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SIX CHARACTERS OF SYSTEMATIC IMPORTANCE IN THE SCINCID LIZARD GENUS *MABUYA*

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(with three text-figures)

ABSTRACT.- Six heretofore unrecognised characters in *Mabuya* are described and their distribution among the species in the genus is given where known. The reduction in the contact between the first supraocular and the frontal may be a derived character for the otherwise poorly diagnosed genus. The most posterior supraocular contacted by the frontal; the number of pretemporals; the number of temporal scales and their configuration; the number of small rows of scales dorsal to the window of the lower eyelid, and the fragility of the skin all vary interspecifically and hence are useful characters not only for the identification and alpha taxonomy of the species, but also for the eventual analysis of their phylogenetic relationships.

KEY WORDS.- *Mabuya*, Scincidae,Taxonomy.

INTRODUCTION

Mabuya is one of the largest and most widespread genera of skinks. It consists of approximately 110 species (pers. obs.) and ranges from south-east Asia west through south-central and south-west Asia, Africa, the Seychelles, Madagascar, and into Central and South America and the Caribbean. It is also one of the most long-recognised genera of skinks, the name having been in use virtually continuously since Fitzinger proposed it in 1826.

The purpose of this note is to discuss six new morphological characters useful in the systematics of *Mabuya*. One character is relevant to the taxon's diagnosis, and five characters are important in the identification of its species and hence ultimately useful in elucidating their phylogenetic relationships. One of the latter also has ecological relevance, as it seems to be part of a predator escape strategy. With regard to the taxon's diagnosis, it is worth noting that despite the size and conceptual durability of the group, none of characters that have been used in the standard generic diagnoses and descriptions are diagnostic either individually or in combination (e.g., Gray, 1845; Günther, 1864; Boulenger, 1887; Smith, 1935; Taylor, 1956, 1963; FitzSimons, 1943; Horton, 1973; Hoogmoed, 1973, 1974). With regard to the species' identification and phylogenetic relationships, it is clear from the use of often overlapping scale counts and morphologies in keys that additional discriminatory characters would be helpful.

MATERIALS AND METHODS

Data on the six scale characters were gathered primarily from examination of museum specimens, and from figures and descriptions in the literature. In a few instances, colleagues checked specimens for character states.

Inferences as to character state polarities have been made relative to *Eumeces*, the most generally structurally primitive skinks. That is, using any list of character states and their polarities derived for the analysis of squamates in general (e.g., Estes et al., 1988; Wu et al., 1996; Hallermann, 1998; Lee, 1998; Reynoso, 1998), *Eumeces* would have by far the largest number of primitive character states of any skink. If necessary, this very obvious observation can be quantified when and if another scincid taxon is ever proposed as a competing contender. The impor-

tance of *Eumeces* as the clearly most primitive taxon in skinks and hence as an outgroup for the analysis of basal relationships within skinks can not be underestimated. This is because there is great uncertainty as to the possible next most distant outgroup - either the gerrhosaurids + cordylids (as the cordylids) (i.e., Estes et al., 1988) or the anguimorphs (Lee, 1998). Added to the uncertainty of the identity of the next nearest outgroup, is the extreme variability of the two currently hypothesized outgroups. The gerrhosaurids and cordylids are very different groups phenetically and, interestingly, have never been entered into any cladistic analysis of squamates as separate taxonomic units to see how they would sort out individually against skinks. And for their part, the anguimorphs include not only a diverse group of lizards but also all snakes (Lee, 1998).

RESULTS AND DISCUSSION

The character relevant to the generic diagnosis of *Mabuya* is the degree of contact between the first supraocular and the frontal (Fig. 1). The five characters important for discriminating among species and species groups within the genus are: the number of the most posterior supraocular modally contacted by the frontal (Fig. 1); the number of pretemporal scales (Fig. 2); the number and configuration of the primary and secondary temporal scales (Fig. 2); in those species with a windowed eyelid, the number of scale rows bordering the upper edge of the window (Fig. 3), and the fragility of the skin when the animal is grasped or struck.

Degree of contact between the first supraocular and frontal.- The character is the size of the first supraocular scale and hence its position relative to the frontal scale. In the generally primitive scincid *Eumeces* and in all other lygosomine skinks the first supraocular makes broad contact with the frontal, the first supraocular's suture line with the frontal being approximately half the length of the supraocular's lateral suture line with the supraciliaries (Fig. 1A). In contrast, in all *Mabuya* except for five species, the first supraocular usually makes only short contact with the frontal or is separated from it entirely, in which case the second supraocular extends forward to contact the prefrontal (Fig. 1B). No other skink in which the homologies of the head scales are unambiguous, effectively all but the most highly modified burrowers, has this reduced first supraocular. In a few species the character is variable. For example, in a sample of 50 *Mabuya margaritifer*, the first supraocular and frontal were separated in one, in "short" contact in 36, and in "broad" contact in 13. However, in all other taxa in the *Mabuya quinquetaeniata* complex (Broadley and Bauer, 1998), the supraocular is separated from, or in only short contact with, the frontal.

Five species of *Mabuya* are exceptional in having what appears to be the generally primitive configuration of the first supraocular, that is, the supraocular large and in broad contact with the frontal (Fig. 1C): the Andaman Islands endemic *M. andamanensis*; the two Seychelles endemics *M. sechellensis* (Brygoo, 1981:fig. 4; Fig. 1C; pers. obs; i.e., n = 5) and *M. wrighti* (Boulenger, 1887: plate 8, i.e., n = 1), the south African *M. laevis* (Steyn and Mitchell, 1965:figs. 3-4; pers. obs.; n = 9), and the west Atlantic island (Fernando de Noronha) endemic *M. punctata* (Boulenger, 1887: plate 9, fig. 1; Schmidt, 1945: fig. 1; Travassos, 1946: Figs 1-2 but not 5, i.e., n = 6). Whether the character state in these species is truly primitive or is secondarily derived may become clearer with a future cladistic analysis of the species of *Mabuya* and their near relatives.

Although this character is not completely diagnostic for the genus *Mabuya*, it is nonetheless valuable in that it is far more inclusive than any other character yet used to diagnose the genus. Hence it serves as one of the strongest pieces of evidence that the skinks in the genus are indeed a phylogenetic lineage.

In the interests of priority, it is worth noting that although the character has never been used explicitly in any generic diagnosis of *Mabuya* (above), it may have been recognised on one occasion as a distinguishing feature of *Mabuya* in comparison with other skink genera. Taylor (1963: 941), with his usual eye for nuance, ap-

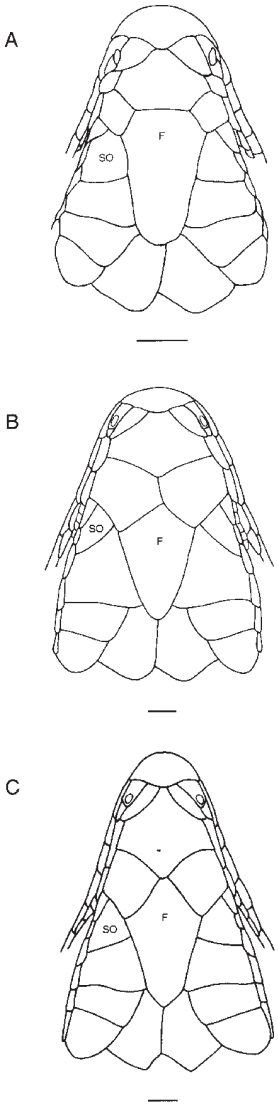

FIGURE 1: The dorsal head scales of *Mabuya* showing the degree of contact between the first supraocular and frontal, and whether the most posterior supraocular contacted by the frontal is the second or third. A: *Lygosoma bowringii* showing the broad contact between the first supraocular (SO) and the frontal (F) that is probably primitive for skinks; B: *Mabuya multifasciata* from south-east Asia showing the separation of the first supraocular from the frontal, and C: *Mabuya sechellensis* from the Seychelles showing broad contact between the first supraocular and frontal. Scale bar = 1 mm. Illustration: H. Finlay and R. Warren.

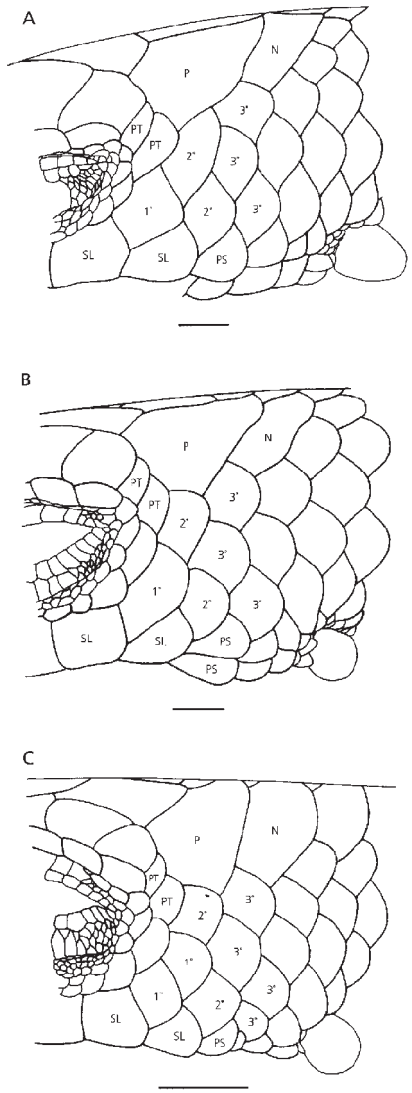

FIGURE 2: The temporal scales of *Mabuya* showing the distinct number and concentric arrangement of the primary, secondary and tertiary temporal scales in the genus, and the variability in the number or primary temporal scales. A: *M. arajara* from South America with a single primary temporal and the two secondary temporals in contact; B: *M. andamanensis* from the Andaman Islands with a single primary and the two secondary temporals narrowly separated, and C: *M. multicarinata* from south-east Asia with two primaries and the two secondary temporals widely separated. Abbreviations: N - nuchal scale; P - parietal scale; PS - postsupralabial scale; PT - pretemporal scale. The primary, secondary and tertiary temporals are designated 1°, 2° and 3°, respectively. Scale bar = 1 mm. Illustration: H. Finlay.

pears to have recognised the character in his descriptor "enlarged second supraocular" (= concomitantly reduced first supraocular?) used when arguing against Smith's (1916) proposal to place *Lygosoma praesignis*, now recognised as a *Sphenomorphus*, in *Mabuya*. However, Taylor never used the character in any of his generic diagnoses of *Mabuya* (above).

It is important to be sure of the monophyly of *Mabuya*, not only to confirm historical assumptions, but also to take advantage of its potential usefulness in some evolutionary studies, that is, as a species rich taxon whose members are all similar in shape but have a wide geographical distribution and an interesting range of subtle morphological and ecological characteristics, such as reproductive modes which range from oviparity through ovoviviparity to viviparity (Blackburn et al., 1984; Blackburn and Vitt, 1992).

Most posterior supraocular contacted by the frontal.- In most species of *Eumeces* there are usually four supraoculars and the first, second and third are contacted by the frontal. For the purposes of the character discussed here, the relevant observation is the number of the most posterior supraocular contacted by the frontal, in *Eumeces*, the third. In most species of *Mabuya* there are also four supraoculars. However, as noted above there is interspecific variation in the number of the most posterior supraocular modally contacted by the frontal. In some species it is the third, but in others it is the second. The former is considered to be the primitive condition and the latter derived.

The third supraocular is contacted by the frontal in almost all species in Africa and south-west Asia and their associated islands, i.e., the Seychelles, Socotra, and Madagascar in the Indian Ocean, and the Cape Verdes and Fernando de Noronha (200 km off the coast of Brazil) in the Atlantic Ocean. The second supraocular is contacted by the frontal in all species in south and south-east Asia and in the Americas (Table 1).

Number of pretemporal scales.- In *Eumeces* there are two pretemporal scales. Most species of *Mabuya* also have two pretemporals (Fig. 2), but a few species appear to have only one: the African *M. bayoni* (but n = 1) and *M. boulengeri*, the south-west Asian *M. vittata*, and the South American *M. guaporicola* (Table 2).

Temporal scale number and arrangement.- In *Eumeces* there is generally one primary temporal, two superimposed secondary temporals, and a variable number of tertiary temporals (these are little studied in the genus). In *Mabuya*, there are three states which can be arranged in the following morphocline: a single primary temporal followed by two superimposed secondary temporals (1+2 contiguous pattern; Fig. 2A); a single primary temporal followed by an upper and lower secondary temporal which are separated by an anteriorly encroaching tertiary temporal (1+2 separated pattern; Fig. 2B), and two primary temporals followed by an upper and lower secondary temporal separated by a well established intervening tertiary temporal (2+2 separated pattern; Fig. 2C). A related trend in this sequence of temporal scale changes is the reduction in size of the temporal scales, especially the upper secondary temporal.

The 1+2 contiguous pattern occurs in a few African species and in all American species. The 1+2 separated pattern occurs in many African species, most Madagascan species, the Seychelles species, and a few south and south-east Asian species. The 2+2 separated pattern occurs in a few African species, one Madagascan species, a few south Asian species, and most south-east Asian species.

Parenthetically, it should be noted that the upper anterior temporal (UAT) of Greer and Nussbaum (in press) is the upper secondary temporal of this work.

Number of scale rows dorsal to the lower eyelid's window(palpebral disc).- It has long been known that there are two basic conditions in the lower eyelid of species of *Mabuya*: the primitive scaly eyelid and the derived widowed eyelid. However, there is an important variant that is related to the windowed eyelid. It is the number of scale rows dorsal to the windowed portion of the eyelid: either one row (Fig. 3A), or two or more (rarely up to four) rows (Fig. 3B). When there are two or more rows, the scales of the ventral

TABLE 1: The most posterior supraocular scale contacted modally by the frontal scale in species of *Mabuya.* In the three species with only three supraoculars surveyed here, i.e., *M. bensonii* and *M. boettgeri*, and *M. ivensii*, it is assumed that the first supraocular has fused to an adjoining scale, and the count is made as if the scale were distinct. Superscripts indicate cases observed based on both sides of single specimens.

Species	Most posterior supraocular contacted by frontal	Reference
South-east Asia	2	
bontocensis	2	Brown and Alcala, 1980
cumingi	2	Brown and Alcala, 1980
englei	2	Brown and Alcala, 1980
indeprensa	2	Brown and Alcala, 1980; pers. obs., n = 4
longicaudata	2	Boulenger, 1887 (as *M. siamensis*); Flower, 1899 (in contact with 3 supraoculars in one of18 specimens); Van Denburgh, 1912; Cheng, 1987: fig. 2A
multicarinata	2	Boulenger, 1887; Cheng, 1987: fig.2B
borealis	2	Brown and Alcala, 1980
multicarinata	2	Brown and Alcala, 1980
multifasciata	$2^{87}/3^{1}$	Boulenger, 1887; Auffenberg, 1980: fig. 20; Brown and Alcala, 1980; pers. obs., n = 44
novemcarinata	$3^{5}/2^{3}$	Taylor, 1963, n = 1; C. McCarthy pers. comm., n = 3
rudis	2	Boulenger, 1887; Taylor, 1918: fig. 5; Brown and Alcala, 1980
rugifera	2	Boulenger, 1887
tytleri	2	Annandale, 1905
Southern Asia		
allapallensis	2	Schmidt, 1926: fig. 1; Sharma, 1973: fig. 2B
beddomii	2	Boulenger, 1887
bibronii	2	Boulenger, 1887
carinata	2	Boulenger, 1887
clivicola	2	Inger et al., 1984
dissimilis	2	Boulenger, 1887; Hora, 1927: fig. 1a (as *M. hodgarti*)
quadratilobus	2	Bauer and Günther, 1992
innotata	2	Boulenger, 1887
macularia	2	Boulenger, 1887
South-western Asia		
aurata	3	Pers. obs., n = 5
septemtaeniata	3	Hora, 1927: fig. 1c
socotrana	3	Pers. obs., n = 4
Seychelles		
sechellensis	3	Boulenger, 1887
wrighti	3	Boulenger, 1887
Madagascar		
aureopunctata	3	Boulenger, 1887; Brygoo, 1983: fig. 8
elegans	3	Boulenger, 1887; Brygoo, 1983: fig. 3-4
gravenhorsti	3	Brygoo, 1983: figs. 1-2
lavarambo	2	Nussbaum and Raxworthy, 1998a
nancycoutuae	3	Nussbaum and Raxworthy, 1998b; fig. 2
tandrefana	3	Nussbaum et al., 1999
vato	3	Nussbaum and Raxworthy, 1994: fig. 2

vezo	3	Ramanamanjato et al., 1999
volamenaloha	3	Nussbaum et al., 1999
Africa		
acutilabris	3	Boulenger, 1887; FitzSimons, 1943; pers. obs., n = 5
affinis	3	Boulenger, 1887 (as *M. raddoni*)
albilabris	2/3	Hoogmoed, 1974 ("2" is "usually" the condition observed)
bayoni	3	Pers. obs., n = 1
bensonii	3	Boulenger, 1887
binotata	3	FitzSimons, 1943; pers. obs., n = 3
bocagii	3	Boulenger, 1887
boettgeri	3	Boulenger, 1887
boulengeri	3	Pers. obs., n = 30
brauni	3	Pers. obs., n = 8
brevicollis	$3^{26}/2^{16}$	Boulenger, 1887; Parker, 1942, n = 11; pers. obs., n = 11
buettneri	3	Hoogmoed, 1974
capensis	3	Boulenger, 1887; FitzSimons, 1943; pers. obs., n = 61
chimbana	3	Pers. obs., n = 2
comorensis	3	Boulenger, 1887
depressa	$3^{95}/2^{5}$	Boulenger, 1887; FitzSimons, 1943: fig. 88: pers. obs., n = 55
ferrarai	3	Lanza, 1978: fig. 3C
hildebrandtii	3	Boulenger, 1887
hoeschi	3	Mertens, 1954; pers. obs., n = 2
homalocephala	3	Boulenger, 1887; FitzSimons, 1943; pers. obs., n = 3
ivensii	3	Pers. obs., n = 5
lacertiformis	3	Boulenger, 1887; pers. obs., n = 51
laevis	3	Steyn and Mitchell, 1965: figs. 3-4; pers. obs., n = 7
langheldi	3	Pers. obs., n = 1
maculilabris		
casuarinae	3	Pers. obs., n = 5
maculilabris	3	Boulenger, 1887; Hoogmoed, 1974; pers. obs., n = 50
margaritifer	$3^{52}/2^{3}$	FitzSimons, 1943; fig. 92; pers. obs., n = 55
megalura	3	Boulenger, 1887; pers. obs., n = 12
occidentalis	3	Boulenger, 1887; FitzSimons, 1943; pers. obs., n = 36
perrotetii	3	Boulenger, 1887; Hoogmoed, 1974; pers. obs., n = 7
planifrons	3	Boulenger, 1887; pers. obs., n = 11
polytropis		
paucisquamus	3	Hoogmoed, 1974 (as *M. p. occidentalis*)
pulcherrima	3	Pers. obs., n = 2
quinquetaeniata	3	Boulenger, 1887
quinquetaeniata	3	Pers. obs., n = 2
scharica	3	Hoogmoed, 1974
rodenburgi	3	Hoogmoed, 1974
spilogaster	3	Pers. obs., n = 50
striata	3	Boulenger, 1887; FitzSimons, 1943
mlanjensis	3	Pers. obs., n = 43
punctatissima	3	Broadley, 1977: fig. 1A; pers. obs., n = 69
sparsa	3	FitzSimons, 1943: fig. 104; pers. obs., n = 37
striata	3	Broadley, 1977: fig. 1B; pers. obs., n = 50

wahlbergi	3	Boulenger, 1887; pers. obs., n = 50
sulcata	$3^{39}/2^{1}$	Boulenger, 1887; FitzSimons, 1943; pers. obs., n = 20
varia	$3^{197}/2^{3}$	Boulenger, 1887; FitzSimons, 1943; pers. obs., n = 100
variegata		
punctulata	3	FitzSimons, 1943; pers. obs., n = 45
variegata	3	Broadley, 1975: plate I (type); pers. obs., n = 11
vittata	3	Boulenger, 1887
Cape Verde Islands		
delalandii	3	Boulenger, 1887; pers. obs., n = 3
fogoensis	3	Boulenger, 1887
stangeri	3	Boulenger, 1887; pers. obs., n = 6
vaillanti	3	Boulenger, 1887
Fernando de Noronha		
punctata	3	Boulenger, 1887; Schmidt, 1945: fig. 1; Travassos, 1946: plate 3
Americas		
agilis	2	Boulenger, 1887; Rebouças-Spieker, 1974: fig. 1, plate 1.1
arajara	2	Rebouças-Spieker, 1981; pers. obs., n = 5
aurata	2	Boulenger, 1887
bistriata	2	Avila-Pires, 1995: fig. 195; pers. obs., n = 2
brachypoda	2	Pers. obs., n = 5
caissara	2	Rebouças-Spieker, 1974: fig. 2
carvalhoi	2	Avila-Pires, 1995: fig. 198
dorsivittata	2	Hellmich, 1960
frenata	2	Boulenger, 1887; Hellmich, 1960
guaporicola	2	Avila-Pires, 1995: fig. 199
heathi	2	Vanzolini, 1980: fig. 92
lineolata	2	Cochran, 1941: fig 86
macrorhyncha	2	Hoge, 1946; Rebouças-Spieker, 1974: fig. 3, plate 1.3
nigropalmata	2	Avila-Pires, 1995: fig. 201
nigropunctata	2	Hoogmoed, 1873: fig. 37 (as *M. mabouya mabouya*); Avila-Pires, 1995: fig. 202
sloanii	2	Schmidt, 1928: fig. 38; Cochran, 1941: plate 9
unimarginata	2	Pers. obs., n = 1

row(s) are generally much smaller than those of the dorsal row. It is difficult to establish the relative polarities of these two character states vis à vis the completely scaly eyelid of *Eumeces*. However, in most other skinks with a windowed eyelid there is but one row of scales forming the upper part of the lower eyelid dorsal to the window. This can tentatively be taken as the more primitive condition.

Among those species of *Mabuya* examined with a windowed eyelid, the species that have only one row of small scales dorsal to the window include those from the Americas - *M. arajara, M. bistriata, M. brachypoda, M. frenata, M. nigropunctata* and *M. unimarginata*; the Cape Verdes - *M. delalandii* and *M. stangeri;* Africa - *M. affinis, M. albilabris, M. bensoni, M. boulengeri, M. brevicollis, M. buettneri, M. depressa, M. ferrarai, M. homalocephala, M. ivensii, M. maculilabris, M. perrotetii* and *M. polytropis*; the Seychelles - *M. sechellensis* and India - *M. bibroni* and *M. dissimilis*.

The species with two or more rows of small scales dorsal to the window are all mainland African - *M. acutilabris, M. bayoni, M. brauni, M. binotata, M. capensis, M. chimbana, M. hildebrandti, M. hoeschi, M. irregularis, M. lacertiformis, M. langheldi, M. margaritifer, M. megalura, M. occidentalis, M. planifrons, M. pulcherrima, M. quinquetaeniata, M.*

TABLE 2: Number of pretemporals, primary temporals, secondary temporals, tertiary temporals and postsupralabials in species of *Mabuya*. Superscripts are the number of occurrences the feature is observed based on examining both sides of the specimen. N is the sample size based on personal observation only unless indicated otherwise. When the superscripts do not equal twice the sample size based on personal observation, it is because the feature could not be scored on all sides. The letter "C" or "S" after the secondary (2°) temporal number indicates whether the secondary temporals are in contact (C) or are separated (S) by what is here interpreted as anteriorly encroaching tertiary (3°) temporal.

Temporal species	Pretemporals	1º	2º	3º	Postsupralabials	Reference
South-east Asia						
andamanensis	2	1	2S	3^{5}-4^{2}	2	Pers. obs., n = 5
indeprensa	2	2	2S	4	1	Pers. obs., n = 3
longicaudata	2	1	2S	3	2	Pers. obs., n = 1
multicarinata						
borealis	2	2	2S	3	1^{5}-2^{1}	Pers. obs., n = 4
multicarinata	2	2	2S	4	1	Pers. obs., n = 1
multifasciata	2	2	2S	3	2	Pers. obs., n > 20
rudis	2	2	2S	3	?	Pers. obs., n = 2
rugifera	2	1	2S	4^{2}-3^{1}	2	Pers. obs., n = 3
South-central Asia						
carinata	2	2	2S	3	2	Pers. obs., n = 2
South-west Asia						
aurata	2	1	2S	3	2	Pers. obs., n = 5
socotrana	2	1	$2S^{6}$-$2C^{1}$	3	2	Pers. obs., n = 4
vittata	1	1	2S	3	2	Pers. obs., n = 2
Seychelles						
sechellensis	2	1	2S	3	2	Pers. obs., n = 4
Madagascar						
lavarambo	2	1	2C	3	1	Nussbaum and Raxworthy, 1998a: fig. 2
nancycoutuae	2	2	2S	?	2	Nussbaum and Raxworthy, 1998a: fig. 2
vato	2	1	2S	3	2	Nussbaum and Raxworthy, 1994: fig. 2
Africa						
acutilabris	2	1	2S	3	1^{5}-2^{4}	Pers. obs., n = 5
affinis	2	1^{1}-2^{2}	$2S^{2}$-$3S^{1}$	3^{1}-4^{2}	1	Hoogmoed, 1974: fig. 7 (as corrected); n = 2 (inclusive of Hoogmoed's figure)
albilabris[1]	2	1	2C	2^{1}	2	Hoogmoed, 1974: fig.2; pers. obs., n = 3
bayoni	1	1	2S	3	2	Pers. obs., n = 1
binotata	2	1	2S	3	?	FitzSimons, 1943: fig. 91; pers. obs., n = 3
boulengeri	$2^{48}/1^{12}$	1	$2S^{57}/2C^{3}$	$3^{58}/4^{2}$	2^{56}-1^{4}	Pers. obs., n = 30
brauni	2	1	2S	4^{8}-3^{6}-5^{2}	2	Pers. obs., n = 8
brevicollis	2	$1^{19}/2^{1}$	2S	3	2	Pers. obs., n = 10
buettneri	2	1	2S	3	2	Hoogmoed, 1974: fig. 14 (as corrected)
capensis	$2^{117}/1^{5}$	$1^{102}/2^{20}$	$2S^{115}/2C^{7}$	4^{71}-3^{40}-5^{8}-2^{2}	2^{87}-1^{35}	FitzSimons, 1943: fig. 95; pers. obs., n = 61
chimbana	2	1	2S	3^{2}-4^{2}	2	Pers. obs., n = 2
depressa	$2^{98}/1^{2}$	1	$2S^{99}/2C^{1}$	3	$2^{91}/1^{9}$	FitzSimons, 1943: fig. 89; pers. obs., n = 50
ferrarai	2	2	2S	-	1	Lanza, 1978: fig. 3
hoeschi	2	1	2C	2^{5}-3^{4}-1^{3}	2^{11}-1^{1}	Pers. obs., n = 6
homalocephala	2	1	2S	$3^{5}/4^{1}$	$1^{4}/2^{2}$	Pers. obs., n = 3

ivensii	2	1	2S	3+	2^{8}-1^{7}	Pers. obs., n = 8
lacertiformis	2^{110}-1^{2}	1^{82}-2^{29}-3^{1}	$2S^{111}$-$3C^{1}$	3^{98}-4^{13}-5^{1}	$2^{108}/1^{4}$	Pers. obs., n = 56
laevis	2	1	2C	2^{5}-1^{3}	2^{7}-1^{1}	Pers. obs., n = 5
langheldi	2	1	2S	3	2	Pers. obs., n = 1
maculilabris						
casuarinae	2	1	2S	3	2	Pers. obs., n = 3
maculilabris	$2^{97}/1^{2}/3^{1}$	1	$2S^{96}/2C^{4}$	$3^{99}/4^{1}$	$2^{94}/1^{6}$	Hoogmoed, 1974: fig. 13 (as corrected); pers. obs., n = 50
margaritifer	2	$1^{103}/2^{2}$	$2S^{97}/2C^{8}$	4^{57}-5^{29}-3^{24}	2	FitzSimons, 1943: fig. 93; pers. obs., n = 55
megalura	2^{17}-1^{7}	1^{22}-2^{2}	$2S^{12}$-$2C^{12}$	3	2	Pers. obs., n = 12
occidentalis	2^{59}-1^{27}	1	2S	3^{82}-4^{2}	2	Pers. obs., n = 43
polytropis						
paucisquamis	2	1	2S	3	1	Hoogmoed, 1974: fig. 10 (as *M. polytropis occidentalis*)
perrotetii	2^{13}-1^{1}	$1^{12}/2^{2}$	2S	5^{9}-4^{5}	2	Hoogmoed, 1974: fig. 9; pers. obs., n = 7
planifrons	2	1	$2S^{20}$-$2C^{2}$	3^{21}-2^{1}	2	Pers. obs., n = 11
quinquetaeniata	2	1	2S	3	2^{20}-1^{4}	Hoogmoed, 1974: fig. 8 (as corrected); pers. obs., n = 12
rodenburgi	2	1	2C	3	2	Hoogmoed, 1974: fig. 1 (as corrected)
spilogaster	2^{92}-1^{8}	1^{93}-2^{7}	2S	3	2	Pers. obs., n = 50
striata						
mlanjensis	2	1^{85}-2^{1}	$2S^{66}/2C^{20}$	3^{79}-4^{7}	2	Pers. obs., n = 43
punctatissimus	2^{135}-1^{3}	1^{129}-2^{9}	2S	3^{123}-4^{15}	2	Pers. obs., n = 69
sparsa	2	1^{68}-2^{8}	2S	3^{72}-4^{2}	2	Pers. obs., n = 37
striata	2	1^{106}-2^{10}	2S	3^{109}-4^{6}	2	Pers. obs., n = 58
wahlbergi	2	1^{96}-2^{4}	2S	3^{98}-4^{2}	2	Pers. obs., n = 50
sulcata	2	1^{40}-2^{2}	$2S^{36}$-$2C^{6}$	3	2^{40}-1^{2}	FitzSimons, 1943: fig. 103; pers. obs., n = 21
varia	$2^{193}/1^{7}$	1	$2S^{191}/2C^{9}$	3^{195}-4^{4}-2^{1}	2^{186}-1^{5}	FitzSimons, 1943: fig. 99; pers. obs., n = 100
variegata						
punctulata	$2^{77}/1^{13}$	$1^{89}/2^{1}$	$2S^{88}/2C^{2}$	$3^{87}/4^{3}$	2^{69}-2^{21}	FitzSimons, 1943: fig. 101 (as *M. damarana*); pers. obs., n = 45
variegata	2	1	$2S^{21}/2C^{1}$	$3^{21}1/4^{1}$	2^{17}-1^{5}	Pers. obs., n = 11
Cape Verde Islands						
delalandii	2	1	2C	3	2	Pers. obs., n = 3
stangeri						
maioensis	2	1	2C		$2^{5}/?^{1}$	Pers. obs., n = 3
stangeri[2]	2	1	2C		2	Pers. obs., n = 3
Americas						
arajara	2	1	2C	3	1^{5}-2^{4}	Pers. obs., n = 5
bistriata	2	1	2C	3	1^{2}-2^{2}	Avila-Pires, 1995: fig. 195; pers. obs., n = 2
brachypoda	2	1	2C	3	1^{9}-2^{1}	Pers. obs., n = 5
carvalhoi	2	1	2C	2	1	Avila-Pires, 1995: fig. 198
frenata	2	1	2C	2-3	2^{2}-1^{2}	Pers. obs., n = 2
guaporicola	1	1	2C	3	2	Avila-Pires, 1995: fig. 199
nigropalmata	2	1	2C	3	1	Avila-Pires, 1995: fig. 201
nigropunctata	2	1	2C	3	2^{2}-1^{2}	Hoogmoed, 1973 (as *M. mabouya*); Avila-Pires, 1995: fig. 202;.pers. obs., n = 2
unimarginata	2	1	2C	3	1	Pers. obs., n = 1

1. An alternative interpretation would be 2S with the medial intervening tertiary temporal so greatly expanded that the dorsal secondary temporal is almost completely squeezed out of its contact with the primary temporal.
2. The posterior supralabial appears to have been divided horizontally, giving the impression of the 2S configuration in the secondary temporal.

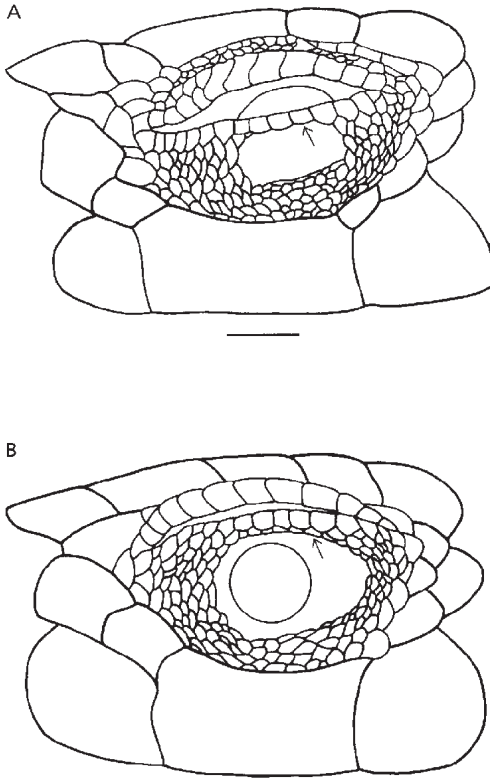

FIGURE 3. The eyelid of *Mabuya* species with a windowed eyelid showing the variation in the number of small scales across the dorsal edge of the window (arrow). A: *M. boulengeri* from southern Africa with a single row and B: *M. vittata* from north-east Africa and south-west Asia with two rows. Scale bar = 1 mm. Illustration: H. Finlay.

spilogaster, M. striata, M. sulcata, M. varia, M. variegata and *M. vittata.*

Fragility of the skin.- *Eumeces* has strongly adherent skin. This is also true of most species of *Mabuya*. However, in a few species of *Mabuya,* notably all African or Madagascan, the skin appears to tear away relatively easily when the animal is grasped: *M. acutilabris* (A. Bauer, pers. comm.), *M. hoeschi* (A. Bauer, pers. comm.), *M. lacertiformis* (pers. obs.), *M. nancycoutuae* (Nussbaum and Raxworthy, 1998), *M. occidentalis* (A. Bauer, pers. comm.), *M. sulcata* (pers. obs.), *M. varia* (pers. obs.), *M. variegata* (pers. obs.) and *M. vato* (Nussbaum and Raxworthy, 1998). Although this feature is most reliably determined in the field with fresh material, it is also indicated when several specimens in a series have large jagged pieces of skin missing.

Similar tear away skin have been observed in some species of the Australian scincid genera *Ctenotus* and *Lerista* and are thought to be an adaptation to allow the lizards to escape from the grasp of a predator (Greer, 1989).

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DESCRIPTION OF A NEW GENUS, *HYPSICALOTES* GEN. NOV. (SAURIA: AGAMIDAE) FROM MOUNT KINABALU, NORTH BORNEO, WITH REMARKS ON THE GENERIC IDENTITY OF *GONOCEPHALUS SCHULTZEWESTRUMI* URBAN, 1999

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(with five text-figures)

ABSTRACT.- The genus *Hypsicalotes* gen. nov. has been erected for *Calotes kinabaluensis,* hence the new combination *Hypsicalotes kinabaluensis* comb. nov. This species has formerly been considered congeneric with either *Calotes* or *Pseudocalotes*. The intergeneric differences between the closely related genera *Bronchocela*, *Calotes, Hypsicalotes* and *Pseudocalotes* are discussed. The recently described *Gonocephalus schultzewestrumi* Urban, 1999 is placed in the genus *Hypsilurus*, therefore the new combination *Hypsilurus schultzewestrumi* comb. nov. *Salea brachydactyla* Rendahl, 1937 turned out to be a junior synonym of *Salea kakhienensis* (Anderson, "1878" 1879).

KEY WORDS.- Agamidae, taxonomy, *Hypsicalotes* gen. nov., neotype designation, *Hypsilurus schultzewestrumi* comb. nov., *Salea brachydactyla* junior synonym of *S. kakhienensis*

INTRODUCTION

Historically, the content of the genus *Calotes* Cuvier, 1817 has been unresolved, and many authors, starting with Boulenger (1885) have utilized a broad concept of the genus. Although *Bronchocela* Kaup, 1827 and *Pseudocalotes* Fitzinger, 1843 were introduced subsequently, their constituent species were considered congeneric with *Calotes* by Boulenger (l. c.) and later Smith (1935), who recognized 25 species, including newly described taxa.

Mertens (1954) transferred the monotypic genus *Dendragama* Doria, 1888 to *Calotes,* disregarding its unique morphological features. Wermuth (1967), while accepting the concepts mentioned above, recognized 30 species within the genus *Calotes,* and treated the related genera *Lophocalotes* Günther, 1872*, Oriocalotes* Günther, 1864*, Paracalotes* Bourret, 1939 and *Salea* Gray, 1845 as valid.

In his attempt to arrive at a phylogeny of agamid lizards, Moody (1980) disentangled the genus *Calotes* and revalidated *Bronchocela* (= *Calotes cristatellus* group sensu Smith 1935, including the additional taxa: *B. celebensis, B. danieli, B. hayeki* and *B. marmorata*) and *Pseudocalotes* (= *Calotes microlepis* group sensu Smith 1935, excluding *C. kakhienensis,* but including *Paracalotes poilani*). The *versicolor* and *liocephalus* groups (sensu Smith 1935), as well as *C. elliotti* and *C. rouxi,* were left in *Calotes* with the addition of *Calotes kinabaluensis* de Grijs. Moody (1980) placed *C. kakhienensis* in *Salea*, and removed the monotypic taxon *Dendragama* from the synonymy of *Calotes*. However, *C. kingdonwardi* and *C. kinabaluensis* were not studied, as specimens were not available to him.

Although Moody's thesis has never been published, many subsequent researchers have followed his scheme of classification (e.g., Böhme 1988; Denzer and Manthey 1990; Inger and Tan 1996; Manthey and Grossmann 1997). On the other hand, several workers have opposed it (Ota and Hikida 1991, 1996; Zhao and Adler 1993), primarily because generic diagno-

ses were missing. As a result Ota and Hikida (1991) described *Calotes nigrigularis,* a species not exhibiting the characteristics of the genus *Calotes* sensu Moody (1980). Manthey in Manthey and Grossmann (1997) consequently erected the genus *Complicitus* and transferred *Calotes nigrigularis* to it.

Inger and Stuebing (1994), while following Moody (1980) reported the genus *Pseudocalotes* for the first time for Borneo, with their description of *P. saravacensis*.

Recent papers followed Moody (1980) and specified a set of characters in order to separate *Bronchocela* from *Calotes* (Diong and Lim 1998). Hallermann and Böhme (1999) present diagnostics for *Pseudocalotes* and discuss the intergeneric differences between *Pseudocalotes, Bronchocela, Calotes* and *Dendragama*. They did, however, not study *Calotes kinabaluensis*.

Ota and Hikida (1996) redescribed *C. kinabaluensis* after a second specimen was at hand, the type being destroyed during World War II. They discussed its relationship to other members of the group while retaining the species in *Calotes*. Inger and Stuebing (1994) however, expressed their opinion that *C. kinabaluensis* might belong to the genus *Pseudocalotes*.

Calotes kinabaluensis resembles in some features specimens of the genus *Hypsilurus* from New Guinea. This genus has been introduced to the literature by Peters (1867) and is widely accepted (Ehmann, 1992; Cogger, 1992). However, some author consider the lizards of this genus to be congeneric with *Gonocephalus* Kaup, 1825. Most recently, Urban (1999) described a *Gonocephalus* from New Guinea that shares some characters with *C. kinabaluensis*.

In the course of our study, it became clear that *Calotes kinabaluensis* is a unique agamid lizard as regards head and gular pouch pholidosis, and we establish a new genus for it.

MATERIALS AND METHODS

Most of the material used in this study is housed in the ZMB (Museum für Naturkunde der Humboldt-Universität zu Berlin), and where necessary, types and additional specimens were borrowed from other collections. A list of taxa is given in Appendix I. We examined almost all species of *Calotes* (sensu Wermuth 1967, Ota and Hikida 1991), plus *Oriocalotes, Lophocalotes,* and most species of *Salea. Hypsilurus* species were included as a phylogenetic outgroup because of their superficial similarities to *C. kinabaluensis* as concerns head pholidosis. Where specimens were not available data were taken from the original description.

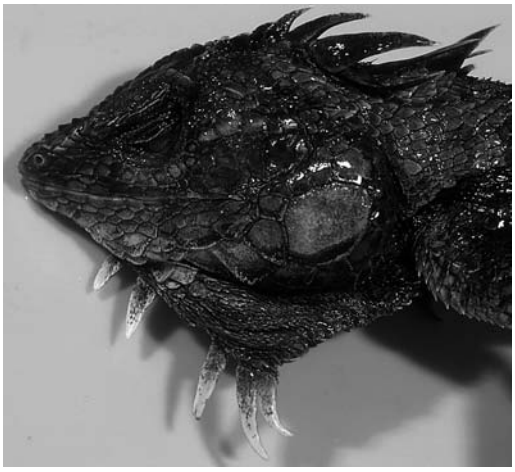

FIGURE 1: Neotype of *Hypsicalotes kinabaluensis* (KUZ 31291), showing lateral view of head.

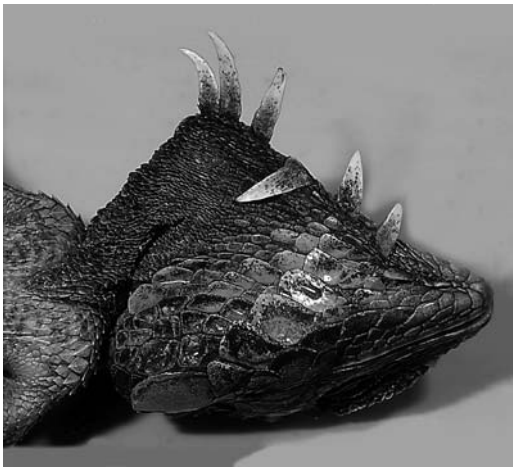

FIGURE 2: Neotype of *Hypsicalotes kinabaluensis* (KUZ 31291), showing lower surface of head with well developed gular pouch.

RESULTS

The recently described *Gonocephalus schultzewestrumi* Urban, 1999 clearly shows all the characteristics of the genus *Hypsilurus* Peters, 1867. Ota et al. (1992) studied karyotypes of Asian and Australian members of *Gonocephalus* and revealed significant differences between the two radiations. However, as they were lacking material, they did not confirm the validity of *Hypsilurus*. The difference between the Asiatic *Gonocephalus* radiation and the New Guinean/Australian *Hypsilurus* radiation was strongly supported by Ananjeva and Matveyeva-Dujsebayeva (1996). Their findings clearly show structural differences in the skin receptors, i. e., hair-like scale organs in *Gonocephalus* and lens-like sense organs in *Hypsilurus* (see also Scortecci 1937, 1941). Additionally, *G. schultzewestrumi*, as are all other species of the genus *Hypsilurus*, is extralimital to the range of *Gonocephalus* s. str. as defined by Manthey and Denzer (1991). *Gonocephalus schultzewestrumi* Urban, 1999 is therefore replaced by *Hypsilurus schultzewestrumi* comb. nov.

Calotes kinabaluensis de Grijs, 1937 differs morphologically from the remaining *Calotes* species and nearly all other agamid lizards, for which reason we describe a new genus to accommodate it.

***Hypsicalotes* gen. nov.**

Species typica.- *Calotes kinabaluensis* de Grijs, 1937; Type locality: Mt. Kinabalu (the holotype deposited in the Zoologisches Museum Hamburg is missing, fide Hallermann, 1998); neotype (here designated) Kyoto University Zoological Collection (KUZ) 31291, Kinabalu Park, Sabah, Malaysia (detailed sampling data unknown).

Diagnosis.- Large species (up to 145 mm SVL), morphometrically similar to *Calotes* with medium sized hindlimbs (44% SVL) and tail (230% SVL); dorsal scales heterogeneous in size, form and arrangement, larger than ventrals; side of head below tympanum covered with an extremely enlarged plate approximately same size as orbit of eye (see Fig. 1); nuchal and dorsal crest clearly separated, present at least in males and continuing on tail; males with well developed gular pouch with long lanceolate scales along anterior edge (see Fig. 2); scales on gular pouch minute, heterogeneous in shape (oval to rhombic) and size; scalation on lower surface of head extremely heterogeneous in shape and size. Tail swollen behind base, posterior part strongly compressed. – Monotypic genus, known only from Mt. Kinabalu, Sabah, Malaysia from three specimens.

Comparison.- *Hypsicalotes* differs from all other agamid genera (except *Hypsilurus*) by the possession of large plates on both sides of head, heterogeneous, partly very large scalation on lower surface of head, by distinctive, lanceolate scales along midline of gular pouch of males as well as minute, mainly oval gular pouch scalation. It is expected that the plate on the sides of the head will be smaller in females as this is

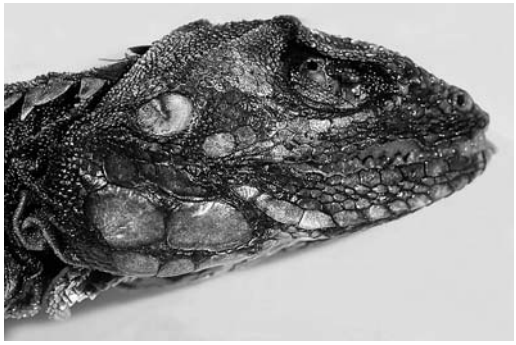

FIGURE 3: Holotype of *Hypsilurus schultzewestrum*i (ZSM 1956/82) from Nondugl, Papua New Guinea, showing lateral view of head.

FIGURE 4: Holotype of *Hypsilurus schultzewestrum*i (ZSM 1956/82), showing lower surface of head.

true for similar species such as *Hypsicalotes schultzewestrumi*.

Additionally to all these characteristics it differs from:

Calotes by heterogeneous, somewhat irregularly arranged dorsal scalation (vs homogeneous, regularly arranged dorsal scalation) and the separation of nuchal and dorsal crest in males (vs a continued vertebral crest).

Bronchocela by absent lateral skinfolds on both sides of neck supported by hyoid apparatus (vs present), inhomogeneous, somewhat irregularly arranged dorsal scalation (vs homogeneous, regularly arranged dorsal scalation) and ventrals smaller than dorsals (vs ventrals larger than dorsals).

Complicitus by absent lateral pockets on gular pouch (vs present).

Dendragama by absent bony ridges on occipital region (vs present)

Lophocalotes by keeled subdigital scales (vs smooth subdigital scales).

Pseudocalotes by the possession of a strongly developed nuchal crest consisting of scales in close neighbourhood (vs single standing scales or a poorly developed nuchal crest).

Pseudocophotis by a present tympanum (vs absent), an absent prehensile tail (vs present), and absent erected superciliary scales (vs present).

As regards the large plates on both sides of head and throat, as well as lanceolate scales along midline of gular pouch *Hypsicalotes* reveals similarities to *Hypsilurus* Peters, 1867.

In *Hypsilurus schultzewestrumi* (Urban, 1999) from Papua New Guinea, plates on both sides of head and on ventral surface of head are also present (see Figs. 3-4). With the exception of tail length, additional morphometric data are similar to those of *Hypsicalotes*. Other undescribed and described *Hypsilurus* species only possess strongly enlarged scales on both sides of the head (e.g., *H. papuensis*) or lanceolate scales along median line of gular pouch are present (e.g., *H. dilophus* and *H. boydii*). We consider the development of the latter two characters as evolutionary convergence in *Hypsicalotes* and *Hypsilurus*.

Hypsicalotes differs from *Hypsilurus* by

- the possession of hair-like sense organs (vs lens-like sense organs).
- a significantly larger dorsal scalation
- an absent oblique fold when the gular pouch is adpressed (vs present, see fig. 4).
- equally sized scalation in the anterior and posterior part of the gular pouch (vs a different scalation in the anterior and posterior part of the gular pouch).

Etymology.- The generic name chosen for the remarkable species is not a combination of morphological attributes (Greek hypsos - height; kallos - beauty), but reflects our view that it shows mixed characteristics between species from the Oriental *Calotes*-radiation and *Hypsilurus* species from New Guinea, hence *Hypsicalotes*.

Taxon. - *Hypsicalotes kinabaluensis* (de Grijs, 1937).

DISCUSSION

The generic classification used for comparisons is compiled below. Most of the genera discussed were at one time or another members of the heterogeneous group *Calotes*. According to the recent literature the following genera are widely recognised. In cases where our view differs from published results, we provide justifications.

Bronchocela **Kaup**, **1827**

Taxa. - *Bronchocela celebensis* Gray, 1845; *B. cristatella* (Kuhl, 1820); *B. danieli* (Tiwari and Biswas, 1973); *B. hayeki* (Müller, 1928); *B. jubata* (Duméril and Bibron, 1837); *B. marmorata* Gray, 1845; *B. smaragdina* Günther, 1864.– South-east Asia to New Guinea.

Calotes **Cuvier**, **1817**

Taxa. - *Calotes andamanensis* Boulenger, 1891; *C. bhutanensis* Biswas, 1975; *C. calotes* (Linnaeus, 1758); *C. ceylonensis* Müller, 1890; *C. elliotti* Günther, 1864; *C. emma* Gray, 1845; *C. grandisquamis* Günther, 1875; *C. jerdoni* Günther, 1871; *Calotes* (inc. sed.) *kingdonwardi* Smith, 1935; *C. liocephalus* Günther, 1872; *C. liolepis* Boulenger, 1885; *C. maria* Gray, 1845;

C. medogensis Zhao and Li, 1984; *C. mystaceus* Duméril and Bibron, 1837; *C. nemoricola* Jerdon, 1853; *C. nigrilabris* Peters, 1860; *C. rouxi* Duméril and Bibron, 1837; *C. versicolor* (Daudin, 1802). – Oriental region.

***Complicitus* Manthey, 1997**

Taxon. - *Complicitus nigrigularis* (Ota and Hikida, 1991). – Monotypic genus, known only from a single specimen from Mt. Kinabalu, Sabah, Malaysia.

***Dendragama* Doria, 1888**

Taxon. - *Dendragama boulengeri* Doria, 1888. – Monotypic genus, known only from Sumatra.

***Lophocalotes* Günther, 1872**

Taxon. - *Lophocalotes ludekingi* (Bleeker, 1860).– Monotypic genus, known only from Sumatra.

***Oriocalotes* Günther, 1864**

Taxon. - *Oriocalotes paulus* Smith, 1935.– Monotypic genus, Xizang (Tibet), Sikkim and Khasi Hills (Eastern India).

***Pseudocalotes* Fitzinger, 1843**

Taxa. - *Pseudocalotes brevipes* (Werner, 1904); *P. flavigula* (Smith, 1924); *P. floweri* (Boulenger, 1912); *P. poilani* (Bourret, 1939); *P. saravacensis* Inger and Stuebing, 1994; *P. tympanistriga* (Gray, 1831).– Oriental region.

A specimen from Malaysia described by Dring (1979) as *Calotes* sp. also clearly belongs to *Pseudocalotes*.

Paracalotes poilani is not unambiguously defined but shows strong affinities towards *Pseudocalotes*. It differs from the remaining members of *Pseudocalotes* by a distinctly depressed, broad head in conjunction with almost granular gular scalation, a missing gular pouch and the clear separation between nuchal and a small dorsal crest. In a recent study Hallermann and Böhme (1999) showed that *Paracalotes poilani* is associated with the Indochinese members of the genus *Pseudocalotes* through the possession of modified subdigital lamellae of the third toe (see also Dring 1979, Fig. 17).

***Pseudocophotis* Manthey, 1997**

Taxon – *Pseudocophotis sumatrana* (Hubrecht, 1879).– Monotypic genus, known from Sumatra and Java.

Hallermann and Böhme (l. c.) also assigned *Pseudocophotis sumatrana* (Hubrecht, 1879) to the genus *Pseudocalotes*. They treat the loss of an external tympanum and a prehensile tail as adaptive characters, not distinctive for a genus. They did not refer to a rostral appendage present in males, as well as a tail crest and erect supraciliary scales. All of these features were used as phylogenetic characters in the cladistic analysis of Moody (1980). Their combination is unique among agamid lizards and we consequently regard the genus *Pseudocophotis* Manthey in Manthey and Grossmann 1997 as valid.

***Salea* Gray, 1845**

Taxa. - *Salea anamallayana* (Beddome, 1878); ? *S. gularis* Blyth, 1853; *S. horsfieldii* Gray, 1845; *S.* (inc. sed.) *kakhienensis* (Anderson, "1878" 1879). – South-western India, Myanmar, Thailand, southern China.

Remark: The status of *Salea gularis* is uncertain (Wermuth, 1967). Unfortunately, we could not examine specimens of this taxa. Smith (1935) states that it may belong to the genus *Calotes*.

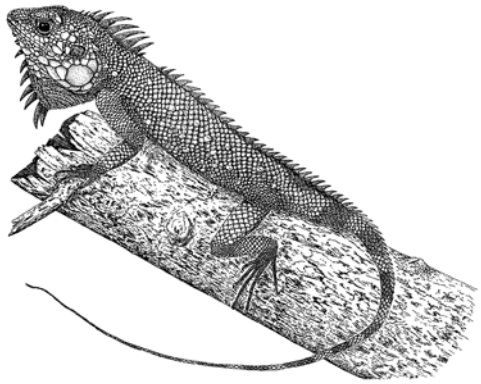

FIGURE 5: Drawing of the neotype (KUZ 31291) of *Hypsicalotes borneensis*, male. Sketch by Vera Heinrich (ZMB).

Oriocalotes kakhienensis Anderson, "1878" 1879 appears closely related to the genus *Salea.* Smith (l. c.) placed this species in the *Calotes microlepis* group, while Moody (1980) allocated it to *Salea*. We provisionally accept the latter assignment. The subdigital lamellae of the third toe are not modified in *S. kakhienensis* as by members of *Pseudocalotes* from the same geographical area. This species is aberrant in *Salea* and *Pseudocalotes* and further investigations are necessary to unambiguously assign it to either of the genera. We examined the holotype of *Salea brachydactyla* Rendahl, 1937 (Swedish Museum of Natural History No. 3958) and consider it conspecific with *Oriocalotes kakhienensis* Anderson, "1878" 1879. It therefore becomes a junior synonym of the latter taxon.

Apparently, Rendahl in his original description (l. c.) only compared the specimen to members of the genus *Salea* (*anamallayana* and *horsfieldii*) but not to other related genera. However, *Oriocalotes kakhienensis* was at that time considered a member of *Calotes* (after Smith 1935) or *Acanthosaura* (after Boulenger 1885), respectively.

DISTRIBUTION

With the taxonomic classification outlined, the distributional pattern of the concerned genera can be drawn up. *Oriocalotes, Salea* and *Calotes* s. str. belong to a mainly Indian radiation of agamid lizards. Four species are endemic to Sri Lanka. Only two species of *Calotes* actually cross the zoogeographical border into the Malay Peninsula south of the Isthmus of Kra, namely *C. versicolor* and *C. emma*. *Pseudocalotes* is an inhabitant of Myanmar, Thailand, Indochina, southern China, the Malay Peninsula and Borneo. The monotypic genera *Complicitus* and *Hypsicalotes* as well as *Dendragama* and *Lophocalotes* are endemic to Borneo and Sumatra, respectively. The most widely distributed genus is *Bronchocela,* with members from India (Nicobar Islands), Myanmar, Indochina (Vietnam), the Malay Peninsula, the Philippines and the Indo-Australian Archipelago, including New Guinea. *Calotes versicolor* and *Bronchocela cristatella* are the most widespread species and can be found in nearly all parts of the distribution of their respective genera. Within the genus *Pseudocalotes,* most species are highly restricted, mainly to mountainous regions as are all the monotypic genera of the group.

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APPENDIX I

The following is a list of taxa examined, where "n" is the number of individuals examined per species. The abbreviation sp**.** denotes specimens of uncertain specific status or as yet undescribed species.

Genera and species examined: *Bronchocela* (sensu Diong & Lim, 1998): *celebensis* (n = 1, type), *cristatella* (n = 78), *hayeki* (n = 1), *jubata* (n = 15), *marmorata* (n = 11), *smaragdina* (n = 1), *danieli* (n = 1, holotype, data from I. Das).

Calotes (sensu Smith 1935, except *microlepis* group, now *Pseudocalotes* and except *cristatellus* group, now *Bronchocela*): *calotes* (n = 3), *ceylonensis* (n = 1), *emma* (n = 9), *grandisquamis* (n = 1), *jerdoni* (n = 2), (inc. sed.) *kakhienensis* (n = 6), *kinabaluensis* (n = 1), *liolepis* (n = 1), *maria* (n = 1), *mystaceus* (n = 7), *nigrilabris* (n = 4), *rouxi* (n = 1), *versicolor* (n = 8).

Complicitus nigrigularis (n = 1, holotype).

Dendragama boulengeri (n = 9).

Pseudocalotes (sensu Hallermann & Böhme 1999): *brevipes* (n = 2, including lectotype), *flavigula* (n = 1, holotype, data provided by J. Hallermann), *floweri* (n = 2, including syntype), *microlepis* (n = 3), *poilani* (n = 1, holotype), *saravacensis* (n = 1, holotype, data provided by J. Hallermann), *tympanistriga* (n = 9).

Oriocalotes paulus (n = 2).

Lophocalotes ludekingi (n = 2).

Salea (sensu Smith 1935): *horsfieldii* (n = 3), *anamallayana* (n = 1), including *brachydactyla* Rendahl, 1937 (n = 1, holotype).

Hypsilurus: *auritus* (n = 1, holotype), *binotatus* (n = 1), *boydii* (n = 1), *geelvinkianus* (n = 2, syntypes), *godeffroyi* (n = 17, including lectotype), *macrolepis* (n = 5, including holotype), *modestus* (n = 12, incl. holotype), *nigrigularis* (n = 1, holotype), *papuensis* (n = 3), *schoedei* (n = 28, syntypes), *schultzewestrumi* (n = 2, holotype and paratype), sp. A (n = 2), sp. B (n = 1), sp. C (n = 1).

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A NEW SPECIES OF *RHACOPHORUS* (ANURA: RHACOPHORIDAE) FROM THE WESTERN GHATS, INDIA

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(with four text-figures)

ABSTRACT.-A new species belonging to the genus *Rhacophorus* is described on the basis of four specimens collected from the Western Ghats of Tamil Nadu, southern India. It is diagnosed by the following characters: moderate size (mean SVL 52.7 mm); indistinct tympanum; diameter over half of that of eye; fingers two thirds and toes fully webbed; a flap of skin on forearms; a conical flap of skin on heels; dorsum green with leaf venation like markings and webs of fingers yellowish-orange. This species resembles closely a congeneric species, *Rhacophorus malabaricus*.

KEY WORDS.- *Rhacophorus pseudomalabaricus*, new species, Rhacophoridae, Anura, Western Ghats, Tamil Nadu, India.

INTRODUCTION

Old World tree frogs are conventionally allocated to the genera *Polypedates* Tschudi, 1838, *Rhacophorus* Kuhl and van Hasselt, 1822, and 27 other genera (Liem, 1970). Dubois (1986) tentatively assigned the contents of both genera to *Rhacophorus*. Following this revision, the genus *Rhacophorus* now includes 57 species (Duellman, 1993) that are confined mainly to the Old World tropics (Liem, 1970; Frost, 1985; Duellman, 1993). Dutta (1997) included 16 species of *Rhacophorus* in the amphibian fauna of India. Among these, 11 species (*R. appendiculatus, R. bipunctatus, R. bisacculus, R. dubius, R. jerdoni, R. maximus, R. namdaphaensis, R. naso, R. nigropalmatus, R. reinwardtii* and *R. tuberculatus*) are found in north-eastern India and three (*R. calcadensis, R. lateralis* and *R. malabaricus*) in the Western Ghats. A solitary report of *R. bipunctatus* from Coorg, Western Ghats (Rao, 1920) has not been verified, and hence its distribution in the Western Ghats is questionable.

Collections of amphibians were made part of an ongoing study on the impact of rainforest fragmentation on the herpetofauna in the Western Ghats.

MATERIALS AND METHODS

The four types obtained in 1998 were euthanized in chloroform and fixed in four percent formalin and transferred to 70% ethanol after 24 h. Sex and maturity of individuals were determined by dissecting and examining the gonads. The following measurements were obtained with a Mitutoyo™ dial vernier calipers (to the nearest 0.1 mm): distance from tip of snout to vent or snout vent length (SVL); distance from angle of jaw to tip of snout or head length (HL); transverse distance between angle of jaws or head width (HW); greatest diameter of orbit or eye diameter (ED); greatest diameter of tympanum (TYD); least distance between upper eye lids or interorbital width (IOW); Distance between nostrils or internarial distance (IND); Distance between anterior margin of eye to tip of snout or eye to tip of snout distance (ESD); distance from anterior margin of eye to nostril or eye to nostril distance (END); highest width of abdominal region or body width (BW); distance from posterior base of forelimb at its emergence from body to base of emergence of hindlimb at its emergence from body or axilla to groin distance (A-G); greatest diameter of disk on third finger or diameter of third finger tip (FT3D); greatest

FIGURE 1: Holotype of *Rhacophorus pseudomalabaricus* (BNHM 3095) showing colour in life.

FIGURE 2: Close-up of head of *Rhacophorus pseudomalabaricus* (holotype).

FIGURE 3: Metamorph of *Rhacophorus pseudomalabaricus*, showing leaf venation-like markings on body.

diameter of disk on fourth toe or diameter of fourth toe tip (TT4D); length of inner metatarsal tubercle (MTL). Characters of congeners listed in the section on comparisons are from comparative material examined (Appendix I), as well as descriptions in Boulenger (1890), Ahl (1931), Wolf (1936), Inger (1954, 1996), Taylor (1962), Chanda (1994) and Dutta and Manamendra-Arachchi (1996). Museum acronyms used follow Leviton et al. (1985). Behavioural observations and collection of individuals were made from a pond in Andiparai, a rain forest fragment in the Indira Gandhi Wildlife Sanctuary.

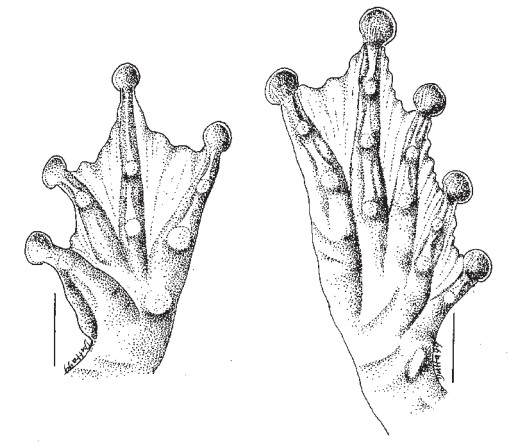

FIGURE 4: 4a.Ventral view of left forelimb of holotype of *Rhacophorus pseudomalabaricus*; 4b. ventral view of right hindlimb of holotype of *Rhacophorus pseudomalabaricus.* Markers represent 4.0 mm.

Rhacophorus pseudomalabaricus sp. nov.

Figs. 1–3

Holotype.- BNHM 3095, from Andiparai Shola, 1,190 m above msl in Indira Gandhi Wildlife Sanctuary, Tamil Nadu, India. Collected by K. Vasudevan, 9 September 1998.

Paratypes.- ZSI/SRS VA/1078-79, WII 514, collection data as above, 23 January 1998; 24 July 1998; and 10 October 1998, respectively.

Diagnosis.- Size (SVL) to 66.8 mm; differentiated from congeners from the Indian subcontinent (India and Sri Lanka) in the following characters: head length about equal to width;

TABLE 1: Measurements (in mm) of holotype and paratypes of *Rhacophorus pseudomalabaricus*.

	Holotype BNHM 3095	Paratype ZSI/SRS VA/1079	Paratype ZSI/SRS VA/1078	Paratype WII 514
	female	male	male	male
SVL	66.8	50.5	43.6	49.9
HL	18.4	15.6	14.25	16.5
HW	22.1	16.3	14.3	15.9
ED	6.8	5.8	5.0	6.15
TYD	3.6	2.9	2.7	3.2
IOW	8.6	6.1	4.8	5.35
IND	4.8	4.4	3.6	4.05
ESD	9.0	6.9	6.4	7.35
END	5.1	4.3	4.4	4.15
BW	20.4	11.75	9.65	12.4
A-G	35.4	28.8	22.85	24.4
FT3D	4.4	2.7	1.8	3.25
TT4D	3.8	2.0	1.55	2.9
MTL	2.3	1.4	1.05	1.3

loreal concave; eye diameter greater than eye to nostril distance; tympanum indistinct, situated away from eye, diameter less than eye diameter; fingers over two-thirds webbed; toes fully webbed; webbing between fingers and toes yellowish-orange; no outer metatarsal tubercle. The new species is differentiable from all south Asian *Rhacophorus* species in showing a dorsal pattern reminiscent of leaf venation on a green dorsum and on dorsal surface of limbs.

Description (based on type series).- A medium-sized *Rhacophorus*. Holotype, adult female: SVL 66.8 mm; paratypes, males: SVL 48 mm; SD ± 3.82. Habitus slender (mean ratio of BW/SVL 0.234; SD ± 0.014), tapering into a narrow waist. Head width about equal to length (mean ratio of HW/HL 0.983; SD ± 0.02). Snout rounded, oriented laterally (Fig. 2), slightly projecting beyond lower jaw. Nostrils nearer to tip of snout than to anterior margin of orbit (mean ratio of END/ESD 0.625; SD ± 0.061). Canthus rostralis vertical in transverse section, loreal concave. Eyes large, diameter more than eye to nostril distance (mean ratio of ED/END 1.322; SD ± 0.174) and pupil vertical. Tympanum indistinct, covered by skin, uniform in colour with dorsum and diameter less than that of eye (mean ratio of TYD/ED 0.52; SD ± 0.02). Interorbital distance greater than internarial distance (mean ratio of IOW/IND 1.347; SD ± 0.035). Supratympanic fold visible, extending from posterior corner of eye, over tympanum to base of forelimbs. Nostrils dorso-laterally oriented. Vomerine teeth placed horizontally, close to choana. Tongue large, smooth, elongated, bifid and free posteriorly.

Forelimbs long with dermal ornamentation. A flap of skin extends laterally on posterior margin of lower arm. Relative length of fingers 1 < 2 < 4 < 3. One subarticular tubercle each on first and second fingers, two each on third and fourth fingers. Webbing between fingers extends from distal subarticular tubercle on outer side of first to between distal subarticular tubercle and disc on inner side of second finger. From base of disk on outer side of second, to distal subarticular tubercle on inner side of third finger. From base of disk on the outer side of third to the base of dick on the inner side of fourth fingers. The web between fingers had corrugated skin. palmar tubercles were indistinct. Finger tips dilated into disks, with circummarginal groove. Third finger has the largest disk. Mature male with nuptial pad dorsolaterally on first finger.

Hind limbs long with reduced dermal ornamentation in form of a thin lining of pale coloured skin on outer margin of fifth toe and a white conical flap of skin on heel. Relative length of toes 1 < 2 < 3 < 5 < 4. Tibio-tarsal articulation barely reached nostril when hindlimbs are extended and bent forward. Heels overlap when the hindlimbs are folded (as seen in natural posture of the frog) and held at right angle to snout-vent axis of the body. Tips of toes with large disks. Fourth toe with largest disk and toe disks smaller than those on fingers. All disks with circummarginal grooves. Toes fully webbed, extending to base of disks. Subarticular tubercles distinct and round. Inner metatarsal tubercle present and elongated, outer absent, a ridge from inner metatarsal tubercle to tibio-tarsal joint.

Dorsal side of body and limbs smooth. Supratympanic fold weak. Flap of skin on arm thick with smooth margin. Conical projection on

heel is a thick flap of skin. Venter uniformly granular, throat sparsely granular. Granular skin extends on outer side of thigh, inner side of thigh smooth. Granules in groin and around cloaca large.

Colour.- Live colouration of dorsum, head, upper aspect of fore- and hindlimbs is green with a few, small, scattered, asymmetric white spots that turned purple after preservation. Dorsum with faint black lines radiating from vertebral region and dorsum of limbs. This pattern in most distinct in metamorphs (Fig. 3). Limbs with a thick green line running on exposed dorsal side along its entire length, extending half way up on outer side of fourth finger and fifth toe. Sides and underside of limbs are yellowish-cream in life. Finger and toe tips yellowish orange in colour and cream or white in preserved material. Webbing and underside of fore and hindlimbs yellowish-orange in life. It turned white or cream when preserved.

Etymology.- The new species name indicates the affinities with *Rhacophorus malabaricus* Jerdon, 1870 and yet differing from this species in morphology, habitat, breeding and development.

Ecology and distribution.- The new species was sighted primarily at night in the understory of rainforests in the Anamalai hill range of the Western Ghats. An aggregation of 24 animals was observed on August 1998 in an artificial pond in the rainforest fragment of Andiparai Shola (1,190 m above msl). It also occurs in another degraded rainforest fragment, Puduthottam (1,000 m above msl), about 10 km from Andiparai Shola. This species was found to breed in the artificial pond in Andiparai and eight freshly laid foam nests were found in the understory vegetation on two occasions (2 February 1998 and 8 September 1998). Breeding activities are suspected to take place throughout the year, peaking during the winter (Northeast) Monsoons (October to January). About five individuals were found as road kills owing to the heavy night traffic adjacent to the breeding pond in May 1998. It is suspected that canopy discontinuity forces this species to come down to the road. Predation of foam nests and adult frogs by lion-tailed macaques (*Macaca silenus*) was observed. A species of dipteran was found to lay eggs in the foam nest.

Behavioural observations.- Nest construction was observed on one occasion (29 November 1998). Only one male participated in amplexus but did not contribute to foam making. The female was observed to actively make the foam and mix it with its hindlimbs. The male positioned itself behind the female, folded its limbs with its feet below the cloaca of the female. The cloaca of the male did not make contact with the foam during the egg laying process. We suspect that the male might be using its feet as a conduit to transport sperm into the foam. The amplexus lasted one hour and the male moved away after completing oviposition. Later, the female performed an elaborate behaviour where she covered the nest with leaves using its forelimbs and stuck them to the foam by "hugging" it, the activity taking for about four and half hours. We presume that this behaviour might provide protection to the nest from predatory insects, which lay eggs inside them and allow the larvae to feed on the eggs (see Ahl, 1931: 160). A nest of this species collected within 24 h after nest making had two maggots and three ootheca in it.

COMPARISONS

The new species has been compared with 19 congeneric species from India and Sri Lanka and only characters separating them have been listed. The distribution of species is provided within brackets.

Rhacophorus appendiculatus (Günther, 1859) (Arunachal Pradesh; outside India- the Philippines, the Malay Peninsula, Sumatra and Borneo) has fingers with rudimentary webbing versus more than two third in the new species. *R. bipunctatus* (Ahl, 1927) (West Bengal, Meghalaya, Assam, Arunachal Pradesh, Manipur, Tripura; outside India- Thailand, Myanmar and the Malay Peninsula) has black spots on the flanks, which was absent in our new species. *R. bisacculus* (Taylor, 1962) (Nagaland; outside India- Thailand) has rudimentary webbing between fingers whereas in the new species it is extensive (two-third). *R. calcadensis* (Ahl,

1927) (Kerala and Tamil Nadu) has rough dorsum with light reddish-brown. This contrasts with the colour description of the new species, which has a green dorsum. *R. cavirostris* (Günther, 1968) (Sri Lanka) has tuberculated dorsum and fringes on arm and tarsus versus smooth skin in the new species. *R. dubius* (Boulenger, 1882) (West Bengal) has conical papilla on middle of tongue versus absent in the new species. *R. fergusonianus* (Sri Lanka) has yellow to yellowish-brown or dark brown, with irregular deep brown patches versus leaf green, and lack of colour patches in the new species. *R. jerdonii* (Günther, 1875) (West Bengal, Arunachal Pradesh and Assam) with two-third webbing between toes differs from the new species which has fully webbed toes. The holotype and sole specimen known of *R. lateralis* (Boulenger, 1883) (Kerala) has brown dorsum with a white streak from nostril along outer edge of upper eyelid to groin and tympanum measures half diameter of eye, whereas the new species was green on dorsum and tympanum measured over half diameter of eye. *R. macropus* (Günther, 1868) (Sri Lanka) with a conical lingual papilla differs from the new species which lacks lingual papilla**.** *R. malabaricus* (Jerdon, 1870) (Kerala, Tamil Nadu and Karnataka) is larger than the new species. Snout-vent length of eight adult males of *R. malabaricus* ranged from 61.9-75.5 mm (Inger et al. 1984). Adult males from Goa (northern Western Ghats) had snout-vent length which ranged from 58-67 mm (Sekar, 1988). However, the sout-vent length of three male paratypes of *R. pseudomalabaricus* ranged from 43.6-50.5 mm (Table 1). Similarly, the snout-vent length of three adult females of *R. malabaricus* from Ponmudi, Anamalais and Goa measured 95.8 mm (Inger et al., 1984), 86.3 (pers. obs.) and 78.5 mm (Sekar, 1988). The holotype of *R. pseudomalabaricus* sp. nov. an adult female measured 66.8 mm. The throat of *R. malabaricus* is smooth where as in the new species it is granular. The vomerine teeth in *R. malabaricus* start from the upper margin of the choana and are placed horizontally (Ferguson, 1904 and pers. obs.). In *R. pseudomalabaricus* sp. nov. the vomerine teeth start from the inner margin of choana and are placed obliquely inwards. The webbing between fingers and toes of *R. malabaricus* are bright red (Inger et al. 1984, pers. obs.), but in the new species it is yellowish orange. The inner metatarsal tubercle of the new species is not seperated from feet. In *R. malabaricus* it is separated from the feet. In addition to differences in morphological characters between these two species, larval stages 42-46 (Gosner 1960) exhibit unique markings so far undescribed for any rhacophorid from India. Sekar's (1991) description of the tadpoles of *R. malabaricus* deviates from markings typical of the new species. *R. maximus* (Günther, 1858) (Arunachal Pradesh, Eastern Himalayas, Assam, West Bengal and Meghalaya; outside India- Nepal, China and Thailand) does not have a flap of skin on arm and tarsus versus a distinct flap of skin extending laterally from forearm in the new species. *R. microtympanum* (Günther, 1858) (Sri Lanka) has grey or brown dorsum with variable patches, whereas, it is green without patches in the new species. *R. namdaphaensis* (Sarkar and Sanyal, 1985) (Arunachal Pradesh) has dorsum, which is reddish-brown with variable black spots, this contrasts with green colouration observed in the new species. *R. naso* (Annandale, 1912) (Arunachal Pradesh) has only rudimentary webbing between fingers versus extensive webbing in the new species. *R. nigropalmatus* (Boulenger, 1895) (Meghalaya and Arunachal Pradesh; outside India- Thailand, Sumatra and Borneo) has fingers webbed to disks. In the new species web extends below the disks. *R. pleurotaenia* (Boulenger, 1904) (Sri Lanka) has webbing between fingers at base versus extensive in the new species. *R. reticulatus* (Günther, 1864) (Sri Lanka) has a lingual papilla, which is lacking in the new species. *R. tuberculatus* (Anderson, 1871) (West Bengal and Assam) has numerous tubercles on abdomen, which is absent in the new species. *R. pleurostictus* (Günther, 1865) (Kerala and Tamil Nadu), shows fingers webbed to base.

DISCUSSION

Rhacophorus pseudomalabaricus sp nov. remains distinct from other Indian and Sri Lankan

rhacophorids in geographic distribution and in specific morphological characters. However *R. malabaricus* is widely distributed along the Western Ghats and also bears some similarities with *R. pseudomalabaricus* sp nov. During 18 months of field study, the new species was found restricted to the rainforests from above 1,000 m elevation in the hill range Anamalais at 10° N latitude. On the contrary, *R. malabaricus* has been recorded in the rainforests and drier secondary forests below 1,000 m elevation (see Inger et al. 1984). These two species were never found syntopic at the type locality of the new species. The lack of any geographical barrier separating the two species in question provides evidence for reproductive isolation.

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APPENDIX 1

List of specimens examined

Rhacophorus bipunctatus: India: Meghalaya: Cherrapunji: FMNH 72406-407.

Rhacophorus cavirostris: Sri Lanka: BMNH 1871.12.14.33; 1973.3143; Pundaluoya, 120 m: BMNH 1890.11.8.32; Ratnapura: BMNH 1955.1.10.51; Hiniduma: BMNH 1975.850.

Rhacophorus fergusonianus: Sri Lanka: Madulsima: BMNH 1908.7.2.3-7; Belihul Oya: BMNH 1931.2.1.8-10; Koslanda: BMNH 1972.1893; Nuwara-Eliya: BMNH 1982.1272-1273.

Rhacophorus macropus: Sri Lanka: No specific locality: BMNH 1871.12.14.20-23; 1877.3.9.10-12; 1973.3116; 1973.3118-19; Dimbulla: Queenswood Estate, 1,515 m, MCZ 20873-74; Pundaluoya 120 m: BMNH 1890.11.8.31; Laxapana, 270-365 m: BMNH 1973.3064; Bogawantalawa, 1,515-1,575 m: BMNH 1973.30.74-82.

Rhacophorus malabaricus: India: Kerala: Trivandrum District: Ponmudi: FMNH 217715-18; 218468-70; Kottayam: FMNH 93729-30.

Rhacophorus maximus: India: Nagaland: Chang Pani: Naga Hills: AMNH 38078-79. West Bengal: Darjeeling: MCZ 15410.

Rhacophorus microtympanum: Sri Lanka: UMMZ 64326; CAS 85283; USNM 19218, 57515; RMNH 1757 (5), 6516 (3); Central Province: Horton Plains, 2,090 m, AMNH 24203-206; Nuwara-Eliya: AMNH 72444, 23774, MCZ 2809, 3489: Pattipola, 1,880 m; MCZ 28098.

Rhacophorus pleurostictus: India: Malabar: MCZ 15409; Nilgiris: AMNH 23733; NHMB 1174; 4025.

Rhacophorus pleurotaenia: Sri Lanka: Kandy: BMNH 1947.2.7.64 (holotype).

Rhacophorus reticulatus: Sri Lanka: No specific locality: MCZ 1324; BMNH 1868.3.17.26, 1868.3. 7.35, 1871.12.14.36, 1973.3136; Pundaluoya, 120 m; BMNH 1890.11.8.30; Laxapana, 270-360 m; BMNH 1973.3060.

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ETHNOZOOLOGY OF THE *NGOO-HOW-PAK-PET* (SERPENTES: TYPHLOPIDAE) IN SOUTHERN PENINSULAR THAILAND

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(with one text-figure)

ABSTRACT.- The tiny snake called *ngoo-how-pak-pet* is worshipped by the inhabitants of the southern Siamese peninsula, who zealously keep dried and perfumed specimens at home as lucky charms, and attribute to it a mythical kinship. According to some, the snake originates from *nok-karaweg*, the king of the birds in paradise. Others believe it is the son of the giant snake *pa-yaa-ngoo-yai*. These legends seem to derive from Indian mythology. The specimens that we obtained were provisionally referred to the typhlopid species, *Ramphotyphlops braminus*.

KEY WORDS.- Ethnozoology, Indian mythology, Typhlopidae, *Ramphotyphlops braminus*, Thailand.

INTRODUCTION

Various cultures have attributed a mythical ancestry to snakes based upon their gigantic size, strength, or toxicity. In West Africa, some tribes continue to worship pythons. Cobras, fascinating on account of their ability to flatten their neck to form a hood but feared because of their potent venom, were raised to the rank of deity in Ancient Egypt and venerated in many parts of Asia, especially in India.

Most people whom we spoke with from the provinces of Phang-Nga, Surat Thani, Nakhon Si Thammarat, Trang and Krabi, knew the story of the snake called *ngoo-how-pak-pet*, which is firmly anchored in the folklore of peninsular Thailand, south of Chumphon Province. The *ngoo-how-pak-pet*, although totally lacking venom and having as its distinctive feature its extreme small size, is said to have a mythical origin, and is worshipped fervently by the local population. According to popular belief, every encounter with this minute snake will bring good luck in the near future. Dried specimens are precious and kept as lucky charms and venerated. We interviewed many people about this legend, and in the course of our investigation, obtained several specimens that allowed us to determine the species.

THE LEGEND

The first part of this story, which seems to be known by nearly everyone in the area, was recorded in July 1998 from Sister Punnee Leakpai (Krabi), a Buddhist nun at the temple of Mongkut Phra That Chedi Nimit, Messrs. Gitti Leeowtragoon and Udom Choosiri (Royal Forest Department, Phang-Nga), and Mrs. Amorat Limarun (Trang), and in February 1998 by Miss. Tasanee Thongjan, Siriwan Wansu and Jutarat Wichaikul (Phang-Nga). It is detailed below.

An encounter with the *ngoo-how-pak-pet* can happen anywhere and is a particularly auspicious event if it occurs in the house. Most of the time, the snake is found already dead and dried

out, which does not, however, decrease its value. The snake quacks when entering a house to inform the owner of its arrival and to announce his good luck to him. The vernacular name (the suffix *pak-pet* meaning duck beak) is derived from the fact that the locals see the elongated head of this snake as resembling that of a duck, and they believe that this snake can produce sounds comparable to those emitted by ducks. The cry was variously described as 'jep-jep-jep…', 'pet-pet-pet…', or 'pit-pit-pit…'. Although none of the villagers of Thung-Hua-Chang (Muang District, Krabi Province) had ever caught nor even seen a *ngoo-how-pak-pet*, they all claimed that it quacked like a duck.

The discovery of a *ngoo-how-pak-pet* is a very important occurrence, demanding some ceremony: 'When people meet the *ngoo-how-pak-pet*, they do not catch it with their hands, but delicately place it on a bank note or on a white tissue or garment (Fig. 1). If it was found outside the home, people bring it in as quickly as possible to the home, and place it in a box in which they have already accumulated other lucky charms, such as gold coins and Buddhist effigies, after which they pray. The snake is then generally perfumed'.

'While drying, the dead specimen, which initially is completely black, becomes uniformly silver, the colour of happiness'. Then people try to guess Thai or Arabian numbers in the coils of the body of the dry snake and use these numbers for playing the lottery and cards. Arabiac numbers are used more often rather than the complicated Thai numbers. The field numbers that we assigned to the specimens that we received were immediately noted and later played by witnesses!

Mrs. Wichaikul owns nine specimens of which three were found in front of her house (Phang-Nga Police Station, Phang-Nga City) in 1996 and 1997, and six others she inherited from her mother who collected them in the vicinity. She very graciously offered us three of her specimens (MCZ 182619-621). Mr. Nildbodee, a policeman in Phang-Nga, gave us a fourth specimen (MCZ 182622) that he received as a lucky charm from a friend. Sister Punnee has a friend who has accumulated more than 60 specimens. It does not seem unusual that people keep at home such large numbers of *ngoo-how-pak-pet*; however, it is a rare that people agree to part with even a single.

The second part of the legend, concerning the origin of the magic snake, is rather complex and controversial. Among the few persons we met who knew the ins and outs of the legend, two distinct origins were proposed. There are some who

FIGURE 1: A dry and coiled *ngoo-how-pak-pet* placed on a Thai bank note.

claim that the *ngoo-how-pak-pet* originated from the king of the snakes, but others believe it is derived from the king of the birds.

The first origin was explained to us in July 1998 by Venerable Phra Acharn Pisarn Purinthako, a famous Buddhist monk in southern Thailand, admired for his mediumistic talent. Purinthako explained that the *ngoo-how-pak-pet* is the child of the King of Snakes, '*tow-wiroon-luk-puk*', a giant snake residing in the deep forest in the west of Thailand. 'This snake is so big that all humans take flight when they meet it. One day, while I was in the forest, I was bitten by a cobra. With my death approaching, I began to meditate. Then the *tow-wiroon-luk-puk* appeared. He ordered my soul, which had already left my body to return, and he gave me two medicines that saved my life. Then we became friends. He told me himself that the *ngoo-how-pak-pet*, the smallest of all snakes, is his child, whereas all other snakes are its subjects. I still have these secret remedies and provide them to people who are bitten by venomous snakes. In exchange, he asked me to release nine snakes every year. Presently, I have already released almost 100 snakes'. (According to Buddhist beliefs, people who release captive animals gain merit.) His encounter with the King of Snakes is detailed in Anonymous (1997: 49-50) where the giant snake is called '*pa-yaa-ngoo-yai*'.

The second origin was reported to us in February 1998 by the Buddhist monks Rit Srisawan Tapanyo (Wat Kiri Wong, Ban Tham Thong Lang, Tap Put District, Phang-Nga Province), and Boonchop Santajitto and Dat Thong-Samrit Pitriyano (Khao Tao Rattanaporn, Ban Khao Tao, Muang District, Phang-Nga Province). Venerable Tapanyo derives from the Province of Nakhon Si Thammarat, Santajitto and Pitriyano from the Province of Surat Thani; the legend is also current in those provinces. While these monks knew perfectly well this very old story, they immediately informed us that it was not a part of the Buddhist teachings.

The *ngoo-how-pak-pet* comes from the paradise in the sky, and more precisely originates from the King of Birds, called '*nok-karaweg*' ('*nok-kalawèg*' in French translitteration; '*nok*' meaning 'bird' in Thai). 'The King of Birds occasionally looses some feathers that fall to the ground. At the precise moment that the feather touches the ground, every one of its barbules becomes a *ngoo-how-pak-pet*. This happens mainly during the hot season, when terrestrial birds have difficulty finding food. These *ngoo-how-pak-pet* are thus originally produced as extra food for birds. When some birds are satiated, they express their gratitude by taking some extra *ngoo-how-pak-pet* back to the *nok-karaweg* to eat because he cannot leave Paradise'.

'The King of Birds can appear in the dreams of humans to show them a place where they could find a *ngoo-how-pak-pet* that will bring them good luck. In general the *nok-karaweg* indicates the entrance of a cave, or near or under a rotten log on the ground'.

'The person who had such a dream keeps it secret and goes as soon as possible to the designated place in order to catch a *ngoo-how-pak-pet*'. Tapanyo has a cousin from Nakhon Si Thammarat who dreamt that the *nok-karaweg* indicated to him a cave where a *ngoo-how-pak-pet* remained: 'He went there, but at the moment that he arrived he saw a bird eating it and flying away'.

Pitriyano did not himself possess a *ngoo-how-pak-pet*, but a cousin of his does: 'A cousin found the *ngoo-how-pak-pet*, which died suddenly. He took it, perfumed it and put it in his house with his other lucky charms. Then everything changed for him: he won the lottery and became rich'. Several times we were informed that *ngoo-how-pak-pet* died at the exact moment that they were encountered. In fact, we know only one person who brought back a live one, but it unfortunately escaped from the box in which it had been placed.

Santajitto specified that the *ngoo-how-pak-pet* is not venomous, and that 'some people believe that it does not come from the sky, but was born as a worm and was later metamorphosed into a snake during its life.' However we did not meet any people who shared this belief.

DISCUSSION

Local people put the '*ngoo-how-pak-pet*' close to the '*ngoo-din*'. The word '*ngoo*' means 'snake' and is applied to most species of snakes by Thai people. The word '*din*' means 'earth', and their combination usually designates the diminutive fossorial ophidians of the family Typhlopidae. The same name is, however, sometimes applied to the caecilians of the genus *Ichthyophis* Fitzinger, 1826 (Amphibia: Gymnophiona). This homonymy is widespread in Thailand (Nutphand, 1990) and also exists in Laos where these phylogenetically very distant animals are termed, in French transliteration, '*ngou lao*' (Deuve, 1970: 36), and in Vietnam, where they are called *con trùn* (Bourret, 1938: 5). Because of their fossorial habits, caecilians look like typhlopids, but this very superficial resemblance is strictly limited to the elongation of the body and the absence of legs.

Whereas the same denomination covers animals belonging to two different classes, the *ngoo-how-pak-pet* is strictly distinguished by the local people from the '*ngoo-din-tham-ma-da*' ('*tham-ma-da*' meaning 'common' in Thai), *Ramphotyphlops braminus* (Daudin, 1803), another blind snake, very common throughout Thailand, and distributed worldwide (Gasperetti, 1988; David and Vogel, 1996; Manthey and Grossmann, 1997).

The verb '*how*' means 'to hiss' or 'to bark'; «*ngoo-how*» designates all Thai species of the genus *Naja* Laurenti, 1768. The Thai spelling of these words can be found in Cox (1991: Appendix 10). In Laos, '*ngou hao*' (French translitteration) designates the *Naja* and more generally all dangerous snakes (Deuve, 1962: 76). By extension '*ngoo-how'* can designate other snakes of exceptional nature, and could be considered the Thai equivalent of the Indian word '*naga*'. The suffix '*pak-pet*' consists of the word '*pak*' meaning 'mouth' and '*pet*' meaning 'duck'. The *ngoo-how-pak-pet* is sometimes called *ngoo-pak-pet*, or *ngoo-lahm-pak-pet*, the latter name curiously also applied in the same area to the short-tailed python, *Python curtus brongersmai* Stull, 1938 (Thai spelling in Cox, 1991: 470).

Thai dictionaries (Thiengburanathum, 1993: 58, 730; Winitchaigoon, 1982; Yarnprateep, 1991) provide sparse information on the mythical *nok-karaweg*, summarized below. The word '*kalawig*' (French translitteration) is a synonym of '*nok-karaweg*'. This legendary bird lives in *Himmaphaan*, a mythic cold forest in the north of India. It can fly far above the clouds. It has a marvelous voice, and when it sings, all the other animals stop in order to listen to it. According to I. Das (pers. comm., 1999), the word *Himmaphaan* may be derived from the Sanskrit *hima* (snow) and *vaan* (forest), and could be in the Himalayas.

It is tempting to connect the word *kalawig*, because of the phonetic similarity, with the '*Kalayéni*' (cited in Duchâteau, undated: 60), 'le roi des Yavanas et des serpents', synonym of *káliya* (cited in Vogel, 1926: 88), 'the fierce lord of snakes, the enemy of the snake-eating *Suparna* [or *Garuda*] the king of the birds', in the Brahminical tradition. Vogel (1926: 55) specified that the giant bird *Garuda* which feeds on the *Nagas*, can cover the sky and eclipse the light of the sun. The hereditary enemity between the *Nagas*, and their cousin, *Garuda*, is a favourite theme in Indian literature and art (Vogel, 1926), also adopted in the Chinese mythology (Mathieu, 1983: xciii). The expansion of Brahminism, and hence the cult of the *nagas* and *garudas* from India to Indochina began at least as early as the fifth century before Christ (Mathieu, 1983: lxxxix). The legend of the *ngoo-how-pak-pet*, a snake born from a bird but eaten by them, expresses also the paradoxical kinship and enemity between these animals.

The feud between the bird and the snake is a classical subject in the mythologies of many other peoples from ancient Mesopotamia to modern Mexico and even Homer's Iliad (Lurker, 1987). The struggle between the bird and the snake symbolizes the fight between life and death to the Bambaras in Mali (Mathieu, 1983: 428).

The word *nok-karaweg* is encountered in the common language everywhere in Thailand, particularly by people who do not know the story of the *ngoo-how-pak-pet*. When somebody sings

very well he is complimented as having the voice of the *nok-karaweg*.

Vogel (1926: 54) reported a case of the birth of snakes from feathers in Indian mythology: 'the feather dropped by *Garuda* [the king of the birds], when struck by *Indra*'s thunderbolt, breaks into three pieces, from which peacocks, two-headed snakes, and mongooses are said to take their origin'. It is noteworthy that the Hindi and Oriya names of *R. braminus* mean 'two-headed snake' (Das, 1998: 37). Typhlopids, because of their almost invisible eyes, and their similarly blunt head without neck and truncated tail, bear this vernacular name in many parts of the world.

The belief that the *ngoo-how-pak-pet* occurs because of the severity of the dry season and also brings good fortune plus the similarity of its name to that of the cobras (*ngoo-how*) is possibly linked to the Indian association between the cobras and the fecundity brought by the rainy season (Boulnois, 1939: 30, 31, 45).

On July 27 1998, Mr. Numkhong gave us a living typhlopid (MCZ 182617) that he found while digging in the garden in front of the Police Station of Phang-Nga where several *ngoo-how-pak-pet* had already been found. All of the people to whom we showed this still live specimen claimed that it was just a *ngoo-din-tham-ma-da*, but not a *ngoo-how-pak-pet*, because its mouth was not flattened like that of a duck. This 'ordinary' snake was indeed positively identified as a *R. braminus*. However, the four 'authenticated' *ngoo-how-pak-pet* (MCZ 182619-622), are probably also *R. braminus*, although their enlarged vertebral scales and brown chins put them closer to *Typhlops khoratensis* Taylor, 1962, a very similar species. The definitive identification of these specimens as *T. khoratensis* would imply a major range extension southward for this species, since this endemic Siamese taxon is not yet known from the peninsula.

Unfortunately, the poor condition of these dried specimens prevented us from noting the visceral and meristic characters that could allow a precise identification.

The story, although with mythical elements, depicts some elements of accurate observation of the natural history of the animal. For instance, the indications given in the dreams by the *nok-karaweg* about where to find the *ngoo-how-pak-pet* are strikingly realistic. They are often found at the entrance of caves where the soil is generally soft and suitable for typhlopids as they can easily burrow into it. They also like to stay in decaying wood (see notably Smith, 1943) where they find their preys, such as small arthropods, worms, plus termites, ants, and their pupae. Also, it is true that typhlopids often venture into dwelling places; for example, *Ramphotyphlops braminus* is regularly found inside gardens and houses (Tweedie, 1954; Minton, 1966) where it presumably forages.

The alleged ability of the *ngoo-how-pak-pet* to quack like a duck is quite intriguing. Sound production has not been reported in blind snakes, and all such accounts are rather anecdotal, with nobody being able to explain the mechanism used by the animal (Young, pers. comm.). For instance, Sweeney (1971: 12, 39) reported that the African species *Rhinotyphlops schlegelii* (Bianconi, 1847) may emit a very faint high-pitched squeak when handled. Schwaner et al. (1985) reported that *Ramphotyphlops australis* (Gray, 1845) makes an audible squeak when roughly handled. Typhlopids have chambered tracheal lungs just like *Ophiophagus* and *Ptyas* spp. that are known to vocalize. Therefore, vocal sound production in typhlopids is certainly possible. According to B. Young (pers. comm.), typhlopids would be more prone to making sound from their cloaca rather than through the respiratory system; cloacal sound production requires a lower volume of air and produces a higher pitched 'squeak'.

Interestingly, two other snake species are said by locals to be able to produce sounds. The *ngoo-how*, genus *Naja* spp. (Elapidae) and the *ngoo-ga-pha-khaw-daeng*, *Rhabdophis s. subminiatus* (Schlegel, 1837) (Colubridae) are said to squawk like chickens, but only when they mate. These latter assertions are doubtful and such sounds seem to be so far unknown in these snakes

(Chanhome, pers. comm.) which emit at the best only hisses when threatened, and no social sound is known in snakes (Young, 1997).

The Malayalam (Kerala State, India) vernacular name of *R. braminus*, *kozhi pambu* (see Das, 1998: 37), the 'hen-snake' might also possibly be derived from the belief that this snake produces sounds like those of chickens (Das, pers. comm.).

While the *ngoo-how-pak-pet* is regarded as beneficial, the other blind snakes, although being completely harmless, are generally considered by Thai people as highly venomous (Gyldenstolpe, 1916; Smith, 1914; pers. obs.) and is therefore dreaded. Bourret (1938: 6) specified that *R. braminus* is one of the most feared snakes in Indochina. According to Russell (1796), *R. braminus*, called '*rondoo talooloo pam*' in the area of Vishakhapatnam, is regarded as mischievous by Indians. Minton (1966) cited an interesting anecdote about a *Typhlops porrectus* Stoliczka, 1871 in Karachi (Pakistan): 'I collected one on February 11 as it was crawling in bright sunlight within a thickly populated refugee encampment. It was being chivied about by a group of excited persons who seemed curiously unwilling to harm it. I could not tell if their behavior was motivated by fear or by some superstitious regard for the reptile'. According to different regions and ethnic groups, typhlopids are regarded as either beneficial or malefic.

In Nyasaland, 'if a *Typhlops* is met on a road this is said to be unlucky, and often means that the person the man is going to meet or visit will be dead when the traveller arrives, or that the wayfarer himself will die' (Sweeney, 1971: 27). In western Cameroon, it is believed that if a young woman encounters a typhlopid, she will become pregnant soon (Lawson, 1993: 64; Stucki-Stirn, 1979: 133). Stucki-Stirn (1979: 134) also reported that in some parts of western Cameroon, typhlopids are believed to bring good luck to a house if they are seen near it, and locals even offer them palm oil; however in the Wum area these snakes are regarded as very dangerous.

As noted notably by Sweeney (1971: 27), and according to our own observations, it is precisely because of the curious fact that typhlopids seem to bear two heads, and are hence believed to be able to bite with their two extremities, that they may be regarded as highly dangerous. For the same reasons have the harmless amphisbaenids an equally bad reputation in some areas. The ancient author Pline told that if they had two heads, it was because one was not enough to eject all their venom (Morris and Morris, 1965: 83-84). On the contrary, the *ngoo-how-pak-pet*, because its head with its duck beak is therefore clearly distinguishable from the tail, looses this malefic appearance.

In southern peninsular Thailand, the *ngoo-how-pak-pet* lives sympatrically with the longest snake in the world, the locally abundant *Python reticulatus* (Schneider, 1801); the smaller and rarer species *Python curtus brongersmai*; the very impressive king cobra *Ophiophagus hannah* (Cantor, 1836), the longest venomous snake in the world, and two species of *Naja* (*N. kaouthia* Lesson *in* Férussac, 1831 and *N. sumatrana* Müller, 1887). All of these snakes are the subject of some folk beliefs and the cobras are even represented in all temples in the area. However, except for the *ngoo-how-pak-pet*, none of them is respected by the locals in their everyday life. Pythons are even a much appreciated food item. They are hunted intensively and this coupled with the destruction of suitable habitats through deforestation has resulted in a decline in their numbers. The decline has been so severe that one of us (O.L.) initiated a breeding program for the Short-tailed Python. Nor are cobras spared. They are often purely and simply slaughtered because of their fatal venom and their unpleasant habit, otherwise shared with the pythons, to decimate the henhouses. Cobras, beaten nearly to death by the farmers, are sometimes thrown on the road, in hope that the next car will give them the *coup de grâce*, and prevent them from returning to the living. Such a method is frequent and was already observed in this area, notably by Frith (1978) on Phuket Island with *Cylindrophis ruffus* (Laurenti, 1768), and by Lim and Ratnam (1996) with *Boiga cyanea* (Duméril, Bibron and Duméril, 1854) on Pulau Langkawi Island in Malaysia. We (C.C. and

O.P.) once relieved the whole family and neighbours of a farmer who had beaten and thrown on the road a very large *Naja kaouthia* (MNHN 1998.0503), by taking it away; all these persons were patiently waiting along the road so that the next car (in this case ours) would finish the animal off.

On the basis of the work of Russell (1796) on the snakes of the east coast of India, Daudin (1803: 277) coined the epithet of the scientific name *Ramphotyphlops braminus* and christened it *éryx bramine*. Its English vernacular name is therefore the 'Brahminy Blind Snake' (Smith, 1943). In the context of the legend of the *ngoo-how-pak-pet*, apparently derived from the Brahminical folklore, *R. braminus* never better wore its scientific epithet.

CONCLUSION

The fresh typhlopids that we obtained from the area, all regarded as common *ngoo-din* by the natives, were unambiguously identified as *Ramphotyphlops braminus*. The purported *ngoo-how-pak-pet* specimens that we got almost certainly belong to this species, although some might be *Typhlops khoratensis*. Only a handful of herpetologists is trained to distinguish both taxa and this usually requires the use of a good microscope; we may reasonably not attribute more scientific acuteness to the laymen. The diagnostic character by which the common blind snakes and the 'magic snake' are distinguished by the natives is the presence of a beak by the latter. The presence of the beak is probably explained by the fact that the *ngoo-how-pak-pet* are found already dead and dry. While desiccating, the head of a *R. braminus* (or of all similar typhlopid - at present four blind snakes species are known to occur in southern peninsular Thailand) flattens, giving finally the rough appearance of a duck beak. The *ngoo-how-pak-pet* and at least *R. braminus* could thus be one and the same thing. Otherwise, Venerable Purinthako explained to us that 'a dead *ngoo-how-pak-pet* never rots away; if it was found spoiled, it was in fact just a *ngoo-din-tham-ma-da*'*…Quod erat demonstrandum*.

Presently the humble origin of the fabulous *ngoo-how-pak-pet* is virtually established, but one may still be filled with wonder at the fascinating worship of which it is the object in that area while elsewhere blind snakes are generally neglected, even by most zoologists. Herpetologists know how rare typhlopids are in the collections of scientific museums and can only be in awe at the untold numbers of them resting in the homes of southern peninsular Thailand.

Folk beliefs exist about typhlopids around the world, reported notably by Tirant (1885: 424) about *Typhlops vermicularis* Merrem, 1820 in Greece, by De Silva (1990: 13) and Das (1998: 37) in India and Sri Lanka, or by Curran and Kauffeld (1951: 148-149) and Sweeney (1971: 27) in Africa. None seems to present the complex mythological dimension of the legend of the *ngoo-how-pak-pet*. In southern Thailand, these diminutive snakes really constitute a material link between the terrestrial and celestial worlds, and more than anywhere else, they belong to the everyday life of the people.

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MICROHYLA SHOLIGARI, A NEW SPECIES OF MICROHYLID FROG (ANURA: MICROHYLIDAE) FROM KARNATAKA, INDIA

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(with two text figures)

ABSTRACT.- A new species of *Microhyla* (Anura: Microhylidae) is described from Biligirirangan Hills in Chamrajanagar District, Karnataka State, south-western India. The new species is compared with congeners from India, Sri Lanka and south-east Asia, that show dilated tips of digits. *Microhyla sholigari* sp. nov. is distinguishable from close relatives within the genus, in possessing the following characteristics: head wider than long; dilated finger tips; dilated toe tips with median longitudinal groove dorsally; webbing between distal and penultimate subarticular tubercles on outer and inner side of fourth toe; two distinct metatarsal tubercles, inner elongated and outer rounded; dorsum smooth, with light brown mid-dorsal marking, venter white; SVL of holotype (a subadult female) 12.0 mm; of four paratypes (all females), 11.0-15.0 mm.

KEY WORDS.- *Microhyla sholigari*, new species, Anura, Microhylidae, Karnataka, India.

INTRODUCTION

The genus *Microhyla* is represented by five species in India, of which only one (*M. chakrapani* Pillai, 1977) is endemic to India (distribution: North Andamans). The most widely distributed species found throughout India is *M. ornata* (Duméril and Bibron, 1842) and the species is also found in Pakistan, Bhutan, Nepal, Bangladesh, Myanmar, China, Japan, Taiwan and Sri Lanka (Dutta, 1997). *Microhyla berdmorei* (Blyth, 1856), a south-east Asian species, has been recorded from north-eastern India (Assam, Meghalaya, Arunachal Pradesh and Mizoram) (Pillai and Chanda, 1981; Chanda, 1994). Another south-east Asian and Chinese species, *M. heymonsi* Vogt, 1911, has been recorded from Great Nicobar (Mehta and Rao, 1987). *Microhyla rubra* (Jerdon, 1853) is found in Sri Lanka, peninsular and north-eastern India, Myanmar and Bangladesh (Dutta, 1997). The occurrence of a sixth species, *M. inornata* (Boulenger, 1890) in India, presently recognised as *Micryletta inornata* is based on a juvenile specimen collected from Port Blair, Andaman Islands (Pillai, 1977).

The present paper reports another new species of *Microhyla* from Karnataka state (south-western India) and altogether five specimens have been collected. The new species is allocated to the genus *Microhyla* for presence of the following diagnostic characters: skin smooth, without tubercles, faint dorsal marking from behind the orbit to near vent, without tympanum, a prominent supratympanic fold, no parotid glands, fingers free, tips of fingers and toes dilated, distinct oval shaped inner and rounded outer metatarsal tubercles.

MATERIALS AND METHODS

The specimen were fixed in 4% formalin, preserved in 70% ethanol and measured after 11 months of collection. Measurements (to the nearest 0.1 mm) were made using a dial calliper. Sex was determined by dissecting and examining the gonad. The following parameters were measured: SVL (snout-vent length: from tip of

snout to vent); HL (head length: distance from angle of jaw to tip of snout); HW (head width: distance between angle of jaws); HD (head depth: greatest transverse depth of head, taken beyond orbital region); ED (eye diameter: greatest diameter of orbit); UEW (upper eyelid width:greatest width of upper eyelid); IOD (inter-orbital width: least distance between upper eyelids); IND (internarial distance: distance between nostrils); ESD (eye to tip of snout distance: distance from anterior margin of eye to tip of snout); END (eye to nostril distance: distance from anterior margin of eye to nostril); BW (body width: highest width of abdominal area); and A-G (axilla to groin distance: distance from posterior base of forelimb at its emergence from body to anterior base of hindlimb at its emergence from body).

Comparative materials examined are in Appendix I. Museum abbreviations follow Leviton et al. (1985), except for NMSL (National Museum of Sri Lanka, Colombo), WHT (Wildlife Heritage Trust of Sri Lanka, Colombo), SKD (field numbers of the first author). Additionally, we referred to Parker (1934) for additional character states for comparison.

DESCRIPTION OF LOCALITY

Biligirirangan Hills is a part of Biligiri Rangaswamy Wildlife Sanctuary covering an area of 539.52 sq. kms. The Hills constitute a discontinuous range, extending from north to south and varying from 600-1,800 m. above msl. The hill range is located between Chamrajanagar, Yellandur and Kollegal in erstwhile Mysore District and the famous Biligiri Rangaswamy temple (after which the Hills are named) is situated at the top of the Hill. The stream 'Bhargava' flows in a south-north direction on the western slope of the Hills. The forest type is moist with evergreen vegetation comprised tall grasses and trees mixed with lianas.

The frogs were collected from below compact leaf-litter near the bank of the stream and also from grassland surrounded by bamboo thickets interspersed with lantana bushes. The new microhylid lives in sympatry with *Bufo melanostictus, Rana temporalis, Limnonectes limnocharis* and *Philautus leucorhinus.*

Microhyla sholigari **sp. nov.**

Figs. 1–2

Holotype.- ZSI A9061 (subadult female, from Bhargavi stream bed near Doddasampige (12° 27' N; 76° 11' E, Biligirirangan Hills, Chamrajanagar District, Yelandur Taluk, Karnataka State, south-western India, collected by P. Ray, 9 February 1997.

Paratypes.- ZSI A9062-65, from Vivekananda Girijana Kalyana Kendra Campus (VGKK), ca. 10 km s Biligirirangan Hills, collected by P. Ray, 10 September 1997.

Diagnosis.- The new species is distinguished from known congeners, in possessing the following characters: head wider than long; dilated finger tips; toe tips dilated with a distinct median longitudinal groove dorsally; webbing between proximal and distal subarticular tubercles on outer and inner side of fourth toe; two large metatarsal tubercles, inner elongated, outer rounded (smaller than inner); smooth dorsum, with a light brown mid-dorsal marking; white venter, SVL of holotype 12.0 mm, a subadult female; four paratypes, SVL 11.0-15.0 mm.

Etymology.- The new species is named after the Sholiga tribe who live in close association with forest and wildlife of the Biligirirangan Hills. The type locality is famous for the old (ca. 200 years) Champaka tree (*Michelia champaka*; Doddasampige in Kannada), the deity of the Sholigas.

Description (based on holotype).- A small *Microhyla* (SVL of holotype 12.0 mm); body elongated, with narrow waist (Figs. 1 & 2). Head broader than long (HL/SVL ratio 0.27; HW/SVL ratio 0.36); snout acute viewed dorsally and rounded viewed ventrally, truncate in lateral view, in level with mandibles; nostrils dorso-lateral in position, with rounded openings, nearer to tip of snout than to anterior margin of eye (END/ESD ratio 0.7); inter-narial distance greater than distance from anterior margin of eye to nostril (IND/END ratio 1.28); canthus rostralis rounded; loreal region oblique; upper jaw edentate, a 'W'-shaped notch (symphysial

FIGURE 1: The holotype of *Microhyla sholigari* sp. nov. (ZSI A9061), in dorsal (left) and ventral (right) views.

knob) on anterior edge of mandible; mouth extending to posterior corner of eye; tongue elongated, smooth and tip rounded; eye large (ED/HL ratio 0.6), diameter greater than eye to nostril distance (ED/END ratio 1.42); interorbital width greater than upper eyelid width (IOW/UEW ratio 2.4); pupil circular; postnarial margin indistinct; tympanum not visible, supratympanic fold present.

No webbing between fingers, their relative lengths 1 < 2 < 4 < 3; tips flat, dilated, rounded and without a median longitudinal groove. Subarticular tubercles prominent, round and largest on second finger; two palmar tubercles, inner divided into two (one smaller than other), smaller one nearer to first finger, larger one close to outer palmar tubercle (Fig. 3).

Relative length of toes 1 < 2 < 5 < 3 < 4; inner and outer edges of toes with lateral fringes, extending upto base of dilated tips (except inner edge of first and outer edge of fifth toes). Toe tips dilated with circummarginal groove; a median longitudinal groove on upper surface, separating tip into two dorsoterminal equal halves prominent on toes III and IV. Two prominent metatarsal tubercles, inner elongated, outer rounded and smaller than inner; subarticular tubercles prominent, rounded. Toes webbed; webbing between proximal and distal subarticular tubercles on inner side of first toe to proximal subarticular tubercle on inner side of second toe; between proximal and distal subarticular tubercles on outer side of second toe to proximal subarticular tubercles on inner side of third toe; between proximal and distal subarticular tubercles on outer side of third toe to inner side of fourth toe and from outer side of fourth toe to distal subarticular tubercle on inner side of fifth toe. Smooth dorsum; abdomen and cloacal area tubercular; a supratympanic fold extends from posterior angle of eye to base of forelimbs.

Colouration (in preservative).- A light brown mid-dorsal marking commencing between eyes, narrowing behind occiput, widening near midbody and narrowing towards abdomen above thigh region and broad above cloaca (Fig. 1). Black patches laterally from behind supratympanic fold to base of hind limbs. Abdo-

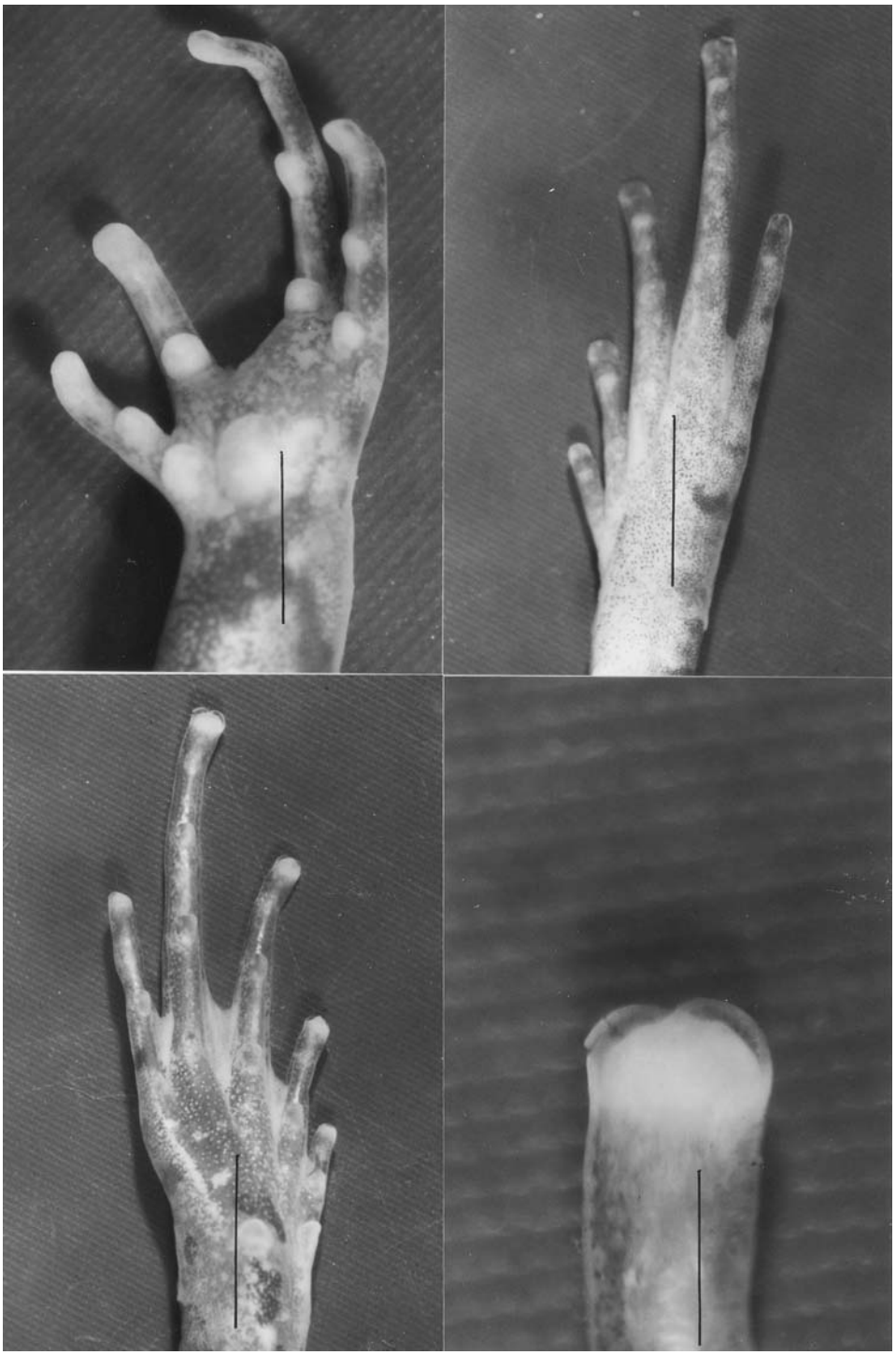

FIGURE 2: Fore and hind limbs of the holotype of *Microhyla sholigari* sp. nov. (ZSI A9061). Top left: Ventral view of left forelimb. Marker = 1.0 mm. Top right: Dorsal view of right hind limb. Marker = 2.2 mm. Bottom left: Ventral view of right hind limb. Marker = 2.2 mm. Bottom right: Magnified view of the tip of fourth toe. Marker = 1.0 mm.

TABLE 1: Measurements (in mm) of the type series of *Microhyla sholigari* sp. nov.

	ZSI A9061 holotype	ZSI A9062 paratype	ZSI A9063 paratype	ZSI A9064 paratype	ZSI A9065 paratype
SVL	12.0	15.0	11.0	12.3	13.0
HL	3.3	4.0	3.1	3.4	3.6
HW	4.4	5.0	4.0	4.5	4.8
HD	3.6	4.0	3.3	3.6	3.8
ED	2.0	2.3	1.9	2.0	2.2
UEW	1.5	1.8	1.4	1.7	1.6
IOD	3.6	4.1	3.5	3.8	3.8
IND	1.8	2.2	1.8	1.9	1.9
ESD	2.0	2.6	2.0	2.2	2.3
END	1.4	1.9	1.4	1.5	1.7
BW	5.2	5.9	5.0	5.3	5.6
A-G	4.6	5.1	4.3	4.7	4.8

men white, chin with fine black dots (Fig. 2). Black patches round cloaca. Forelimbs (except humerus), hindlimbs and toes with dark brown bars.

COMPARISONS

The new species has been compared with congeners from India, Sri Lanka, Japan, China, Taiwan and south-east Asia, that show discs on toe tips, i.e., toe tips with expanded tips that bear a median groove dorsally. The new species resembles *M. berdmorei, M. borneansis, M. annectans, M. annamensis, M. butleri, M. palmipes, M. superciliaris, M. heymonsi, M. achatina, M. karunaratnei* and *M. zeylanicus* in the presence of toe discs. However, the following characters separate the new species from the above: more webbing between proximal and distal subarticular tubercle of toes III and IV (vs. webbing restricted to proximal subarticular tubercle of toes III and IV in *M. heymonsi* and *M. achatina*); dilated toe tips with median longitudinal grooves (vs. no median longitudinal grooves in *M. palmipes*, *M. superciliaris* and *M. zeylanicus*). Further, dorsum of the new species is smooth (vs. with elongated ridges and rounded warts in *M. zeylanicus*). The new species differs from the others that have a distinct terminal median longitudinal groove dividing toe tips, by the following characters: two metatarsal tubercles (vs. one only: an inner in *M. annectans* and *M. annamensis*); no discs (but with dilated tips) on finger and without longitudinal grooves (vs. with discs in *M. butleri, M. borneensis* and *M. karunaratnei* and discs with longitudinal grooves in *M. borneensis* and *M. karunaratnei*); toes > ½ webbed (vs. completely webbed in *M. berdmorei*). In addition, the new species differs from *M. karunaratnei* in the absence of marbled black and white colouration of the venter and dark-brown mid-dorsal marking on the dorsum. Jerdon (1853) described two new species (*Engystoma malabaricum* and *Engystoma carnaticum*) from ' Malabar' (presently in Kerala) and 'Carnatic' (at present in Karnataka), respectively. Parker (1934) synonymised both the species under *Microhyla ornata*. Jerdon's ("1853" 1854) descriptions are based on brief notes which are not clear for species identification. Hence, resurrection of *E. malabaricum* and *E. carnaticum* from the synonymy of *M. ornata* on the basis of distributional criteria seems untenable when types are not available for comparison.

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Sudarsan for extending generous help at the V.G.K.K Campus. Permission provided by the Forest Department of Karnataka is gratefully acknowledged. The authors are thankful to Ramachar, S. J. Srinivasa and Shri Santappa, for help and assistance in the field. SKD thanks Ellen Censky (Carnegie Museum of Natural History; CM), Robert F. Inger, Harold Voris and Alan Resetar (Field Museum of Natural History; FMNH), Robert C. Drewes and Jens V. Vindum (California Academy of Sciences; CAS), Charles W. Myers (American Museum of Natural History; AMNH), Peter Ocello (The Museum, Michigan State University; MSU), William E. Duellman (University of Kansas, Museum of Natural History; KU), Rohan Pethiyagoda (Wildlife Heritage Trust of Sri Lanka; WHT), Barry T. Clarke (The Natural History Museum, London; BMNH), José Rosado (Museum of Comparative Zoology; MCZ), and Eugene Kramer (Naturhistorisches Museum; NHMB) for facilities and loans.

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APPENDIX I

Comparative material examined

Microhyla berdmorei: BANGLADESH: Harbang Forest, s of Chittagang, CAS 94615; Chickmagul, n of Sylhet, CAS 94616. THAILAND: Phan Rang Province, Daban Langbian Plateau, AMNH 10767-70; 5165-67; Changmai, AMNH 8064; Khao Yai National Park, AMNH 81597; 83928; Songkla, AMNH 107896. MALAYSIA: Perak, Melaka (= Malacca), AMNH 23991.

Microhyla karunaratnei: SRI LANKA: Sinharaja World Heritage Site, Morningside Estate, AMS R 148277 (holotype); AMS R 148278-83 (paratypes); NMSL, 1 example (paratype).

Microhyla ornata: INDIA: Orissa: Bhubaneswar, KU 193763-822; FMNH 211879-80; Sambalpur District, Barpali, KU 200386-94; Tamil Nadu; Madras (= Chennai), USNM 69116-17; 84660-68; Nilgiri, Shrine River, USNM 66947; Ratnagiri District, USNM 66951; Maharashtra: Satara District, Panchgani, FMNH 40039-43; 62966; Andhra Pradesh: Hyderabad, MSU 6709; West Bengal: Borio, CAS 102930; Dumka, CAS 94599-603; Assansol, CAS 94598; Dumka, CAS 95216-20; Jantara, CAS 94604-607; Camp Kanchrapara; n of Calcutta (= Kolkata), CM 25265; 25268; 25273; 25275; 25290-91; 25342; Bihar:

Ranchi, CAS 95260-62; 94611-12;102928; Dhanbad, CAS 94613-14; Ramgarh, CAS 102929; Madhya Pradesh: Bisrampur, CAS 14853; Uttar Pradesh: Moradabad, CAS 102943; Punjab: Ambala, CAS 101515; Assam: n of Tinsukia, AMNH 53081. BANGLADESH: Harbang Forest, s of Chittagong, CAS 94608; Dacca (= Dhaka): Tezgaon; CM 25356 (11 nos): JAPAN: Ryukyu: Irimote-Jima, Otomi, KU 153159-162: TAIWAN: Taipei, Shu-Lin, KU 194624-626. SRI LANKA: No further locality, USNM 57869-70 Western Province: Puttalam, AMNH 742665-67; Marichchukkaddi, CM 83613; North Central Province: Polonnaruwa, CM 67545-51; Eastern Province, Trincomalee; FMNH 124547-63; NMSL AM 6(a); Ranamure (near Pellegama), Ratnapura, WHT 1207 (5 nos); Ritigala, WHT 432; Palatupana (Kirinda), WHT 1208; Maligawila, WHT 1209.

Microhyla rubra: INDIA: No further data, MCZ 1328 Karnataka: Mysore, AMNH 62918-19; Bangalore, MCZ 23137-38: Kerala: Travancore, AMNH 23993; Cochin, CAS 14866-67. Tamil Nadu: Madras (= Chennai), MCZ 5131; CAS 6718; Kanyakumari (= Cape Comorin) District: James Town, CAS 104126. SRI LANKA: No further locality, NHMB 1368; USNM 57796; Northwestern Province, NHMB 1369-70. Western Province: n of Puttalam, AMNH 74268-69. Yala (sea level), AMNH 74291-92; Weligatta, WHT 612; Palavi (Puttalam), WHT 245; Debaragaswewa (near Habarana), WHT 1199; Palatupana (Kirinda), WHT 1200; Siyambalakotuma Wewa, Kiriyankali (near Mundel), WHT 1201; Weligatta (Bundala), WHT 612. Inginiyagala, CM 83550. Marichehukkaddi, CM 83614. Southern Province near Deniyaya: on road to Sinharaja Camp Forest Reserve, CM 67955-56. Uva Province, FMNH 131386-400. Wariyapola, BMNH 1955. 1.10.74-75.

Microhyla zeylanica: SRI LANKA: No specific locality, MCZ 281(2); 8200-202; Nuwara-Eliya, MCZ 3488; CAS 38822; Hakgala near Nuwara Eliya, WHT 1198 (4); Pattipola, WHT 1211; Central Province: Bapatalawa (600 feet), BMNH 1948. 1.1.48 (paratypes).

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Notes on distribution and breeding ecology of *Geckoella collegalensis* (Beddome, 1870)

(with one text-figure)

The Kollegal gound gecko, *Geckoella collegalensis* (Beddome, 1870) was originally described as *Gymnodactylus collegalensis* from Balarangans (in the old Kolegal State), near Yelandur, Karnataka State, and allocated to the genus *Geckoella* by Kluge (1993). The species is known from Nilambur, Kerala State and Manar at the foot of the Nilgiris, Madurai and Anaikatty, in Tamil Nadu in the Western Ghats of south-western India (Smith, 1935; Gupta, 1998). The northern-most extent of the range of the species within the Western Ghats was recorded by Sekar (1991) as the Sanjay Gandhi National Park, Borivali, near Mumbai, Maharashtra. Figure 1 shows the known distribution of the species.

Recently, Vyas (1998) recorded the species from the Gir National Park and Sanctuary (20º 40'-21º 30'N; 69º 14'-70º 10'E), Gujarat State, western India, the only known locality outside the Western Ghats. Since then, I have collected additional specimens from the state (Table 1), and here provide new data on the species from the north of its range.

While conducting a herpetofaunal survey on 22 August 1998, a specimen of this species was collected from the Sadad Devi area of the Vansda National Park (20º 44'-49'N; 73º 26'-30'E), Valsad, Gujarat. Morphometric details are as follows (all measurements in mm): snout-vent length 52.0; tail length 41.0; head length 13.7; head width 10.0; axilla to groin length 23.0; forelimb length 13.7; hindlimb length 16.2; eye to snout distance 5.7; eye to ear opening distance 4.7; eye diameter 3.0; upper labials (left/right) 9/9; lower labials (left/right) 9/8; sex: female. Other characters and colouration matches the description in Smith (1935) and Vyas (1998). It contained two eggs in its body cavity that were evident from outside. The lizard was found under a large boulder, along with two eggs (dimensions: 9.8 x 8.5 and 10.5 x 8.5 mm; weight 0.5 g apiece). *Hemidactylus brookii*, *Mabuya macularia* and *Lygosoma guentheri* were found syntopic with the present species. A ca. 10 m radius within the collection site yielded no further specimens of *Geckoella*. When disturbed, it assumed a posture that kept the body high and hissing, which is here interpreted as defence of the accompanying eggs. Both the eggs and the gravid female were transferred to the laboratory for further observations. The eggs were kept separately for incubation.

The female laid two white, hardshelled eggs (dimensions: 10.0 x 8.6 and 11.0 x 8.7 mm) on the night of 25 August 1998. On 3 October, 1998. 43 days after laying, a hatchling emerged from one of the eggs. Five days later, the second egg was checked and found to be infertile. The hatchling was active and measured 33.5 mm in

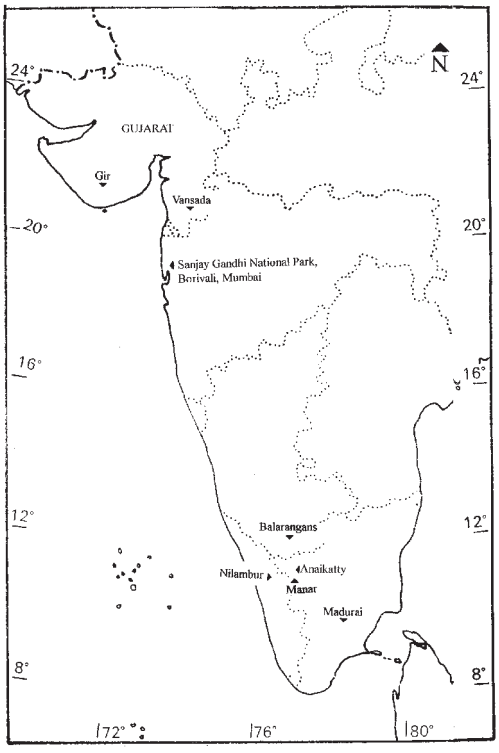

FIGURE 1: Map of peninsular India, showing the distribution of *Geckoella collegalensis* (Beddome, 1870).

TABLE 1: Measurements (in mm) and other details of *Geckoella collegalensis* collected from Gujarat State. Abbreviations: SVL - snout-vent length; TBL = total body length; * = missing/damaged tail; M = male; F = female; BNHM = Bombay Natural History Society registration number.

Sl. No.	SVL	TBL	Sex	Date of Coll.	Locality and remarks
1	40.0	30.0	-	8.11.1996	Pilipat, Sasan Gir (BNHM 1434)
2	35.0	25.0	M	9.11.1996	Adhodia, Sasan Gir (Crocodile Rearing Centre, Sasan)
3	44.5	*8.0+	F	10.6.1998	Sasan Gir. Released after examination
4	52.0	41.0	F	22.8.1998	Sasad Devi, Vansda (Vansda NP 123)
5	24.5	19.0	-	3.10.1998	Captive-born. Released in Navtad, Vansda N. P.

total body length. It had an egg-tooth. The body was bright grey with two rows of dark brown spots on the dorsum, the limbs marbled with black and 11 dark brown bands on the tail. These observations suggest that the species may lay double clutches in a season, similar to the habits of *Hemidactylus leschenaultii* observed (Vyas, unpubl.)

A total of four specimens were found from two localities in Gujarat. Both habitats are deciduous forests characterized by a mosaic of high canopy trees and more open scrubland and patches of wetlands. During the day, they apparently hide under rocks and during late evenings, come out in search of insects, as was observed at the Pilipat area of Gir Forest.

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On the identity of *Lacerta tjitja* Ljungh 1804, a gecko from Java

(with one text-figure)

Although numerous synonymies of gekkonid lizards have been published (e.g., Wermuth, 1965; Kluge, 1993; Bauer and Henle, 1994), older names that have never been identified as synonyms of valid taxa are occasionally "rediscovered." One such name is *Lacerta Tjitja*, used by Sven Ingemar Ljungh (1757-1828) to describe a gecko from Java in the third issue (July, August, September) of the 1804 volume of the important Swedish periodical *Konglig Vetenskaps Academiens nya Handlingar*. Ljungh's specimen was collected in Java in 1784 by Joh. Brandes. Ljungh (1804) noted that the species was a house gecko and that it could be quite vocal, repeating a loud "Tje" several times in rapid succession. A detailed description was also provided and illustrations of the body dorsum, dorsal and ventral surfaces of the foot, pupil, and eggs appeared on an accompanying plate (Fig. 1) based on a drawing by Brandes.

The specific epithet, which is clearly onomatopoeic, is also very similar to the Malay term for house geckos. It appears to have been almost

TABLE 1: Measurements (in mm) and other details of *Geckoella collegalensis* collected from Gujarat State. Abbreviations: SVL - snout-vent length; TBL = total body length; * = missing/damaged tail; M = male; F = female; BNHM = Bombay Natural History Society registration number.

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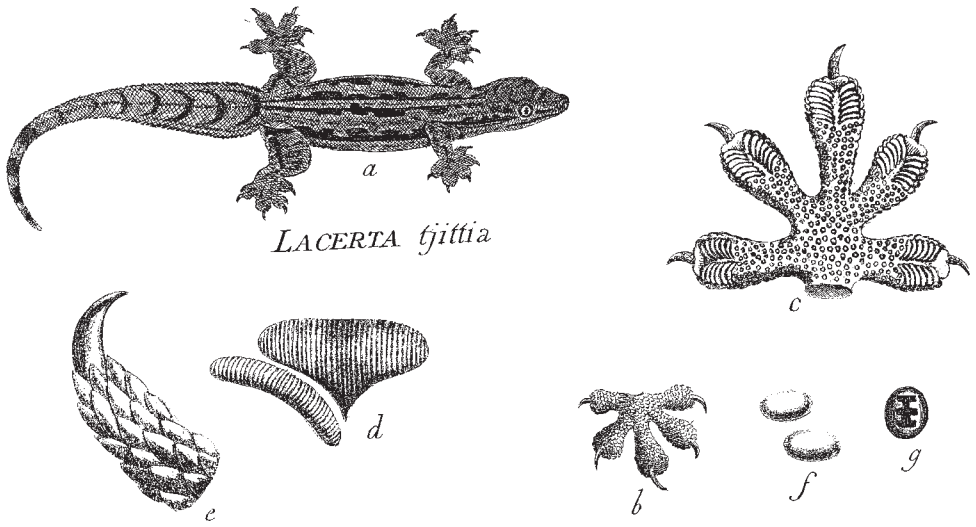

FIGURE 1: Fig. V accompanying Ljungh's (1804) description of *Lacerta tjitja*. a. dorsal view of the whole animal, b. dorsal view of the manus, c. ventral view of the manus, d. detail of the terminal digital scansors, e. detail of a claw, f. eggs of *L. tjitja*, g. detail of the eye. Note that the specific epithet is misspelled on the plate. Figure parts b, f, and g have been moved from their original positions on the plate in order to consolidate the

entirely ignored by subsequent workers. It is not mentioned by Cuvier (1817), Merrem (1820), or Tilesius von Tilenau (1820), each of whom provided lists and synonymies of the geckos known at the time. Neither does it appear in any of the standard works of later Nineteenth Century lizard systematics. Indeed, there appears to be only one subsequent reference to the taxon, by Schneider (1812), who provided a detailed German translation of the description and considered it as valid. Schneider's primary division among geckos was between those forms with rounded tails and those with partially or entirely flattened tails. Included among the latter was his species number nine, "Der chamaeleonartige g[ecko]," Ljungh's *Lacerta Tjitja*.

Schneider (1812) considered Ljungh's species to be closely allied to *Lacerta chinensis* Osbeck. This name was first used by Osbeck in 1757 and is thus pre-Linnaean and unavailable. As noted by Zhao and Adler (1993), who tentatively referred this gecko to *Hemidactylus bowringii* (Gray 1845), its subsequent use by Osbeck (1765) was in the vernacular sense. Oddly, Ljungh (1804) himself considered his new species to be similar to *Lacerta sputator* Sparrman (= *Sphaerodactylus sputator*), a species from the Lesser Antilles differing markedly from *Cosymbotus*, or any other Asian house geckos. Ljungh's interpretation was almost certainly based on his own greater familiarity with the work of other Swedish authors, of whom only Linnaeus and Sparrman had described geckos prior to 1804.

It is obvious that both Ljungh's (1804) illustration and his description of habitat and habits are consistent with the well known *Cosymbotus platyurus*, which has a broad distribution in parts of south-east Asia, including Java (Bauer and Henle, 1994; Manthey and Grossmann, 1997) and which occurs commonly as a house gecko (Ulber and Ulber, 1991). It is surprising, given Ljungh's accurate illustrations, that Schneider (1812) did not recognize the species as synonymous with *C. platyurus*, as this species was actually described by Schneider (1792) as *Stellio platyurus* and was listed and figured by him (1812) as the tenth species of gecko, "Der Gecko mit kegelförmigen Schuppen".

Lacerta tjitja (and *L. tjittia*, apparently used in error in the plate accompanying the description) is a junior subjective synonym of *Stellio platyurus* Schneider 1792 which, in the current combination *Cosymbotus platyurus*, has near

universal acceptance (see the chresonymy in Bauer and Henle, 1994). The older name was based on a specimen of unknown provenance in the collection of Marcus Eleisar Bloch, Schneider's friend and collaborator. However, the specimen does not appear to be present in the collections of the Zoological Museum, Berlin, where most of Bloch's herpetological material was eventually accessioned (Bauer and Günther, 1991; Bauer 1999). The only other synonym for this species to predate *L. tjitja* is *Lacerta Schneideriana* (Shaw 1802), which was proposed as a replacement name. Ljungh (1804) appears to be the first author to provide a specific locality for a specimen referable to *C. platyurus*.

Ota et al. (1987) identified possible karyological differentiation within *Cosymbotus platyurus* and raised the possibility that it may be a complex of similar, but chromosomally (and supposedly biologically) distinct species. *Lacerta tjitja* remains an available name and could be resurrected should Javan *C. platyurus* be recognized as distinct from the (currently unknown) population from which the type of *Stellio platyurus* was derived.

I am indebted to Richard Wahlgren for providing me with an original copy of Ljungh's paper and other important early Swedish herpetological references.

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First record of *Polypedates taeniatus* (Boulenger, 1906) from Assam, north-eastern India

(with one text-figure)

Polypedates taeniatus (Boulenger, 1906) was originally described from "Purneah, Bengal" (at present in Bihar State, eastern India). The species is related to *P. leucomystax* (Gravenhorst, 1829), which is widely distributed in north-eastern India (Dutta, 1997) and south-east Asia (Church, 1963). Dubois ("1986" 1987) included *P. taeniatus* in the *Polypedates leucomystax* group. In India, *P. taeniatus* has been recorded from Bihar (Boulenger, 1906) and Dudhwa National Park in Uttar Pradesh (Ray, 1991). Outside India, the species is known from Nepal, from the Royal Chitwan National Park and Koshi Tappu Wildlife Reserve (Anders et al., 1998). According to Anders et al. (1998), the report of *Rana tytleri* from Bangladesh by Khan (1982) is based on misidentified specimens of *P. taeniatus*. If confirmed, the range of the species would therefore include Bangladesh.

FIGURE 1: *Polypedates taeniatus* (ZSI A9092) from Orang National Park, Assam, north-east India.

On 8 October 1998, an adult female (SVL 39.5 mm; Zoological Survey of India, ZSI A9092) *Polypedates taeniatus* was collected by the first author from the banks of the Pachnoi River, within the Orang National Park (20º 40'N; 92º 30'E), Darrang District, Assam State, north-eastern India. This constitutes the first record of the species from Assam. The nearest confirmed records are the ones by Anders et al. (1998) from Nepal.

We thank C. R. Bhobra, Divisional Forest Officer and Pallab Deka, Range Officer, Orang National Park for permission and support to conduct the amphibian survey in the area. MFA is indebted to Aaranyak Nature Club, Guwahati, for sponsoring the survey and to Bibhuti and Sudip of Aaranyak for their assistance in the field.

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Melanobatrachus indicus Beddome, 1878, resighted at the Anaimalai Hills, southern India

Melanobatrachus indicus, the Malabar black narrow-mouthed frog, was described by Beddome (1878), based on a few specimens collected from the Anaimalai hills. This black and scarlet coloured frog has been resighted only thrice since its original description: Roux (1928) from Valparai; Vasudevan (1997) from Kakachi, Kalakad-Mundanthurai Tiger Reserve (KMTR), and Daltry and Martin (1997) from the Periyar Tiger Reserve, Kerala. The Kalakad report extends its distribution range southwards up to the Ashambu Hills from the Anaimalais.

On 9 April 1999, while sampling reptiles in the rainforest fragments in the Valparai area of Anaimalai Hills (Indira Gandhi Wildlife Sanctuary, Tamil Nadu), I found a female *Melanobatrachus indicus* in the Pudhuthottam rainforest fragment (alt. 1,100 m). This heavily disturbed rainforest fragment borders Valparai town and is under intense anthropogenic pressure. The species was found under a rock, < 1 m away from a rocky perennial stream. Interestingly, all collections have been between 1,000-1,500 m, in the wet evergreen forests of the Western Ghats, south of 13º N latitude. This is the first sighting of the species from the Anaimalai Hills since Roux's (1928) report from Valparai.

The external characters and colour of the specimen agree with the description by Boulenger (1890) and Vasudevan (1997): body slender, circular pupil, fingers free, toes with minimal webbing, absence of disc on tips of fingers and toes, and skin pustular above while smooth below. The characteristic colouration of the species- black, with bright scarlet patches on the underside of thighs and pectoral region, small blue spots on the sides and belly, and a few on the dorsum. The individual I collected differed from other described specimens in its scarlet colour on the pectoral region. It only had small bright scarlet spots, instead of large overlapping blotches (specimen from KMTR, pers. obs.).

Live measurements (in mm) are given below: snout-vent length 29.5; head length 6.1; head width 9.1; snout length 3.9; eye diameter 3.4; and interorbital distance 3.5. The specimen has been deposited in the Wildlife Institute of India Museum, WIINI 215.

These observation were part of a study to understand the impact of rainforest fragmentation on the biological diversity of herpetofauna and small mammals in the Western Ghats, a collaborative project of the United States Fish and Wildlife Service and the Wildlife Institute of India.

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PHILIPPINE AMPHIBIANS. AN ILLUSTRATED FIELD GUIDE by Angel C. Alcala and Walter C. Brown. 1998. Bookmark, Inc., Makati City. xii + 116 pp. ISBN 971-569-314-8. Available from Bookmark, Inc., 264-A Pablo Ocampo Sr., Avenue, Makati City, Philippines. Fax: 96320 897 08 24; email: bookmark@info.com.ph. Price: Philippine Pesos 350.

This delightful little (ca. 15 x 13 cm) book introduces readers to the world of Philippines amphibians, a fauna that continues to reveal remarkable new species every year. The contents include: a foreword (by Robert C. Drewes), a preface, an "Ice-age map of the Philippines" (when sea levels were at their lowest), an introduction, a section on how the work should be used, microhabitats of Philippine amphibians (with photographs of representative microhabitats, from tree crevices to bird's nest ferns), species accounts, selected references (listing a dozen papers and monographs, from the classical works to the more recent papers describing new taxa by the authors of the present work and their associates), an index to popular (= English) names, an index to scientific names and acknowledgments and credits. Each species account comprises an English name, the scientific name and authority, size (i.e., snout-vent length, in mm), habitats, diet, mode of reproduction, time of activity, substratum of activity of adults, conservation/population status, frequency of occurrence), miscellaneous remarks (including similar species, diagnostic characters, conservation status, etc.) and geographic range (within the Philippines and extralimitally). Nearly every species is illustrated with a colour photo, which ranges from passable to good, except for the often artificial background. Seven families and 79 species are dealt with. Essential reading on a diverse herpetofauna.

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AMFIBI JAWA DAN BALI (English language edition: The amphibians of Java and Bali) by Djoko Iskandar. 1998. Puslitbang Biologi- LIPI and GEF- Biodiversity Collections Project, Bogor. xviii + 117 pp; 26 pl. ISBN 979-579-015-3. English edition, 1998. Research and Development Centre for Biology- LIPI and GEF- Biodiversity Collections Project, Bogor. xix + 117 pp; 26 pl. Available from Gramedia, Asri Media, Jalan Merdeka 43, Bandung, Indonesia and Yayasan Hayati, LIPI, Bogor, Indonesia. Price: US$ 30-35 or Indonesian Rupiah 15,000-20,000.

Strangely, the better-explored Indonesian islands of Java and Bali (relative to Borneo) were not to have a field guide to the amphibian fauna before this. The author of the present work, Djoko Iskandar is a respected Indonesian herpetologist, is naturally the appropriate person to write such a work.

The text includes the following sections: a general account of the biology of amphibians of Java and Bali (including systematics, morphology, ecology, reproductive biology, dietary patterns, defence mechanisms and role in economy); classification of Javanese amphibians; a dichotomous identification key to the adult amphibians and a separate one for their larval stages (including line drawings of body forms of both life history stages); species accounts; a bibliography (including references in Bahasa Indonesian, English and German), a glossary of technical terms used; checklist of local species; acronyms of museum and other systematic institutions cited in the text, and index of scientific, Bahasa Indonesian and English names.

One new species is described in the work-*Kalophrynus minisculus* Iskandar, 1998 (distribution: Cieunteur, Ujung Kulon, Java). *Fejervarya* Bolkay, 1915, given as "jenis baru" (= gen. nov.) on p. 74, is obviously in error, as on

p. 72, the appropriate authorship is provided. Seven families of local amphibian species are covered, comprising 37 species. Three exotic species are also dealt with- *Rana catesbiana*, *Xenopus laevis* and *Hymenochirus* sp.

Typos are dealt with in the form of a slip of paper inserted into the book that, given the nature of typos (e.g., species names, labial tooth row formulae and measurements), will need to be kept next to the work and referred to alongside the text. Colour plates of habitats and of frogs have been gathered at the back of the book, in 26 plates, each usually with two photographs that have printed well.

Given Djoko's extensive work on the herpetofauna of Sulawesi, perhaps one can now look forward to a field guide to the frogs, toads and caecilians of that remarkable island.

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