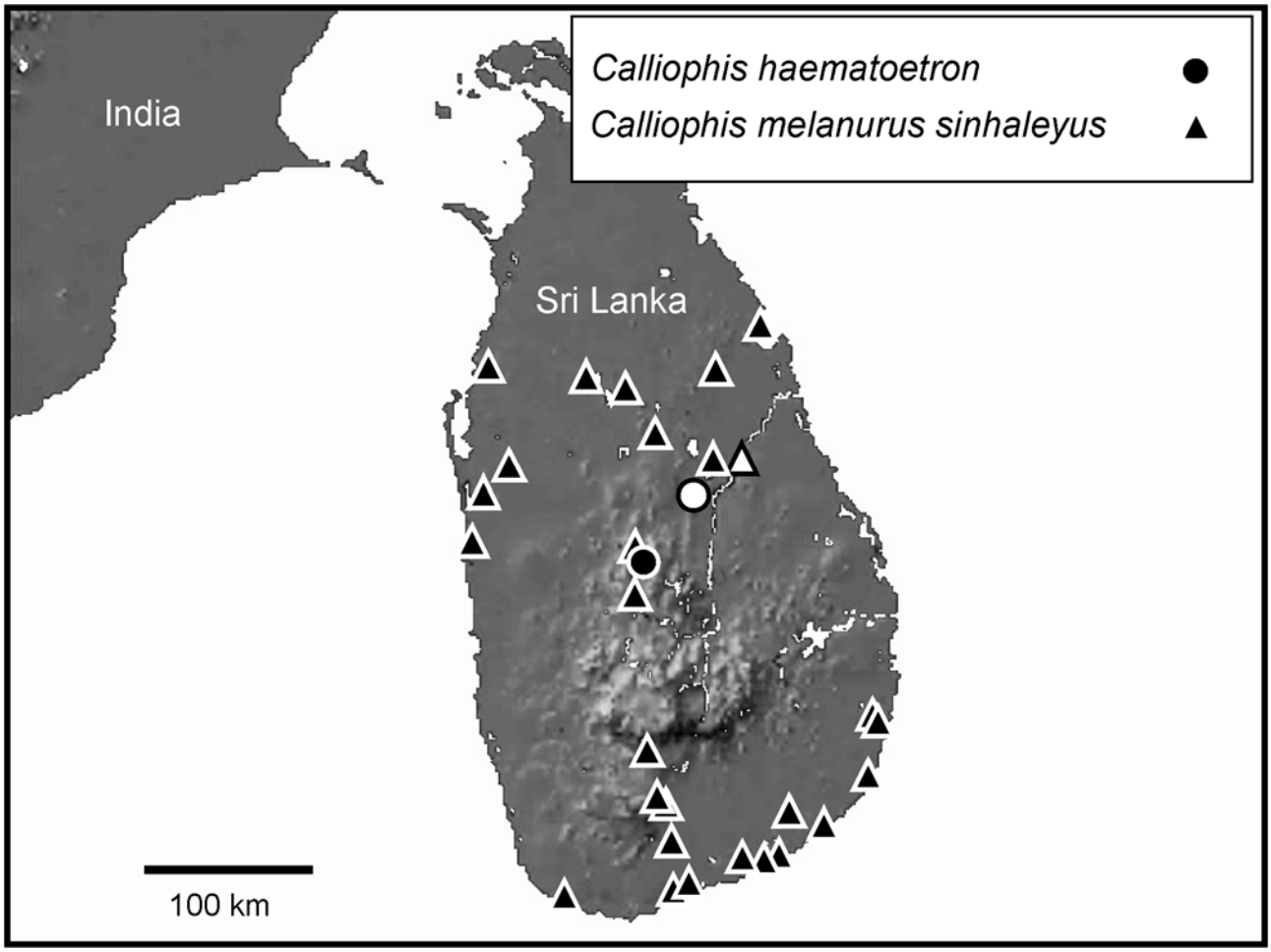

FIGURE 4. Distribution of *Calliophis haematoetron* (circles) and *Calliophis melanurus sinhaleyus* (triangles) in Sri Lanka. Type localities in white symbols. Localities for *C. melanurus* are those of material examined, unpublished localities kindly provided by Mr. L. J. Mendis Wickramasinghe, and those given by Wall (1921), Smith (1943), Deraniyagala (1951, 1955), and Das & De Silva (2005).

Habitat, distribution and natural history (Figs. 4–7)—The two known localities for *Calliophis haematoetron* lie in two different types of forest. The holotype was collected at Wasgomuwa National Park, a tropical dry (mixed) evergreen forest, whereas the paratypes from Clodagh Estate, Rattota, come from an originally tropical moist semi-evergreen forest locality. Nowadays, however, no significant forest remnants of the latter formation remain (Gunatilleke & Gunatilleke, 1990). The recorded altitudinal range of the new species is ca. 90–570 m. The moment of capture and associated defensive behavior of the holotype was described by Bahir (1999): "Running my hand under the thick layer of brown leaves on the forest floor, I uncovered a long, brown snake, almost 40 cm (rather more than a foot) long. Immediately I disturbed it, it turned the underside of its tail up displaying a stunningly spectacular blue which instinctively had me letting go. As I tried to grasp it in my hand again, it turned its belly up at me all the while keeping its head concealed and the right way up, displaying a bright red underside." Bahir (1999) also stated that "it moves with incredible stealth and speed through leaf litter." The female paratype, collected 2 July, has yolked oviductal eggs with soft shells, two anteriorly in the left oviduct (anterior 22 mm, posterior 27 mm), and one posterior, in the right oviduct (30 mm). Egg deposition presumably happens later during the month of July.

FIGURE 5. Type locality of *Calliophis haematoetron*, Wasgomuwa National Park, Central Province, Sri Lanka, ca. 90 m showing leaf litter being searched by scientists of WHT, the activity that led to the collection of the new species by Mohomed M. Bahir and Sampath Nanayakkara on 7 June 1997. Photo courtesy of WHT (UTA Image-1929).

FIGURE 6. Locality in Rattota, Matale, Central Province, Sri Lanka, near locality of *Calliophis haematoetron* paratype showing recent vegetation in the area, hills and rock cliffs. Photo by R. Somaweera.

FIGURE 7. Tea plantation and current levels of deforestation at Rattota, Matale, Central Province, Sri Lanka, near locality of *Calliophis haematoetron* paratype. Photo by R. Somaweera.

Endoparasite (Fig. 8)—The adult female paratype contained a single encysted nematode in the abdominal cavity; this larval individual endoparasite appears to belong to the family Spiruridae, a member of the superfamily Dracunculoidea Cameron, 1934. It possesses a long and relatively thin body, a rounded cephalic end with a cuticular shield and cephalic papillae, a reduced buccal capsule, an esophagus consisting of short muscular and long glandular parts, and an intestine that is straight and tubular (Skryabin 1984). Numerous species of Spiruridae infect the mesentery, coelomic cavity, and blood vessels of snakes. This nematode could not be assigned to a lower taxonomic rank because it is in a larval stage and diagnostic features have not yet developed. The specific identity of this Spiruridae found in *Calliophis haematoetron* remains to be corroborated.

Relationships—*Calliophis haematoetron* is probably closely related to the lowland *Calliophis* with blue tail venters namely, *C. melanurus* from India and Sri Lanka and *C. maculiceps* from southern Myanmar, Thailand, Cambodia, and northern peninsular Malaysia. These species share melanized musculature and tissues at the base of the tail, blotching in some of the subcaudals, tail bands (usually two), and a body venter with red or orange, particularly towards the anal plate.

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FIGURE 8. Larval nematode (Spiruridae) found encysted in abdominal cavity of female paratype *Calliophis haematoetron*. A. Anterior end and buccal area. B. Terminal spine. C. Body.

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Appendix

Specimens Examined

Calliophis beddomei (4) – INDIA: ***Karnataka***: Chikmagalur: Koppa, Mysore, ZSI (Calcutta) 13559; ***Tamil Nadu***: Nilgiris, Nilgherries, CAS 17266; Salem: Shevaroys, CAS 17262; Salem: Shevaroys, 4000 ft, BMNH 1946.1.17.99.

Calliophis bibroni (10) – INDIA: ***Karnataka***: Kodagu: Coorg, BNHS 2119, BMNH 1937.4.3.15; ***Kerala***: Kannur: Thottada, ZSI (Calicut) 18-viii-1996; Kasaragod: Cherupuzha, ZSI (Calicut) 12-vi-1996; Wayanad: Wynad, BMNH 1922.5.25.58, 72.1.2.7; 3000 ft, BMNH 1946.1.17.93; ***South India***: Unknown, ZSI (Calcutta) 11376; ***Tamil Nadu***: Nilgiris: Mudumallays, BMNH 74.4.29.51, BMNH 74.4.29.53.

Calliophis bivirgatus (13) – INDONESIA: ***Kalimantan Tengah***: Boentok, C. Borneo [Buntok], BMNH 1910.1.12.18; ***Kalimantan Timur***: Balakpappan [Balikpapan], Dutch Borneo, BMNH 1912.6.26.23; ***Sumatera Utara***: Sumatra: Deli [Delitua], BMNH 89.12.26.14; MALAYSIA: ***Johor***: Gunong, Pulai, Johore [Gunung Pulai], BMNH 97.12.28.27; Johore Bahru, W Malaysia [Johor Baharu], BMNH 97.12.28.57; ***Kedah***: Kedah, Malaya, BMNH 95.10.7.23; ***Kelantan***: Kelantan N.E. W Malaysia, BMNH 1912.2.22.25–27; ***Perak***: Sungkai, BMNH 1969.334; ***Sabah***: Bongon, N. Borneo: (6 33': 116 58 Sabah), BMNH 93.5.30.13; SINGAPORE, BMNH 1930.12.2.12–13.

Calliophis gracilis (7) – INDONESIA: ***Aceh*****:** Paru (= Parue, Paroee) [original: Moluccas: Ceram: "Piroe (=Piru)"], USNM 103517; MALAYSIA: ***Johor***: Johore [Johor Baharu], ZSI (Calcutta) 13323; ***Pulau Pinang***: Pinang [Georgetown], BMNH 1946.1.19.17, BMNH 60.3.19.1255 (2 specimens); ***Selangor***: Batang Padang, Malaya [Batang Berjuntai], BMNH 1903.4.13.96; SINGAPORE: (Bangkok) Singapore, BMNH 98.4.2.27.

Calliophis haematoetron (3) – See species description.

Calliophis intestinalis (42) – INDONESIA: ***Jawa Timur***: Willis Mk, Kediri, Java: 5000 ft, BMNH 85.12.31.30; ***Kalimantan Barat***: Sintang, Borneo, BMNH 1946.1.17.96; ***Kalimantan Selatan***: Tandjong, S.E. Borneo [Tanjung], BMNH 96.2.17.14; ***Sulawesi Utara***: Manado, Celebes, BMNH 71.7.20.205; ***Sumatera Barat***: Fort de Kok [Kock], W. Sumatra, BMNH 1928.2.18.45; ***Sumatera Utara***: Nias: Unknown, BMNH 84.12.31.10; MALAYSIA: ***Johore***: Gungong [Gunong] Pulai, S. Johore, BMNH 1971.1521; Gunong Pulai catchment area, S. Johore, 300 ft., BMNH 1971.793; ***Kelantan***: Kelantan, Malaya, BMNH 1905.2.7.12, 1911.6.29.6–8; ***Kuala Lumpur Federal Territory***: Kuala Lumpur, Selangar, BMNH 98.9.22.59; ***Negeri Sembilan***: Repoh Est., Negri Sembilan, Malaya [Tampin], BMNH 1931.5.14.10–11; ***Pahang***: Pahang, Malaya: 400 ft, BMNH 1936.6.10.6; ***Perak***: Batang, Padang [Daerah Batang Padang], BMNH 1903.4.13.93; ***Pulau Pinang***: Pinang [Georgetown], BMNH 1946.1.18.2, 60.3.19.1270; Prov. Wellesley [Seberang Perai], Malaya, BMNH 96.6.25.30–31; ***Sabah***: Kina Balu, N. Borneo, BMNH 95.11.7.30–31; ***Sarawak***: Matang, BMNH 72.2.19.48; Mt. Dulit, BMNH 91.8.29.32 (2); PHILIPPINES: ***Unknown***, BMNH 1946.1.19.22; ***Mindanao***, BMNH 72.8.20.55–56; ***Southern Tagalog***: Palawan: Balabac, BMNH 1894.6.30.59; Palawan: Puerto Princesa, Palawan, BMNH 79.4.16.13; SINGAPORE: ***Singapore***, BMNH 80.9.10.15–17, 94.6.25.12, 95.1.8.10; THAILAND: ***Nakhon Si Thammarat***: N. Sritamarat [Nakhon Si Thammarat], S. Thailand, BMNH 1968.831; ***Pattani***: Bukit Besar, Malaya [Sai Kao Waterfall], BMNH 1903.4.13.94; UNKNOWN, BMNH 56.12.26, 72.2.19.48, 89.11.8.3; VIET NAM: ***Lang Son***: Mam-Son Mts. Tonkin: 3-4000 ft [Mau Son Mts], BMNH 1903.7.2.25.

Calliophis maculiceps (38) – MYANMAR: ***Mon***: Moulmein, BNHS 2177; ***Tanintharyi***: Amherst, Tenasserim [Tanintharyi], ZSI (Calcutta) 2940; ***Yangoon***: Rangoon, BNHS 68.4.3.33, 2175–76, ZSI (Calcutta) 2937, 2939, ZSI (Calcutta) 2948; THAILAND: ***Chiang Mai***: Amphoe [District] Mae Wang: N. Siam, Me Wang Forest [Mae Wang Forest], BMNH 1938.8.7.57; Chiengmai (Chiang Mai), USNM 101519; ***Chon Buri*****:** Gulf of Siam: Koh-Si-Chang [Ko Si Chang], BMNH 1938.8.7.45; Hup Bon [Hup Baun], BMNH 1968.827–29 1974.5195; Nong Khor [Ban Nong Kho], USNM 70331; Nong Khor, Siam [Ban Nong Kho], BMNH 1968.821; Sriracha [Si Racha], BMNH 1968.822; ***Chumphon***: Lang Suan, BMNH 1968.823; ***Kanchanaburi***: Kamburi [Kanchanaburi] BMNH 1914.1.27.2; Sai Yok Camp: BMNH 1987.1152; ***Krung Thep Mahanakhon***: Bangkok, BNHS 2174; Bangkok, Siam, BNHS 2174 (2) [260-2]; ***Lop Buri***: Lopburi [Lop Buri], BMNH 1914.1.27.3; ***Nakhon Si Thammarat***: Khao Ronpilun [Khao Ron Phibun], 1000 ft, BMNH 1974.5196; ***No other data***, BMNH 58.4.20.6, type; ***Nong Bua Lamphu***: Nong Kai Ploi, Thailand, BMNH 1946.1.17.81 (1937.2.1.23); ***Phrae***: Prae, Siam [Phrae], BMNH 1968.824; ***Phuket***: Phuket Town (suburbs), Phuket Island, S. Thailand, BMNH 1976.22.82; ***S. Thailand***, BMNH 1987.1153; ***S.W. Siam***, BMNH 1968.825–26; ***Siam***, BMNH 1968.820; ***Nakhon Nayok***: Umper Sarika water fall, BMNH 1987.1154; VIET NAM: ***Cochin China***: No other data, BMNH 1920.1.20.269 (2), 85.3.3.10; ***Ho Chi Minh City***: French Cochin China, Saigon [Thành Pho Ho Chí Minh], BMNH 1938.8.7.58.

Calliophis melanurus melanurus (16) – INDIA: ***Andhra Pradesh***: Putlegudem Village, Nagarjumakonda valley: Alt: 360–370', Lat: 16deg, 29minN, Long 79deg, 14minE, ZSI (Calcutta) 21460; ***West Bengal*** [?]: Bengal, Nerva, BMNH 1946.1.17.86; ***Karnataka***: Dharwad: Dharwar: Gadag, BNHS 2171; ***Maharashtra***: Dhulia: [Dhule], BNHS 2173; Mumbai: J.J. Hospital ground, Bombay city, BNHS 2172; Nasik: Deolali, Bombay, BNHS 2170; Pune: Pune, BNHS No Number (1–2); Ratnagiri, BNHS No Number (3); ***Tamil Nadu***: Anamallies: [Anaimalai], BMNH

74.4.29.44–45; Chennai: Madras, MAD 1948/10; Kanchipuram: Chingleput, MAD No Number; Tiruchchirappalli: Trichinopoly [Tiruchchirappalli], BMNH 82.8.26.1; Unknown, MSP No Number, ***Unknown***: Unknown, BMNH 52.10.4.60.

Calliophis melanurus sinhaleyus (6) – SRI LANKA: *North Central Province*: Anuradhapura, BMNH 1915.5.3.12; *Sabaragamuwa Province*: Balangoda: S. Sri Lanka, BMNH 1937.8.1.3; *Southern Province*: Between Thangalla and Kahandamodara: Diyawaragama, To be deposited at NMSL (3); Hambanthota District: Between Sooriyawewa and Mirijjawela, To be deposited at NMSL (1–2); Kirinda, WHT 1753.

Calliophis nigrescens (36) – INDIA: ***Karnataka***: Chickmagalur: Banakal [Kannada], BNHS 3157; ***Kerala***: Ernakulam: Cochin Hills, West India, USNM 42467; Unknown: N. Travancore Hills, BMNH 72.1.2.8; Unknown: Punakanaad, Travancore, BMNH 1924.10.13.24; Wayanad: Nilgiri, Wynad, BMNH 1955.1.3.63–65; Wayanad: Wynad, BMNH 74.4.29.48, 82.8.26.2–3, 82.8.26.7; ***Maharashtra***: Pune: Bhimashankar, BNHS 3181; Satara: Mahabaleshwar, BNHS 2192, BNHS 2754; Satara: Mahableshwar, Pauchgari, Bombay , BMNH 1937.3.1.4–5; Satara: Panchgani, BNHS 2193; Sindhudurg: Amboli [Village], BNHS 3348; ***Tamil Nadu***: Coimbatore: Anamallays: 4700 ft, BMNH 85.3.21.10, 88.1.27.62, BMNH 88.1.27.63; Coimbatore: Anamallays: 4701 ft, BMNH 85.3.21.11; Coimbatore: Anamallays, BMNH 82.8.26.4–6, 1955.1.3.66–68; INDIA: Tamil Nadu: Nilgiris: Kotagiri, Nilgherries, BMNH 91.11.27.11; Nilgiris: Nilgherries, BMNH 68.4.3.32 (2 specimens), 74.4.29.40; Nilgiris: Nilgherries: 6000 ft, BMNH 64.3.9.7; Tirunelveli: Tinnevelly Hills, BMNH 74.4.29.239, 74.4.29.47; ***Unknown***: BMNH 1946.1.17.78.

Hemibungarus calligaster (6) – PHILIPPINES: Albay, S.E. Luzon, BMNH 95.1.11.9; ***Unknown***: BMNH 72.10.11.13, 72.10.11.14, 72.10.11.18, R.R.; ***Negros Oriental***: N.E. Slope Cuernos de Negros, 2600 ft, BMNH 1964.664.

Sinomicrurus japonicus (11) – JAPAN: ***Kagoshima***: Anami-Oshima [Amami O Shima], BMNH 1906.8.16.16–19; Oo Sima [Amami O Shima], BMNH 95.9.9.2–3; Nagasaki [?] [Amami O Shima], BMNH 1946.1.17.97 [Holotype]; ***Okinawa***: Great Loo Choo [Okinawa Shima], BMNH 92.9.3.14; Okinawa [Okinawa Shima], BMNH 1906.8.16. 12–14.

Sinomicrurus kellogi (1) – CHINA: ***Fujian***: Kuatun, NW Yokien, BMNH 99.4.24.58.

Sinomicrurus macclellandi (54) – CHINA: ***Hainan***: Nodoa [Nadou], BMNH 1913.9.3.9; ***Hong Kong***: Hong Kong Museum, ZSI (Calcutta) 12698; May road/ Peak district & Tai Moshan N.T. 865 m (approx.), BMNH 1983.267–69; Pok Fulam y Pok Fulam reservoir road, BMNH 1983.265–66; ***Jiangxi***: Mts. N of Kiu Kiang [Jiujiang Shi], BMNH 88.1.30.66; ***South China***, BMNH 1948.1.18.3; INDIA: ***Arunachal Pradesh***: No other data, BNHS 3099; ***Assam***: Jaipur, Assam, BMNH 1908.6.23.92, BNHS 2211; Margherita, near Ledo, USNM 118038; ***Himachal Pradesh***: Kasauli, Punjab, BMNH 1948.1.7.7; Kasuli [Kasauli], Punjab, BMNH 1946.1.17.82; ***Meghalaya***: East Khasi Hills: Shillong, Khasi Hills, BMNH 1907.12.16.22–23; West Garo Hills: Tura Garo Hills, Assam [Tura], BMNH 1937.4.3.16; ***Unknown***: Assam, BMNH 67.7.22.2, ZSI (Calcutta) 2933; ***West Bengal***: Darjeeling, BMNH 1940.3.4.42, 91.9.11.24; Darjeeling: Mungpoo, W. Darjeeling, BMNH 1920.7.7.1; MYANMAR: ***Bago***: Pegu [Pegu Yoma], BMNH 68.4.3.34–36; Pegu Hills [Pegu Yoma], BMNH 1908.6.23.93; ***Kachin***: Hutong, Bhamo [not Maymyo] District, Upper Burma [Hutung], BMNH 1925.12.22.6; Hutong, Bhamo District, Upper Burma [Hutung], BMNH 1946.1.19.8–9; Myitkyina: 25 23 00 N 97 24 00 E, USNM 122200; ***Mandalay***: Maymo, Burma, BMNH 1926.3.17.5–7, 1975.459, BNHS 2194, 2200; Maymyo, Upper Burma, BNHS 2204; Mogok, Upper Burma [Magok], BMNH 1901.4.26.5 [1907.4.26.5 on label]; ***Unknown***: Burma, BMNH 1908.6.23.91, ZSI (Calcutta) 18707; NEPAL: ***Bagmati***: Katmandu, ZSI (Calcutta) 8771; ***Nepal***, BMNH 1946.1.17.84, 1946.1.17.90; TAIWAN: Formosa, BMNH 66.6.8.72; UNKNOWN, BMNH 1946.1.17.82, 1946.1.17.90, 66.6.8.72, 67.7.22.2, 80.11.10.143 (2), ZSI (Calcutta) No number; VIETNAM: ***Bac Khan***: Bac-Kan, Tonkin, BMNH 1928.10.26.25; ***Cao Bang***: Cao Bang, Upper Tonkin, BMNH 96.4.21.4.