A REVISION OF THE GENUS MACROCALAMUS (SERPENTES: COLOUBRIDEAE), WITH DESCRIPTION OF A NEW SPECIES AND A KEY TO THE GENUS

Gernot Vogel
Society for Southeast Asian Herpetology, Im Sand 3, D-99115 Bredlburg, Germany

Patrick David
Laboratoire des Reptiles et Amphibiens, Muséum National d'Histoire Naturelle, 25 rue Cuvier, F-75005 Paris, France

ABSTRACT. - The Asian snake genus Macrocalamus (Serpentes, Colubridae), endemic to Peninsular Malaysia, is revised based on the examination of 119 preserved specimens in conjunction with observations on living, freshly collected animals. The species M. lateralis was previously reported as having a red or yellow venter, with or without ventrolateral stripes. It is shown that a positive correlation exists between the color of the venter, the occurrence of the ventrolateral stripes, and morphological and meristic data. Therefore, the yellow-bellied form is considered to be specifically distinct from the red-bellied form. The herpetology of two species (M. lateralis, M. schultzi, new species) are described for the first time. Macrocalamus tweediei, previously known from only three specimens, is redefined on the basis of nine recently collected animals. A key to the genus and new biological data are provided.

INTRODUCTION

Southeast Asia is especially rich in colubrid snake genera and species (see, for example, Welch, 1988). The genus Macrocalamus was erected by Gösster (1864) to accommodate his new species Macrocalamus lateralis. Until now, three species of this poorly known genus of small, secretive, terrestrial montane snakes, were recognized (Welch, 1988). This genus, endemic to the mountains of Peninsular Malaysia, has no synonym. The type species, Macrocalamus lateralis, was regarded as a rare snake until Smelley (1932) found it to be common at high elevations in the hills of western Malaysia. Two species, Macrocalamus tweediei Lim, 1964 and Macrocalamus jacou Grandison, 1972, were later described from a few specimens and are still poorly known. None of the three species has synonyms. There are few relevant references dealing with these animals, and little information is published on their variation and biology.

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309
An examination of preserved specimens of *Macrocyclamus*, including freshly collected animals still bearing their natural colours, led us to reconsider the variability of the nominal species *M. lateralis*, and the systematics of this genus. In addition we were also able to see nine recently collected *Macrocyclamus tweediei*, a species for which Tweedie (1983) mentioned only three known specimens. This taxon is here redefined.

Hemipenes of *M. lateralis* and *M. schulte*, new species are described for the first time. The currently known distribution of all species is also given, as well as a summary of their natural history.

MATERIALS AND METHODS

Morphometric, meristic and coloration characters were obtained by the examination of 119 preserved specimens, the list of which is given in Appendix I. Colouration of living specimens was taken from slides or from freshly collected material. The colour of the venter in life is an important character in our study. The form with the red venter is hereafter referred to as the "red venter" *lateralis*; the other form is called "yellow venter" *lateralis*.

We examined 15 characters: body colour and pattern (dorsal colour; ventral colour; number and percentage of specimens having ventrolateral stripes; number and percentage of specimens having a median stripe beneath the tail); morphometric characters (snout-vent length; tail length; ratio tail length/total body length); and meristic characters (number of ventrals [according to the Dowling's method (Dowling, 1951)]; number of subcaudals [terminal count not included in the number]; number of dorsal scale rows at mid-body; number of supralabials [on left and right sides of head, respectively]; presence of subocular; number of supralabials entering orbit; number of preoculars [left / right]; number of postoculars [left / right]; number of temporals [left / right]; number of infralabials [left / right].

When appropriate, we give the range limits, mean value (s) and standard deviation (s). We did not use values published in the literature for the nominal species *lateralis*, as two species were confused, but we included data taken from the descriptions of *M. tweediei*.

In the species accounts, we mention primary references, then all chessonisms and literature citations. The chrestonomy of each species is followed by a diagnosis and a description of the species with its known morphological and meristic variation.


RESULTS

The data obtained from the examination of the specimens (listed in Appendix) are reported in Tables 1-3.

310
<table>
<thead>
<tr>
<th>Taxon</th>
<th>Total</th>
<th>Dorsal</th>
<th>Ventral</th>
<th>TL (mm)</th>
<th>VLS %</th>
<th>TS %</th>
<th>VLS % TS %</th>
<th>Ratio</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>lateralis</td>
<td>47</td>
<td>no</td>
<td>spotted</td>
<td>100</td>
<td>57.4</td>
<td>0.87</td>
<td>0.13</td>
<td>0.122</td>
<td>0.181</td>
<td>0.007</td>
</tr>
<tr>
<td>&quot;red vent&quot;</td>
<td>56</td>
<td>no</td>
<td>bright</td>
<td>91</td>
<td>0</td>
<td>0.13</td>
<td>0.168</td>
<td>0.007</td>
<td>0.019</td>
<td>0.007</td>
</tr>
<tr>
<td>&quot;yellow vent&quot;</td>
<td>56</td>
<td>no</td>
<td>yellow</td>
<td>91</td>
<td>0</td>
<td>0.13</td>
<td>0.168</td>
<td>0.007</td>
<td>0.019</td>
<td>0.007</td>
</tr>
<tr>
<td>BM 1968:764</td>
<td>1</td>
<td>no</td>
<td>yellow</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0.14</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>tordoii</td>
<td>12</td>
<td>no</td>
<td>black</td>
<td>136</td>
<td>500</td>
<td>0.112</td>
<td>0.155</td>
<td>0.112</td>
<td>0.155</td>
<td>0.112</td>
</tr>
<tr>
<td>jami</td>
<td>5</td>
<td>no</td>
<td>black</td>
<td>755</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

(1) In several specimens, the stripe beneath tail is faint.
(2) This value includes unsexed specimens.
(3) The stripe beneath tail is always incomplete and faint to very faint.
(4) The two types of M. tordoii plus a third specimen mentioned by Lim (1967) and Tweedie (1983) could not be examined in the present study. However, we include data given by these authors, as no confusion between other species is likely to occur.
(5) No male known.

**DISCUSSION**

As shown in Tables 1-3, the genus Macrocalamus is homogeneous in scolation and meristic data, with marked differences only in colouration and patterns. This apparent homogeneity led previous authors to consider that Macrocalamus lateralis was a quite variable species, with either a yellow or reddish-orange venter, and with or without ventrolateral stripes and a median stripe beneath the tail. Smedley (1932, 1939) considered that these differences were ontogenetic, with the lateral lines and red venter colour characteristic of young specimens. Subsequent authors merely mentioned two colouration variants, without further discussion (see, for example, Tweedie, 1983).

With the exception of the specimen BM 1968:764, which is discussed below, these data show that for all other specimens of the nominal species lateralis examined, a correlation exists between the venter colour, the dorsal markings, the presence or absence of ventrolateral stripes, and significant morphometric and meristic characters. However, after only some
Table 2. Variation of body meristic data in the genus Macrolepasix.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Co (m)</th>
<th>Total</th>
<th>M</th>
<th>F</th>
<th>Total</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;red venter&quot;</td>
<td>(s = 6.15)</td>
<td>(s = 2.96)</td>
<td>(s = 4.11)</td>
<td>(n = 45 (1))</td>
<td>(n = 13)</td>
<td>n = 25</td>
<td>n = 25</td>
</tr>
<tr>
<td>&quot;yellow venter&quot;</td>
<td>15</td>
<td>114-134</td>
<td>114-125</td>
<td>119-134</td>
<td>17-31</td>
<td>23-31</td>
<td>17-27</td>
</tr>
<tr>
<td>(s = 6.15)</td>
<td>(s = 2.91)</td>
<td>(s = 4.33)</td>
<td>(n = 54 (1))</td>
<td>(n = 13)</td>
<td>n = 28</td>
<td>n = 32</td>
<td></td>
</tr>
<tr>
<td>BM 1968-764</td>
<td>15</td>
<td>124</td>
<td>-</td>
<td>-</td>
<td>29</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>tweediei</td>
<td>15</td>
<td>128-147</td>
<td>128-134</td>
<td>132-147</td>
<td>24-32</td>
<td>31-32</td>
<td>24-28</td>
</tr>
<tr>
<td>(s = 5.13)</td>
<td>(s = 5.09)</td>
<td>(s = 5.33)</td>
<td>(n = 11 (1))</td>
<td>(n = 2)</td>
<td>n = 8</td>
<td>n = 7</td>
<td></td>
</tr>
<tr>
<td>jasoni</td>
<td>15</td>
<td>131-133</td>
<td>-</td>
<td>-</td>
<td>19-22</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(s = 0.94)</td>
<td>(n = 3)</td>
<td>(n = 3)</td>
<td>(n = 3)</td>
<td>(n = 3)</td>
<td>(n = 3)</td>
<td>(n = 3)</td>
<td>(n = 3)</td>
</tr>
</tbody>
</table>

(1) This value includes unsexed specimens.

Table 3. Variation of meristic head data in the genus Macrolepasix.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>n</th>
<th>N Spl. %</th>
<th>PreOc</th>
</tr>
</thead>
<tbody>
<tr>
<td>lateralis &quot;red venter&quot;</td>
<td>47</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>lateralis &quot;yellow venter&quot;</td>
<td>56</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BM 1968-764</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>tweediei</td>
<td>11</td>
<td>72.7</td>
<td>9.1</td>
</tr>
<tr>
<td>jasoni</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(a): two prosocals on left side in ZRC 2.2773.
ments in preservative, the bright red colour of the "red venter" *lateralis* vanishes and becomes whitish, very pale pink or even pale yellow. It thus appears to be identical with the venter colour of the "yellow venter" *lateralis*. Nevertheless, both, the examination of about 20 freshly collected specimens (out of a total of 47) still bearing their natural colour, and the mention of "red venter" reported on legs of another 10 preserved specimens, allow us to unambiguously associate the red colour with the presence of ventrolateral lines.

The "red venter" form is associated with: (1) the constant presence of ventrolateral stripes and paravertebal the dorsal rows made of either black spots or of white, black-edged occelli; (2) a lower mean value of ventral number; and (3) a reversed sexual dimorphism in relative proportions of body. The "yellow venter" form is characterised by: (1) a constant absence of ventrolateral stripes; (2) a totally uniform dorsum; (3) a higher mean value of ventral number; and (4) a smaller difference in relative proportions of the body according to the sex. These conditions are summarized in Table 4.

A median stripe beneath tail is frequently present in "red venter" *lateralis* and rarely in "yellow venter" *lateralis*. This stripe beneath the tail is also present in one specimen of *Macrocalamus tweediei* described by Lim (1964) but absent in the other.

These data also demonstrated that the colour of the venter is not related to the age or the size of animals, contrary the statement of Smedley (1932) and Lim (1967). The smallest measured "yellow venter" form (ZFMK 51160) has a total length of 128 mm, whereas the smallest "red venter" form is 84 mm long (BM 1974.3860). On the other hand, the largest "red venter" form is 300 mm long (BM 1964.1.7.23), versus 199 mm for the largest "yellow venter" form (ZFMK 1684). Adults of the red belledled *lateralis* are smaller than those of the yellow belledled form (see Table 5 and Pl. 5), but the colour of the venter is not related to the age of the animal. We examined large adults of both forms with their respective bright venter colour.

Lastly, both forms occur symptomatically on the Cameron Highlands in the area of Tanah Rata and on Mt. Batu Brinchang, without obvious ecological differences.

The specimen BM 1968.764 does not fit with any other taxon. It was found on Mount Tahan (Gunong Tahan), about 60 km airline east from Cameron Highlands, and has both dark ventrolateral lateral stripes and a yellow venter that is finely yet heavily speckled with black. So, it differs in the pattern of its venter both from "red venter" *lateralis* (venter not yellow nor speckled, lateral stripes always present) and "yellow venter" *lateralis* (venter not speckled, no lateral stripe). It also differs from *lateralis* "red venter", which has ventrolateral stripes, by a higher number of ventrals. Although it comes from a different area belonging to a disjoint mountain range, we refrain from formally recognizing it at the present time, pending the examination of further specimens.

The holotype of *M. lateralis* has both lateral stripes and a tail stripe according to Günther's (1864) description. The same author described it as having a whitish venter. We could see that the pink or red colour typical of *M. lateralis* became creamy white to pale yellow in preservative. Therefore, we consider the taxon with a yellow venter and no ventrolateral stripes, occurring in sympathy with the red belledled form, to be specifically distinct from this red belledled form. It represents a new taxon that we describe as *Macrocalamus whaitzi* (see later).
"Macrocalamus" Günther. 1863: 3 (nonus nudum).

Macrocalamus Günther, 1864: 198. - Type species. Macrocalamus lateralis Günther, 1864 by monotypy.

Comments. - The taxon was first mentioned by Günther (1863) without any diagnosis or description of the sole species included, making the name a nomen nudum. The first valid diagnosis appeared in Günther (1864). This genus has no junior synonym. Its relationships within the family Colubridae are unclear. According to V. Wallach (pers. comm.), Macrocalamus has strong tracheal lung, similar to Pseudoblabio and Calamorhabdium, both members of the Calamariinae (or Calamariina). In English, they are called "Mountain Reed Snakes" (Tweedie, 1983).

Diagnosis. - A colubrid snake genus characterized by: a cylindrical body, a head triangular, depressed, bale: distinct from a thick neck with tapered precocular region and snout. 15 smooth dorsal scale rows, without apical pits throughout the body, internasals fused with prefrontals and a very elongate loreal.

Description. - Other characters of the body include: anal entire; subcaudals paired; tail short, rather thick and terminating in an acute, spine scale.

Rostral higher than broad, triangular, well visible from above, totally separating the nasals from each other and contacting the prefrontals that are significantly notchted by the rostral on their anterior margin; internasals fused with prefrontals; nasals entire, rather small, roughly pentagonal; nostril piercing shield between the lower margin of the nasal and the upper margin of the 1st supralabial; one pair of large prefrontals, followed by an hexagonal, elongated frontal, pointing caudally, that is followed by one undivided supracaudal on each side: a very large parietal separated from the 7th supralabial by the anterior temporal; one elongated loreal between the nasal and the preocular; 8 (rarely 7) supralabials, first very small, second and third always in contact with the loreal, fourth and fifth always entering orbit; 1 preocular (2 preoculars on left side in one specimen of M. schulzi [ZRC 2.2773]) due to the division of the 4th supralabial); 1 postocular; no subcaudals; 1 squamos anterior temporal and 2 superposed posterior temporals, the superior one much longer than inferior, 7 infralabials.

A summary of the morphological and meristic characters in the genus Macrocalamus is given in Table 6. Living or freshly preserved specimens of M. lateralis and M. schulzi can easily be distinguished by the colouration of their venter. A comparison of venter coloration of M. lateralis, M. schulzi and M. tweediei can be found on Pl. 5 & 6.

Hemipenes. - The hemipenis of Macrocalamus schulzi is described later. We also examined hemipenes of M. lateralis (ZFMK 62596; SVL 141 mm; hemipenis length 9 mm) and M. tweediei (ZFMK 6249; SVL 280 mm; hemipenis length 11 mm). Both were prepared from preserved specimens according to the method described in Pessant (1994) and Ziegler & Böhme (1997). These hemipenes do not differ conspicuously from those of M. schulzi. The hemipenes of M. tweediei are relatively smaller. In both M. tweediei and M. lateralis the calcyulate surface extends more proximal on the trunk. However, because of the small

314
size and the delicate genital preparation of the hemipenes in these two species, some better preparations are required before more conclusive statements can be done.

**Range.** - Malaysia: Endemic to the mountain ranges of central Malaysia.

**Biological.** - This genus of small, terrestrial and secretive snakes inhabits tropical montane wet forests of Malaysia between ca. 1000 and nearly 2000 m above sea level. They are mostly found under moss, decaying logs, and in the litter on the floor of wet montane forest and in clearings, fields, and the vegetation along forest paths. These snakes seem to be restricted to moist areas. Most animals were encountered at night or basking in the early morning, but a large number were collected dead on roads. Members of the genus *Macrocalamus* feed mainly on invertebrates, earthworms and insects, although *M. tweediei* is known to take small lizards. All species seem to be oviparous. Little has been recorded on breeding habits; one female of *M. schultzi* (MNHN 1997.3273) kept in captivity laid four eggs in late August 1995. *Macrocalamus* spp. are reported as being very common in Cameron Highlands.

*Macrocalamus latistriatus* Günther, 1864

(Phs. 2, 5-8)

"*Macrocalamus latistriatus* Günther, 1864: 3 (nom. nudum). - Type locality: 'India'.

*Macrocalamus latistriatus* Günther, 1864: '99, pl. 18; fig. D. - Type locality: 'From the continent', restricted by Tweedie (1963: 101) to Cameron Highlands, Pahang, Malaysia. - Holotype. BM 1946.1.7.22, adult male; coll. unknown.


**Comment.** - This species was described from a single specimen of unknown locality. The holotype has an anomalous head scalation, the loreals being fused with the prefrontals. Although it is a male, its numbers of ventrals and subcaudals are more typical of females. Günther (1964) and Boulegger (1984) stated that the holotype of *M. latistriatus*, a male, had 118 ventrals. In the genus *Macrocalamus*, the Dowling's method for counting ventrals usually gives a value similar, or only one scale less, compared with other pre-Dowling methods. We examined this specimen and it appears that the value given by these two authors is incorrect; we found that the holotype has 114 ventrals, whatever the method used for their counting.

**Diagnosis.** - A *Macrocalamus* species characterized by both a red, pink or orange venter in life, the presence of one pair of dark ventraloesophageal stripes made by the dark colour of ventral plates (tip) and dorsal colour brown with, at least on the anterior part of body, two discontinuous dorsal rows made of white, dark edged occuli that are sometimes reduced to small black spots; often a median black stripe beneath the tail.

**Description and variations.** - Maximum known total length 298 mm (SVL 262 mm; tail length 36 mm; holotype), but usually much less; tail length/total length ratio 0.09-0.16 (x = 0.12; s = 0.236; 0.12-0.16 in males (x = 0.15; s = 0.011), 0.09-0.11 in females (x = 0.10; s = 0.009); ventrals 104-132 (x = 116.1; s = 6.15), 104-115 in males (x = 110.1; z = 2.96); 116-132 (x = 120.3; s = 4.11) in females; subcaudals 18-27 (x = 22.2; s = 2.95), 23-27 in males (x = 25.4; s = 2.02), 18-23 in females (x = 20.3; s = 1.35).

315
The holotype has a rather abnormal morphology and scalation. Its tail is complete, its tail length/total length ratio (0.122) is lower than in other males (n = 14), all of which are greater than 0.135. Its number of subcaudals is also rather low, with 20 plates vs. 23 or more for other males. The holotype is also the largest specimen known.

An elongated loreal always present except in the holotype; 8 supralabials, second, third and fourth in contact with the loreal, fourth and fifth always entering orbit, seventh largest; scalation otherwise as given for the genus.

Upper surfaces in life and alcohol pale to dark brown or greyish-brown, usually with one discontinuous dorsal on each side of the back row made of white, dark edged, elongated ocelli located one or two scale rows from the vertebral row; the white ocelli are sometimes much reduced, appearing as black spots that are better defined on anterior part of body; each lower side of body marked with a ventrolateral dark stripe made by the dark tips of every ventral scale, bordered above by a pale line made by the pale colour of the lowest row of dorsal scales, making the dark stripe quite vivid. Some animals have a pale streak running from the parietals, or sometimes only from the posterior temporals, that extends to the ventrals; in a few animals this streak is followed by two short, parallel and similarly coloured streaks on each side that are indifferently dark edged; frequently a dark median, zigzag-like stripe beneath the tail. The venter is vividly pink, coral red or orange in life, becoming pale pink, very pale yellow or creamy white in preservative; sometimes a few dark, scattered spots on venter. The colouration of juvenile and adults is similar.

Table 4. Characteristic variation in relation to the venter colour of *M. lateralis*

<table>
<thead>
<tr>
<th>Venter colour</th>
<th>Dorsal pattern</th>
<th>Ventrolateral stripes</th>
<th>Ratio of TL male/female</th>
<th>Mean number of ventrals</th>
<th>Number of ventrals in male</th>
</tr>
</thead>
<tbody>
<tr>
<td>mudfish</td>
<td>speckled or scattered</td>
<td>present</td>
<td>0.147/0.100</td>
<td>116.1</td>
<td>104-115</td>
</tr>
<tr>
<td>yellowish</td>
<td>uniform</td>
<td>absent</td>
<td>0.144/0.108</td>
<td>124.0</td>
<td>114-125</td>
</tr>
</tbody>
</table>

Range. - Malaysia: Pahang: Cameron Highlands (Tanah Rata, Mt. Baru Berinchant), Bukit Fraser (formerly Fraser’s Hills); Perak: Bukit Larut (formerly Maxwell’s Hills).

Biological data. - This terrestrial, secretive, forest litter species has been found in tropical wet forests from 1100 to 1500 m elevation. Lim (1967) mentioned an elevation of 6300 ft [1920 m], but it is possible that this record refers to *M. schulzii*. Lim (1964) found specimens under logs on Mt. Baru Berinchant. Lim (1967) often found specimens basking on the road in early morning. According to Twedde (1954, 1983) and Lim (1967), this species feeds on worms, slugs, insects and their larvae, but these observations may also apply to *M. schulzii*. In captivity, our specimens accepted crickets. Nothing is known about the breeding habits of this species. It is regarded as common in its range, and Lim (1967) described it as being one of the most common snakes on Mt. Baru Berinchant. As most of the examined specimens previously labelled in collections as *M. lateralis*, in fact *M. schulzii*, it is likely that *M. schulzii* is the most common species.

316
**Macracalamus cf. lateralis**

**Macrocalamus lateralis**: Smith, 1922: 266, 1936: 57 (part.).

**Comments**: Smith (1922, 1930) described under the name *Macrocalamus lateralis* a single specimen with a dark ventrolateral stripe, a median stripe above the tail, a yellow ventral (like *M. schacli*) and a high number of ventrals. We examined this animal (BM 1968.764) and it differs from both *M. lateralis* and *M. schacli*. Because of these differences, and its disjunct distribution, we presently assign it to a new taxon. We list it here under the name *Macrocalamus cf. lateralis* pending the examination of further specimens from Gunong Tahan, and we do not consider it in the chrosomy and in the distribution of *M. lateralis*.

**Description**: Only a single male specimen is known, with the following characters: total length 194 mm (SVL 165 mm, tail length 29 mm); tail length / total length ratio 0.149; ventrals 125; subcaudals 29. Otherwise, head and body scalation like *M. lateralis* and *M. schacli*.

Uppersurface dark brown, nearly uniform; faint oblique yellow bands on the neck sides and anterior part of body; each side of body marked with a ventrolateral black stripe made by the dark tips of every ventral plate, bordered dorsally by a pale line due to the pale colour of the lowest row of dorsal scales; ventral dark, dirty yellow, finely but heavily speckled with minute black spots, on the anterior margin, the middle and the outer tips of each ventral, making the venter dark and dirty-looking; a dark median, zigzag stripe beneath the tail.

**Range**: Malaysia: Pahang, Bukit Tahan (Mt. Tahan).

**Biological data**: Nothing is known about this animal, except that it was caught between 1650 m and 1750 m above sea level.

**Macrocalamus jasoini** Grandison, 1972

(Pls. 13-16)


**Comments**: This species is known only from three female specimens.

**Diagnosis**: A large and stout *Macrocalamus* species characterized by a deep black upper surface marked with a pair of orange dorsal stripes and a bright yellow venter, with up of ventrals marked with black.

**Description and variations**: Maximum known total length 752 mm (SVL 692 mm, tail length 50 mm; 934 1967.2283); tail length / total length ratio for the three known females 0.08-0.10 (x = 0.09); s = 0.008); ventrals 131-133 (x = 131.7; s = 0.84); subcaudals 19-22 (x = 20.7; s = 1.25).

317
Head more or less triangular, quite elongate and narrow, much depressed, not distinct from a thick neck and with a rounded snout.

An elongate head always possessing 8 supralabials, second, third and fourth in contact with the loreal, fourth and fifth on either side, seventh largest; scalation otherwise as given for the genus.

Upper surfaces deep irdescent black, marked on each side with a reddish-brown or rusty stripe extending from the nape to the tip of the tail where they meet; these dorsal stripes are located on the 5-7th dorsal rows and are about 1.5 to 2 scales wide; they are sometimes interrupted by a length of 1 or 2 scales; a short diffuse, yellowish-brown streak runs on the 3rd and 4th dorsal rows on the anterior part of the body, for a length of about 25 ventrals; some scattered scales of flanks tinted with yellow. Upper head surface dark reddish brown with a lighter snout tip; supralabials, mental and chin shields yellow or yellowish-brown marked with black; a black spot on the 3rd and 7th pairs of infralabials; lower part of neck yellow, up to the middle of the flank; venter bright yellow, with outer tips of ventrals black; venter either totally uniform or with ventrals widely marked with black along the middle throughout the body length, or only anteriorly, giving the appearance of a broad, discontinuous median stripe that is best defined anteriorly.

Range. - Malaysia: Pahang: Gunong Benom (Mt. Benom). Known only from the type locality.

Biological data. - All known animals were found in damp habitat in leaf litter on the floor of a montane wet forest or crossing a track, between 1770 and 1980 m. The natural size is unknown. The holotype was gravid when collected in early April.

*Macrocalamus schultzii*, new species

(Pis. 1, 4, 5, 9-12; Figs. 1-2)


*Macrocalamus cf. lateralis* Mantle & Grassman: 366, fig. 274.

**Materia examined.** - Holotype. - ZFMK 51159, Borne; adult male, from Tanah Rata (ca 4°29'N, 103°12'E), Cameron Highlands, Pahang, Malaysia; col: Klaus-Dieter Schulte, Bonn, Jul 1989, deposited Sep 1999.

Paratypes (7 specimens). - MNHN 1997 3268, MTKD 3266, SMF 79368, all adult males from Cameron Highlands, Pahang, Malaysia; ZRC 2 3097, MNHN 1997 3266, ZFMK 65536, adult females, same locality; ZMB 49145, juvenile, from Mt. Biau Berningkang, Cameron Highlands, Pahang, Malaysia.

**Diagnosis.** - A species of *Macrocalamus* characterized by a yellow, unpigmented venter, the yellow colour being present both in young and adult specimens and retained in preservative, uniform dorsal colouration, the complete absence of ventrolateral stripes, and the number of ventrals ranging in males from 114 to 125.

It differs from *Macrocalamus* latidorsis, its pressed newest relative, which has both ventrolateral stripes and a pink to pale red venter in life, a speckled or scalated dorsum, at least on its anterior half, and the number of ventrals ranging in males from 104 to 115.

318
The background colour of *M. tweediei* and *M. javani* is deep coal black above and black and yellow below.

**Description of the holotype.** - Head triangular strongly tapering in dorsal view; two distinct from neck; body round, covered with smooth scales; 15 dorsal scale rows behind head, 15 at midbody and 15 before vent; 123 ventrals, 29 paired subcaudals plus the terminal scale; anal entire.

Rostral much higher than broad, triangular and largely visible from above, totally separating the nasals each from another, and reaching the prefrontals that are significantly touched by the rostral on their anterior margin; internasals absent; nasals entire, pentagonal; nostril piercing the lower margin of the nasal, adjacent to the upper margin of the 1st supralabial; one pair of large prefrontals; a hexagonal, elongated frontal, pointing caudally, located between an undivided supracocular on each side; two very large parietals separated from the supralabials by the temporals; 1 elongated loreal, twice as long as wide; 1 preocular; 1 postocular; no subocular; 1 squarish anterior temporal and 2 posterior temporals, the upper one being much longer; 8 supralabials, 2nd, 3rd and 4th in contact with the loreal, 4th and 5th entering the orbit, 7th the largest; 7 infralabials; first pair of infralabials in contact, 6th the largest.

Total length 383 mm, snout-vent length 326 mm, tail length 57 mm; tail length / total length ratio 0.1-0.9.

Dorsal surface uniformly brown; some scales lighter on their anterior edge and darker on the posterior one; upper dorsal scale row pale yellow, mottled below with brown; venter yellow; tips of ventrals light brown, forming a broad, indistinct ventrolateral stripe beginning on 6th ventral; 4th ventral with two brown spots; tail uniformly brown above, subcaudals

Figs. 1-2. *Marascolamus schulzi*, new species (ZFMK 16684). 1. dorsal view of the head. 2. lateral view of the head; drawing by Peer Klinert.

319
yellow below and brown laterally, entirely brown on the posterior part of the tail; head brown above, with a light temporal streak extending from the parietals to the throat; two oblique yellow stripes, parallel to the temporal streak, extending on the neck from the top of the back down to the ventral; the second bony distinct; throat uniformly yellow.

**Description of the paratypes.** A summary of morphological and meristic data of the paratypes is given in Table 6.

All other morphological, colouration and sculation features agree with those of the holotype. There is little variation in the coloration except for the juvenile (ZMB 49143), which is described separately below. In all other paratypes, the dorsal colour is chestnut brown. The temporal streak is present in all paratypes; the two oblique, parallel yellow streaks on neck side are present, some specimens showing the remaining of a faint third streak. The venter colour is identical with that of the holotype, except for the dark markings on the throat. Lower surface of tail identical with that of the holotype, except for MTKD 39366, which has a very faint median stripe.

The juvenile (ZMB 49143) is slightly different from the other paratypes, having a more vivid pattern. The dorsal colour is dark brown. The temporal streak is present. Instead of the two to four oblique lateral streaks on the neck in adults, there are 12 oblique, parallel streaks, the last one ending at the level of ventral 39. These streaks are followed by light spots forming the dorsolateral row on 5th dorsal scale rows extending up to the tip of tail. There is no median stripe beneath the tail.

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**Fig. 3.** *Macrocalamus schulzi*, new species (ZFMK 16684), hemipenis; drawing by Thomas Ziegler.
Variation (48 specimens). - Maximum total length reaching at least 400 mm; largest measured specimen 399 mm (ZFMK 16684; SVL 342 mm), but one damaged specimen (SMF 78390) with a snout-vent length above 350 mm was examined; tail length / total length ratio 0.09-0.16 (x = 0.127; s = 0.0196; 0.13-0.16 in males; x = 0.144; s = 0.088; 0.09-0.12 in females (x = 0.108; s = 0.008); ventrals 114-134 (x = 123.2; s = 5.9); 114-125 in males (x = 119.4; s = 2.9); 119-134 (x = 129.5; s = 4.3) in females; subcaudals 17-31 (x = 25.1; s = 3.07), 23-31 in males (x = 27.4; s = 1.6), 17-27 in females (x = 22.5; s = 1.9).

An elongated loreal always present; 8 supralabials, second, third and fourth in contact with the loreal, fourth and fifth always entering orbit, seventh largest; one precocular (2 precoculars on left in specimen ZEC 2-2773 due to the division of the 4th supralabial); scalation otherwise as given for the genus.

Colouration in preservative. - Upper surface reddish-brown to dark brown, totally uniform or sometimes with irregular faint black transverse markings; from two to four oblique yellow bands on the side of the neck and forepart of body, sometimes very vivid, the last two often barely visible, depending on the age of specimens; no ventrolateral black stripe, or a faint, irregular darker markings on tips of ventrals; sometimes a faint dark median, zigzag-like stripe beneath the tail; venter yellow or yellowish-brown, becoming creamy white with time, entirely uniform.

Colouration in life. - The colouration in life is identical to the preservative, except that the venter is bright yellow.

Description of the hemipenis (Fig. 3). - From ZFMK 16684 (SVL 320 mm; terminology following Böhme, 1988). Fully everted hemipenes elongate, total length 15-16 mm, apically folded and bicolored only along its distal part; pedicle and truncus largely without ornamentation but exhibiting unique bilateral concave bulges that narrow proximally; apex covered with numerous calycels that become smaller towards the tips of the short lobes; basal region of lobes with lateral enlargements of the calyculate surface; uccus spermaticus bifurcata for about 1/3 of its length, with the branches terminating laterally at the tips of the lobes.

Etymology. - We are pleased to name this new taxon in honour of Mr. Klaus-Dieter Schulz (Würselen, Germany), who collected and sent us specimens that allowed us to determine this new species, and for his major contribution to the knowledge of the snake fauna of Southeast Asia, especially of the genus Elaphe.

Range. - Malaysia: Pahang; Cameron Highlands (Tanah Rata, Mt. Batu Berincang). This species is currently known only from wet, forested mountains between 1000 and 1800 m.

Biological data. - This secretive terrestrial species was collected under sphagnum moss and in the litter on the floor of montane tropical wet forests, under wet moss and vegetation among terrace fields, and on forest roads or along their sides. Most specimens are seen crawling at night. Lardner (1994) observed most of its specimens crawling at night on roads or along their sides. Members of this species are frequently found on dead on roads in the morning. In the same biotope, scincid lizards Lammatris trifasciata and earthworms were observed. The natural diet is not well known. Specimens mentioned by Lim (1967) at M. lateralis, but most likely referable to the present species, contained insect larvae and cockroaches. Another snake, also probably belonging to this species, had eaten an earthworm (Smledley, 1932). In captivity, our specimens refused crickets, earthworms and baby mice.
Table 5. Morphological and meristic data of paratypes of *M. schulzi*.

<table>
<thead>
<tr>
<th>Collection</th>
<th>number</th>
<th>Sex</th>
<th>Dorsal colour</th>
<th>Ventral colour</th>
<th>Length</th>
<th>VTL (mm)</th>
<th>TL/TL</th>
<th>Ratiation</th>
<th>Sc</th>
<th>Vert</th>
<th>St</th>
<th>Co (m)</th>
<th>Largest ind.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTK 3560</td>
<td>M</td>
<td>brown</td>
<td>yellowish</td>
<td>no</td>
<td>236</td>
<td>36</td>
<td>0.132</td>
<td>119</td>
<td>28</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MNHN 1997.2369</td>
<td>M</td>
<td>brown</td>
<td>yellowish</td>
<td>no</td>
<td>245</td>
<td>41</td>
<td>0.147</td>
<td>115</td>
<td>27</td>
<td>15</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SeF 7816</td>
<td>M</td>
<td>brown</td>
<td>yellowish</td>
<td>no</td>
<td>320</td>
<td>-</td>
<td>-</td>
<td>125</td>
<td>-</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZBC 1.367</td>
<td>F</td>
<td>brown</td>
<td>yellowish</td>
<td>no</td>
<td>329</td>
<td>36</td>
<td>0.099</td>
<td>132</td>
<td>23</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MNHN 1997.2368</td>
<td>F</td>
<td>brown</td>
<td>yellowish</td>
<td>no</td>
<td>310</td>
<td>40</td>
<td>0.114</td>
<td>133</td>
<td>24</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZMB 5506</td>
<td>F</td>
<td>brown</td>
<td>yellowish</td>
<td>no</td>
<td>309</td>
<td>36</td>
<td>0.104</td>
<td>134</td>
<td>22</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZMB 4914</td>
<td>F</td>
<td>dark brown</td>
<td>yellowish</td>
<td>no</td>
<td>124</td>
<td>14</td>
<td>0.101</td>
<td>132</td>
<td>23</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One adult displayed a rather surprising strong constriction behaviour when coiled around a thumb (B. Lardner, pers. comm.). One female (MNHN 1997.2370), kept in captivity by one of us (GV), laid 4 eggs on August 26th 1995.

This species is common in the Cameroon Highlands (Lardner, 1994). A specimen (ZMB 53220) was removed from the stomach of a *Matricola intestinalis* (ZMB 57221) found dead on the road in the Cameroun Highlands, between Tanah Rara and Béincang, after a heavy rainshower (Grossmann, pers. comm.). About half of the *Macrolepidium* body was hanging out of the *Matricola*’s mouth.

Fig. 4. Snout-vent length of *Macrolepidium laterealis* and *M. schulzi*.

322
Macrolepus tweediei Lim, 1964
(Pls. 3, 5)

Macrolepus tweediei Lim, 1964: 100, fig. 1, pl. 2. - Type locality: "Gunung Brinchang, Cameron Highlands, Pahang, at an elevation of 6000 ft." Mt. Batai Berinchang in Pahang, 1830 m. - Holotype: R 57,656, male, Institute for Medical Research, Kuala Lumpur, now ZRC.2174, Zoological Reference Collection, Singapore; coll. Lim Boo Lue & H. E. McClure, 2 Oct. 1959. - Paratypes: R 54,070, Institute for Medical Research, Kuala Lumpur, now FMNH 109865, Field Museum of Natural History, Chicago, female, from the same locality as holotype, elevation 1500 m.; coll. Phang Ong Wah & M. Nalchitham, 10 Nov. 1958.


Comments. - This species was previously known from three specimens (Tweedie, 1953). Nine freshly collected specimens were examined in this study. The species is redescribed and its variation is redefined.

Diagnosis. - A Macrolepus species characterised by an uniform deep black dorsal colour and a black and yellow or white chequered venter; no ventrolateral stripe; usually 7, sometimes 8 supralabials.

Description and variations. - The body is round, cylindrical and covered with smooth scales on 15 dorsal rows throughout; head more or less triangular, rounded, depressed, not distinct from a thick neck, anal entire; subcaudals paired; tail short, rather thick and ended by an acute, spiny scale.

A large species, reaching about 500 mm in total length; tail length / total length ratio 0.112-0.165 (x = 0.135; s = 0.0146), 0.164 in one male, 0.115-0.15 in eight females (x = 0.132; s = 0.0011); ventrals 126-147 (x = 136.2; s = 5.13), 128-134 in two males (x = 131.0), 132-147 (x = 137.6; s = 5.00) in eight females; subcaudals 24-32 (x = 27.3; s = 2.35), 31-32 in males (x = 31.5; s = 0.5), 24-28 in females (x = 26.3; s = 1.18).

Rostral higher than head, triangular, well visible from above, totally separating the nasals from each other, and contacting the prefrontals that are significantly notched by the rostral on their anterior margin; internasals fused with prefrontals; nasals entire, rather small, roughly pentagonal; nostril piercing the lower margin of the nasal ans the upper margin of the 1st supralabial; one pair of large prefrontals; one very elongate loreal present between the nasal and the preocular 7 supralabials (in 8 specimens), 7, 8 (in specimen SMF 78389) and 8 (in two specimens, ZRC.2.3700, ZMB 56887), first very small, second and third always in contact with the loreal, sometimes the fourth also in contact with the loreal, fourth and fifth always entering orbit, xth largest (when there are 7 supralabials) or seventh largest (8 supralabials); 1 preocular; 1 undivided supraocular; 1 postocular; no subocular, one undivided supraocular; frontal hexagonal, elongated, pointed caudally; 1 anterior and 2 posterior temporals, the upper larger of the two, 7 infralabials.

Upper surfaces in life uniformly deep coal black; venter also deep black, marked or chequered with large yellow square blotches, either placed alternately with each other on each side of the venter, or confluent into a single series of ventral markings, 2 to 3 ventrals wide and separating each other by 2 or 3 ventrals; head black with lateral yellow markings extending onto supralabials and infralabials, then towards venter, sometimes meeting ventrally. In alcohol, the sole difference is that the ventral yellow blotches become white.

323
Table 6. Summary of morphological and meristic characters in *Macrocalamus*

<table>
<thead>
<tr>
<th>TAXON</th>
<th>TAIL LENGTH</th>
<th>TOTAL LENGTH RATIO</th>
<th>VERTEBRAL</th>
<th>VENTRAL</th>
<th>GENERAL</th>
<th>MYEODAURAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>sizea</td>
<td>0.087-0.106</td>
<td>0.102-0.106</td>
<td>0.087-0.114</td>
<td>106-117</td>
<td>116-123</td>
<td>10-17</td>
</tr>
<tr>
<td>sizeb</td>
<td>0.077-0.106</td>
<td>0.080-0.106</td>
<td>0.087-0.113</td>
<td>114-125</td>
<td>119-135</td>
<td>17-31</td>
</tr>
<tr>
<td>sizec</td>
<td>0.111-0.134</td>
<td>0.127-0.134</td>
<td>0.125-0.150</td>
<td>125-147</td>
<td>132-147</td>
<td>21-32</td>
</tr>
<tr>
<td>sizeb</td>
<td>0.080-0.100</td>
<td>0.100-0.120</td>
<td>0.120-0.130</td>
<td>116-132</td>
<td>119-132</td>
<td>19-22</td>
</tr>
</tbody>
</table>

(1) No male known.

The colouration of the two juveniles that we examined (ZFMK 65037, SVL 120 mm; SMF 78389, SVL 119 mm) is entirely similar to that of the adult. According to Syl (1976), the colouration of the ventral surface of a juvenile (size not reported) was uniformly black with the posterior margin of the ventral scales edged with yellowish-orange. Its throat was somewhat mottled. It is believed that the chequered pattern of the ventre had not yet developed, and the motting of the throat gave the impression that the chequered pattern found in adults was beginning to develop in that region.

Range. - Malaysia: Pahang: Mt. Buto Berinchang, in Cameron Highlands; Selangor: Jabatan Talakom station, Mt. Ulu Kali, Gombak Highlands.

Biological data. - This species has been found between 1500 and 1000 m in wet montane forests, under logs beside a mountain stream, and on a forest track. A juvenile described by Syl (1976) was collected on a road. This secretive, sluggish snake is associated with fairly damp biotopes. In captivity, we observed one specimen coiling itself around a soaked psd. It fed upon young house geckos, while rearing crickets baby mice and earthworms.

Nothing is known about its breeding habits. This species occurs in sympathy with *M. schaeldi* and *M. lateralis* on Mt. Buto Berinchang.

Relationships of the genus *Macrocalamus*

The position of the genus within the Colubridae is controversial. It is placed either in the subfamily Lycodontinae (Dowling & Duellman, 1978, in tribe Lycodontinae; Dowling, m.s., 1998) or Calamariinae (McDowell, 1987). Tweddie (1983) considers it to be related to the genus *Calamaria*, and calls its members "Mountain red snakes."

The closest relative to *Macrocalamus*, at least on the basis of morphology and pholidosis, seems to be the genus *Oreocalamus* Boulenger, 1899. The sole known species of this genus, *Oreocalamus hantishi* Boulenger, 1900 (Boulenger, 1899: 453. Type locality: Kina Bala, 4200 feet), is endemic to the Federation of Malaysia and is currently known from Mt. Kinabalu, Mt. Loyang (both Sabah), and Borneo Island. In the Cameron Highlands (Pahang, Malaysia) (Lim, 1972; Tweddie, 1983). The habits and distribution of this genus are similar to *Macrocalamus*, from which it differs by the number of dorsal scale rows (17 at midbody) and the presence of a pair of intermaxillary shields. *Oreocalamus*, the first upper labial may either be distinct or united to the nasal. Quite interestingly, a dark, median zigzag-like stripe beneath the tail is present else in
Pt. 17. Biotope of Macropalmarum schaubi, new species, Cameron Highlands, West-Malaysia. This species was commonly found under the moss along the fields. (Photo by Gernot Vogel)
Macrocalamus. A review of the genus Orocalamus will be given in a forthcoming paper. However, Orocalamus has no traumatic lung. White Pseudotabanus and Calamorhadinia are morphologically more different externally, their strong tracheal lung being an externally character. Some other Calamariastegia have a weak tracheal lung (Calamodrhiastegia, Bhasidin) and many have a weak tracheal lung (Calamoria, Orocalamus) (V. Wallis, pers. comm.).

IDENTIFICATION KEY TO THE GENUS MACROCALAMUS

1 Upper surface deep pink black, with or without a pair of yellow dorsal stripes; venter at least partially deep black ................................................................. 2
   Upper surface pale to dark brown, reddish-brown or greyish-brown, never deep black, and without dorsal/dorsolateral stripes; venter colour never black ................................................................................................................................. 3

2 Venter distinctly black and yellow, dorsal surface uniform, without stripes; usually ? (rarely 8) supralabials ........................................................................................................... Macrocalamus corvus
   Venter uniformly bright yellow or orange; dorsal surface with a pair of bright yellow dorsal stripes; 8 supralabials ........................................................................................................... Macrocalamus jasi

3 Venter uniform, without any marking ......................................................................................................................................................... 4
   Venter heavily speckled with black ................................................................................................................................. Macrocalamus cf. lateralis

4 A pair of dark ventrolateral stripes; venter bright red, orange or pink in life, creamy white or pale pink in alcohol; upper surface marked with a dorsolateral ocellus; often a median stripe under the tail; 115 or fewer ventrals in males; total length less than 300 mm......................................................................................................................... Macrocalamus lateralis
   No ventrolateral stripes; venter bright yellow in life, yellowish-brown in alcohol; upper surface uniform, lacking ocellus; median stripe behind the tail usually absent, rarely present and faint in very large specimens; 114 or more ventrals in males; total length up to 400 mm ................................................................................................................................. Macrocalamus schulzi, new species

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We are much indebted to Prof. Alain Dauvin, Director of the Laboratoire de Zoologie (Reptiles & Amphibians), to Dr. Ivan Incher and Mr. Oliver Pauwels, Laboratoire de Zoologie (Reptiles & Amphibians), Musée National d'Histoire Naturelle (Paris), to Dr. Wolfgang Böhme, Zoologisches Forschungsinstitut and Museum Alexander Koenig (Bonn) and to Mr. Van Wallach, Museum of Comparative Zoology, Harvard University (Cambridge), for their careful reading of the manuscript, their constructive comments and their technical support.

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328


329


Appendix: specimens examined


