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Author(s): Thomas Ziegler, Nguyen Van Sang, Nguyen Quang Truong

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A New Reed Snake of the Genus *Calamaria* Boie (Squamata: Colubridae) from Vietnam

THOMAS ZIEGLER^{1*}, NGUYEN VAN SANG², AND NGUYEN QUANG TRUONG^{2,3}

¹ Cologne Zoo, Riehler Straße 173, D-50735 Köln, GERMANY

² Institute of Ecology and Biological Resources, Vietnamese Academy of Science and Technology, 18 Hoang Quoc Viet St., Hanoi, VIETNAM

³ Zoologisches Forschungsmuseum Alexander Koenig, Adenauerallee 160, D-53113 Bonn, GERMANY

Abstract: We describe a new species of *Calamaria* Boie on the basis of a single specimen collected in broadleaved evergreen forest from Gia Lai Province, Central Vietnam. This is a large species (total length of the unique male 457 mm) characterized by rostral wider than high, with portion visible from above more than half of prefrontal suture; paraparietal surrounded by five shields and scales; presence of preocular; four supralabials, of which second and third entering orbit; modified maxillary teeth; five infralabials, of which first three are in contact with anterior chin shield; mental touching anterior chin shields; 3+191 ventrals, single anal scale; 23 divided subcaudal scales; tail relatively short, as thick as body, not tapering, with rounded end (8.1% of the total length); dorsum light greyish brown, with an indistinct dark neck collar and few dark blotches along posterior vertebral region; two pairs of light blotches on tail; venter yellowish beige, with dark outermost corners in each of ventrals and anterior subcaudals. A key to the Vietnamese and Chinese species of *Calamaria* is provided. *Calamaria gialaiensis* sp. nov. is the sixth species of *Calamaria* recorded from Vietnam.

Key words: Serpentes; *Calamaria*; Taxonomy; Gia Lai Province; Vietnam

INTRODUCTION

Reed snakes of the genus *Calamaria* Boie are burrowing, forest-dwelling snakes, and are distributed from eastern China and the Ryukyu Islands in the north, through Vietnam, Laos, Cambodia, Thailand, Malay Peninsula and Myanmar in the west, and southward to Sulawesi, Seram and the Philippines. Inger

and Marx (1965) argued that the Greater Sunda Islands housed more than 60% of the *Calamaria* species and was most probably the principal centre of evolution and dispersal of the genus. Inger and Marx (1965) recognized a total of 50 species, and only a few species have been described since then (Grismer et al., 2004; Ziegler and Le, 2005; Howard and Gillespie, 2007). From Vietnam, the following five species are reported: *C. buchi* Marx and Inger; *C. lovii* Boulenger, with the subspecies *C. lovii inger-marxorum* Darevsky and Orlov (new name combination following Michels and Bauer,

* Corresponding author. Tel: +49-221-7785104;
Fax: +49-221-7785111;
E-mail address: ziegler@koelnerzoo.de

2004); *C. pavimentata* Duméril and Bibron; *C. septentrionalis* Boulenger; and *C. thanhi* Ziegler and Le (Darevsky and Orlov, 1992; Nguyen and Ho, 1996; Nguyen et al., 2005; Ziegler and Le, 2005; Ziegler et al., 2007).

In the framework of recent investigations in the herpetological collection of the Institute of Ecology and Biological Resources in Hanoi, one snake collected nearly a decade ago in the broad-leaved evergreen forest of Gia Lai Province in central Vietnam, came to an attention of the senior author. With its dorsal scales in 13 rows throughout body, internasals and prefrontals fused, and the parietal being broadly in contact with the supralabials, the specimen obviously belonged to the genus *Calamaria* (Inger and Marx, 1965).

Because of its apparent resemblance with *C. septentrionalis*, a species already recorded from numerous localities in Vietnam (see Ziegler and Le, 2005; Nguyen et al., 2005), the specimen was listed as of this species in the technical report by Le et al. (2000). By detailed comparisons, however, we noticed distinct differences in body size, scalation, and colour pattern between the present specimen and specimens representing *C. septentrionalis*. This, along with Inger and Marx (1965) statement that *C. septentrionalis* is a remarkably uniform species, not showing such amount variation in ventral and subcaudal counts as usual in other reed snakes, led us to the conclusion that another species must actually be involved. The specimen also differed from the other *Calamaria* species so far known from Vietnam, as well as from the adjacent countries (e.g., Inger and Marx, 1965; Zhao and Adler, 1993; Grismer et al., 2004; Howard and Gillespie, 2007). Thus, we herein describe this *Calamaria* as a new species.

MATERIALS AND METHODS

The unique holotype deposited in the Institute of Ecology and Biological Resources (IEBR), Vietnamese Academy of Science and Technology, Hanoi, Vietnam, was examined in the ethanol-preserved state. Methods and

comparisons follow Inger and Marx (1965), Darevsky and Orlov (1992), and Ziegler and Le (2005). External characters including scale counts were examined using a stereo dissecting microscope. Measurements, other than body and tail lengths, were taken with a slide-calliper to the nearest 0.1 mm. Body and tail length were taken by measuring tape to the nearest 1 mm. Ventral scales were counted following Dowling (1951).

RESULTS

Calamaria gialaiensis sp. nov. (Figs. 1–2)

Holotype

Adult male, IEBR A.0714, Kon Ka Kinh, K Bang District, Gia Lai Province, Vietnam, 1,300 m asl, Nguyen Van Sang, April 1999.

Diagnosis

This new species is distinguished from congeneric species in having the following combination of characters: 1) rostral wider than high, portion visible from above more than half of prefrontal suture; 2) paraparietal surrounded by five shields and scales; 3) eye diameter larger than eye-mouth distance; 4) preocular present; 5) supralabials four, second and third entering orbit; 6) maxillary teeth modified; 7) infralabials five, first three touching anterior chin shield; 8) mental touching anterior chin shields; anterior shields meeting in midline; posterior chin shields diverging, only touching anteriorly; 9) 3+191 ventrals; 23 divided subcaudal scales; 10) single anal plate; 11) tail relatively short, as thick as body, not tapering, with rounded end (8.1% of the total length); 12) dorsum light greyish brown with indistinct dark neck collar and few dark blotches along vertebral region before cloaca; with two pairs of light blotches and a yellow ring around tip in tail; outermost dorsal scale rows yellow with dark dorsal corners; 13) venter yellowish beige, with dark outermost corners in each of ventrals and anterior subcaudals; 14) body relatively large, total

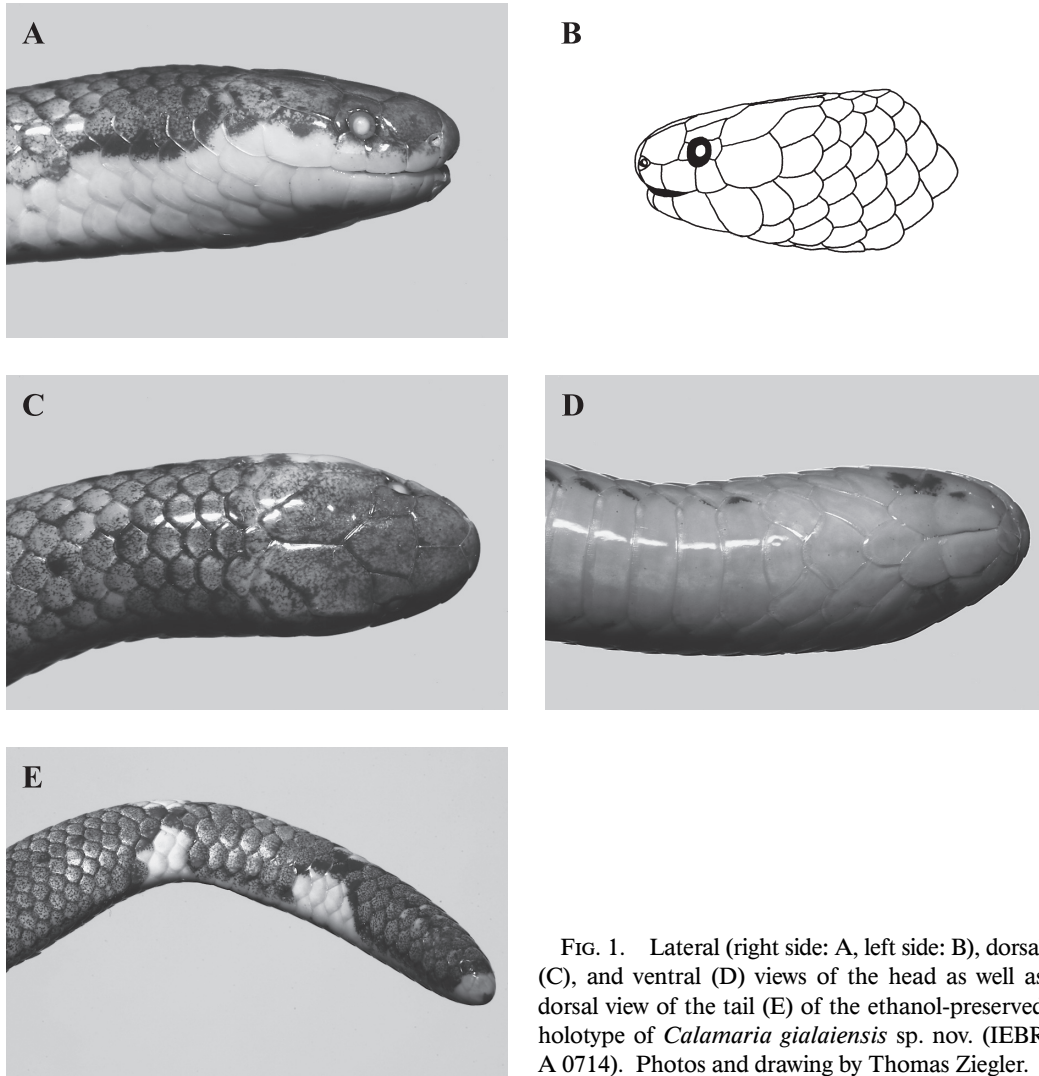


FIG. 1. Lateral (right side: A, left side: B), dorsal (C), and ventral (D) views of the head as well as dorsal view of the tail (E) of the ethanol-preserved holotype of *Calamaria gialaiensis* sp. nov. (IEBR A 0714). Photos and drawing by Thomas Ziegler.

length of the unique male 457 mm.

Description of holotype

Habitus vermiform, head indistinct from neck. Rostral slightly wider than high, portion visible from above more than half of prefrontal suture. Prefrontal shorter than frontal, separated from orbit, touching first two supralabials. Frontal pentagonal, about two times as broad as supraocular. Paraparietal surrounded by five shields and scales. Preocular present, small. Postocular single,

higher than wide, not as high as eye diameter. Eye diameter slightly larger than eye-mouth distance. Pupil rounded. Supralabials four, first longer than third, second and third entering orbit, fourth longest. Mental semicircular to triangular, touching anterior chin shields. Infralabials five, first three touching anterior chin shield. Anterior chin shields meeting in midline, posterior chin shields diverging and only touching anteriorly. Three preventrals in midline between posterior chin shields and first ventral. Ventral scales 191,

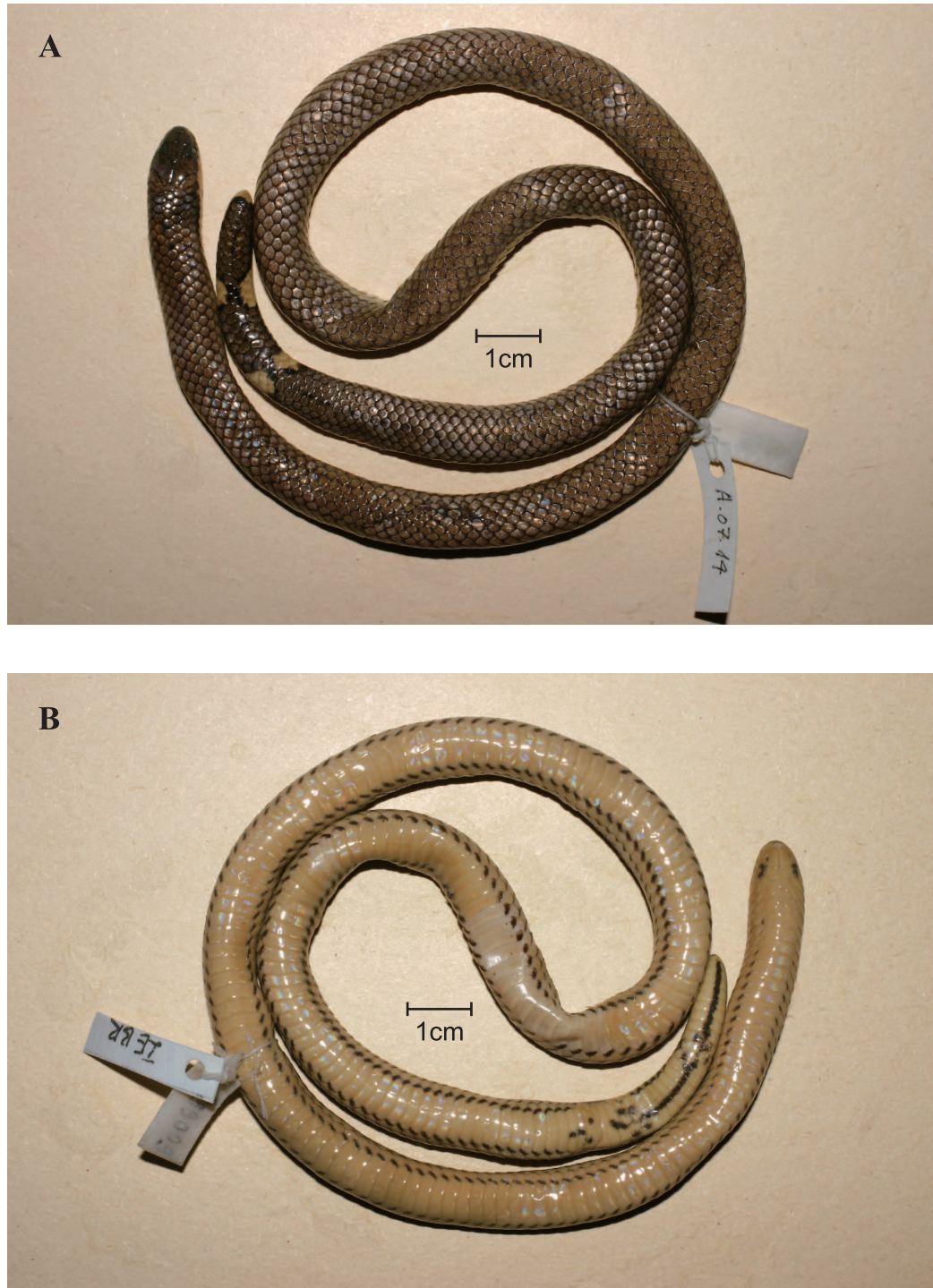


FIG. 2. Dorsal (A) and ventral (B) views of the ethanol-preserved holotype of *Calamaria gialaiensis* sp. nov. (IEBR A 0714). Photos by Thomas Ziegler.

and subcaudals 23, divided, followed by a shield covering tail tip. Anal scale single. Dorsal scales in 13 rows throughout body, reducing to six rows above fourth subcaudal, to five rows above 22nd subcaudal, and to four rows above last subcaudal on tail. Tail not tapering, with rounded end.

Snout-vent length 420 mm, tail length 37 mm, eye diameter 1.4 mm, distances from anterior corner of eye to centre of nostril 2.8 mm, to tip of snout 4.0 mm. Body height about 8 mm, height of tail at base 7 mm. Nine modified maxillary teeth.

Color in preservative

Color in ethanol light greyish brown above, somewhat iridescent. Ventral side yellowish beige. Upper parts of supralabials dark greyish brown like dorsal side of head, lower parts yellowish beige like ventral side. Rostral grey, lighter in lower part. Dorsal scales of body with fine dark mottling. A few dark spots on vertebral scales in nuchal region, a series of dark vertebral spots on posterior body before cloaca. Nuchal region with indistinct dark collar of approximately four scales width. Two outermost body scale rows yellowish beige like ventral side. Dorsum of tail with a pair of large yellow blotches immediately behind cloaca and at middle portion, these blotches fused with yellow region on ventral side and bordered by wholly or partially brownish black scales. Distal portion of tail also yellowish, bordered by wholly or partially dark scales, with almost discernible tiny black dot on tip. Outermost edges of ventrals black, like dorsal margins of dorsal scales in two outermost rows. Underside of head with brownish markings on anterior chin shields and base of third and fourth infralabials. Last two ventrals and anal scale with few dark blotches. A dark longitudinal line on ventral side of tail, subcaudals at position of light dorsal blotches with a few dark blotches.

Comparisons

Diagnostic characters, which separate *Calamaria gialaiensis* sp. nov. from the

remaining Vietnamese *Calamaria* are summarized in Table 1. The dorsal colour pattern readily distinguishes *Calamaria gialaiensis* sp. nov. from most other species known to occur in Vietnam: *C. buchi* has a blackish dorsum, with a few light spots on each dorsal scale; *C. pavimentata* usually has narrow, dark, longitudinal stripes on the dorsum; *C. septentrionalis* is dark brown or black above, and usually has a narrow yellow ring in the region about six to eight scales length behind head; *C. lovii ingermarxorum* has an immaculate grey-bluish dorsum with light spots covering four scales on each side of the neck; and *C. thanhi* has a dark dorsum with distinct transverse light body bands (Inger and Marx, 1965; Darevsky and Orlov, 1992; Ziegler and Le, 2005; Ziegler et al., 2007). Furthermore, *Calamaria gialaiensis* sp. nov. is distinguishable from all other Vietnamese species of *Calamaria* by having dorsal scales reducing to four rows above the last subcaudal (dorsal scales reducing to four rows above 3rd-4th subcaudal in *C. buchi*, above 1st-13th in *C. pavimentata*, above 1st-5th subcaudal in *C. lovii ingermarxorum*, and not reducing to four rows on tail in *C. septentrionalis* and *C. thanhi*). *Calamaria gialaiensis* sp. nov. differs from *C. lovii ingermarxorum* and *C. thanhi* by having preocular (absent in *C. lovii ingermarxorum* and *C. thanhi*); parapariental surrounded by fewer shields and scales (five versus six in *C. lovii ingermarxorum* and six to seven in *C. thanhi*); difference of ratio of tail length to total length in males (8.1% versus 7.4% and 9.9%, respectively). *Calamaria gialaiensis* sp. nov. differs from *C. buchi*, *C. pavimentata* and *C. septentrionalis* by having posterior chin shields diverging and meeting only anteriorly (posterior chin shields meeting in midline in latter species). *Calamaria gialaiensis* sp. nov. further differs from *C. pavimentata* and *C. septentrionalis* by having mental touching anterior chin shields (mental separated from anterior chin shields in *C. septentrionalis* and usually also in *C. pavimentata*). *Calamaria gialaiensis* sp. nov. differs from *C. buchi* by having rostral wider

TABLE 1. Diagnostic characters of Vietnamese *Calamaria* (after Inger and Marx, 1965; Darevsky and Orlov, 1992; Ziegler and Le, 2005; and Ziegler et al., 2007). M=male, F=female. *Character not obtainable from literature.

| <i>C. gialaiensis</i> sp. nov. | |
|---|----------------|
| Scalation | |
| Rostral | H < W |
| Portion visible from above in comparison with length of prefrontal suture | > 1/2 |
| Length of prefrontal in comparison with the length of frontal | < |
| Number of shields and scales surrounding paraparietal | 5 |
| Nasal in comparison with postocular | ≤ |
| Preocular: present (1) or absent (0) | 1 |
| Eye diameter in comparison with eye-mouth distance | > |
| Mental touching (1) or separated from (0) anterior chin shields | 1 |
| Posterior chin shields meeting in midline (1), diverging or meeting only in anteriorly (0) | 0 |
| Tail: tapering (2), slightly tapered (1), or not (0) | 0 |
| End of tail | rounded |
| Dorsal scales reducing to four rows above position of subcaudal on tail | last subcaudal |
| Maxillary teeth (modified=m) | 9 (m) |
| Ventrals | 3+191 (M) |
| Subcaudals | 23 (M) |
| Total length (in mm) | 457 (M) |
| Ratio of tail length to total length (%) | 8.1 (M) |
| Coloration | |
| Dorsum | greyish brown |
| Dorsal scale with light spots: present (1), or absent (0) | 0 |
| Dark collar in nuchal region: distinct (1) or indistinct (0) | 0 |
| Yellow ring or blotches behind head: present (1), or absent (0) | 0 |
| Transverse light body bands on dorsum: present (1), or absent (0) | 0 |
| Light spots on each dorsal scale: present (1), or absent (0) | 0 |
| Yellow ring around tip in tail: present (1), or absent (0) | 1 |
| Outermost dorsal scale rows | yellow |
| Venter of body | yellow |
| Underside of tail: dark longitudinal line (2), dark scattered spots/flecks (1), or absent (0) | 2 |
| Ventral scale with dark outermost corners: present (1), or absent (0) | 1 |

| <i>C. buchi</i> | <i>C. pavimentata</i> | <i>C. septentrionalis</i> | <i>C. loyii ingermaxorum</i> | <i>C. thanhi</i> |
|-----------------------------------|--|--------------------------------------|----------------------------------|---|
| H>W | H≥W | H<W | H<W | H<W |
| >1/2 | 1/2–1 | <1/3 | >1/2 | >1/2 |
| ≤ | ≤ | < | > | < |
| 5 | 5–6 | 6 | 6 | 6–7 |
| ≥ | ≤ | ≤ | < | < |
| 1 | 1 | 1 | 0 | 0 |
| ≤ | ≥ | ≥ | * | > |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 | 0 |
| 1 | 2 | 0 | 0 | 2 |
| obtuse point 3rd–4th subcaudal | gradually to a point 1st–13rd subcaudal | rounded not reducing to 4 rows | blunt 1st–5th subcaudal | gradually to a point not reducing to 4 rows |
| 9 (m) | 8–10 (m) | 8–9 (m) | 8 (m) | 9 (m) |
| 221–236 (F) | 125–168 (M) 137–206 (F) | 148–166 (M) 168–188 (F) | 205 (M) | 184 (M) 198 (F) |
| 13–14 (F) | 13–33 (M) 8–20 (F) | 15–19 (M) 6–11 (F) | 23 (M) | 28 (M) 21 (F) |
| 389–466 (F) | 84–313 (M) 115–485 (F) | 111–344 (M) 117–384 (F) | 318 (M) | 461 (M) 455 (F) |
| 3.9–4.1 (F) | 6.9–16.9 (M) 3.7–8.5 (F) | 6.3–8.6 (M) 2.6–4.3 (F) | 7.4 (M) | 9.9 (M) 6.8 (F) |
| black | brown | dark brown or black | grayish blue | dark blue to grey |
| 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 0 | 0 | 0 | 0 | 1 |
| 1 | * | 1 | 0 | * |
| 0 | 1 or 0 | 1 | 0 | 1 |
| yellow | dark line | yellow | * | yellow |
| yellow | yellow | yellow | dark gray | yellow |
| 1 | 2 or 0 | 2 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 |

than high (rostral higher than wide in *C. buchi*); and tail not tapering, with rounded end (tail tapering, ending in obtuse point in *C. buchi*).

Calamaria gialaiensis sp. nov. differs from the male holotype of the Chinese species *C. yunnanensis* Chernov, that was judged as doubtful form by Inger and Marx (1965), but listed as valid by Yang and Inger (1986) or Zhao and Adler (1993), in having a preocular, 3 preventrals+191 ventrals versus 173 ventrals, 23 versus 20 subcaudals, and by the presence of light spots on the side of the tail, as well as the absence of narrow, dark, elongated stripes along the body. A key to the species of *Calamaria* from China and Vietnam is presented below.

Key to the species of *Calamaria* known from China and Vietnam (after Inger and Marx, 1965; Darevsky and Orlov, 1992; Ziegler and Le, 2005; and Ziegler et al., 2007)

- 1a Preocular absent2
- 1b Preocular present4
- 2a Dark dorsal stripes on body; males with 173 ventrals; 20 subcaudals; tail length 8.2% of total length.....*C. yunnanensis*
- 2b No dorsal stripes on body; males with 184–205 ventrals; 23–28 subcaudals; tail length 7.4–9.9% of total length3
- 3a Dorsum immaculate bluish grey, with light spots covering four scales on each side of the neck; 205 ventrals; 23 subcaudals; tail not tapering, with the length 7.4% of total length; prefrontal as long as or longer than frontal; mental touching anterior chin shields*C. lovii ingermarxorum*
- 3b Dorsum dark, with 4–6 light body bands; 184 ventrals; 28 subcaudals; tail tapering, with the length 9.9% of total length; prefrontal shorter than frontal; mental not touching anterior chin shields..... *C. thanhi*
- 4a Tail tapering, ending in obtuse or sharp point5
- 4b Tail not tapering, with rounded end.....6
- 5a Dorsum usually with narrow, dark,

longitudinal stripes, and with solid black collar immediately behind neck; tail ending in sharp point; mental usually not touching anterior chin shields; less than 206 ventrals.....*C. pavimentata*

- 5b Dorsum blackish, lacking stripes and collar, each dorsal scale with small light spots; tail ending in obtuse point; mental touching anterior chin shields; 221–236 ventrals..... *C. buchi*
- 6a Portion of rostral visible from above less than 1/3 of prefrontal suture; paraparietal surrounded by six shields and scales; mental not touching anterior chin shields; 148–166 ventrals and 15–19 subcaudals in males; maximum total length in males 344 mm..... *C. septentrionalis*
- 6b Portion of rostral visible from above greater than 1/2 of prefrontal suture; paraparietal surrounded by five shields and scales; mental touching anterior chin shields; 3 preventrals+ 191 ventrals and 23 subcaudals in male; total length in male reaching 457 mm*Calamaria gialaiensis* sp. nov.

Calamaria gialaiensis sp. nov. can be distinguished also from the non-Vietnamese subspecies of *C. lovii* Boulenger by the presence of a preocular (preocular lacking in all subspecies of *C. lovii*), fewer ventrals and more subcaudals (3+191 and 23 vs. 256 and 11 in *C. l. wermuthi* Inger and Marx), contact of mental with the anterior chin shields (they are separated in *C. l. gimletti* Boulenger), and by the rostral being wider than high as well as by colour pattern (in *C. l. lovii* dorsum is dark brown with yellow spots on body, one complete or narrowly interrupted yellow ring at vent, and obscure lighter markings on head, see Inger and Marx, 1965).

From the four *Calamaria* species that reach the Malay Peninsula (*C. albiventer* Gray, *C. ingeri* Grismer, Kaiser and Yaakob, *C. schlegeli* Duméril and Bibron) and Thailand (*C. lumbricoidea* Boie), *Calamaria gialaiensis* sp. nov. is distinguishable in having four supralabials, of which the second and third

entering the orbit (others have five supralabials with the third and fourth entering orbit), and a mental that touches the anterior chin shields (mental is separated from the anterior chin shields in *C. ingeri* and *C. schlegeli*), as well as by lacking a yellow belly with wide black crossbars as in *C. lumbricoidea*, four narrow light stripes on body as in *C. albiventer*, with light transverse bands as in *C. ingeri*, and distinctly bicolored body as in *C. schlegeli*.

Most of the remaining, geographically quite distant *Calamaria* species (i.e., those from Sumatra, Borneo, Java, the Philippines, Sulawesi, and the Moluccas) can be distinguished from *Calamaria gialaiensis* sp. nov. by having differential coloration, five supralabials (four in *Calamaria gialaiensis* sp. nov.), of which, in addition, the third and fourth (and not the second and third as in *Calamaria gialaiensis* sp. nov.) entering orbit (*C. abstrusa* Inger and Marx, *C. acutirostris* Boulenger, *C. alidae* Boulenger, *C. apraeocularis* Smith, *C. bicolor* Duméril and Bibron, *C. bitorques* Peters, *C. boesemani* Inger and Marx, *C. brongersmai* Inger and Marx, *C. butonensis* Howard and Gillespie, *C. ceramensis* de Rooij, *C. crassa* van Lidth de Jeude, *C. curta* Boulenger, *C. doederleini* Gough, *C. eiselti* Inger and Marx, *C. everetti* Boulenger, *C. forcarti* Inger and Marx, *C. gervaisi* Duméril and Bibron, *C. grabowskyi* Fischer, *C. griswoldi* Loveridge, *C. hilleniusi* Inger and Marx, *C. joloensis* Taylor, *C. lateralis* Mocquard, *C. lautensis* de Rooij, *C. leucogaster* Bleeker, *C. lumholtzi* Andersson, *C. margaritophora* Bleeker, *C. mecheli* Schenkel, *C. modesta* Duméril and Bibron, *C. muelleri* Boulenger, *C. nuchalis* Boulenger, *C. palavanensis* Inger and Marx, *C. prakkei* van Lidth de Jeude, *C. rebentischi* Bleeker, *C. suluensis* Taylor, *C. sumatrana* Edeling, *C. ulmeri* Sackett, and *C. virgulata* Boie). Of the remaining species, *C. gracillima* (Günther), *C. javanica* Boulenger, *C. longirostris* Howard and Gillespie, and *C. schmidtii* Marx and Inger have no preocular; *C. battersbyi* Inger and Marx has fewer ventrals (171) and subcaudals (16), and narrow longitudinal stripes mid-



FIG. 3. Map showing the type locality (closed circle) of *Calamaria gialaiensis* sp. nov. (IEBR A 0714) in northeastern Gia Lai Province, Central Vietnam.

dorsally; *C. borneensis* Bleeker has the tail gradually tapering to point; and *C. linnaei* Boie and *C. melanota* Jan have fewer ventrals (130–166 and 121–154, respectively).

Etymology

The specific epithet *gialaiensis* refers to name of the province (Gia Lai), which houses the type locality. As common names we suggest Gia Lai reed snake (English), Ran mai gam gia lai (Vietnamese), Calamaire de Gia Lai (French), and Gia Lai Zwergschlange (German).

Distribution and habitat

Calamaria gialaiensis sp. nov. is known only from the type locality (Fig. 3). The holotype was found on the floor of the broadleaf evergreen forest at an altitude of 1300 m asl.

REMARKS

Subsequent to the comprehensive overview by Inger and Marx (1965), in which eight

species of reed snake were described as new to science, four *Calamaria* species were described as new in the past five years: *C. ingeri* from Pulau Tioman, Pahang, West Malaysia (Grismer et al., 2004), *C. thanhi* from Vietnam (Ziegler and Le, 2005), as well as *C. butonensis* and *C. longirostris* from Buton Island near Sulawesi (Howard and Gillespie, 2007). Of the *Calamaria* taxa known so far for Vietnam, *C. pavimentata* and *C. septentrionalis* are relatively well known, in contrast to *Calamaria buchi*, *C. lovii ingermarxorum*, and *C. thanhi*, each known only from very few specimens from a single province (Darevsky and Orlov, 1992; Orlov et al., 2003; Ziegler and Le, 2005; Ziegler et al., 2007). The present finding argues once more for the rarity of certain *Calamaria* species and for the necessity of further researches for more accurate estimation of species richness of this genus in Vietnam, especially as it is well documented that certain *Calamaria* species tend to be locally restricted (e.g., Tweedie, 1961).

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