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BOOK REVIEW

INSTRUCTIONS TO CONTRIBUTORS

Hamadryad publishes original papers dealing with, but not necessarily restricted to, the herpetology of Asia. Reviews of books and major papers are also published.

Manuscripts should be only in English and submitted in triplicate (one original and two copies, along with three copies of all tables and figures), printed or typewritten on one side of the paper. Manuscripts can also be submitted as email file attachments. Papers previously published or submitted for publication elsewhere should not be submitted. Final submissions of accepted papers on disks (IBM-compatible only) are desirable. For general style, contributors are requested to examine the current issue of *Hamadryad.* Authors with access to publication funds are requested to pay US$ 5 or equivalent per printed page of their papers to help defray production costs. Reprints cost Rs. 2.00 or 10 US cents per page inclusive of postage charges, and should be ordered at the time the paper is accepted.

Major papers exceeding four pages (double spaced typescript) should contain the following headings: Title, name and address of author (but not titles and affiliations), Abstract, Key Words (five to 10 words), Introduction, Material and Methods, Results, Discussion, Acknowledgements, Literature Cited (only the references cited in the paper). Appendices follow the main paper. Descriptions of new taxa will be considered as major papers regardless of size. Abstracts (up to 150 words) should summarize the important findings of the paper and should avoid references. In case of descriptions of new taxa, diagnoses should be provided in the abstract. Special attention should be paid to accents and diacritical marks: if fonts are not available in the software or typewriter, these may be put directly on the hard copy of the manuscript by hand.

References should be in the following format:

Papers:
GAULKE, M. 1994. Notes on the herpetofauna of Panaon and Sámar, East Visayans, Philippines. *Hamadryad* 19:1-10.

Books:
RUSSELL, P. 1796. An account of Indian serpents collected on the coast of Coromandel; containing descriptions and drawings of each species; together with experiments and remarks on their several poisons. George Nicol, London. viii + 90 pp + Pl. I-XLVI.

Chapters in books:
KIEW, B. H. 1984. Terrestrial vertebrate fauna of Lambir Hills National Park. *In*: An ecological survey of Lambir Hills National Park, Sarawak. pp: 55-63. E. Soepadmo & K. I. Sudderuddin (Eds). University of Malaya, Kuala Lumpur.

Unpublished reports:
WILKINSON, J. W., J. W. ARNTZEN & R. S. THORPE. 1995. Amphibian populations on organic farms: their role in pest control. M.A.F.F. Report. iv + 48 pp.

Publications in languages other than English:
SZCZERBAK, N. N. & M. L. GOLUBEV. 1986. [The gekkonid fauna of the USSR and adjacent countries.] *Sci. Acad. Ukranian SSR Zool. Inst.* 1986: 1-232. [In Russian.]

Tables should be comprehensive without reference to the text. Tables should follow the main body of the paper, and their desired location within the text indicated on the manuscript. Footnotes are generally not allowed. Line art and half tones are preferred as electronic files saved on compact disks or attached to email files. Black and white photographic prints and slide transparencies are accepted if they are sharp and show good contrast. Black and white photos should be printed on glossy paper at least 152 x 204 mm after being trimmed at right angles and should carry the name of the author and of the manuscript at the back. Illustrations should be preferably done with Indian ink on good quality tracing paper. All lettering should be done using high quality computer printouts or transfers. Illustrations should be planned to fit either one column (6.5 mm) or one page (14 mm) width, after suitable reduction.

All manuscripts received for *Hamadryad* are sent to two or more referees. Authors of papers describing range extensions and descriptions of new taxa should deposit their material in established systematic institutions and cite museum registration numbers. Range extensions not based on specimens, such as endangered or other protected species, may be based on photographs that are deposited in a recognized systematic institution.

Manuscripts should be sent by registered post to: Indraneil Das, Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia. Email: idas@ibec.unimas.my

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A NEW SPECIES OF REED SNAKE OF THE GENUS *CALAMARIA* H. BOIE, 1827, FROM PULAU TIOMAN, PAHANG, WEST MALAYSIA

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(with four text-figures)

ABSTRACT.– **A new species of *Calamaria* is described from Pulau Tioman, Pahang, West Malaysia. It is distinguishable from all other species by sharing a unique combination of scale, tooth, and colour pattern characteristics. This brings the total number of endemic species of snakes on Pulau Tioman to at least three.**

KEY WORDS.– ***Calamaria*, new species, Malaysia, Pulau Tioman, endemic.**

INTRODUCTION

The colubrid genus *Calamaria* is one of the largest groups of Asian snakes which currently contains approximately 51 species as indicated by Inger and Marx (1965). *Calamaria* extends from the Ryukyu Archipelago of Japan, southward through south-east Asia to Sumatra and adjacent islands, thence eastward to Sulawesi. Species of *Calamaria* are generally small, terrestrial to semifossorial, forest dwelling species that are morphologically distinct in having blunt heads, fused cephalic plates, reduced number of dorsal scales, and short tails; all conducive to a semifossorial lifestyle. In a monumental systematic revision of this genus, Inger and Marx (1965) noted the circumscribed distribution of many species and high levels of endemism on many Sunda Shelf islands. In the Seribuat Archipelago, located off the south-eastern coastline of West Malaysia, three species of *Calamaria* are known to be present: *C. lumbricoidea* and *C. pavimentata* from Pulau Tioman (Grismer et al., 2003; Lim and Lim, 1999) and *C. lovii* from Pulau Aur (Grismer et al., 2003; Inger and Marx, 1965). Recent work on Pulau Tioman (Fig. 1) has resulted in the discovery of a new population of *Calamaria* that is distinct from all other species on the combination of scalation, tooth morphology, and colour pattern. It is therefore described herein as new.

MATERIALS AND METHODS

Terminology and measurements follow Inger and Marx (1965). Museum acronyms follow Leviton et al. (1985) except that ZRC is retained for the Zoological Reference Collection of the The Raffles Museum of Biodiversity Research at the National University of Singapore.

SYSTEMATICS

Calamaria ingeri sp. nov.

(Figs. 2, 3, 4)

Holotype.- Adult female (FMNH 262246) collected from a pitfall trap at 98 m above sea level in lowland dipterocarp forest on the west side of Pulau Tioman along the Tekek-Juara trail, 1.9 km east of Kampung Tekek, Pahang, West Malaysia. Collected by W. Grossmann and F. Tillack on 23 July 2002.

Paratype.- Subadult female (ZRC 2.5780), paratopotype, 22 July 2002.

Diagnosis.- Distinguished from all other species by the unique combination of having 7 modified maxillary teeth; 3rd and 4th supralabials contacting orbit; preocular present; mental separated from anterior chinshields; six scales sur-

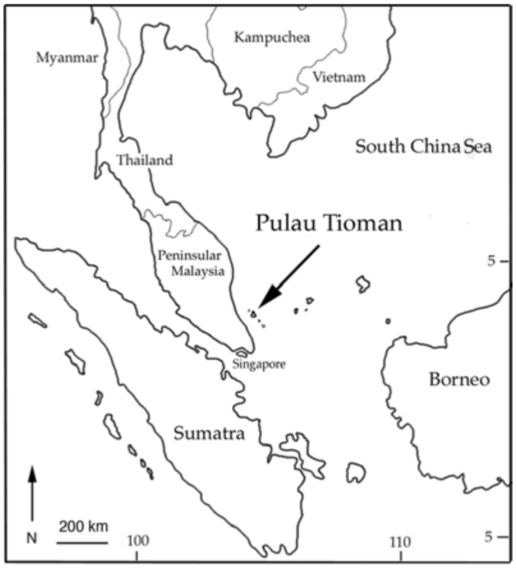

FIGURE 1: Map of south-east Asia, showing the distribution of *Calamaria ingeri* sp. nov.

rounding the paraparietal; 213-228 ventral scales (Table 1); tail short, thick, and abruptly tapered (Fig. 4); and dorsal scales reduced to 4 rows on tail opposite last subcaudal anterior to terminal scute.

Description of holotype.- Rostral slightly narrower than high, dorsal portion visible, equal to 1/2 length of prefrontal suture; prefrontals as long as frontal, touching first two supralabials; frontal hexagonal and protracted posteriorly, slightly more than twice the width of supraoculars, approximately 3/4 length of parietal; parietal approximately 1.25 times as long as prefrontal; paraparietal surrounded by 6 scales; nasals smaller than postocular; small triangular preocular present; neither ocular as tall as eye, postocular taller; eye less than eye-mouth distance; 5 supralabials, 3rd and 4th entering orbit, 5th the largest, 4th the smallest; mental triangular, not touching anterior chinshields; 5 infralabials, first three touching anterior chinshields; anterior and posterior pairs of chinshields meet at midline; 3 gulars in midline between anterior ventral and mental; seven modified maxillary teeth ($n = 2$).

Ventrals 228; subcaudals 11, paired; dorsal scales reduced to 4 rows on tail opposite last subcaudal anterior to terminal scute. Anal plate entire.

Snout-vent length 171 mm; tail length 6 mm. Body thin; tail thick, short, tapering quickly to point from base.

Head, body and tail dark brown above, intermittent light minute spotting in scales; dark colouration extends ventrally 2/3 the way down the supralabial scales, 1/2 the way down on 1st dorsal scale rows on body, and nearly all the way down first dorsal scale rows on tail; light coloured vertical bar extends 1/2 way up the neck immediately posterior to angle of jaw; 26 incomplete light transverse bands one scale wide on body and tail; gular, abdominal, and subcaudal region cream-coloured and immaculate.

Variation.- The paratype is a subadult (SVL 144 mm; tail length 6 mm). It has 213 ventrals and 10 subcaudals. Its colour pattern is more pronounced in that its cream coloured transverse bands are complete across the dorsum and number 20.

Distribution.- Known only from the type locality on Pulau Tioman, Pahang, West Malaysia.

Etymology.- The specific name honors Robert F. Inger for his tremendous contributions to south-east Asian herpetology and especially to an understanding of the genus *Calamaria.*

COMPARISONS

Calamaria ingeri most closely resembles *C. virgulata* that extends from Sumatra, Java and Borneo to Sulawesi and the Philippines (see Inger and Marx, 1965: Fig. 53). It differs from *C. virgulata* in that the rostral is not wider than high; the prefrontals are as long as the frontals rather than shorter; having seven modified maxillary teeth as opposed to 8-10; lacking a light network of spots and longitudinal stripes on dark dorsal scales, having 20-26 cream coloured dorsal bands. *Calamaria ingeri* differs from *C. gracillima, C. mechei, C. schmidti, C. lovii lovii, C. l. gimletti, C. l. wermuthi, C. javanica, C. borneensis, C. battersbyi, C. malanota, C. buchi, C. linnaei, C. pavimentata* and *C. septentrionalis* by the 3rd and 4th supralabials entering the orbit rather than the 2nd or 3rd. *Calamaria ingeri* differs from *C. gracillima, C. mechei, C. schmidti,*

FIGURE 2: Dorsal view of body of paratype of *Calamaria ingeri* sp. nov. (ZRC 2.5780), showing the banding pattern.

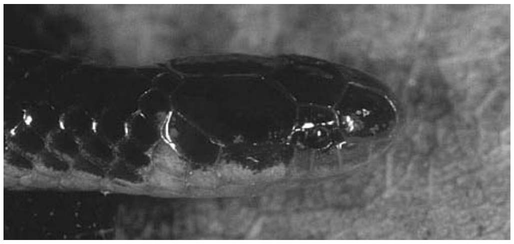

FIGURE 3: Dorsolateral view of head of holotype of *Calamaria ingeri* sp. nov. (FMNH 262246).

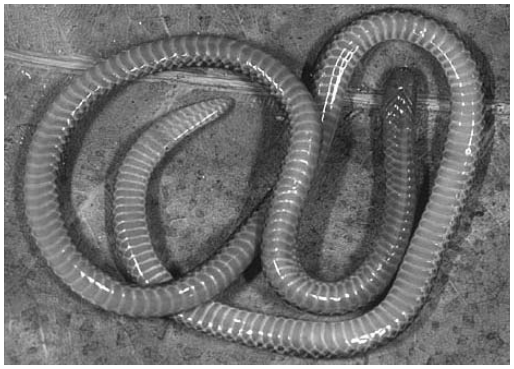

FIGURE 4: Ventral view of body of holotype of *Calamaria ingeri* sp. nov. (FMNH 262246), showing belly and short tail.

C. lovii lovii, C. l. gimletti, C. l. wermuthi, C. javanica, C. apraeocularis, C. alidae, C. ceramensis and *C. rebentischi* in not lacking a preocular scale. It differs from *C. l. lovii, C. l. wermuthi, C. javanica, C. borneensis, C. battersbyi, C. melanota, C. buchi, C. linnaei, C. apraeocularis, C. curta, C. acutirostris, C. virgulata, C. forcarti, C. sumatrana, C. abstruse, C. margaritophora, C. nuchalis, C. eiselti, C. crassa, C. albiventer, C. griswoldi, C. lumbricoidea, C. hilleniusi, C. bitorques, C. prakkei, C. grevaisi, C. grabowskyi, C. suluensis, C. joloensis* and *C. muelleri* in that the mental does not contact the anterior pair of chinshields. *Calamaria ingeri* differs from *C. schmidti, C. curta, C. acutirostra, C. leucogaster, C. ulmeri* and *C. lautensis* in having modified maxillary teeth. It differs from *C. buchi, C. alidae, C. ceramensis, C. rebentischi, C. albiventer, C. griswoldi, C. hilleniusi, C. bitorques, C. prakkei, C. grevaisi, C. grabowskyi, C. suluensis, C. joloensis, C. muelleri, C. bicolor, C. lateralis, C. lumholtzi, C. everetti, C. brongersmai, C. palavanensis, C. leucogaster* and *C. ulmeri* in having six as opposed to five shields and scales surrounding the paraparietal. Differences in the numbers of ventrals and subcaudals are listed in Table 1.

Other material examined.- *Calamaria lumbricoidea* BPBM 7498, LSUHC 3781 from Pulau Tioman, Pahang, West Malaysia. *Calamaria pavimentata* LSUHC 3920 from Pulau Tioman, Pahang, West Malaysia. *Calamaria lovii gimletti* ZRC 2.2684 from Pulau Aur, Johor, West Malaysia, ZRC 2.2686 from Bukit Lagong, Selangor, West Malaysia, ZRC 2.2685 Gunung Pulai, Johor, West Malaysia. *Calamaria virgulata* FMNH 63571 Sapagaya Forest reserve, Sapagaya River, Sandakan District, Sabah, FMNH 152151-52 Mt. Kinabalu, Sabah, FMNH 212584 Lake Lindu area, Paku, central Sulawesi.

DISCUSSION

Calamaria ingeri appears to be most closely-related to *C. virgulata* in having five supralabial scales, a preocular, high ventral scale count (> 175), and a thick short blunt tail (Inger and Marx, 1965). The extensive distribution and character variation within *C. virgulata* suggest that it may be composed of more than one species (Inger and Marx, 1965; R. F. Inger, pers. comm., 2002). In fact, the populations from central and southern Sulawesi are unique in having the mental touching the anterior chinshields (Inger and Marx, 1965). In all other populations of *C. virgulata,* including those from Sulawesi's northern peninsula, these scales are not in contact. This pattern of variation is geographically

TABLE 1: Selected diagnostic characters of the species of the genus *Calamaria*. 1 = supralabials contacting orbit; 2 = preocular present (+) or absent (0); 3 = mental contacts chin shields (+) or not (0); 4 = maxillary teeth modified (+) or not (0); 5 = number of scales contacting paraparietal; 6 = tail tapers abruptly (+) or not (0); 7 = number of ventrals; 8 = number of subcaudals. Data on all species except *C. ingeri* are taken from Inger and Marx (1965).

Characters								
Species	1	2	3	4	5	6	7	8
ingeri	3,4	+	0	+	6	+	?m, 213-228 f	?m, 10-11 f
gracillima	2,3	0	0	+	6	0	295 m, 290-304 f	15m, 12-13 f
schmidti	2,3	0	0	0	6	0	?m, 144 f	?m, 14 f
lovii lovii	2 or 2,3	0	+	+	6	+	190-222m, 218-254 f	17-26m, 11-18 f
lovii gimletti	2,3	0	0	+	6	0	161-202m, 215-249 f	14-20m, 10-12 f
lovii wermuthi	2,3	0	+	+	?	+	?m, 256 f	?m, 11 f
javanica	2,3	0	+	+	6	0	176m, 168-170 f	16m, 10-12 f
borneensis	2,3	+	+	+	6	0	126-169m, 159-192 f	20-26m, 13-21 f
battersbyi	2,3	+	+	+	6	+	171m, ? f	16m, ? f
melanota	2,3	+	+	+	6	0	121-142m, 131-154 f	23-26m, 16-20 f
buchi	2,3	+	+	+	5	+	?m, 221-236 f	?m, 13-14 f
linnaei	2,3	+	+	+	6	+	130-149m, 148-166 f	15-22m, 7-13 f
pavimentata	2,3	+	+,0	+	5,6	0	125-168m, 137-206 f	13-33m, 8-20 f
septentrionalis	2,3	+	0	+	6	0	148-166m, 168-188 f	15-19m, 6-11 f
apraeocularis	3,4	0	+	+	6	0	178m, 218-220 f	18-19m, 10 f
alidae	3,4	0	+,0	+	5	0	185-203m, 231 f	22-27m, 17 f
ceramensis	3,4	0	0	+	5	0	139-146m, 148-165 f	28-30m, 17-21 f
rebentischi	3,4	0	0	+	5	-	140m, ? f	29m, ? f
mechei	3,4	0	0	+	6	0	174m, 167-195 f	28m, 12-16 f
curta	3,4	+	+	0	6	0	156m, 153-170 f	23m, 17-17 f
virgultea	3,4	+	+,0	+	5,6	+	160-237m, 180-260 f	16-30m, 8-16 f
acutirostris	3,4	+	+	0	6	0	148-162m, 163-174 f	20-24m, 13-17 f
forcarti	3,4	+	+	+	6	0	176-177m, 194-20 f	30m, 16-17 f
sumatrana	3,4	+	+	+	6	+	126-157m, 164-175 f	14-20m, 10-14 f
abstrusa	3,4	+	+	+	5,6	+	129-148m, 145-152 f	24-25m, 14 f
margaritophora	3,4	+	+	+	6	?	150-159m, 147-163 f	13-17m, 8-11 f
nuchalis	3,4	+	+	+	5,6	0	133-146m, 156 f	14-20m, 9 f
eiselti	3,4	+	+	+	6	+	137m, 151-153 f	21-22m, 16-15 f
crassa	3,4	+	+	+	6	+	136-154m, 158-164 f	21-28m, 14-17 f
albiventer	3,4	+	+	+	5	0	146-144m, 147-162 f	21-22m, 15-19 f
griswoldi	3,4	+	+	+	5	0	155-179m, 183-192 f	16-18m, 16-16 f
lumbricoidea	3,4	+	+	+	4,5	+	144-196m, 167-229 f	17-27m, 13-21 f
hilleniusi	3,4	+	+	+	5	0	147-155m, 154-161 f	18-21m, 14-16 f
bitorques	3,4	+	+	+	5	+	150-157m, 157-197 f	17-20m, 12-17 f
prakkei	3,4	+	+	+	5	0	126-132m, 142-144 f	31-33m, 24-25 f
grevaisi	3,4	+	+	+	5	0	132-164m, 142-190 f	15-21m, 10-18 f
grabowskyi	3,4	+	+	+	5	0	150-186m, 164-190 f	23-29m, 20-28 f
suluensis	3,4	+	+	+	5	0	129-138m, 142-168 f	18-20m, 14-26 f
joloensis	3,4	+	+	+	5	+	199m, ? f	13m, ? f
muelleri	3,4	+	+	+	5	0	129-155m, 155-178 f	16-21m, 9-15 f
bicolor	3,4	+	0	+	5	0	139-169m, 149-161 f	21-28m, 18-21 f
lateralis	3,4	+	0	+	5	0	146m, 150-151 f	23m, 16-18 f

lumholtzi	3,4	+,0	0	+	5	+	?m, 161-171 f	?m, 13-15 f
schlegeli	3,4	+,0	0	+	5,6	0	129-161m, 136-180 f	25-44m, 19-37 f
everetti	3,4	+	0	+	5	0	140-157m, 136-155 f	20-22m, 16-25 f
brongersmai	3,4	+	0	+	5	+	155m, 157 f	18m, 11 f
palavanensis	3,4	+	0	+	5	+	171-181m, 171-187 f	23-25m, 16-20 f
modesta	3,4	+	0	+	5,6	0	131-179m, 158-202 f	19-31m, 12-21 f
doderleini	3,4	+	0	+	6	+	163m, ? f	20m, ? f
boesemani	3,4	+	0	+	6	+	170m, ? f	16m, ? f
leucogaster	3,4	+	0	0	5	0	126-146m, 129-157 f	17-26m, 12-19 f
ulmeri	3,4	+	0	0	5	0	?m, 186 f	?m, 23+ f
lautensis	3,4	+	0	0	6	0	123-130m, 146 f	29-32m, 14+ f

concordant with that of other vertebrates on Sulawesi (Evans et al., 2003) and is a result of this island being formed through the accretion of multiple islands (Hall, 1996, 1998, 2001) along with Pleistocene and Holocene inundations of the northern peninsula (Whitten et al., 2002). If *C. ingeri* is related to this putative species complex, it is significant in being the only West Malaysian representative. Its presence on Pulau Tioman and absence from peninsular Malaysia is in accordance with the biogeographic pattern of other populations of amphibians and reptiles from Pulau Tioman (Grismer et al., 2003) and is consistent with biogeographical patterns of other Sundaland species (Inger and Voris, 2002).

The addition of *Calamaria ingeri* to Pulau Tioman brings the total of endemic amphibians and reptiles on the island to nine: two frogs, three lizards, and four snakes (see Grismer et al., 2003 and references therein). There is at least one new frog and lizard from Pulau Tioman yet to be described. This high degree of endemism parallels the island's high species diversity (22 frogs, one caecilian, one turtle, 33 lizards and 38 snakes) which J. Grismer et al. (2004) attributed to Pulau Tioman's complex habitat heterogeneity.

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A SYNOPSIS OF THE AMPHIBIAN FAUNA OF GOA

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ABSTRACT.– **This report deals with 27 species in 12 genera, five families and two orders representing the amphibian fauna of the State of Goa State, western India, based on collections in the Zoological Survey of India that were made between March, 1966 and July, 1979. A total of 397 specimens of amphibians are being reported. Four additional species (including *Microhyla rubra, Indirana beddomii, Limnonectes brevipalmatus* and *Gegeneophis ramaswami*) are recorded for the first time from Goa. A microhylid, *Ramanella mormorata* Rao, which was recorded by Das and Whitaker (1997) from southern Goa after over half a century, is here being reported from both the northern and southern parts of Goa. Diagnoses have been added for determination of species.**

KEY WORDS.– **Amphibians, inventory, Goa, India.**

INTRODUCTION

Goa lies on the west coast of India, between approximately 15° 0'–50'N; 73° 40'–74° 20'E. The southern part of Goa is characterised with forest-clad hills, supporting evergreen forests.

The amphibian fauna of Goa is rich in species, and includes representatives of two orders, the Gymnophiona and Anura. In all, 27 species of amphibians are being reported from Goa. Apart from some isolated publications and records by Abdulali and Sekar (1988), Sekar (1991; 1992), Bhat and Desai (1998) and Das and Whitaker (1997), no consolidated faunal account on the amphibians from the State as a whole is available. This therefore is the first detailed account on the amphibian fauna of Goa, based mainly on the collection made by several expeditions by the Zoological Survey of India. Apart from these studies, the species recorded by earlier authors have also been included in the paper in order to provide a complete faunal account of the amphibians of Goa.

MATERIALS AND METHOD

Aquatic amphibians were collected with a net fitted with a metal ring fixed at the end of a long bamboo pole, cast-net and fishing hook; terrestrial and arboreal forms by hand. In the field, notes have been taken on the habitats of specimens collected. Specimens obtained were euthanised and fixed in a 5% formalin solution for at least 24 h. An abdominal incision was made for smaller specimens, while larger specimens were injected with a 10% formalin solution. The fixed material along with labels containing the data of locality, altitude, habitat, date of collection and name of collector, were packed in 5% formalin and transported to the lab for study.

SYSTEMATIC ACCOUNT

BUFONIDAE

Bufo Laurenti, 1768:

Bufo melanostictus Schneider, 1799:

1799. *Bufo melanostictus* Schneider, *Hist. Amph*. 1: 216.

Material examined.- 1 ex. (ZSI A9042), Forest, 2 km s. Rest House, Valpoi, 11.i.1969, V. C. Agarwal. 2 ex. (ZSI A9054), Mollem, 6.ix.1969; 1 ex. (ZSI A9025), 5 km n.-e. Forest Rest House, Mollem, 9.ix.1969; 2 ex. (ZSI A9026-27), Valpoi, 15.ix.1969; 1 ex. (ZSI A9028), Karki River and its vicinity, 11 km w. Valpoi, 15.ix.1969; 1 ex. (ZSI A9029), Kandal rubber plantation, 18 km s. Forest Rest House, Valpoi, 20.ix.1969; 2 ex. (ZSI A9030), 5 km w. Forest Rest House, Valpoi, 22.ix.1969; All coll. R. C.

Sharma. 1 ex. (ZSI A8997), Valpoi, 20.ix.1977; 2 ex. (ZSI A8998), Mollem, 29.ix.1977; 1 ex. (ZSI A8999), Mollem 30.ix.1977. All coll. A. K. Mondal. 1 ex. (ZSI A8971), Bhagwan Mahaveer Wildlife Sanctuary, 1 km n. Forest Rest House, Mollem, 23.vi.1979; 1 ex. (ZSI A8972), 2 km s. Forest Rest House, Ponda. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 19–58 mm.

Identification.- Dorsum dark brownish; venter dull white; dorsum skin rough with several spiny warts; skin of venter with numerous small spiny warts; head broader than ling, with cornified bony ridges; snout rounded, nearly equal the diameter the eye; nostril a little nearer the tip of snout than to the eyes; interorbital width broader than that of upper eyelid; tympanum distinct, two-third diameter of eye; fingers free, first a little longer than the second, tips of fingers and toes swollen; toes about half webbed, more than three phalanges of fourth toe free; two oval (inner and outer) metatarsal tubercles present; tarsometatarsal articulation reaches between tympanum and eye.

Distribution.- Abdulali and Sekar (1988) reported it from Valpoi, Goa. Common throughout the plains of India, and Andaman and Nicobar. Elsewhere, Pakistan, Bangladesh, Sri Lanka, Nepal, Myanmar, southern China, the Malay Peninsula and Archipelago.

Remarks.- Terrestrial and nocturnal, being found in and near water during the breeding season. This species is used for dissection in college laboratories, and the males are used in human pregnancy tests.

MICROHYLIDAE

Microhyla Tschudi, 1838:

Microhyla ornata (Duméril and Bibron, 1841):

1841. *Engystoma ornatum* Duméril and Bibron *Erpet. Gen*., 8: 745.

Material examined.- 1 ex. (ZSI A9000), Mollem, 5.x.1977, A. K. Mondal. 2 ex. (ZSI A8967), around Forest Rest House, Mollem, 21.vi.1979; 1 ex. (ZSI A9868), Mollem, 22.vi.1979; 1 ex. (ZSI A8969), 2 km s. Forest Rest House, Ponda, 3.vii.1979; 1 ex. (ZSI A8970), 2 km s. Forest Rest House, Ponda, 3.vii.1979. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 17–22 mm.

Identification.- Dorsum brownish with broad darker markings; venter whitish, little darker on throat; dorsum skin smooth, ventrally with also smooth; head broader than long; snout obtusely pointed, a little longer than diameter of eye; nostril nearer to tip of snout than eye; interorbital width a little broader than that of upper eyelid; tympanum indistinct; fingers free, first shorter than second, tips flattened; toes with rudiment of web, tips blunt; two small but distinct oval (inner and outer) metatarsal tubercles present. Tibiotarsal articulation reaches nearer to eye.

Distribution.- Abdulali and Sekar (1988) reported it from Bondla, Goa. It is a widely distributed species in the plains of India, up to an altitude of 1,524 m, and also the Andaman Islands. Elsewhere, Pakistan, Nepal, Bangladesh, Sri Lanka, eastern and south-east Asia.

Remarks.-A small frog generally found inside bushes and under leaf litter on moist soil. They are nocturnal, sometimes found inside human dwellings on rainy days.

Microhyla rubra (Jerdon, 1854):

1854. *Engystoma rubrum* Jerdon, *J. Asiat. Soc. Bengal*, 22: 534.

Material examined.- 2 ex. (ZSI A9055), nr. Police Training School, Valpoi, Goa, 16.ix.1969, R. C. Sharma.

Snout-vent length.- 21–22 mm.

Identification.- Dorsum brownish, venter dull whitish, darker on gular region; dorsum warty, ventrally smooth; head broader than long, snout rounded a little shorter than diameter of eye; nostril nearer tip of snout than eye; interorbital width broader than that of upper eyelid; tympanum hidden; fingers free, first finger much shorter than second, tips swollen, two large shovel-shaped metatarsal tubercles present; tibiotarsal articulation reaching eyes.

Distribution.- Besides Goa, Assam, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh in India. Also, Sri Lanka.

Remarks.- First report from Goa. A small, cryptic and nocturnal species.

Ramanella Rao and Ramanna, 1925:

Ramanella montana (Jerdon, 1854):

1854. *Hylaedactylus montanus*: Jerdon, *J. Asiat. Soc. Bengal*, 22: 533.

Material examined.- Recorded by Abdulali and Sekar (1988). ZSI A9048, A9049 and A9047.

Identification.- Dorsum pale brown to chocolate; venter white with blotches; dorsum skin smooth, venter smooth; head broader than long; snout truncate, a little longer than diameter of the eye; nostril nearer the tip of the snout than eye, interorbital width about one and half times greater than that of upper eyelid; tympanum hidden; fingers free, first shorter than second, tips bearing large triangular discs, subarticular tubercles of fingers and toes moderately distinct; toes one-third webbed in female and half webbed in male, tips slightly dilated; both rounded inner and outer metatarsal tubercles present; tibiotarsal articulation reaching shoulder, sometimes posterior of eye.

Distribution.- Abdulali and Sekar (1988) reported it from Bondla, Goa. Elsewhere, Gujarat, Maharashtra and Kerala in India.

Remarks.- Generally found in holes on tree trunks.

Ramanella mormorata Rao, 1937:

1937. *Ramanella mormorata* Rao, *Proc. Indian Acad. Sci*. 6: 419.

Material examined.-1 ex. (ZSI A9048), 5 km n. Forest Rest House, Valpoi, 22.ix.1969, R. C. Sharma. 8 ex. (ZSI A9049), ½ km s.-w. Forest Rest House, Foinguinim, Canacona, 17.vi.1979; 1 ex., 1½ km n.-w. Forest Rest House, Poinguinim, Canacona, 19.vi.1979. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 21– 37 mm.

Identification.- Dorsum pale-olive with darker bands between eyes and with scattered darker blotches; skin on dorsum granulated; venter pale yellowish, variegated with dark brown, more or less smooth; head broader than long; snout truncated, as long as diameter of eye; nostril nearer to tip of snout than eye; interorbital width over two times greater than that of upper eyelid; tympanum hidden; fingers free, first shorter than second, tips bearing well developed truncated discs; subarticular tubercles of fingers and toes indistinct; toes basally webbed, three phalanges of fourth toe free; tips obtusely swollen; a large elongated shovel-shaped inner metatarsal tubercle and distinct round outer metatarsal tubercles present; tibiotatrsal articulation reaching near axilla; heels do not overlap when hind limbs are set right angles to body.

Distribution.- Rao (1937) described the species from Saklespur, Hassan District Mysore (at present Karnataka). Das and Whitaker (1997) redescribed the species from Canacona, near Cotigao Wildlife Sanctuary, Goa. Rao's types are now no longer extant, and this is the second report of the same species after Das and Whitaker (1997) from Valpoi, north Goa, and Canacona, South Goa. Elsewhere, Malabar, south-western India.

Remarks.- Fossorial/terrestrial and nocturnal, leading a subterraneous existence, and surfacing during the breeding season starting with the monsoon showers in Goa. Specimens from Canacona were collected from marshy cultivated land within an evergreen forest. The site was visited on the morning on 16 June 1979, when no collections could be made. Monsoon showers started on the same night. The authors revisited the site in the early morning of 17 June before sunrise, upon hearing the breeding calls of this species, which is akin to that of *Hoplobatrachus tigerinus*. Several frogs were found active inside bushes on the rain-fed ground, and disappeared inside burrows on the demarcating line of the cultivated land, with the appearance of the sun.

Uperodon Duméril and Bibron. 1841:

Uperodon globulosus (Günther, 1864):

1864. *Cacopus globulosus* Günther, *Rept. British India*: 416.

Material examined.- Recorded by Sekar (1992).

Identification.- Dorsum reddish brown; venter dull white; dorsum smooth or slightly tuberculate, ventrally wrinkled; head broader than long; snout rounded, about twice as long as diameter of eye; nostril equidistant from tip of snout and eye; interorbital width about thrice width of upper eyelid; tympanum hidden; fingers free, first shorter than second, tips not bearing discs; subarticular tubercles of fingers and toes not distinct; toes with a rudiment of web; both inner and outer shovel shaped metatarsal tubercles present, inner large; tibiotarsal articulation not reaching shoulder.

Distribution.- Sekar (1992) recorded it from Sanguem, Goa. Also Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Maharashtra, Gujarat and Karnataka in India. Elsewhere, Bangladesh and Sri Lanka.

Remarks.- Nocturnal and subterranean, surfacing during the breeding season (the monsoons).

RANIDAE

Euphlyctis Fitzinger, 1843:

Euphlyctis cyanophyctis Schneider, 1799:

1799. *Rana cyanophlyctis* Scheinder, *Hist. Amph*. 1: 137.

Material examined.- 2 ex. (ZSI A9039), near Forest Rest House, Canacona, 25.xii.1968; 2 ex. (ZSI A9040), 2 km w. Mollem Rest House, Mollem, 7.i.1969; 1 ex. (ZSI A9041), 2 km n. Rest House, Valpoi, 10.i.1969. All coll. V.C. Agarwal; 1 ex. (ZSI A8995), Poinguinim, Canacona, 16.vi.1979; 1 ex. (ZSI A8896), 1½ km n.-w. Forest Rest House, Poinguinim, Canacona, 19.vi.1979; 10 ex. (ZSI A8897-906), 1 km w. Forest Rest House, Mollem, 21.vi.1979; 1 ex. (ZSI A8907), Mollem, 22.vi.1979; 1 ex. (ZSI A8908), Bhagwan Mahaveer Wildlife Sanctuary, 1 km n. Forest Rest House, Mollem, 23.vi.1979; 10 ex. (ZSI A8909–18), ¼ km e. Forest Rest House, Valpoi, 26.vi.1979; 10 ex. (ZSI A8919), near Govt. High School, Valpoi, 27.vi.1979; 3 ex. (ZSI A8920), Masordom village, 3 km s.-e. Forest Rest House, Valpoi, 29.vi.1979; 3 ex. (ZSI A8921), 2 km s. Forest Rest House, Ponda. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 21–61 mm.

Identification.- Dorsum darker with small warts, venter whitish and smooth; head broader than long; snout generally rounded, equal or a little longer than diameter of eye; nostril equidistant from tip of snout and eye; interorbital width much smaller than that of upper eyelid; tympanum distinct, nearly once diameter eye; fingers free, first equals second, tips pointed; subarticular tubercles of fingers and toes feebly prominent; toes fully webbed, tips swollen; a pointed digit-like inner metatarsal tubercle absent; tibiotarsal articulation reaches between posterior end of tympanum and nostril.

Distribution.- Abdulali and Sekar (1988) reported it from Bondla, Goa. Common throughout the plains of India, and up to 1,846 m in the Himalayas. Elsewhere, Pakistan, Bangladesh, Nepal, Afghanistan, Balochistan, Iran, Saudi Arabia, Thailand and Sri Lanka.

Remarks.- Generally found floating on the surface of water.

Euphlyctis hexadactylus Lesson, 1834:

1834. *Rana hexadactyla* Lesson, in: Belang, *Voyage aux Indes-Orientales, Rept*.: 331.

Material examined.- 3 ex. (ZSI A9050), about 5 km s.-e. Govt. Rest House, Margao, 25.iii.1966, K.S. Pradhan. 2 ex. (ZSI A9059-60), 1 km w. Forest Rest House, Mollem, 21.vi.1979; 1 ex. (ZSI A8922), ¼ km e. Forest Rest House, Valpoi, 26.vi.1979. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 17–52 mm.

Identification.- Dorsum leaf-green or darker with porous warts; venter dull whitish; ventral surface more or less granulated with porous warts on throat; under surface of thighs and sides of belly; head as long as broad or a little broader than long; snout rounded or slightly pointed; hardly projecting beyond mouth, longer than diameter of eye; nostril nearer tip of snout than eye; fingers free, first longer than second, tips pointed; subarticular tubercles of fingers and toes feeble; toes fully webbed, tips pointed, digit like inner metatarsal tubercle present; outer metatarsal tubercle absent; tibiotarsal articulation reaching between posterior of tympanum and anterior corner of eye.

Distribution.- Sekar (1991) reported it from Goa. Elsewhere, southern India; Punjab, Rajasthan, Maharashtra, West Bengal and Andhra Pradesh in India. Also Sri Lanka.

Remarks.- A large-growing edible frog generally found floating in ponds with dense aquatic vegetation.

Fejervarya Bolkay, 1915:

Fejervarya limnocharis Boie in: Wiegmann, 1834:

1834. *Rana limnocharis* H. Boie in: A. F. A. Wiegmann. *Nova Acta Acad. Caesar Leopold Carol.* 17(1): 255.

Material examined.- 1 ex. (ZSI A9044), Margao Camp, 1 km w. Rly. Stn. Margao, 17.xi.1968; 1 ex. (ZSI A9045), Forest, 5 km e. Mollem Rest House, 2.i.1969. All coll. V.C. Agrawal. 1 ex. (ZSI A9010), Mollem-Ponda road, 1 km Forest Rest House, Mollem, 7.ix.1969; 4 ex. (ZSI A9011 and A 9012), 1/4 km s. Forest Rest House, Mollem, 11.ix.1969; 1 ex. (ZSI A9013), Nanus village, 5 km n. Forest Rest House, Valpoi, 19.ix.1969; 1 ex. (ZSI A9014), 5 km w. Forest Rest House, Valpoi, 22.ix.1969; 16 ex. (ZSI A9015), Canacona, 9.x.1969. All coll. R. C. Sharma. 7 ex. (ZSI A8923, Poinguinim, Canacona, 6.vi.1979; 4 ex. (ZSI A8924), ¼ km e. Forest Rest House, Valpoi, 16.vi.1979; 16 ex. (ZSI A8925, Galjibagh, 2 km w. Forest Rest House, Poinguinim, Canacona, 18.vi.1979; 7 ex. (ZSI A8926), 1½ km n.-w. Forest Rest House, Poinguinim, Canacona, 19.vi.1979; 9 ex. (ZSI A8927 & A 8928), 1 km w. Forest Rest House, Mollem, 21.vi.1979; 3 ex. (ZSI A8929), nr. Govt. High School, Valpoi, 27.vi.1979; 7 ex. (ZSI A8930), Bujai village, 2 km w. Forest Rest House, Valpoi, 28.vi.1979; 3 ex. (ZSI A8931), 2 km s. Forest Rest House, Ponda, 3.vii.1979. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 16–40 mm.

Identification.- Dorsum greyish and warty; venter white and smooth; head generally as long as broad; snout generally pointed, projecting beyond mouth, as long as or a little longer than diameter of eye; nostril nearer to tip of snout than eye; interorbital width much smaller than that of upper eyelid; tympanum distinct, nearly two-third diameter of eye; fingers free, first longer than second, tips swollen; subarticular tubercles of fingers and toes distinct; toes half-webbed to two-third webbed, more than two penultimate phalanges of fourth toe free from webbing; a distinct oval inner metatarsal tubercle, and feebly distinct outer metatarsal tubercle present; tibiotarsal articulation reaches between tympanum and nostril.

Distribution.- Abdulali and Sekar (1988) reported it from Bondla, Goa. It is a widely distributed species in India. Distributed from Pakistan, Bangladesh, Sri Lanka and China to Japan.

Remarks.- Generally found inside bushes growing on moist soil, and in moist forests.

Fejervarya syhadrensis Annandale, 1919:

Rana limnocharis syhadrensis Annandale. 1919. *Rec. Indian Mus*. 16: 121.

Material examined.- 1 ex. (ZSI A9043), 5 km e. Ponda, 20.xii.1968, V. C. Agrawal. 3 ex. (ZSI A9016), Mollem, 7.ix.1969; 1 ex. (ZSI A9053), nr. Police Training School, Valpoi, 16.ix.1969. All coll. R. C. Sharma. 2 ex. (ZSI A8988), Valpoi, 23.ix.1977; 1 ex. (ZSI A8989), Mollem, 28.ix.1977. All coll. A. K. Mondal. 1 ex. (ZSI A8949), Poinguinim, Canacona, 16.vi.1979; 1 ex. (ZSI A8950), on way to Galjibagh, 2 km w. Forest Rest House, Poinguinim, Canacona, 18.vi.1979; 4 ex. (ZSI A8951), 1 km w. Forest Rest House, Mollem, 21.vi.1979; 8 ex. (ZSI A8952), Mollem, 22.vi.1979; 9 ex. (ZSI A8953), Forest Rest House, Mollem, 23.vi.1979; 9 ex. (ZSI A8954), nr. Forest Rest House, Mollem, 24.vi.1979; 6 ex. (ZSI A8955), 1 km e. Forest Rest House, Mollem,24.vi.1979; 11 ex. (ZSI A8956), Biyas village, 2 km w. Forest Rest House, Valpoi, 28.vi.1979; 6 ex. (ZSI A8957), 1½ km w. Forest Rest House, Ponda, 1.vii.1979; 15 ex. (ZSI A8958), 2 km s. Forest Rest House, Ponda, 3.vii.1979. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 16–33 mm.

Identification.- Dorsum dark brown with some warts; venter dull whitish, smooth with some darker spots on gular region; head as long as broad; snout subacuminate, projecting beyond mouth, as long as diameter of eye, nostril nearer to tip of snout than eye; interorbital width smaller than that of upper eyelid; tympanum less distinct, nearly half diameter of eye; fingers free, first longer than second, tips swollen, subarticular tubercles of fingers and toes distinct; toes barely one-third webbed, more than three phalanges of fourth toe free; a shovel shaped inner metatarsal tubercle present, a smaller but distinct outer metatarsal tubercle present; tibiotarsal articulation reaching mid-eye.

Distribution.- Sekar (1992) recorded it from Valpoi, Goa.

Remarks.- This represents the second record of the species after that of Sekar (1992). The specimens have been collected from moist grassy patches on sandy soil, collected during the rains.

Hoplobatrachus Peters, 1863:

Hoplobatrachus tigerinus (Daudin, 1803):

1803. *Rana tigerina* Daudin, *Hist. Rain. Gren, Crap*.:. 64.

Material examined.- 1 ex. (ZSI A9057), nr. Forest Rest House, Mollem, 10.ix.1969; 1 ex. (ZSI A9022), Valpoi, 15.xi.1969; 1 ex. (ZSI A9023), Kanki River and its vicinity, 11 km w Valpoi, 15.ix.1969. All coll. R. C. Sharma. 3 ex. (ZSI A8994–96), Mollem, 30.xi.1977, A. K. Mondal. 1 ex. (ZSI A8959), Poinguinim, Canacona, 16.vi.1979; 1 ex. (ZSI A8960), 1 km w Forest Rest House, Mollem, 21.vi.1979; 1 ex. (ZSI A8961), around Forest Rest House, Mollem, 21.vi.1979; 3 ex. (ZSI A8962-63 and A8966), Bhagwan Mahaveer Wildlife Sanctuary, 1 km n. Forest Rest House, Mollem, 23.vi.1979; 2 ex. (ZSI A8964-65), nr. Govt. High School, Valpoi, 27.vi.1979. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 33–148 mm.

Identification.- Dorsum olive green with darker spots, distinct warts and long glandular folds; venter whitish and smooth. Head as long as broad or a little broader than long, snout rounded or pointed, projecting beyond mouth, longer than diameter of eye; nostril generally equidistant from snout and eye; interorbital width much smaller than that of upper eyelid; tympanum distinct, nearly equal to diameter of eye; fingers free, first longer than second, tips not sharply pointed; subarticular tubercles of fingers and toes not distinct; toes entirely webbed, tips not pointed; a blunt, not shovel-shaped inner metatarsal tubercle present, outer metatarsal tubercle absent; tibiotarsal articulation reaches between posterior end of eye and nostril; heels overlapping when limbs are folded at right angles to body.

Distribution.- Sekar (1992) reported it from Mollem, Goa. It is common throughout India from the base of Himalaya to southern part of country, and the Andaman Islands. Elsewhere, Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar, South China and Thailand.

Remarks.- The commonest and largest species of edible frog. It frequents bushes associated with banks of ditches, ponds, canals and lakes.

Indirana Laurent, 1986:

Indirana beddomii (Günther, 1875):

1875. *Polypedates beddomii*, Günther, *Proc. Zool. Soc. London* 1875: 571.

Material examined.- 1 ex. (ZSI A9006), Mollem-Ponda Road, 1 km from Forest Rest House, Mollem, 7.ix.1969; 1 ex. (ZSI A9007), 5 km, n.-e. Forest Rest House, Mollem, 9.ix.1969; 1 ex. (ZSI A9008), Nalus village, 5 km n. Forest Rest House, Valpoi, 19.ix.1969; 1 ex. (ZSI A9009), nr. Forest Rest House, Mollem, 10.ix.1969. All coll. R. C. Sharma. 2 ex. (ZSI A8980), Mollem, 27.ix.1977; 3 ex. (ZSI A8981-82), Mollem, 28.ix.1977; 1 ex. (ZSI A8983), Mollem, 29.ix.1977; 5 ex. (ZSI A8984-85), Mollem, 5.ix.1977. All coll. A. K. Mondal.

Snout-vent length.- 22-34 mm.

Identification.- Dorsum brown; venter whitish; dorsum finely granular; a strong glandular fold from eye to shoulder; ventrally smooth; head as long as or a little broader than long; snout rounded, as long as or slightly longer than eye; nostril equidistant from tip of snout and eye; interorbital width equal or greater than that of upper eyelid; tympanum distinct, half or two third diameter of eye; fingers free with large discs, first finger as long as or a little longer than second; subarticular tubercles of fingers large and prominent, that of toes small and prominent; toes two-third webbed, three phalanges of fourth toe free, tips with discs, inner metatarsal tubercle small, prominent, outer metatarsal tubercle absent; tibiotarsal articulation reaching tip of snout; heels strongly overlapping when limbs are folded at right angle to body.

Distribution.- New record for Goa. Elsewhere, Karnataka, Kerala, Maharashtra and Tamil Nadu in India.

Limnonectes Fitzinger, 1843:

Limnonectes brevipalmatus (Peters, 1871):

1871. *Rana brevipalmata* Peters, Mon. Berl. Ac.: 646.

Material examined.- 1 ex. (ZSI A8987), Valpoi, 20.ix.1977; 1 ex. (ZSI A8986), Mollem, 29.ix.1977. All coll. A. K. Mondal.

Snout-vent length.- 17–28 mm.

Identification.- Dorsum warty with glandular longitudinal folds, greyish or reddish-brown with blackish spots; venter smooth; head as long as or slightly longer than broad; snout rounded, as long or a little longer than eye; nostril a little nearer to tip of snout than eye; interorbital width smaller than that of upper eyelid; tympanum distinct, half to three-fifth diameter of eye; fingers obtusely pointed, first longer than second; subarticular tubercles of fingers well developed and prominent, and that of toes small, moderately prominent; toes one-third webbed, rather pointed; inner metatarsal tubercle strong, elliptical (not shovel-shaped), outer metatarsal tubercle indistinct; heels strongly overlapping when limbs are folded at right angles to body; tibiotarsal articulation reaching tip of snout or a little beyond.

Distribution.- New record for Goa. Elsewhere, Karnataka (Mysore).

Limnonectes keralensis Dubois, 1980

1875. *Rana verrucosa* Günther, *Proc. Zool. Soc*. London,: 567.

1980. *Rana keralensis* Dubois, *Bull Mus., nat. Paris* (94) 2, Sec. A: 928 (replacement name.).

Material examined.- Recorded by Sekar (1992).

Identification.- Dorsum greyish; venter whitish; dorsum skin warty, ventrally smooth; head a little broader than long; snout pointed, equals diameter of eye; nostril equidistant from tip of snout and eye; interorbital width shorter than that of upper eyelid; tympanum distinct, about two-third diameter of eye; fingers free, first longer than second, tips more or less pointed; subarticular tubercles of fingers and toes large and distinct; toes three-fourth webbed, two phalanges of fourth toe free; inner metatarsal tubercle elliptical, outer metatarsal tubercle oval, small; tibiotarsal articulation reaching between nostril and tip of snout.

Distribution.- Sekar (1992) reported this species from Valpoi, Goa. Elsewhere, West Bengal, Orissa, Gujarat, Kerala and Tamil Nadu in India.

Micrixalus Boulenger, 1888:

Micrixalus fuscus (Boulenger, 1882):

1882. *Ixalus fuscus* (Boulenger), *Cat. Bat. Sal. British Mus*.: 96.

Material examined.- Recorded by Bhatt and Desai (1998).

Identification.- Dorsum light-tan to dark reddish-brown; ventrally yellowish-tan, with or without brown reticulation; dorsolateral fold wide, black or similar in colour to tan background; snout pointed, generally longer than eye; nostril half way between eye and tip of snout; interorbital width as broad as upper eyelid; tympanum small, indistinct; tongue without lingual papilla; fingers free, tips dilated into small discs; tibiotarsal articulation reaching between eye and tip of snout; toes three-fourth to entirely webbed; tips of toes dilated into small discs; a small inner metatarsal tubercle present.

Distribution.- Bhat and Desai (1998) reported it from Goa. Elsewhere, Tamil Nadu, Karnataka and Kerala in India.

Micrixalus opisthorhodus (Günther, 1868):

1868. *Ixalus opisthorhodus* (Günther)*, Proc. Zool. Soc. London* 1868: 484.

Material examined.- Recorded by Bhatt and Desai (1998).

Identification.- Dorsum dark-brown; venter yellowish; skin smooth, a strong narrow glandular lateral fold and another cutaneous fold extending from eye to shoulder; venter surface smooth; head small, snout subacuminate, as long as diameter of eye; nostril almost equidistant from eye and tip of snout; interorbital width slightly broader than that of upper eyelid; tympanum small, hidden; tongue with a free, pointed papilla on median line; fingers free, tips dilated into discs; toes about three-fourths webbed; tibiotarsal articulation reaching between eye and tip of snout; tips of toes dilated into discs; subarticular tubercles small; a small inner metatarsal tubercle.

Distribution.- Bhat and Desai (1998) reported it from Goa. Elsewhere, Tamil Nadu and Kerala in India.

Nyctibatrachus Boulenger, 1882:

Nyctibatrachus humayuni Bhaduri and Kripalani, 1954:

1954. *Nyctibatrachus humayuni*, Bhaduri and Kripalani, *J. Bombay nat. Hist. Soc*. 52: 852.

Material examined.- Recorded by Abdulali and Sekar (1988).

Identification.- Dorsum greyish to brownish black with irregular darker markings; venter pale yellow; indistinct cross bar present in limbs; dorsally covered with numerous fold; head broader than long; tympanum hidden; fingers free, dorsoventrally flattened; tips of fingers dilated into prominent disks with horizontal circummarginal groove; hind limb stout; tibiotarsal articulation reaching in front of eye; toes three-fourth webbed. Inner metatarsal tubercle present; outer metatarsal tubercle absent.

Distribution.- Abdulali and Sekar (1988) reported it from Valpoi, Goa. Elsewhere, Maharashtra and Karnataka in India.

Rana Linnaeus, 1758:

Rana malabarica Tschudi, 1838:

1838. *Rana malabarica* (Bibron), Tschudi Class Batrachia,: 40,80.

Material examined.- 1 ex. (ZSI A9046), 20 km s.-e. Forest Rest House, Poinguinim, Canacona, 29.xii.1969, V. C. Agrawal. 1 ex. (ZSI A9056), Mollem, 6.ix.1969; 2 ex. (ZSI A9017), Nanus village, 5 km n. Forest Rest House, Valpoi, 19.ix.1969; 1 ex. (ZSI A9019), Asavani village, 5 km n. Forest Rest House, Valpoi, 19.ix.1969; 2 ex. (ZSI A9019), 5 km w. Forest Rest House, Valpoi, 22.ix.1969; 1 ex. (ZSI A9020), Ponda and its surroundings, ix.1969; 1 ex. (ZSI A9021), 6 km w. Forest Rest House, Canacona, 6.x.1969. All coll. R. C. Sharma. 1 ex. (ZSI A8990), Valpoi, 20.ix.1977; 2 ex. (ZSI A8991 & A 8992), Mollem, 29-30.ix.1977; 1 ex. (ZSI A8993), Mollem, 5.x.1977. All coll. A. K. Mondal. 4 ex. (ZSI A8932 – A 8935), 1 km w. Forest Rest House, Mollem, 21.vi.1979; 4 ex. (ZSI A8936–39), 1 km n. Forest Rest House, Mollem, 22.vi.1979; 5 ex. (ZSI A8940 – A 8944), Bhagwan Mahaveer Wildlife Sanctuary, 1 km n. Forest Rest House, Mollem, 23.vi.1979; 20 ex. (ZSI A8945), ¼ km e. Forest Rest House, Valpoi, 26.vi.1979; 7 ex. (ZSI A8946), nr. Govt. High School, Valpoi, 27.vi.1979; 1 ex. (ZSI A8947), Bujao village, 2 km w. Forest Rest House, 28.vi.1979; 1 ex. (ZSI A8948), 2 km s. Forest Rest House, Ponda, 3.vii.1979. All coll. A. K. Sarkar and S. Ray.

Snout-vent length.- 17–79 mm.

Identification.- Dorsum finely granulate, dark-whitish with a few scattered small black spots; flanks granular and darker; upper surface of hindlimbs with broad darker cross bars; venter more or less smooth; dark whitish with light darker spots in some examples; undersurface of thighs granular; a broad but feebly prominent glandular dorso-lateral fold from above tympanum to groin present; head as long as broad; snout rounded, as long as diameter of eye, nostril nearer to tip of snout than eye; interorbital width equal or a little smaller than that of upper eyelid; tympanum distinct, two-third to once diameter of eye; fingers free, first longer than second; subarticular tubercles of fingers and toes large and prominent; toes half webbed; three phalanges of fourth toe free; tips of fingers and toes swollen; inner metatarsal tubercle oval, prominent, outer metatarsal tubercle large, round, prominent; tibiotarsal articulation reaching tympanum or eye; no tarsal fold; heels strongly overlapping when limbs are folded at right angles to body.

Distribution.- Sekar (1992) reported it from Cotigao, Goa. Elsewhere, Gujarat, Maharashtra, Kerala and Tamil Nadu (Nilgiris) in Western India; Madhya Pradesh and Orissa in India.

Remarks.- A common, nocturnal species. *Rana malabarica* takes shelter inside crevices in rocks during the day. On a night in June 1979, at Valpoi, north Goa, the authors collected a number of specimens from a rain-fed cultivated land, the demarcating lines of which were constructed by mud and boulders. During the day, these frogs took shelter inside the crevices among boulders. The mating call is low which could be syllabylized as “ku, ku, ku……..”. These frogs entered the crevices before dawn.

Sphaeroteca Günther, 1859:

Sphaeroteca breviceps (Schneider, 1799):

1799. *Rana breviceps* Schneider, *Hist. Amph*. 1: 140.

Material examined.- Recorded by Abdulali and Sekar (1988).

Identification.- Dorsum greyish; venter whitish; skin of dorsum warty, ventrally granular; head broader than long; snout rounded, shorter than the diameter of the eye; nostril equidistant from tip of snout and eye; interorbital width smaller than that of upper eyelid; tympanum distinct, about half diameter of eye; fingers free, first much longer than second, as long as or shorter than third, tips swollen, subarticular tubercles of fingers and toes well developed; toes basally webbed, more than three phalanges of fourth toe free; a highly developed large, shovel-shaped inner metatarsal tubercle present; outer metatarsal tubercle absent; tibiotarsal articulation reaches axilla, sometimes shoulder.

Distribution.- Abdulali and Sekar (1988) reports it from Bondla, Goa. The species is widespread in the plains of India. Elsewhere, Sri Lanka, Nepal and Myanmar.

Sphaeroteca sp.

Material examined.- 35 ex. (ZSI A9209-43), ZSI A9209–43, Bhagwan Mahaveer Wildlife Sanctuary, 1 km north of Forest Rest House, Mollem, 23.vi.1979; 6 ex. (ZSI A9244–49), 1 km e. Forest Rest House, Mollem, 24.vi.1979; 1 ex. (ZSI A9250), 2 km s Forest Rest House, Ponda, 3.vii.1979; 1 ex. (ZSI A9251), 1 km w. Forest Rest House, Ponda, 4.vi.1979. All coll. A. K. Sarkar and S. Ray.

Description (based on the material above).- Colour: (In spirit) Dorsum dark brown with a few dark spots on lateral sides, and whit patches on thighs; a faint mid-dorsal line running from between eyes and vent present in some and absent in others (ZSI A9211, A 9212, A 9214, A 9215, A 9219, A 9220, A 9222, A 9223, A 9226, A 9227, A 9229, A 9230, A 9232, A 9236, A 9238, A 9239, A 9244, A 9246, A 9247, A 9248, A 9249, A 9250); jaws with a few cross-bars; upper surfaces of limbs with faint cross-bars; venter dull whitish with light brownish patches on breast; gular region dark (as in ZSI A9210–30); dark patches in front of eye, and on upper part of tympanum present.

Head: Head broader than long; snout rounded; longer than horizontal diameter of eye; canthus rostralis more or less distinct; loreal region concave; nostril equidistant from eye and tip of snout; interorbital width shorter than maximum breadth of upper eyelid; tympanum distinct, half diameter of eye; vomerine teeth distinct, placed between choana and directed inwards; tongue fairly large, forked; lower jaw with a tooth-like conical process.

Forelimbs: Fairly stout with moderate fingers with highly developed subarticular tubercles; fingers free from webbing, tips not pointed, first finger much longer than second and longer than third; a thick palmer pad at base of third finger, and another long pad placed on lateral side of base of first finger.

Hind limb: Fairly stout with moderate toes possessing distinct subarticular tubercles that are smaller than those of fingers; toes are more or less webbed at base, four penultimate phalanges of fourth toe free; a large; strongly compressed with a sharp edge, much longer than first toe, inner metatarsal tubercle present; outer metatarsal tubercle absent; tibiotarsal articulation reaches mid-eye; heels do not overlap when hind limbs are kept at right angle to body; outer metatarsal united.

Skin: On head, upper surfaces of limbs smooth, rest of dorsum finely granular; a distinct fold from posterior corner of eye to shoulder present; venter granular on belly and undersurface of thighs; breast, gular region and under surface of forelimbs smooth; distinct palmar warts on base of first and third fingers present. Sex of males determined from blackish external vocal sacs.

All specimens , apart from two specimens, were collected from areas adjacent to Mollem, such as Ponda, have been collected from Bhagwan Mahaveer Wildlife Sanctuary, 1 km n. Forest Rest House, Mollem on 23 June 1979. The frogs were found entrapped in a cemented tank.

Remarks.- The systematic status of this population is currently under study.

Sphaeroteca rufescens (Jerdon, 1854):

1854. *Tomopterna rufescens* (Jerdon), *J. Asiatic Soc. Bengal*, 22: 534.

Material examined.- 3 ex. (ZSI A9024), 5 km n. Forest Rest House, Valpoi, 19.ix.1969, R. C. Sharma, 14 ex. (ZSI A9051 and A 9052), Bujai village, 2 km w. Forest Rest House, Valpoi, 28.vi.1979, A. K. Sarkar and S. Ray.

Snout-vent length.- 18–36 mm.

Identification.- Dorsum greyish brown; dorsal skin warty, ventrally granular; head broader than long, snout rounded, as long as or a little shorter than eye; nostril equidistant from eye and tip of snout; interorbital width smaller than that of upper eyelid; tympanum distinct half diameter of eye; finger free, first much longer than second, tips pointed; subarticular tubercles of fingers and toes well developed and prominent; toes one-third to one-fourth webbed; a prominent, large, compressed inner metatarsal tubercle and a small outer metatarsal tubercle present; tibiotarsal articulation reaches tympanum, sometimes posterior corner of eye.

Distribution.- Abdulali and Sekar (1988) reports it from Bondla and Valpoi, Goa. Also.-Maharashtra, Karnataka and Kerala in India.

RHACOPHORIDAE

Philautus Gistel, 1848:

Philautus bombayensis (Annandale, 1919):

1919. *Ixalus bombayensis* Annandale *Rec. Indian Mus*. 16: 121.

Material examined.- 1 ex. (ZSI A9253), Bhagwan Mahaveer Wildlife Sanctuary, 1 km n. Forest Rest House, Mollem, Goa, 23.vi.1979, A. K. Sarkar and S. Ray.

Snout-vent length.- 26 mm.

Identification.- Dorsum dark brown; venter greenish-yellow; skin more or less rough with small scattered warts; nostril closer to tip of snout than to eye; interorbital width broader than diameter of eye; tympanum hidden; tongue with inconspicuous papillae; fingers free, toes one-third webbed; subarticular tubercles moderately large; tibiotarsal articulation reaching anterior corner of eye; inner metatarsal tubercle present.

Distribution.- Sekar (1991) reported it from Goa. Elsewhere: Maharashtra and Karnataka in India.

Philautus leucorhinus (Lichtenstein and Martens, 1856):

1856. *Ixalus leucorhinus* Lichtenstein and Martens, *Nomencl. Rept. Mus. Berol*.: 36.

Material examined.- 3 ex. (ZSI A8979), 1 km w. Forest Rest House, Ponda, 4.vii.1979, A. K. Sarkar and S. Ray.

Snout-vent length.- 23–26 mm.

Identification.- Dorsum brown and smooth; upper part of hind limbs with crossbars; a fold from eye to shoulder; venter dull whitish and granular; undersurface of thighs granular; snout acuminate, a little longer than diameter of eye; nostril nearer tip of snout than eye; interorbital width broader than that of upper eyelid; tympanum distinct, half diameter of eye; fingers with rudimentary web, tips with distinct discs; subarticular tubercles well developed; toes half or one-third webbed with distinct discs; a small inner metatarsal tubercle present; tibiotarsal articulation reaches between eye and tip of snout; male with an internal vocal sac.

Distribution.- Abdulali and Sekar (1988) reported it from Valpoi, Goa. Also Kerala and Karnataka in India.

Remarks.- On the evening of 4 July 1979, these frogs were collected from shrubs at the edges of the Ponda-Margaon metalled road. They were traced through their breeding calls which coincided with the rains. This is the second report after Abdulali and Sekar (1988) from Goa.

Polypedates Tschudi, 1838:

Polypedates maculatus (Gray, 1832):

1832. *Hyla maculata* Gray, *Ill. Indian Zool.*: 1, pl. 82. fig. 1

Material examined; 1 ex. (ZSI A9031), Kandal Rubber plantation, 18 km s. Forest Rest House, Valpoi, 20.xi.1969; 1 ex. (ZSI A9032), Canacona, 9.x.1969. All coll. R. C. Sharma. 2 ex. (ZSI A9001-02), Valpoi, 22.ix.1977; 1 ex. (ZSI A9003), Mollem, 29.ix.1977; 4 ex. (ZSI A9004 and A 9005), Mollem, 5.x.1977. 2 ex. (ZSI A8973 & A 8974), around Forest Rest House, Mollem, 21.vi.1979; 1 ex. (ZSI A8975), Forest Rest House, Mollem, 23.vi.1979; 1 ex. (ZSI A9058), 1 km w. Forest Rest House Mollem, 23.vi.1979; 1 ex. (ZSI A8076), Forest area, 1 km e. Forest Rest House Mollem, 24.vi.1979; 1 ex. (ZSI A8977), Ponda, 1.vii.1979; 1 ex. (ZSI A8978), Forest Rest House, Ponda, 3.vii.1979. All col. A. K. Sarkar and S. Ray.

Snout-vent length.- 21–68 mm.

Identification.- Dorsum brownish with light darker spots, and smooth; venter whitish and granular; skin on head free; head broader than long; pointed, projecting a little beyond mouth, generally longer than diameter of eye; nostril nearer tip of snout than eye; interorbital width broader than upper eyelid; tympanum distinct, about three-fourth diameter of eye; fingers with rudimentary web, first equals second, tips of fingers and toes bear horse-shoe shaped distinct discs; subarticular tubercles of fingers and toes distinct; toes nearly three fourth webbed, two phalanges of fourth toe free; a distinct oval inner metatarsal tubercle present, outer metatarsal tubercle absent; tibiotarsal articulation reaches between posterior end of eye and tip of snout.

Distribution.- The species is widespread in the plains of India, and also, Sri Lanka. Abdulali and Sekar (1988) reported it from Goa.

Remarks.- Nocturnal, generally found inside thick bushes.

Rhacophorus Kuhl and van Hasselt, 1822:

Rhacophorus malabaricus Jerdon, 1870:

1870. *Rhacophorus malabaricus* Jerdon, *Proc. Asiatic Soc. Bengal*: 84.

Material examined.- Recorded by Abdulali and Sekar (1988).

Identification.- Dorsum granular and greenish; venter granular and whitish; heel with a triangular dermal process; outer border of forearm and tarsus with a dermal fold; snout subacuminate, as long as diameter of eye; nostril nearer tip of snout than eye; interorbital width broader than upper eyelid; tympanum three-fifths or two-thirds diameter of eye; fingers over half webbed, webbed to discs; subarticular tubercles of fingers and toes well developed; toes with distinct web at base; tibiotarsal articulation reaches eye or nostril.

Distribution.- Abdulali and Sekar (1988) reported it from Valpoi, Goa. Also Kerala and Karnataka.

Rhacophorus pleurostictus (Günther, 1864):

1864. *Polypedates pleurostictus* Günther, *Rept. British India*: 430.

Material examined.- Recorded by Bhatt and Desai (1998).

Identification.- Dorsum greenish and smooth, finely granular venter; granular with posterior of thighs brown, speckled with white; a strong fold from eye to shoulder. Snout rounded; as long as diameter of eye; nostril a little nearer tip of snout than eye; interorbital width as long as upper eyelid or a little broader; tympanum one-third to half diameter of eye; fingers less than half webbed, webbed at base, with large disks; subarticular tubercles of fingers and toes well developed; toes almost entirely webbed; tibiotarsal articulation reaches eye or end of snout.

Distribution.- Bhat and Desai (1998) reported it from Goa. Also Kerala (Ootacamand and Malabar), Tamil Nadu (Nilgiri Hills and Anaimalai Hills) in India.

ORDER GYMNOPHIONA

CAECILIDAE

Gegeneophis Peters, 1879:

Gegeneophis ramaswami Taylor, 1964:

1964. *Gegeneophis ramaswami* Taylor, *Senck. Biol.* 45(3 & 5): 227-231.

Material examined.- 1 ex. (ZSI A9252), Bhagwan Mahaveer Wildlife Sanctuary, 1 km n.

Forest Rest House, Mollem, Goa, 23.iv.1979, A. K. Sarkar and S. Ray.

Snout-vent length.- 235 mm.

Identification.- Body greyish on dorsal surface, light grey on ventral surface; terminus of body wide; tentacles behind and below nostrils, not visible when viewed dorsally; eyes not visible; first and second nuchal grooves distinct on dorsum, venter and flanks; a short transverse groove on first collar.

Distribution.- New record from Goa. Elsewhere, Kerala.

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THE AMPHIBIANS AND REPTILES OF THE PHONG NHA - KE BANG NATIONAL PARK, QUANG BINH PROVINCE, VIETNAM

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(with 54 text-figures)

ABSTRACT.– **An updated list of the herpetofauna of the Phong Nha - Ke Bang National Park, situated in the Quang Binh Province, central Vietnam, is provided. As a result of recent fieldwork, 33 species were added to the list of amphibians and reptiles for the area. This brings the total number of amphibian (40) and reptile (92) species to 132. Thirty-two of the amphibian species (80%) and 62 of the reptile species (67%) were recorded. We also recommend removing *Phrynoglossus laevis*, *Rana sauteri*, *Cyrtodactylus pulchellus* and *Takydromus wolteri* from the herpetofaunal list of the National Park, resulting in 128 species records. The status of some species remains unclear. Of the 33 species which are recorded for the first time for the Phong Nha - Ke Bang area, two, *Cyrtodactylus phongnhakebangensis* and *Triceratolepidophis sieversorum,* were recently described. They are endemics to the study area, the latter, cooccurring in the adjacent Hin Namno National Biodiversity Conservation Area on the Laotian side of the border. The taxonomic status of four newly recorded taxa (*Gekko* sp., *Scincella* sp., *Amphiesma* sp. and *Trimeresurus* sp.) remains in question. The status of *Leptolalax* sp., *Microhyla* cf. *annamensis*, *Polypedates* sp., *Gekko gecko*, *Draco maculatus*, *Scincella reevesii*, *Dinodon* cf. *rufozonatum*, *Lycodon* cf. *paucifasciatus*, *Rhabdophis chrysargos*, *Naja* cf. *atra* and *Trimeresurus* cf. *vogeli* needs further attention. The records of *Leptobrachium chapaense*, *Taylorana hascheana*, *Dinodon* cf. *rufozonatum*, *Lycodon fasciatus*, and *Oreophis porphyraceus* represent the southernmost localities for Vietnam, those of *Rhacophorus orlovi*, *Takydromus kuehnei*, *Xenopeltis hainanensis* and *Amphiesma* sp. represent the southernmost record for the respective species. The discoveries of *Lycodon* cf. *paucifasciatus* and *Trimeresurus* cf. *vogeli* represent the northernmost species records. Approximately 20% of the herpetofaunal species are listed in the Red Data Book of Vietnam, among them two of the new records (*Oreophis porphyraceus*, *Trimeresurus cornutus*).**

KEY WORDS.– **Herpetofauna; taxonomy; distribution; limestone forest; Phong Nha - Ke Bang National Park; Quang Binh province; Vietnam.**

INTRODUCTION

Phong Nha - Ke Bang National Park is situated in the Quang Binh Province in central Vietnam. The status of this former Nature Reserve was upgraded to National Park by the Vietnamese Government in December, 2001; it comprises 85,754 hectares, according to Marianne Meijboom (in litt., February 2002, see also Meijboom and Ho 2001, 2002a, b). Together with the adjacent Hin Namno National Biodiversity Conservation Area (NBCA) in Laos, it is one of the largest areas of contiguous karst limestone in Indochina (Fig. 1). The Phong Nha - Ke Bang limestone massif is characterized by precipitous karst cliffs (Fig. 2) and extensive cave systems, making it one of the most exceptional geological sites in Vietnam. It is located in a transition zone between the northern and central Annamite mountains. Due to the limestone topography, there are few permanent water courses (Fig. 3); these are fed by underground streams. Apart from the cliff faces the karst is almost entirely forested. The forests can be divided into three main types (Le et al., 1997, Meijboom and Ho, 2002a): (1) evergreen dense monsoon limestone tropical forest (altitude < 500-600 m), (2) evergreen dense monsoon tropical forest (altitude 500/600-900 m), and (3) subtropical monsoon forest (altitude > 900 m). The most widespread forest type is limestone forest. On the Vietnamese side of the Laos/Vietnam border, no deciduous or mixed deciduous forest is present; however, in the Laotian Hin Namno NBCA, vegetation types include evergreen forest, mixed deciduous forest, deciduous forest, limestone forest and bamboo forest. In Phong Nha - Ke Bang, forest clearings are exclusively found in valleys within the limestone massif, and in bordering lowland areas. The maximum altitude exceeds 1,000 m above sea level (asl.). The rainy season extends from August to February, with the heaviest rainfall from August/September to October/November (Le et al., 1997). According to the climatic data presented in Ziegler and Herrmann (2000), the hot season ranges from April/May to July/August with temperatures exceeding 40°C. For more data we refer to "www.wing-wbsj.or.jp/~vietnam/source_book/sb_pdf/Phong_Nha.pdf" and literature cited therein.

A preliminary list of the herpetofauna of the Phong Nha - Ke Bang area was published by Ziegler and Herrmann (2000). This list was based on two difficult-to-access project reports and initial excursions by the authors in 1998 and 1999. Since then additional project reports have become available (among them the unpublished list of Vassiliev, 1999, that was not considered in Ziegler and Herrmann, 2000) and further herpetological field work was conducted by the authors in August and September 2001 as well as from July to September 2003. Thus, as a further result of the long-standing partnership between the Phong Nha - Ke Bang National Park and the Zoological Garden Cologne, we herein provide an update on the knowledge of the National Park's herpetofauna with comments on taxonomy and distribution as bases for future research, as well as for further conservation action.

MATERIAL AND METHODS

Voucher specimens collected subsequent to the list published by Ziegler and Herrmann (2000) are deposited in the collections of the Vietnam National University, Hanoi (HNUV; not individually labeled), the Staatliche Naturhistorische Sammlungen Dresden, Museum für Tierkunde (MTD; MTD D 44014-44029, 44033-44046, 44048-44051, 45242), and the Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (ZFMK; ZFMK 75066-75067, 75798-75803, 76165-76169, 76171-76194, 76197-76226, 80638-80668). Specimens were collected by the authors between the end of August and beginning of September 2001 and between July and the end of September 2003 in the surroundings of the Phong Nha - Ke Bang National Park (17° 23 - 38'N; 106° 06 - 18'E, ca. 50-500 m asl.; Figs. 4-5), except for *Microhyla* cf. *annamensis* and *Oreophis porphyraceus* (formerly *Elaphe porphyracea*, see below). Specimens collected by the National Park staff or together with other collectors that are stored in the collection of the Phong Nha - Ke Bang National Park Research Centre are usually only

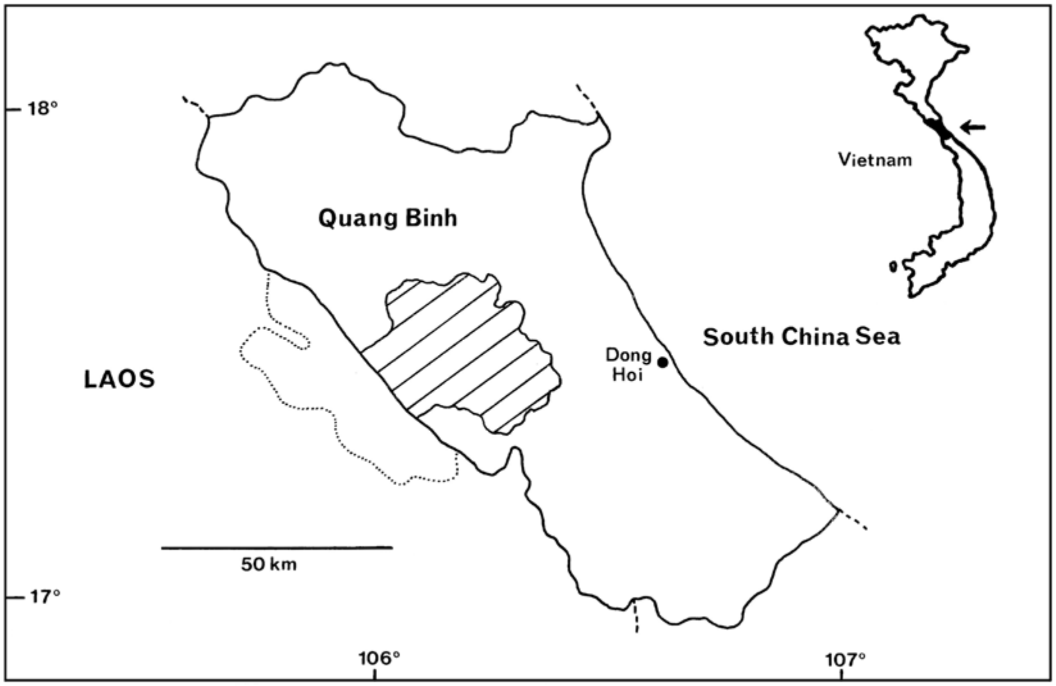

FIGURE 1: Location of the Phong Nha - Ke Bang National Park (hatched) in the Quang Binh province (for the position in Vietnam see smaller map); the location of the Laotian Hin Namno National Biodiversity Conservation Area is indicated with the dotted line (after Ziegler & Herrmann 2000, Meijboom & Ho 2002a).

listed if they represent a new species record for the study area. Minimum/maximum temperatures measured in the primary forest between 28 and 29 August 2001 range from 24.3-30.2°C. Determination of species followed Bourret (1935, 1936, 1942), Pope (1935), Smith (1943), Taylor (1963), Campden-Main (1970), Deuve (1970), Zhao and Adler (1993), Matsui et al. (1996), Orlov (1997), Inger et al. (1999), Lanza (1999), Ziegler and Weitkus (1999), Ziegler et al. (2000), David et al. (2001), Daltry and Wüster (2002), and Ziegler (2002a, b). Abbreviations are: NP - National Park, SVL - snout vent length, TaL - tail length.

The following data are based on the preliminary list provided in Ziegler and Herrmann (2000). Species given there are listed under the heading "previously listed": here, species whose presence was confirmed by the authors are marked with an asterisk, the remaining listed species are based on project reports by Le et al. (1997; erroneously cited as "VQNR 1998" in Ziegler and Herrmann l. c.) and Nguyen et al. (1997). We refrain from presenting the conservation status and from listing species known only from Hin Namno NBCA in Laos (compare Stuart, 1999a, b as well as the project reports by Meijboom and Ho, 2001, 2002a, b) in this list. Species records from Le et al. (1997) and Nguyen et al. (1997) that are doubtful are marked with a question mark. A discussion of such doubtful species' records (if not discussed in Ziegler and Herrmann, l. c.) is given under "comments". Species, previously recorded by Le et al. (1997) and Nguyen et al. (1997), which were confirmed by us in this study, are listed under the heading "confirmed". Our new records for the Phong Nha - Ke Bang National Park are listed under "new records". Remarkable new voucher specimens are treated under "remarkable new material". New herpetological findings of a Russian expedition to the Ke Bang area (see the re-

FIGURE 2: Limestone massif with primary karst forest, Phong Nha - Ke Bang NP.

FIGURE 3: Permanent lowland water course, Phong Nha - Ke Bang NP.

FIGURE 4: View of the primary forest, Phong Nha - Ke Bang NP.

FIGURE 5: Agricultural landscape, surroundings of Phong Nha - Ke Bang NP.

ports by Meijboom and Ho, 2001, 2002a, b) are given under "additional records by Vassiliev (1999)".

RESULTS AND DISCUSSION
AMPHIBIA
ANURA

Discoglossidae

Previously listed: *Bombina maxima*? (Boulenger, 1905)

Comments: Ziegler and Herrmann (2002) questioned whether *Bombina maxima*, known only from the northernmost highlands of Vietnam, occurs in the survey area. Ohler et al. (2000) argued that *B. maxima* should no longer be considered an element of the Vietnam herpetofauna but be replaced by *B. microdeladigitora* Liu et al., 1960. According to Ohler et al. (l. c.), the only confirmed records of this species and of Vietnamese *Bombina* in general are the Fan Si Pan mountains in northern Vietnam. Orlov et al. (2002) named the Lao Cai and Lai Chau provinces in the distribution areas of this species in Vietnam.

Megophryidae

Previously listed: *Leptolalax* cf. *pelodytoides** (Boulenger, 1893)

Comments: The two adult *Leptolalax* males from Phong Nha - Ke Bang (ZFMK 71346-71347), which were listed as cf. *pelodytoides* by Ziegler and Herrmann (2000), differ from typical *pelodytoides* from the Ha Tinh Province not only by their external morphology (Fig. 6) but also on the basis of molecular data compatible with that observed in distinct species (Ziegler 2002a). The specimens from Phong Nha - Ke Bang are somewhat similar with the recently described *L. tuberosus*. However, one specimen lacks a ventrolateral glandular ridge, the other shows a partially developed one. In addition, the tympanum of the two specimens from Phong Nha - Ke Bang is well developed compared to *tuberosus* and has a well developed

FIGURE 6: *Leptolalax* sp., Phong Nha - Ke Bang NP.

FIGURE 7: Tadpole of *Leptolalax* sp., Phong Nha - Ke Bang NP.

FIGURE 8: *Leptobrachium chapaense*, Phong Nha - Ke Bang NP.

FIGURE 9: *Megophrys lateralis*, Phong Nha - Ke Bang NP.

FIGURE 10: *Bufo galeatus*, Phong Nha - Ke Bang NP.

FIGURE 11: *Hyla simplex*, Phong Nha - Ke Bang NP.

tympanic fold. In addition, five specimens (SVL: 21-31 mm), which are deposited in the Research Centre collection of Phong Nha - Ke Bang National Park, show a ventrolateral glandular ridge, as well as a tympanum with tympanic fold. Future studies may be able to clarify the taxonomic status of the *Leptolalax* specimens from Phong Nha - Ke Bang. Nucleotide sequences from one (ZFMK 71341) of four tadpoles (Fig. 7) collected in Phong Nha - Ke Bang proved to be identical with the sequence of a syntopic adult male ZFMK 71346 (Ziegler 2002a).

New records: (a) *Leptobrachium chapaense* (Bourret, 1937), ZFMK 76205, adult female (Fig. 8), collected at night in leaf litter of primary limestone forest. Southernmost species record in Vietnam (compare Ziegler, 2002a).

FIGURE 12: *Microhyla pulchra*, Phong Nha - Ke Bang NP.

FIGURE 13: *Micryletta inornata*, Phong Nha - Ke Bang NP.

FIGURE 14: *Kaloula pulchra*, Phong Nha - Ke Bang NP.

FIGURE 15: *Microhyla berdmorei*, Phong Nha - Ke Bang NP.

FIGURE 16: *Kalophrynus interlineatus*, Phong Nha - Ke Bang NP.

FIGURE 17: *Microhyla* cf. *annamensis*, Ha Tinh province.

(b) *Megophrys lateralis* (Anderson, 1871), ZFMK 80638-80639, adult female and male (Fig. 9), collected at night on the ground of primary karst forest near a small stream.

Bufonidae

Previously listed: *Bufo galeatus** Günther, 1864 (Fig. 10), *B. melanostictus** Schneider, 1799

Hylidae

Previously listed: *Hyla simplex** Boettger, 1901

Remarkable new material: *Hyla simplex*, ZFMK 76187, adult female (Fig. 11), collected at night on leaves (ca. 1 m above ground), in secondary vegetation by karst rock face. This single specimen from Ziegler and Herrmann (2000) was collected by locals and therefore lacks exact

FIGURE 18: *Microhyla butleri*, Phong Nha - Ke Bang NP.

FIGURE 19: *Taylorana hascheana*, Ha Tinh province.

FIGURE 20: *Rhacophorus reinwardtii*, Phong Nha - Ke Bang NP.

FIGURE 21: *Polypedates* sp., Ha Tinh province.

FIGURE 22: *Chirixalus vittatus*, Phong Nha - Ke Bang NP.

FIGURE 23: *Rhacophorus orlovi*, Phong Nha - Ke Bang NP.

locality data. For natural history and bioacoustic notes of this poorly known species in Vietnam see Ziegler and Weitkus (1999).

Microhylidae

Previously listed: *Kaloula pulchra* Gray, 1831, *Microhyla berdmorei* (Blyth, 1856), *M. heymonsi** Vogt, 1911, *M. ornata** (Duméril and Bibron, 1841), *M. pulchra* (Hallowell, 1861) (Fig. 12), *Micryletta inornata** (Boulenger, 1890) (Fig. 13)

Confirmed: (a) *Kaloula pulchra*, MTD D 44040, adult (Fig. 14), collected at night on the ground, in secondary vegetation near a stream.

(b) *Microhyla berdmorei*, ZFMK 76209-76218, subadult to adult (Fig. 15), collected day and night along sparcely vegetated,


FIGURE 24: *Cuora galbinifrons*, Phong Nha - Ke Bang NP.


FIGURE 25: *Pyxidea mouhotii*, Phong Nha - Ke Bang NP.


FIGURE 26: *Pelodiscus sinensis*, Phong Nha - Ke Bang NP.


FIGURE 27: *Cyrtodactylus phongnhakebangensis*, Phong Nha - Ke Bang NP.


FIGURE 28: *Gekko* sp., Phong Nha - Ke Bang NP.


FIGURE 29: *Takydromus kuehnei*, Ha Tinh province.

sandy stream banks within primary forest (see Ziegler 2002b: 88).

(c) *Microhyla pulchra*, MTD D 44037, 44038, ZFMK 76189-76190, adult, collected at night on primary forest floor.

New records: (a) *Kalophrynus interlineatus* (Blyth, 1854), ZFMK 80643-80644, adult males (Fig. 16), collected at night in leaf litter of forest floor.

(b) *Microhyla* cf. *annamensis* Smith 1923, ZFMK 76192, adult female (Fig. 17), collected by T. Pagel in 2001 ca. 800 m asl. in forest.

(c) *Microhyla butleri* Boulenger, 1900, ZFMK 80645, adult female (Fig. 18), collected at night on forest floor near a stream.

Comments: The specimen constituting the new record of *Microhyla* cf. *annamensis* differs from the original description of *annamensis* as do

FIGURE 30: *Scincella melanosticta*, Phong Nha - Ke Bang NP.

FIGURE 31: *Sphenomorphus indicus*, Phong Nha - Ke Bang NP.

FIGURE 32: *Tropidophorus cocincinensis*, Phong Nha - Ke Bang NP.

FIGURE 33: *Eutropis macularia*, Phong Nha - Ke Bang NP.

FIGURE 34: *Scincella* sp., Phong Nha - Ke Bang NP.

FIGURE 35: *Scincella reevesii*, Ha Tinh province.

the 27 specimens from Gia Lai Province (Inger et al., 1999) and the two records by Ziegler (2002a) from the Ha Tinh Province (Fig. 17) by the presence of a small but distinct outer metatarsal tubercle. The closest relative, *M. berdmorei* (Bourret, 1942, Taylor, 1962), which shares pronounced webbing between the toes with the former species, generally shows two metatarsal tubercles but has a greater snout-vent length in Vietnam (Inger et al., 1999). Furthermore, *M. berdmorei* differs by toes which are completely incorporated in the webbing. Further studies should show whether the specimens provisionally referred to *M. annamensis* in Inger et al. (1999), Ziegler (2002a) and here warrant a separate taxonomic status.

FIGURE 36: *Xenopeltis unicolor*, Phong Nha - Ke Bang NP.

FIGURE 37: *Xenopeltis hainanensis*, Phong Nha - Ke Bang NP.

FIGURE 38: *Python reticulatus*, Phong Nha - Ke Bang NP.

FIGURE 39: *Enhydris plumbea*, Phong Nha - Ke Bang NP.

FIGURE 40: *Coelognathus radiatus*, Phong Nha - Ke Bang NP.

FIGURE 41: *Amphiesma* sp., Phong Nha - Ke Bang NP.

Ranidae

Previously listed: *Amolops ricketti* (Boulenger, 1899), *Hoplobatrachus rugulosus** (Wiegmann, 1835), *Limnonectes kuhlii** (Tschudi, 1838), *L. limnocharis** (Gravenhorst, 1829), *Occidozyga lima* (Gravenhorst, 1829), *Phrynoglossus laevis*? (Günther, 1858), *P. martensii** Peters, 1867, *Rana andersonii* Boulenger, 1882, *R. guentheri** Boulenger, 1882, *R. livida** (Blyth, 1856), *R. nigrovittata** (Blyth, 1856), *R. sauteri*? Boulenger, 1909, *R. taipehensis* Van Denburgh, 1909

Additional records by Vassiliev (1999): (a) *Amolops* sp.

(b) *Rana macrodactyla* (Günther, 1859)

New records: *Taylorana hascheana* (Stoliczka, 1870) (Fig. 19), five specimens deposited in the Research Centre collection of

FIGURE 42: *Dendrelaphis ngansonensis*, Phong Nha - Ke Bang NP.

FIGURE 44: *Lycodon* cf. *paucifasciatus*, Phong Nha - Ke Bang NP.

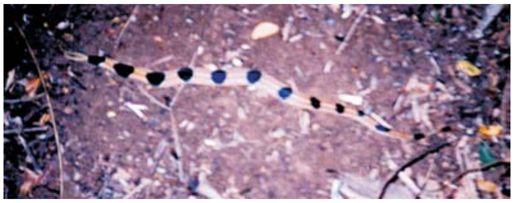

FIGURE 46: *Oreophis porphyraceus*, Phong Nha - Ke Bang NP.

Phong Nha - Ke Bang National Park. Southernmost species record in Vietnam (compare Ziegler, 2002a: 108).

Comments: (a) The above-mentioned *Amolops* sp. does not necessarily represent a new record as the species *A. ricketti* is not mentioned by Vassiliev (1999).

(b) Ziegler and Weitkus (1999) showed that *R. macrodactyla* can easily be confused with *R. taipehensis* or *R. erythraea* in Vietnam. This has to be considered for the above mentioned *R. taipehensis* as well as the *R. macrodactyla* listed by Vassiliev (1999). *Rana erythraea* shows a more developed webbing between the toes and *R. taipehensis* has shorter legs than *R. macrodactyla* and rarely shows a light vertebral line.

FIGURE 43: *Lycodon fasciatus*, Phong Nha - Ke Bang NP.

FIGURE 45: *Oligodon chinensis*, Phong Nha - Ke Bang NP.

FIGURE 47: *Psammodynastes pulverulentus*, Phong Nha - Ke Bang NP.

Rhacophoridae

Previously listed: *Polypedates dennysi** (Blanford, 1881), *P. leucomystax** (Gravenhorst, 1829), *Polypedates* sp.*, *Rhacophorus reinwardtii** (Schlegel, 1837)

FIGURE 48: *Rhabdophis chrysargos*, Phong Nha - Ke Bang NP.

FIGURE 49: *Sinonatrix percarinata*, Ha Tinh province.

FIGURE 50: *Triceratolepidophis sieversorum*, Phong Nha - Ke Bang NP.

FIGURE 51: *Trimeresurus cornutus*, Phong Nha - Ke Bang NP.

FIGURE 52: *Trimeresurus* cf. *vogeli*, Phong Nha - Ke Bang NP.

FIGURE 53: *Trimeresurus* sp., Phong Nha - Ke Bang NP.

(Fig. 20), *R. verrucosus** Boulenger, 1893, *Rhacophorus* sp.*

Comments: The *Polypedates* sp. from Phong Nha - Ke Bang (ZFMK 71340, as listed in Ziegler and Herrmann [2000], as well as the current specimens ZFMK 76184-76186) refer to the same species mentioned as *Polypedates* sp. in Ziegler (2002a: 122-127). *Polypedates* sp. (Fig. 21) differs from syntopic *P. leucomystax* with respect to morphology and pattern in having: greater snout-vent length; rough dorsum; more pointed snout; terminal disk of the third finger almost or as large as the tympanum; pronounced light tubercles in the lower cloacal area; tibio-tarsal articulation extending over snout tip; dorsum often with four dark longitudinal stripes; lacking dark area on the sides of the head between eye and snout; inner and posterior sides of thighs with large light flecks with dark borders; throat and pectoral areas partially spotted dark or with dark flecks. Furthermore, differences in ecology and habitat preference are noticeable: *Polypedates* sp. is a strict forest species. Besides different advertisement calls, significant divergence in molecular data between the two taxa was found in syntopic specimens from the Ha Tinh Province, arguing for a separation of the two (Ziegler, 2002a). Final taxonomic assignments will necessitate a comprehensive revision of the south-east-Asian members of the complicated *P. leucomystax* group (Dubois, 1986).

New records: (a) *Chirixalus vittatus* (Boulenger, 1887), ZFMK 80647, male (Fig. 22), collected at night at forest edge in secondary vegetation around a water filled bomb crater.

(b) *Rhacophorus bipunctatus* Ahl, 1927, specimen (SVL: 34 mm) deposited in the Research Centre collection of Phong Nha - Ke Bang National Park.

(c) *Rhacophorus orlovi* Ziegler and Köhler 2001, ZFMK 75798-75803, subadult to adult (Fig. 23), collected at night on low vegetation in primary forest. This frog was recently described from the South of Ha Tinh Province (Ziegler and Köhler, 2001). The new findings from Phong Nha - Ke Bang represent the first record for the Quang Binh Province as well as the southernmost species record (Ziegler et al., 2002a). Most probably, the *Rhacophorus* sp. listed in Ziegler and Herrmann (2000) refers to *R. orlovi*. Among the six collected frogs are the largest recorded female (ZFMK 75800: SVL: 52.5 mm) and male (75802: SVL: 39.2 mm).

(d) *Theloderma asperum* (Boulenger, 1886), specimen (SVL: 15.0 mm) deposited in HNUV, collected in forest.

REPTILIA
TESTUDINES

Platysternidae

Previously listed: *Platysternon megacephalum** Gray, 1831

Bataguridae

Previously listed: *Cuora galbinifrons** Bourret, 1939, *C. trifasciata** (Bell, 1825), *Cyclemys tcheponensis** (Bourret, 1939), *Malayemys subtrijuga* (Schlegel and Müller, 1844), *Mauremys mutica** (Cantor, 1842), *Pyxidea mouhotii** (Gray, 1862), *Sacalia quadriocellata** (Siebenrock, 1903)

Remarkable new material: *Pyxidea mouhotii*, MTD D 44046, from local trade.

Comments: Intergradation areas between the subspecies *Cuora g. galbinifrons* and *C. g. bourreti* (Fig. 24) as well as *Pyxidea m. mouhotii* and *P. m. obsti* (Fig. 25) were already discussed by Ziegler (2002a) for the Ha Tinh Province. New material from the Phong Nha - Ke Bang area confirms intergrades for the Quang Binh Province (Fritz et al., 2002).

Testudinidae

Previously listed: *Indotestudo elongata* (Blyth, 1853), *Manouria impressa* (Günther, 1882)

Trionychidae

Previously listed: *Palea steindachneri** (Siebenrock, 1906), *Pelodiscus sinensis* (Wiegmann, 1834)

Confirmed: *Pelodiscus sinensis*, MTD D 44045 (Fig. 26), from local trade (allegedly captured in sandy stream).

SQUAMATA: SAURIA

Gekkonidae

Previously listed: Gekkonidae sp.*, *Gekko gecko** (Linnaeus, 1758), *Hemidactylus karenorum* (Theobald, 1868), *H. frenatus** Duméril and Bibron, 1836, *H. garnotii* Duméril and Bibron, 1836.

Remarkable new material: *Gekko gecko*, adult specimen deposited in HNUV, collected in forest. This specimen represents the only voucher from Phong Nha - Ke Bang. All other records are based on calls of the species heard in the area.

Additional records by Vassiliev (1999): *Cyrtodactylus pulchellus* Gray, 1827.

New records: (a) *Cyrtodactylus phongnhakebangensis* Ziegler et al., 2003, MTD D 45242 (formerly ZFMK 76170), two specimens deposited in HNUV (formerly ZFMK 76195, 76196), ZFMK 76168-76169, 76193-76194, 76197, 80648-80650, adults (Fig. 27), collected at night in primary limestone forest on or near karst rock faces. For more details see the species description (Ziegler et al., 2002b).

(b) *Gehyra mutilata* (Wiegmann, 1834), ZFMK 80653, juvenile, collected at day on the outer wall of a house.

(c) *Gekko* sp. (Fig. 28), ZFMK 76174, 76198, 80651-80652, adults, ZFMK 76175-76179, 76199 juveniles (embryos), ZFMK 76180 three eggshells, collected at night in primary limestone forest close by or on karst rock faces. In addition, in September/October 2001 we hatched five eggs (3.2) which were removed from a karst cave.

Comments: (a) Ziegler et al. (2002b) doubted the record of *Cyrtodactylus pulchellus* from the primary forest by Vassiliev (1999). *C. pulchellus* is not known from Vietnam and may be confused with the recently described *C. phongnhakebangensis*. In Meijboom and Ho (2002a) Vassiliev's record is treated as misidentified: "as the species only occurs in peninsular Thailand and Malaysia. There are possibly one or two *Cyrtodactylus* spp. in the area, but not *C. pulchellus*". Gekkonidae sp. and *Cyrtodactylus phongnhakebangensis* are considered as one species (Ziegler et al., 2002b).

(b) The vouchers of *Gekko* sp. could not be determined thus far. The specimens possibly represent a hitherto undescribed species (in prep.).

(c) Ziegler (2002a) mentions the differences in colouration of Vietnamese *G. gecko* compared to tokays from other countries (in prep.).

Agamidae

Previously listed: *Acanthosaura lepidogaster** (Cuvier, 1829), *Calotes emma** Gray, 1845, *C. versicolor** (Daudin, 1802), *Draco maculatus* (Gray, 1845), *Leiolepis belliana*? (Gray, 1827), *Physignathus cocincinus** Cuvier, 1829

Additional records by Vassiliev (1999): (a) *Acanthosaura crucigera* Boulenger, 1885

(b) *Draco* sp.

Comments: (a) As only *Acanthosaura crucigera* was listed by Vassiliev (1999) we stress the possibility of confusion with the species *A. lepidogaster*. The latter species is common in the primary forest of Phong Nha - Ke Bang.

(b) *Draco maculatus* was recorded by Ziegler (2002a) from the southern parts of Ha Tinh, the province which borders Quang Binh in the north. However, these specimens differ from typical *D. maculatus* by having more (each six) ribs supporting the patagium. More material is needed to assess whether variability is involved or taxonomic changes are justified. In general, the taxonomy and distribution of *Draco* in Vietnam is poorly understood (Ziegler, l.c.: 181).

Varanidae

Previously listed: *Varanus salvator** (Laurenti, 1768)

Lacertidae

Previously listed: *Takydromus sexlineatus* Daudin, 1802, *T. wolteri*? (Fischer, 1885)

New records: *Takydromus kuehnei* van Denburgh, 1909 (Fig. 29), ZFMK 80655, male, collected at day in forest. Southernmost species record (see Ziegler and Bischoff, 1999).

Comments: Ziegler and Bischoff (1999) stressed in detail that records of *Takydromus wolteri* for Vietnam were based on misidentified *T. kuehnei* (and also *T. sexlineatus*). Meanwhile, due to the new record of *T. kuehnei* for Quang Binh Province beside *T. sexlineatus*, and because the occurrence of the strictly Palearctic *T. wolteri* in Vietnam must be seriously doubted (see also Ziegler et al., 1999), we recommend to delete *T. wolteri* both from the National Park's and the country's herpetofaunal list.

Scincidae

Previously listed: *Eumeces quadrilineatus* (Blyth, 1853), *Lygosoma quadrupes* (Linnaeus, 1766), *Mabuya chapaense* (Bourret, 1937), *M. longicaudata** (Hallowell, 1856), *M. multifasciata** (Kuhl, 1820), *Scincella melanosticta** (Boulenger, 1887) (Fig. 30), *Sphenomorphus buenloicus* Darevsky and

Nguyen, 1983, *S. indicus** (Gray, 1853) (Fig. 31), *Tropidophorus cocincinensis** Duméril and Bibron, 1839 (note: Asian *Mabuya* are referred to the genus *Eutropis* Fitzinger, 1843 by Mausfeld et al., 2002).

Remarkable new material: *Tropidophorus cocincinensis*, deposited in HNUV, juvenile, was collected in a primary forest stream. The small collection of this poorly-known species listed in Ziegler and Herrmann (2000), three subadult to adult males (ZFMK 71275-71277) (Fig. 32) and two juveniles (ZFMK 71278-71279), is enlarged by a further juvenile. The species was only known from southern Vietnam, with the Kon Tum Province being the northernmost record (Bourret, unpubl.; Bobrov, 1993, Nguyen and Ho, 1996). Currently the findings from Phong Nha - Ke Bang represent the northernmost occurrence in Vietnam.

Additional records by Vassiliev (1999): *Sphenomorphus* sp.

New records: (a) *Eutropis macularia* (Blyth, 1853) (Fig. 33), ZFMK 76171 juvenile, ZFMK 76200 female, collected at day in leaf litter of primary limestone forest.

(b) *Scincella reevesii* (Gray, 1838), adult male deposited in HNUV, collected in forest.

(c) *Scincella* sp., ZFMK 76173, 76202-76204, 80656-80657 juvenile to adult (Fig. 34), collected at day on rocks, under logs, in pebble and/or leaf litter of primary limestone forest.

Comments: (a) The *Sphenomorphus* sp. of Vassiliev (1999) is the only listed representative of the genus, beside "*Scincella melanosticta* (?)".

(b) Contrary to the findings of Ouboter (1986) and Bobrov and Ho (1993) the *Scincella reevesii* specimen possesses distinctly separated prefrontals as also seen in other specimens (Fig. 35) from northern Vietnam (see discussion in Ziegler, 2002a: 205).

(c) Specimens listed under *Scincella* sp. could not be assigned to a taxon. Due to the presence of a transparent window in the lower eyelid of all specimens we refrained from assigning it to the genus *Sphenomorphus*. Further research should reveal whether these specimens represent a new species (in prep.).

SQUAMATA: SERPENTES

Typhlopidae

Previously listed: *Ramphotyphlops braminus* (Daudin, 1803), *Typhlops diardii* Schlegel, 1839

Xenopeltidae

Previously listed: *Xenopeltis unicolor* Boie, 1827

Confirmed: adult specimen deposited in HNUV (Fig. 36), collected at night in primary karst forest near a stream.

New records: *Xenopeltis hainanensis* Hu and Zhao, 1972, photograph only (Fig. 37), in primary limestone forest. Southernmost species record (compare Orlov, 2000: 104).

Comments: According to Orlov (2000), the single "postorbital" (postocular) scale together with only seven supralabials are characteristic for *X. hainanensis* (vs. two "postorbitals" and eight supralabials in *X. unicolor*); in Orlov's key also different ventral counts were given, but ventrals were not counted in the single known specimen of *X. hainanensis* from Phong Nha - Ke Bang.

Boidae

Previously listed: *Python molurus** (Linnaeus, 1758), *P. reticulatus** (Schneider, 1801)

Remarkable new "material" (record only): *Python reticulatus* has been confirmed for Phong Nha - Ke Bang from the local trade (Ziegler and Herrmann, 2000) but not collected by us from the region. At the end of August 2003, we photographed a young specimen crossing a small primary karst forest path at night (Fig. 38).

Colubridae

Previously listed: *Ahaetulla prasina** (Boie, 1827), *Amphiesma khasiensis* (Boulenger, 1890), *Boiga cynodon* (Boie, 1827), *B. multomaculata** (Boie, 1827), *Calamaria pavimentata* Duméril, Bibron and Duméril, 1854, *C. septentrionalis* Boulenger, 1890, *Chrysopelea ornata* (Shaw, 1802), *Cyclophiops multicinctus** (Roux, 1907), *Dendrelaphis pictus* (Gmelin, 1789), *Elaphe moellendorffi* (Boettger, 1886), *E. radiata** (Boie, 1827), *E. taeniura** Cope, 1861, *Enhydris plumbea*

(Boie, 1827) (Fig. 39), *Pareas margaritophorus* (Jan, 1866), *Ptyas korros** (Schlegel, 1837), *P. mucosus** (*Linnaeus*, 1758), *Rhabdophis subminiatus** (Schlegel, 1837), *Sibynophis collaris* (Gray, 1853), *Xenochrophis piscator** (Schneider, 1799) (note: David et al., 1998 stressed the neutral gender of the name *Amphiesma*: thus the correct name is *A. khasiense*; *Elaphe moellendorffi*, *E. radiata*, and *E. taeniura* are referred to as *Coelognathus* Fitzinger, 1843, and *Orthriophis* Utiger et al., 2002: thus becoming *C. radiatus*, *O. moellendorffi*, and *O. taeniurus*, by Utiger et al. 2002)

Confirmed: (a) *Enhydris plumbea*, ZFMK 76167, collected at night near rice fields close to a village.

(b) *Pareas margaritophorus*, ZFMK 80664, collected at night in forest.

Remarkable new material: *Coelognathus radiatus*, ZFMK 76165, juvenile (Fig. 40), collected at day between buildings in a village. This species had been confirmed for Phong Nha - Ke Bang from the local trade (Ziegler and Herrmann, 2000) but has not been collected by us from this region.

Additional records by Vassiliev (1999): (a) *Dinodon septentrionalis* (Günther, 1875)

(b) *Elaphe* sp.

(c) *Oligodon taeniatus* (Günther, 1861)

New records: (a) *Amphiesma* sp., ZFMK 80660, adult (Fig. 41), collected at night on a forest clearing near a stream. Southernmost species record (compare Ziegler, 2002a: 219-221).

(b) *Amphiesma stolatum* (Linnaeus, 1758), ZFMK 80658-80659, subadult to adult, collected by locals in the surroundings of the National Park and lack precise locality data.

(c) *Dendrelaphis ngansonensis* (Bourret, 1935), adult female deposited in HNUV, collected in forest (Fig. 42).

(d) *Dinodon* cf. *rufozonatum* (Cantor, 1842), ZFMK 80662, adult female, collected in primary forest. Southernmost species record in Vietnam (Ziegler, 2002a: 228-230).

(e) *Lycodon fasciatus* (Anderson, 1897), ZFMK 80665, juvenile (Fig. 43), collected at night in primary karst forest on a branch. Southernmost species record in Vietnam (compare Nguyen and Ho, 1996: 87).

(f) *Lycodon* cf. *paucifasciatus* Rendahl, 1943, ZFMK 80661, male (Fig. 44), collected at night on a forest clearing on the ground. Northernmost species record (compare Lanza, 1999: 96).

(g) *Oligodon chinensis* (Günther, 1888), ZFMK 80663, adult male (Fig. 45), collected at night on karst rock face.

(h) *Oreophis porphyraceus* (Cantor, 1839), ca. 40 cm long specimen, photograph only (Fig. 46, courtesy of Marianne Meijboom), 27 July, 2002 at 0900 h, at the foot of limestone rocks. Southernmost species record in Vietnam (Ziegler, 2002a: 293).

(i) *Psammodynastes pulverulentus* (Boie, 1827), ZFMK 76166, adult male (Fig. 47), collected at day in forest near a village.

(j) *Rhabdophis chrysargos* (Schlegel, 1837), juvenile deposited in HNUV and an adult deposited in the Research Centre collection of Phong Nha - Ke Bang National Park (Fig. 48), collected in primary forest.

(k) *Sinonatrix percarinata* (Boulenger, 1899) (Fig. 49), three specimens deposited in the Research Centre collection of Phong Nha - Ke Bang National Park.

Comments: (a) The above mentioned *Elaphe* sp. does not necessarily represent a new record from Vassiliev (1999), but most likely represents one of the species formerly assigned to *Elaphe* and recorded from the area. Furthermore, *Elaphe moellendorffi*, *E. porphyracea*, *E. radiata*, and *E. taeniura* are referred to the genera *Coelognathus* Fitzinger, 1843, *Oreophis* Utiger et al., 2002, and *Orthriophis* Utiger et al., 2002, thus being *Coelognathus radiatus*, *Oreophis porphyraceus*, *Orthriophis moellendorffi* and *Orthriophis taeniurus* (see Utiger et al., 2002).

(b) Vassiliev's (l. c.) *Pareas margaritafolius* (sic) most probably refers to *P. margaritophorus* (see above).

(c) *Amphiesma* sp. refers to the same species mentioned in Ziegler (2002a: 219-221) and most probably represents an undescribed taxon.

(d) *Dendrelaphis ngansonensis* is a poorly known taxon which had been treated as a subspecies and later as a synonym of *D. pictus* (see Ziegler and Vogel, 1999).

(e) The juvenile voucher specimen of *Rhabdophis chrysargos* from the National Park shows few pore-like structures on some scales of the posterior head. The colouration of the juvenile corresponds well with the colouration of specimens from the Ha Tinh province (Ziegler, 2002a: 257). In the latter book also a specimen of *Rhabdophis* from Ha Tinh is mentioned, which keyed out (after Bourret, 1935, 1936) as *R. chrysargos* but showed similarities to *R. subminiatus* in the pattern of the head and neck. Therefore and for possessing pore-like structures on some scales of the posterior head it was listed as *Rhabdophis* sp. in Ziegler (2002a). If these pore-like structures occasionally occur in *R. chrysargos* or if they are of diagnostic and taxonomic value and possibly characterize another taxon remains questionable and requires further research. However, the adult voucher specimen did not reveal distinct pore-like structures.

(f) The *Dinodon* cf. *rufozonatum* specimen showed a somewhat unusual dorsal pattern (compare discussion in Ziegler, 2002a: 230): it bears only 49 light transversal dorsal stripes in total (33 on body, 16 on tail).

(g) The *Lycodon* cf. *paucifasciatus* voucher reveals also a somewhat unusual dorsal pattern: it bears 25 light transversal dorsal stripes on the body, and 11 on the tail. In the original description (in Smith, 1943) it is stated “black above, with whitish annuli of irregular outline, 14 on the body and 8 on the tail”; however, Lanza (1999) merely mentions the presence of irregular cross-bars.

Elapidae

Previously listed: *Bungarus candidus** (Linnaeus, 1758), *B. fasciatus** (Schneider, 1801), *Naja naja*? (Linnaeus, 1758), *Naja* cf. *atra** Cantor, 1842, *Ophiophagus hannah** (Cantor, 1836)

Additional records by Vassiliev (1999): *Calliophis* (now genus *Sinomicrurus*, see Slowinsky et al., 2001) *macclellandi* (Reinhardt, 1844)

Viperidae

Previously listed: Viperidae sp.*, *Trimeresurus albolabris* (Gray, 1842)

New records: (a) *Triceratolepidophis sieversorum* Ziegler et al., 2000, ZFMK 75066, adult female (SVL: 887 mm, TaL: 165 mm) (Fig. 50), collected at night coiled on a forest path in primary karst forest close to limestone outcrops (Herrmann et al., 2002, Ziegler and Herrmann, 2002).

(b) *Trimeresurus cornutus* Smith, 1930, ZFMK 75067, adult male (SVL: 555 mm, TaL: 141 mm) (Fig. 51), collected at night in primary karst forest on the side of a small path while crawling on leaf litter, near limestone outcrops (Herrmann et al., accepted, Ziegler and Herrmann, 2002).

(c) *Trimeresurus* cf. *vogeli* David et al., 2001, ZFMK 80666-80668 (Fig. 52), two females and one juvenile, collected at night in forest on branches near streams. Together with specimens from Ha Tinh (see Ziegler 2002: 287-290) northernmost species record (compare David et al. 2001).

(d) *Trimeresurus* sp., photograph only (Fig. 53), in low vegetation of primary karst forest.

Comments: (a) In Ziegler and Herrmann (2000) “Viperidae sp.” was used for a male pitviper specimen (ZFMK 71262) which was found preserved in a local medicine man’s collection and could not be assigned to a species at the time. Since then it has become the holotype of a new genus and species of pitviper, namely *Triceratolepidophis sieversorum* (Ziegler et al., 2000). The above listed first live specimen found confirmed its existence at the type locality, in the National Park area. This specimen is the first known female and after the holotype and one specimen from Hin Namno NBCA in Laos, the third specimen found for the genus and species (Herrmann et al., 2002). Meanwhile, biochemical and biological activities of a venom sample were assayed and compared with those of other viperids (Mebs et al., 2003): the venom has high proteolytic and haemorrhagic properties, relatively little or no thrombin-like properties, and low lethal activities.

(b) A second horned pitviper species, *Trimeresurus cornutus*, was found in the same area which initially caused some confusion relative to *Triceratolepidophis* (see discussion in Ziegler and Herrmann, 2000: 56-57). *Trimeresurus cornutus* is endemic for Vietnam and listed as rare in the Red Data Book of Vietnam (Ministry of Science, Technology and Environment, 2000). Only two voucher specimens of this species were collected from northern Vietnam in the 1920's and in 1937. A third specimen, of which no voucher exists, was reported by Campden-Main (1970) from Bach Ma, Thua Thien-Hue province in South Vietnam. The voucher from Phong Nha - Ke Bang represents the largest specimen and the first male which allows for the first time detailed insights into colouration, life history, genital morphology and its systematic position (see Herrmann et al., accepted).

Vassiliev (1999) lists "*Trimeresurus cornutus* (?) or *Daboia* sp. (?) [...] 1 specimen in primary forest". It most likely refers to a horned pitviper of either *Trimeresurus cornutus* or *Triceratolepidophis sieversorum.*

(c) The specific status of *Trimeresurus* cf. *vogeli* (e. g., differing eye colouration, see David et al. 2001) and *Trimeresurus* sp., pitvipers hitherto not documented for Vietnam, have yet to be resolved.

Our recent fieldwork enabled the addition of 33 species to the list of amphibians and reptiles for the Phong Nha - Ke Bang area. These include 10 frog species (*Leptobrachium chapaense*, *Megophrys lateralis*, *Kalophrynus interlineatus, Microhyla* cf. *annamensis*, *Microhyla butleri*, *Taylorana hascheana, Chirixalus vittatus*, *Rhacophorus bipunctatus*, *R. orlovi*, *Theloderma asperum*), seven lizard species (*Cyrtodactylus phongnhakebangensis*, *Gehyra mutilata*, *Gekko* sp., *Takydromus kuehnei*, *Eutropis macularia*, *Scincella reevesii*, *Scincella* sp.) and 16 snake species (*Xenopeltis hainanensis*, *Amphiesma* sp., *A. stolatum*, *Dendrelaphis ngansonensis*, *Dinodon* cf. *rufozonatum*, *Lycodon fasciatus*, *L.* cf. *paucifasciatus*, *Oligodon chinensis*, *Oreophis porphyraceus*, *Psammodynastes pulverulentus*, *Rhabdophis chrysargos*, *Sinonatrix percarinata*, *Triceratolepidophis sieversorum*, *Trimeresurus cornutus*, *T.* cf. *vogeli*, *Trimeresurus* sp.). Two of these species (*Cyrtodactylus phongnhakebangensis*, *Triceratolepidophis sieversorum*) are newly discovered taxa, representing one new genus and two new species. Four further taxa (*Gekko* sp., *Scincella* sp., *Amphiesma* sp., *Trimeresurus* sp.) are currently under study. The rare *Trimeresurus cornutus* was rediscovered after more than half a century and in a new locality (Ziegler and Herrmann, 2002). The records of the species *Leptobrachium chapaense*, *Taylorana hascheana*, *Dinodon* cf. *rufozonatum*, *Lycodon fasciatus* and *Oreophis porphyraceus* represent the southernmost localities for Vietnam, the findings of *Rhacophorus orlovi*, *Takydromus kuehnei*, *Xenopeltis hainanensis*, and *Amphiesma* sp. in Phong Nha - Ke Bang even represent the southernmost species records. The vouchers of *Lycodon* cf. *paucifasciatus* and of *Trimeresurus* cf. *vogeli* represent the northernmost species records. Two of the 33 newly recorded species are listed in the Red Data Book of Vietnam. *Oreophis porphyraceus* is listed as threatened and *Trimeresurus cornutus* is listed as rare (Ministry of Science, Technology and Environment, 2000). Seven species (*Kaloula pulchra*, *Microhyla berdmorei*, *M. pulchra*, *Pelodiscus sinensis*, *Xenopeltis unicolor*, *Enhydris plumbea*, *Pareas margaritophorus*) which were listed previously for the Phong Nha - Ke Bang area could be confirmed by us by voucher specimens. Remarkable new voucher specimens for the area are these of *Hyla simplex*, *Pyxidea mouhotii*, *Gekko gecko*, *Tropidophorus cocincinensis* (the specimens from Phong Nha - Ke Bang represent the northernmost occurrence of the species in Vietnam) and *Coelognathus radiatus*.

A total of 40 anuran species is recorded for Phong Nha - Ke Bang: one discoglossid, three megophryids, two bufonids, one hylid, nine microhylids, 15 ranids (Vassiliev's *Amolops* sp. was not counted) as well as nine rhacophorids (*Rhacophorus* sp. and *R. orlovi* are treated as a single species). Thirty-two (80%) of these 40 species were recorded and confirmed by us. Spe-

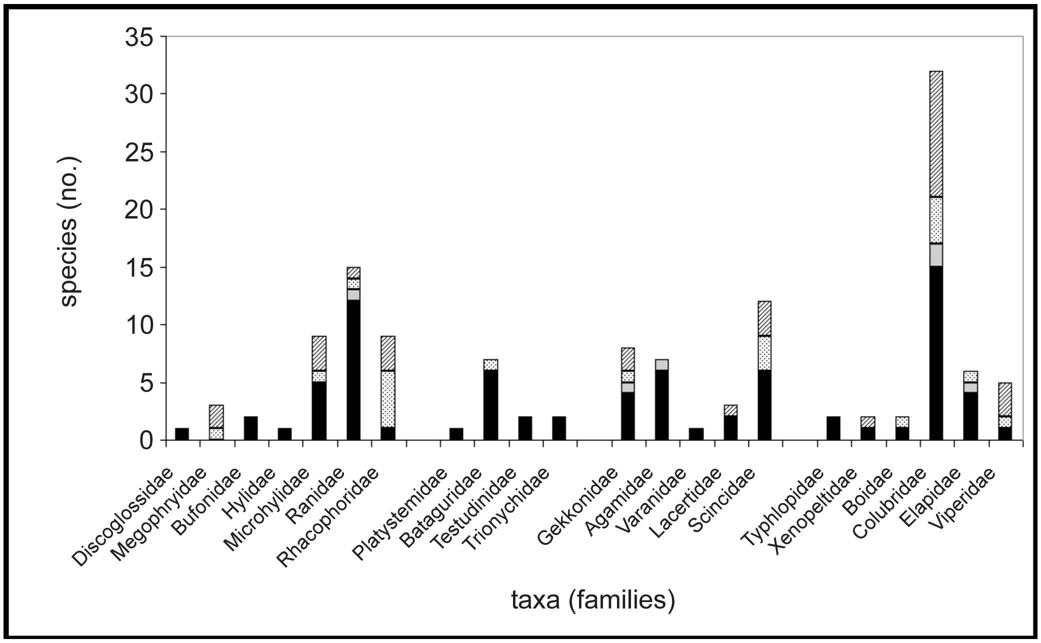

FIGURE 54: Amphibian and reptile species recorded for Phong Nha - Ke Bang based on the lists by Le et al. (1997) and Nguyen et al. (1997) (black bars), updated by identifiable records by Vassiliev (1999) (gray bars), Ziegler and Herrmann (2000) (stippled bars) as well as the findings of the 2001 and 2003 surveys by the authors (this paper) (hatched bars).
Because *Rhacophorus orlovi* and *Cyrtodactylus phongnhakebangensis* most probably refer to *Rhacophorus* sp. and Gekkonidae/*Cyrtodactylus* sp. mentioned in Ziegler and Herrmann (2000), they were listed under this reference in the diagram (although named here with the appropriate names for the first time). In the diagram, *Triceratolepidophis sieversorum* is listed under Ziegler and Herrmann (2000) although the scientific description followed later (the latter holotype was mentioned there as "Viperidae sp.").
Because the results (determinations) of several authors are treated together, double- or misidentifications cannot be excluded; we also did not delete the four species recommend for deletion from the herpetofaunal list of the National Park. For details we refer to the comments in the species sections and in the discussion, respectively.

cies we could not confirm are the discoglossid *Bombina maxima* and the seven ranids *Amolops ricketti*, *Occidozyga lima*, *Phrynoglossus laevis*, *Rana andersonii*, *Rana sauteri*, *Rana macrodactyla* and *Rana taipehensis*. The occurence of *Bombina maxima* is doubtful. Within the ranids, *Phrynoglossus laevis* was most probably confused with *P. martensii* as was *Rana sauteri* with *R. johnsi*; based on former discussions (e. g. Ziegler, 2002a: 92-93, 98), we recommend the removal of *Phrynoglossus laevis* and *Rana sauteri* from the herpetofaunal list. The possibility of confusing *Rana macrodactyla* and *R. taipehensis* was discussed earlier in this paper. The problems of determination and distribution of *Rana andersonii* and *R. schmackeri* are discussed in Ziegler (2002a: 105-108). The taxonomic status of *Leptolalax* sp., *Microhyla* cf. *annamensis* and *Polypedates* sp. from the study area needs further clarification (Ziegler and Herrmann, 2000, Ziegler, 2002a).

Ninety-two species of reptiles are recorded for the Phong Nha - Ke Bang National Park: 12 turtle species (one platysternid, seven batagurids, two testudinids, two trionychids), 31 lizard species (eight gekkonids [Gekkonidae sp. and *Cyrtodactylus phongnhakebangensis* are considered as one species], seven agamids [Vassiliev's *Draco* sp. is not counted in], one varanid, three lacertids, twelve scincids [Vassiliev's *Sphenomorphus* sp. is not counted]), as well as 49 snake species (two typhlopids, two xenopeltids, two boids, 32 colubrids [Vassiliev's *Elaphe* sp. is not counted], six elapids, five viperids [Viperidae sp. and *Triceratolepidophis sieversorum* are one species]). Of these 92 species we confirmed 62 (67%): nine turtles, 19 lizard and 34 snake species. We were unable to confirm three turtle species (*Malayemys subtrijuga*, *Indotestudo elongata* and *Manouria impressa*), 12 lizard species (*Cyrtodactylus pulchellus*, *Hemidactylus karenorum*, *H. garnotii*, *Acanthosaura crucigera*, *Draco maculatus*, *Leiolepis belliana*, *Takydromus sexlineatus*, *T. wolteri*, *Eumeces quadrilineatus*, *Lygosoma quadrupes*, *Eutropis chapaense* and *Sphenomorphus buenloicus*), and 15 snake species (*Ramphotyphlops braminus*, *Typhlops diardii*, *Amphiesma khasiense*, *Boiga cynodon*, *Calamaria pavimentata*, *C. septentrionalis*, *Chrysopelea ornata*, *Dendrelaphis pictus*, *Dinodon septentrionalis*, *Oligodon taeniatus*, *Orthriophis moellendorffi*, *Sibynophis collaris*, *Naja naja*, *Sinomicrurus macclellandi* and *Trimeresurus albolabris*). Within lizards, we doubt the occurence of *Cyrtodactylus pulchellus* as well as of *Leiolepis belliana*. The former was probably confused with another *Cyrtodactylus* species as discussed in Meijboom and Ho (2002a) and Ziegler et al. (2002b). According to the distribution given in Darevsky and Kupriyanova (1993) and Nguyen and Ho (1996), the species *Leiolepis belliana* occurs only in the south of Vietnam. Most probably, Le et al. (1997) and Nguyen et al. (1997) recorded another species for the Phong Nha - Ke Bang National Park. In addition, meanwhile only *L. guttata* is listed in the current Red Data Book of Vietnam's animals (Ministry of Science, Technology and Environment, 2000) instead of *L. belliana guttata*, which was the only *Leiolepis* taxon listed in the former Red Data Book (Ministry of Science, Technology and Environment, 1992) with records from the central and southern parts of Vietnam. *Acanthosaura lepidogaster* and *A. crucigera* can easily be confused as well (see above). As indicated above, the lacertid *Takydromus wolteri*, mentioned by Le et al. (1997) and Nguyen et al. (1997) may have been confused with another *Takydromus* species. Therefore, we recommend the removal of at least *Cyrtodactylus pulchellus* and *Takydromus wolteri* from the herpetofaunal list. Because *Naja naja* was mentioned by Le et al. (1997) and Nguyen et al. (1997) according to the old Asian cobra concept, it is unclear, which species was implied to occur (*Naja atra*, *N. kaouthia* or another species, compare discussion in Ziegler, 2002a: 279). For a discussion of the difficult taxonomy and distribution of *Xenochrophis piscator*/*X. flavipunctatus* see, e. g., Ziegler (2002a: 268). The taxonomic status of *Gekko gecko*, *Gekko* sp., *Draco maculatus*, *Scincella reevesii*, *Scincella* sp., *Amphiesma* sp., *Dinodon* cf. *rufozonatum*, *Lycodon* cf. *paucifasciatus*, *Rhabdophis chrysargos*, *Naja* cf. *atra*, and *Trimeresurus* cf. *vogeli* from the study area needs further attention (compare Ziegler and Herrmann, 2000, Ziegler, 2002a).

Figure 54 suggests that additional records of new species, either for the area or to science, are to be expected. Some of the 132 species of amphibians and reptiles may be omitted from the list (as recommended for the four species *Phrynoglossus laevis*, *Rana sauteri*, *Cyrtodactylus pulchellus* and *Takydromus wolteri*) if future studies cannot confirm their presence or identifications. Taxonomic changes may be warranted in others when additional material allows for a more thorough analysis.

Hunting appears to be a major threat to the vertebrate diversity of this area (e. g., Timmins et al., 1999). An overview of the amphibian and reptile trade with respective prices is provided in Ziegler and Herrmann (2000) and Ziegler (2002a: 322). Planned roads will border or bisect the National Park, thus the potential for future habitat loss and disturbance resulting from infrastructural development is high. In addition, timber extraction (Timmins et al., 1999) and development of tourism also threatens the biodiversity. About 20% of the amphibian and reptile species known for the Phong Nha - Ke Bang region are listed in the Red Data Book for Vietnam. The threatened snake species *Oreophis porphyraceus* and the rare *Trimeresurus cornutus* can be added to the region's list of endangered species (Red Data Book). To underline the importance of the area as a unique karst habitat that requires further investigation as well as protection measures: *Cyrtodactylus phongnhakebangensis*, which was recently named after the National Park, represents the third known karst cave-dwelling bent-toed gecko in the genus with some 70 species (Bauer et al., 2002). Special conservation attention may be warranted for this endemic gecko along with the remarkable pitviper diversity, namely the scarcely known horned pitvipers *Triceratolepidophis sieversorum* and *Trimeresurus cornutus*, as well as the only recently discovered *Trimeresurus* cf. *vogeli* and *Trimeresurus* sp., to name but some of the outstanding reptile species.

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NOTE ADDED IN PROOF

While the present paper was in press, an extensive study on cryptic species of the south-east Asian cascade frog, *Rana livida*, was published (Bain et al., 2003. Amer. Mus. Nov. 3417: 1-60). Accordingly, the *Rana livida* mentioned in this overview currently have to be regarded as *R. chloronota*. In addition, *Microhyla* cf. *annamensis*, erroneously assigned to *M. berdmorei* by Ananjeva and Orlov (2003. Herpetol. Rev. 34(4): 404-405), in fact represents a new species which is currently under description (Raoul Bain, New York, pers. comm.). Meanwhile, *Gekko* sp. proved to be a new species to science that will be formally described by some of us elsewhere.

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KAESTLEA: A NEW GENUS OF SCINCID LIZARDS (SCINCIDAE: LYGOSOMINAE) FROM THE WESTERN GHATS, SOUTH-WESTERN INDIA

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(with four text-figures)

ABSTRACT.– **A lineage of lygosomines, allocated in the past variously to *Scincella, Lygosoma, Leiolopisma* and *Asymblepharus,* comprising five nominal species endemic to the Western Ghats of south-western India, is allocated to a new genus, *Kaestlea.* The genus includes the following species: *Mocoa bilineata* Gray, 1846; *Mocoa travancorica* Beddome, 1870; *Lygosoma beddomii* Boulenger, 1887; *Lygosoma laterimaculatum* Boulenger, 1887 and *Lygosoma (Leiolopisma) travancoricum* var. *palnica* Boettger, 1892. Lectotypes of all recognised species are designated. The relationships of these species with others lygosomine skinks of Asia and America (including the genera *Scincella, Sphenomorphus* and *Asymblepharus)* are discussed. Diagnoses and a key to the species of *Kaestlea* are provided.**

KEY WORDS.– ***Kaestlea*, new genus, Scincidae, lectotype designation, systematics, Western Ghats, India.**

INTRODUCTION

In the last major work on the lizard fauna of southern Asia, Smith (1935) transferred several species of lygosomine scincids, variously allocated to the genus *Mocoa* (*bilineatum* and *travancorica*), or to *Lygosoma* (*laterimaculatum, beddomii, travancoricum* var. *palnica*) to the genus *Leiolopisma.* However, several subsequent authors (e.g., Constable, 1949) have retained them in *Lygosoma* (*Leiolopisma*). Subsequently, these nominal species have been included in the genus *Scincella* Mittleman, 1950 (e.g., Mittleman, 1952; Greer, 1974; Ouboter, 1986), and more recently, together with the Himalayan species (*ladacensis, himalayanus, sikkimensis,* and *capitaneus*), were transferred to *Asymblepharus* Eremchenko and Szczerbak, 1980, subgenus *Himalblepharus* Eremchenko, 1987 (type species: *Mocoa sikimmense* Blyth, 1835).

We examined a series of representatives of all five nominal species of the group from the Western Ghats, and report differences from both *Asymblepharus* and *Scincella,* including Group II alpha palate (sensu Greer, 1974: primitive in the *Sphenomorphus*-group, but in respect to *Asymblepharus* and *Scincella*, is an apomorphy) and the presence of rudimentary pterygoid teeth (e.g., *travancorica*: 4-5 [BMNH 82.5.22.114] or 2-3 [BMNH 82.5.22.127-128]; *bilineata*: 1 [BMNH 70.1129.1-2]; absent in *laterimaculata* and *palnica*). These and other characters (including their allopatric distribution), here considered synapomorphies, support the elevation of the lineage to the rank of a genus, which is formally described herein.

ABBREVIATIONS USED

Institutional abbreviations used here are listed below. Abbreviations follow Leviton et al. (1985).

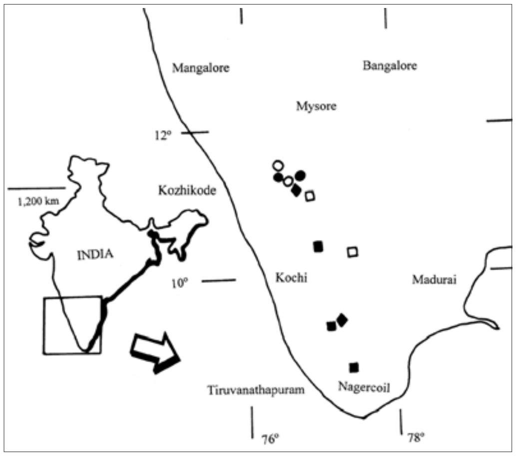

FIGURE 1: Map of south-western India, showing collection localities for members of the genus *Kaestlea* gen. nov. See text for localities and sources. Symbols: ● = *Kaestlea beddomii* (Boulenger, 1887); ○ = *Kaestlea bilineata* (Gray, 1846); ◆ = *Kaestlea laterimaculata* (Boulenger, 1887); □ = *Kaestlea palnica* (Boettger, 1892); and ▪ = *Kaestlea travancorica* (Beddome, 1870).

BMNH- The Natural History Museum, London, U.K.

CAS- California Academy of Sciences, San Francisco, U.S.A.

NMW- Naturistorisches Museum Wien, Vienna, Austria.

ZISP- Zoological Institute, Russian Academy of Sciences, St. Petersburg (formerly ZIL).

ZSI- Zoological Survey of India, Kolkata, India.

In addition, the following measurements were taken: FL = fore-arm length; GA = distance between glenohumeral (glenoid) and acetabulum (between the posterior base of the front limbs and the anterior base of the rear limb); HL = hindlimb length; SVL = snout-vent length; and TL = tail length. Abdominal scales = ventral scales in a midline from chest, at level of forelimbs, to preanals; scale rows across neck = scales from back of head and fore limbs; centre of secondary temporal = between anterior /primary temporals, supratemporals and supralabial.

SYSTEMATICS

KAESTLEA GEN. NOV.

Type species.- *Mocoa bilineatum* Gray, 1846 : 430; designated herein.

Diagnosis.– A member of *Sphenomorphus* group of *lygosomine* scincids and a derived member of the *variegatus* species-group (sensu Greer, 1974; 1979) showing similarities to the primarily Asian *Scincella*-like and *Ablepharus*-like species groups (genera: *Asymblepharus* and *Scincella* [sensu Eremchenko, 1987]), but differing from them in having the following combination of characters: A). Group II alpha palate (sensu Greer, 1974); lower eyelid with a clear window; nuchals and Group I temporal scales (Greer, 1974); two frontoparietals, or frontoparietal single; prefrontals small and separated; tympanum slightly or deeply sunk; limbs well-developed; scales around midbody 20-30; and middle neck and dorsum 26-41; four enlarged preanals, central pair larger than lateral pair. B). premaxillary teeth nine; pterygoid teeth rudimentary, 0-5; postorbitals present, elongated, thin; greater part of dorsal surface of digits with 1-2 rows of scales (Fig. 2) sharing characters with Group I and III (sensu Brongersma, 1942: Fig. 1b-d) fifth and sixth supralabial in midorbital position; size small, SVL to 62.0 mm; tail bright blue.

For a general description of the constituent species within the taxon, see Beddome (1870), Boulenger (1887), Boettger (1892), Smith (1935), Constable (1949), Ouboter (1986) and Murthy (1985; 1990).

Etymology.- The name of the new genus honours Professor Werner Kästle, German herpetologist, co-editor of the volume 'Amphibians and reptiles of Nepal. Biology, Systematics, Field guide' (2002).

Referred species.- *Mocoa bilineata* Gray, 1846; *Mocoa travancorica* Beddome, 1870; *Lygosoma beddomii* Boulenger, 1887; *Lygosoma laterimaculatum* Boulenger, 1887 and *Lygosoma* (*Leiolopisma*) *travancoricum* var. *palnica* Boulenger, 1892.

Distribution and life history.- The genus is endemic to the Western Ghats of south-western India, including Travancore, Anaimalai, Palni and Nilgiri Hills (Fig. 1). The species in the genus are diurnal and terrestrial.

Relationships.- The new genus differs from the genera *Ristella* and *Sphenomorphus* sensu

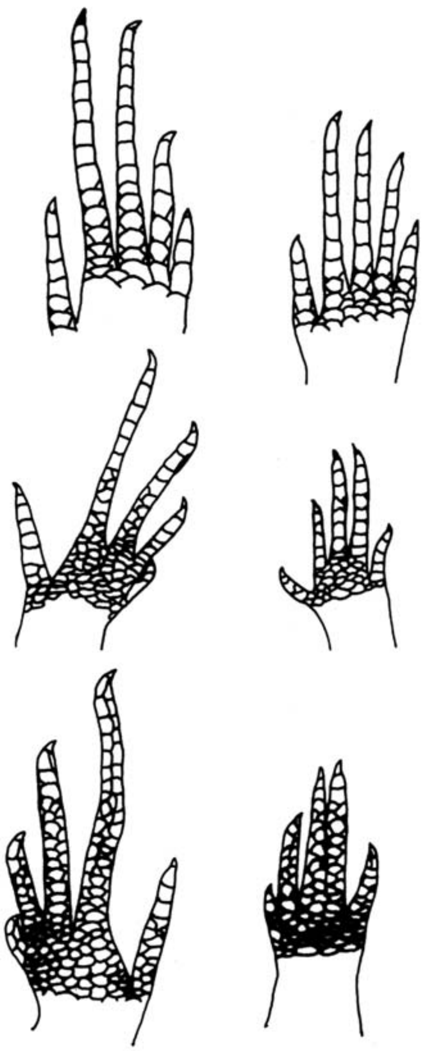

FIGURE 2: Toe lamellae of hind and fore limbs of members of the genus *Kaestlea* gen. nov. Top row, *K. bilineata* (ZISP 683); middle row, *K. palnica* (BMNH 70.11.29.2); bottom row, *K. travancorica* (BMNH 1934.10.9.8).

stricto in having lower eyelids with a clear window and well developed nuchals.

The following combination of characters: thin, elongated postorbitals, Group II alpha palate, pterygoid teeth, distinguish the new genus from the Asian *Scincella*-like genera (*Scincella* and *Asymblepharus*).

Asian members of *Scincella* (including *barbouri*, *huanrenensis*, *modesta*, *monticola*, *potanini*, *rupicola*, *tsinlingensis* and *vandenberghi*) typically show a reduction of postorbitals into granular structures; from American species of *Scincella* (including *gemmingeri* and *lateralis*), lack of postorbitals. Lack of postorbitals is also the usual condition for some American species of *Sphenomorphus* (*assata* and *cheriei*).

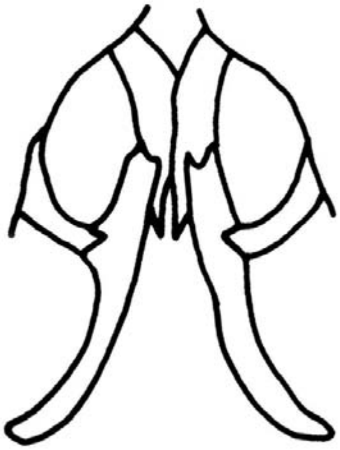

FIGURE 3: Ventral view of palate of *Kaestlea bilineata* (ZISP 5821).

Additionally, the genera *Ablepharus* and *Asymblepharus* (including eight nominal species under the subgenus *Himalblepharus*: *A. himalayanus*, *A. ladacensis*, (*ladacensiss* and *stimsoni*), *A. tragbulensis*, *A. capitaneus*, *A. nepalensis*, *A. mahabharatus* and *A. victoriana* (fide Eremchenko, 1987, 1992; Eremchenko et al., 1998; Das et al., 1998; the last-mentioned species not examined by us), differ from the new genus in typically showing a single row of scales covering the dorsal surface of digits and Group I alpha palate.

Blue tail colour occurs only in a few genera of the *Sphenomorphus* group, such as in juvenile *Asymblepharus alaicus* (from the Tien-Shan Mountains; Eremchenko et al., 1986) and *Scincella reevesi* from China (Karsen et al., 1998: 98). The bright blue tail is typical of all species of *Kaestlea* and is therefore considered a synapomorphy.

CONTENTS OF *KAESTLEA* GEN. NOV.

KAESTLEA BEDDOMII
(BOULENGER, 1887)

Mocoa travancorica (in part) Beddome, 1870:34.

Lygosoma beddomii G. A. Boulenger, 1887. Cat. Lizards British Mus. 3: 261; Pl. XVIII; Fig. 3.

Lectotype.- BMNH 1946.8.17.68; "Travancore Hills" (southern Western Ghats, south of Palghat, 10° 46'N; 76° 39'E, Kerala state, south-western India) and "Wynad" (ca. 11° 45'N; 76° 02'E, Kerala State, south-western India); collector: R. H. Beddome; paralectotypes (n = 2): BMNH 1946.8.17.69-70; same locality.

Description of lectotype.- Adult female, SVL 48.5 mm; GA 26 mm. FL 11 mm, HL 18 mm. Scales round middle of neck and dorsum 26; midbody scales rows 21; scale rows across neck and body 4; abdominal scales 36; loreal + presubocular = 2 + 2; prefrontal separated; frontoparietals divided; supraciliaries 5 (left)/6 (right); supralabials 7, four before subocular; temporal three in a single line from centre of secondary temporal to edge of ear; nuchals: ½ 3 – ½ 4 (on right, first incomplete, followed by three enlarged ones, first from left incomplete, followed by four that are enlarged); ear equal in size to palpebral disc; two small ear lobules); four large preanals, middle pair broader than long; lamellae under toe IV 17; supradigital scales in two rows basally (longest row with multiple scales, extending in five rows) and in a single row distally (Fig. 2).

Colour.- Bronzy brown above with a black vertebral line; tail blue.

Diagnosis.- This species differs congeneric species of *Kaestlea* in the number of scales round neck (26), midbody (20-21/mean 20.5) and abdominal scales (32-36). It differs from *Kaestlea travancorica* and *K. palnica* in having completely divided frontoparietals.

Derivation.- For Richard Henry Beddome (1830-1911), of the Imperial Forest Department, and a major contributor to the literature on the south Indian herpetofauna and of botany.

Distribution.- Travancore Hills, Kerala State, south-western India. According to Smith (1935), this species has been collected in the Nilgiris Hills at Coonoor. Also, Silent Valley, Kerala State, south-western India (Thomas and Easa,

FIGURE 4: *Kaestlea laterimaculata* in life, showing the bright blue tail (Photo: S. U. Saravanakumar).

1997). One specimen (BMNH 1934.3.4.1) was erroneously reported as *Scincella bilineata* (Gray, 1846) by Ouboter (1986).

KAESTLEA BILINEATA (GRAY, 1846)

Mocoa bilineata J. E. Gray, 1846. *Ann. & Mag. nat. Hist. Ser.* 1 18:430.

Lectotype.- BMNH 1946.8.17.71; "Madras" (at present Chennai, 13° 05'N; 80° 17'E, a city in Tamil Nadu State, south-eastern India; in the past Madras Presidency included much of southern India, south of 16° N). Type locality is here restricted to "Summit of the Nilgiris" (in Tamil Nadu State, south-western India), based on catalogue information; collector T. C. Jerdon; paralectotypes (n = 3), BMNH 1946.817.72-74 (only the first specimen examined), same locality; topotypes (n = 14), BMNH 70.11.29.1-2; BMNH 67.8.11.18-19; BMNH 91.11.27.5; NMW 9858:1-2; NMW 9859:1-2; NMW 9857; ZISP: 5821; 681-683.

Description of lectotype.- Adult female; SVL 55.0 mm; TL (regenerated) 57 mm; GA 31 mm; FL 10 mm, HL 15.6 mm; scales round middle of neck 33; midbody scales rows 24; scale rows across neck 4; abdominal scales 42; loreal + presubocular: 3 + 2, first loreal from left divided dorsally; prefrontals separated; supraocular 4, two in contact with frontal; frontoparietals distinct; supraciliaries 7; supralabial 7, four before subocular; temporal four in a single line from centre of secondary temporals to edge of ear; nuchals 4 – ½ 4 (4 increased from left and first not completed from right, following four enlarged); ear lobules 2; four large preanals, longer the broad, especially the middle pair; lamellae under toe IV 16; dorsal surface of fingers with a single row of scales (Fig. 2a-b).

Colour.- Brown dorsally; dark brown lateral band broken up by small cream spots; temporal and labials edged with dark brown. A pair of indistinct black lines along dorsum. Limbs brown dorsally. Tail violet.

Diagnosis.- This species differs from all other species of *Kaestlea* in showing the median pair of preanals larger than the lateral pair, which are pointed in males (preanals scales of females and juveniles are relatively less pointed) and with a single row of scales on dorsal surface of fingers (Fig. 2a-b). Additionally, it differs from *Kaestlea travancorica* and *K. palnica* in showing separated frontoparietals.

Derivation.- Latin for two-lined, in allusion to the dark stripe along the side of head and body.

Distribution and life history.- The species occurs in the Nilgiri Hills in south-western India. Roux (1928) records the species from Avalanche and Bangitapalli. It was discovered by Surgeon-Major Thomas Claverhill Jerdon (1811-1872), a Scottish surgeon with the British East India Company, under stones (Günther, 1864). This species is probably oviparous; a female of SVL 46 mm (ZISP 683) contained a single egg of dimensions 6 x 11 mm.

KAESTLEA LATERIMACULATA
(BOULENGER, 1887)

Lygosoma laterimaculatum G. A. Boulenger, 1887. Cat. Lizards British India 3: 260; PL. XVIII; Fig. 2.

Lectotype.- BMNH 1946.8.17.54; top of Sivagherry Ghat; paralectotypes (n = 5), BMNH 1946.8.17.53, same locality, BMNH 1946.8.17.55, same locality, BMNH 1946.8.16.83, Nilgiris. BMNH 1946.8.16.83, Travancore. BMNH 1946.8.16.18, Wala Ghat, Nilgherries. The type localities in the original description is given as "Nilgherees" (= Nilgiri Hills, Tamil Nadu State, south-western India); "Travancore" (southern Western Ghats, south of Palghat, 10° 46'N; 76° 39'E, Kerala State, south-western India); "Top of Sivagherry Ghat" (Sivagiri, 09° 20'N; 77° 26'E, Kerala state, south-western India); "Wala Ghat, Nilgherries" (presumably Walakkad, Silent Valley National Park, 11° 15'N; 76° 20-35'E, Kerala State, south-western India).

Description of lectotype.- Adult male; SVL 38 mm; TL (regenerated) 45 mm; GA 20 mm; FL 11, HL 15.5 mm; scales around middle of neck 34; midbody scales rows 26; scales rows across neck 4; (midbody scales rows 6 across the back, according to Smith, 1935); abdominal scales 39; loreals + presubocular: 2 + 1 (fused with another subocular); prefrontals small and separated; frontoparietals distinct; supraciliaries 7 and 6 (fifth reduced); supralabials 7, four before subocular; temporal 3, from centre of temporals to edge of ear; nuchals 6, enlarged, first largest; ear equal palpebral disc; ear lobules 2-3, tiny granules; a pair of enlarged preanals broader than long; lamellae under toe IV 22; subdigital scales in a single row on fingers and less than half on toes.

Colour.- Brown dorsally, with a light-edged black stripe along sides of head and body; sides of neck and flanks below lateral stripe thickly spotted with black; two black lines on dorsum along outer margins of two vertebral series of scales. Lower parts grey. Tail blue (see Das, 2002: 114, also reproduced here as Fig. 4).

Diagnosis.- Differs from the last species as follows: subdigital scales in a single row on fingers and less than half on toes; greater number of scales round middle of neck (33-36/mean 34.7), midbody scales rows (25-26/25.8) and greater number of lamellae under toe IV (19-22/ 20.5; 20-25, according to Smith, 1935); and from *Kaestlea palnica* and *K. travacorica*, in showing paired frontoparietals

Derivation.- Latin for spotted-side.

Distribution.- South-western India: Tinnevelly District; Nilgiri Hills, Tamil Nadu; Travancore, in Kerala State.

KAESTLEA PALNICA
(BOETTGER, 1892)

Lygosoma (*Leiolopisma*) *travancoricum* var. *palnica* O. Boettger, 1892. Ber. Offenbach. Ver. nat. 29-32: 72.

Lectotype.- BMNH 1946.8.16.53; type locality "Kodaikanal in den Palni Hills" (10° 14'N; 77° 29'E, Madurai District, Tamil Nadu State, south-western India); paralectotypes (n = 4), BMNH 1934.10.9.8, CAS 104254-55; Kodaikanal, Palni Hills, Tamil Nadu State; BMNH 1934.3.4.2, Coimbatore, Tamil Nadu State.

Description of lectotype.- Adult male, SVL 47.3 mm; TL 79 mm; GA 23.8 mm FL 12.0, HL 18.5 mm. Scales round middle of neck 40, midbody scale rows 28; scales across neck and dorsum 4; abdominal scales 43; loreal + presubocular: 2 + 2; prefrontals separated; supraocular 4, two in contact with frontal; frontoparietal single; supraciliaries 7; supralabials 7, four before subocular; temporals 5 from centre of secondary temporals to edge of ear; ear x 0.5 greater than palpebral disc; no lobules, 4 small granules; nuchals: ½, ½, 3 (on left) – ½, 3 (on right); lamellae under toe IV 19; scales on dorsal surface of fingers of forelimbs situated in a single row; a single row of scales on toes I and V of hindlimbs, and on other digits, approximately from middle, row moved aside from small scales of second row (Fig. 2c-d).

Colour.- Light dorso-lateral stripe distinct, margined on inner side with dark brown; greyish-white below; tail blue.

Diagnosis.- Differs from *Kaestlea travancorica* as follows: scales round middle of neck and dorsum 36-41 (mean 39); midbody scale rows 28-30/ mean 28.7; 5 temporal in a single line from centre of secondary temporals to edge of ear; a single row of scales on dorsal surface of fingers on forelimbs (Fig. 2c-d).

Derivation.- Latin for inhabitant of the Palni Hills, Tamil Nadu State, south-western India.

Distribution.- South-western India: Palni Hills, up to 2134 m; Coimbatore, Tamil Nadu State.

KAESTLEA TRAVANCORICA
(BEDDOME, 1870)

Mocoa Travancorica. R. H. Beddome, 1870. Madras Monthly J. Med. Sci. 1: 34.

Lectotype.- BMNH 1946.8.16.34; type localities Travancore Hills and Wynad, paralectotypes (n = 3), BMNH 1946.8.16.33, 1946.8.16.35-36; same locality; topotypes (n = 6), BMNH 82.5.114-117; BMNH 82.522.127-128. Type localities in the original description is given as "Travancore hills and Wynad" (Travancore = southern Western Ghats, south of Palghat, 10° 46'N; 76° 39'E, Kerala State, south-western India; Wynad = ca, 11° 45'N; 76° 02'E, Kerala State, south-western India).

Description of lectotype.- Adult male, SVL 42.5 mm; TL (regenerated) 48 mm; GA 22; FL 11.0, HL 16.0 mm; scales round middle of neck and dorsum 31; midbody scale rows 23; scales across neck and body 4; abdominals 39; loreal + presubocular: 2 + 2; prefrontals separated; supraoculars 4, two in contact with frontal; frontoparietal single; supraciliaries 7; supralabials 7, four before subocular; temporal 2-3 in a single line from centre of secondary temporals to edge of ear; nuchals 4; ear equal in size to palpebral disc; no ear lobules, two granules; tympanum deeply sunk; lamellae under toe IV 22; scales on anterior portion of dorsal surface of fingers in more than one row, rest with a single row (Fig. 2e-f).

Colour.- Bronze or greyish-brown dorsally, with a black vertebral line along head, neck and anterior part of body. Dark brown flecks on throat and side of body. Tail light blue, with paler flecks.

Diagnosis.- Differs from *Kaestlea palnica* as folows: loreal + presubocular: 2 + 2; 2-3 temporals in a line between the central scale (temporal) and edge of ear; slight increase in the number of scales on upper surface of digits, especially on hindlimbs; reduced number of scales round middle of neck (26-32/mean 29.4, as opposed to 36-41 in *palnica*), body (20-26/mean 22.7, as opposed to 28-30/mean 28.7 in *palnica*) and also with reduced number of midventral scales (36-42/mean 38.5, as opposed to 43-49/mean 46.3 in *palnica*).

Derivation.- Latin for inhabitant of Travancore, Kerala State, south-western India.

Distribution.- South-western India: Travancore, Anaimalai and Palni Hills, up to 1525 m altitude. Roux (1928) recorded the species from the following localities: Kodaikanal, Pumbari, Vandavavu, Mariyanshola, Maryyand and Tandikudi, in Tamil Nadu and Kerala States, and Das and Whitaker (1990) found them near hill streams, within an evergreen forest in Vanjikadavu, Kerala State and Ishwar et al. (2001) reported this species from the Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu.

KEY TO SPECIES OF *KAESTLEA*

1. Auricular lobules present 2
   Auricular lobules absent............................3
2. Loreal + presubocular = 2 + 3 ....*bilineata*
   Loreal + presubocular = 2 + 2........*beddomii*
3. Frontoparietal divided.........*laterimaculata*
   Frontoparietal single................................4
4. Dorsals x 2 as broad as long; temporals 2-3; midbody scale rows 20-26 ......*travancorica*
   Dorsals x 3 as broad as long; temporals 5; midbody scale rows 28-30 ....*palnica*

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ON THE SYSTEMATIC STATUS OF *GECKOELLA DECCANENSIS* (GÜNTHER, 1864) AND *G. ALBOFASCIATA* (BOULENGER, 1885) (SQUAMATA: GEKKONIDAE)

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(with eight text-figures)

ABSTRACT.– **Two nominal species of Indian geckos, *Geckoella deccanensis* and *G. albofasciata*, are similar in general appearance and have been regarded as conspecific by some recent authors. Although there are no obvious morphometric differences between the two forms, they differ consistently in dorsal scalation and in juvenile colour pattern. *Geckoella deccanensis* is characterized by large, flattened, juxtaposed dorsal scales and a series of yellow cross-bands on the body, whereas *G. albofasciata* has smaller, heterogeneous, conical dorsal scales and juveniles possess a series of white dorsal trunk bands and a single, yellow nape band. The rapid loss of life colours in preservative have contributed to the confusion over the systematic status of the two species.**

KEYWORDS.– ***Geckoella deccanensis*, *Geckoella albofasciata*, systematic status, colouration, distribution.**

INTRODUCTION

The genus (or subgenus within *Cyrtodactlyus*, fide Rösler, 2000) *Geckoella* consists of a number of distinctive terrestrial geckos with short toes that are endemic to peninsular India and Sri Lanka. Recently, a superficially similar species has been described from Myanmar (Bauer, 2002), although its affinities to *Geckoella* sensu stricto remain unclear. Little is known of the biology of the group or its relationships, and although its monophyly has not been explicitly demonstrated nor rigorously tested, the overall similarity in body form as well as geographic restriction of the group has served as the basis for the recognition of genus as a distinctive lineage of padless gekkonine geckos (Ulber and Gericke, 1988; Kluge, 1993, 2001).

Although the alpha systematic status of *Geckoella* is fairly stable, the status of two Indian species, *G. deccanensis* and *G. albofasciata*, has remained problematic. Both forms are brownish in colour and bear a series of light cross bands across the nape, body and tail. They are nocturnal forest dwellers that are terrestrial and insectivorous and are uncommonly encountered due to their secretive habits (Tikader and Sharma, 1992).

Günther (1864) described *Gymnodactylus deccanensis* on the basis of a single specimen collected "in the Deccan". Boulenger (1885) in describing *Gymnodactylus albofasciatus* distinguished it from the former species by its possession of the following suite of characters: dorsal pholidosis heterogeneous (vs. uniform large tubercles), small scales of limbs and dorsal aspect of tail intermixed with larger keeled tubercles (vs. homogeneous), one pair or enlarged postmental scales (vs. additional pairs of enlarged chin shields posterior to first post-mentals), tubercular lamellae under basal phalanx enlarged (vs. barely larger than adjacent tubercles), ventral scales enlarged, weakly keeled (vs. smaller, smooth), and base colour chestnut brown (vs. reddish-brown). Boulenger's type material originated from "South Canara" and his comparative material of *G. deccanensis* included the holotype plus a specimen from Matheran.

Annandale (1913) in his review of Indian "*Gymnodactylus*" confirmed these differences, but Hora (1926) called the distinctness of the two forms into question. He examined six additional specimens from North Canara (Castle Rock and Karmal), ostensibly referable to *G. albofasciatus*, and indicated that the chin shield and ventral scale characters were more similar to *G. deccanensis* while the dorsal tubercles and subdigital characters were as stated by Boulenger, and the ground colour was variable. On the basis of this he concluded that it was probable that additional material would prove the two forms to be conspecific, with *albofasciatus* perhaps representing a "local race". However, he did note that the two forms could be distinguished on the basis of their banding: with *G. deccanensis* having broader white bands with well-defined black margins. Hora (1926) also provided measurements for two specimens from Castle Rock.

Many subsequent authors, whether allocating the species to *Gymnodactylus*, *Cyrtodactylus* or *Geckoella*, have recognized the two forms as distinct (Smith, 1935; Wermuth, 1965; Murthy, 1985a, 1985b, 1990; Tikader

TABLE 1: Morphometric data for *Geckoella deccanensis* (* indicates regenerated tail). Coordinates provided to the nearest minute are approximate only.

BNHS Reg. No.	LOCALITY (in Maharashtra unless otherwise indicated)	SVL	TL	AG	HL	HW	HD	ED	EE	ES	ScB	ITB	IITB	SB
60	Vihar Lake, Sanjay Gandhi National Park 19° 16' 11"N; 72° 57' 35"E	77.00	66.00	33.70	23.50	15.50	9.70	4.90	7.50	8.60	2.10	3.00	3.15	3.20
61	Matheran 19° 00'N; 73° 17'E	77.60	–	31.10	24.70	15.30	8.50	5.20	7.60	9.00	2.20	3.00	3.05	3.00
62	Khandala 18° 48'N; 73° 24'E	53.40	–	24.50	17.20	11.60	6.60	3.35	5.70	6.60	1.80	2.05	2.10	–
63	Tungareshwar 19° 36'N; 73° 00'E	59.20	36.10	21.00	19.40	12.50	7.30	4.70	6.00	7.60	1.60	1.90	2.00	2.45
63-1	Tungareshwar	72.00	–	32.80	22.00	9.50	8.50	4.60	6.40	8.60	1.90	2.10	1.90	2.20
64	Khandala	54.40	54.40	21.70	17.00	11.20	6.90	4.10	5.80	7.20	1.70	1.90	2.00	2.10
65	Koyna Wildlife Sanctuary 17° 40'N; 73° 40'E	64.20	–	22.10	20.40	13.00	7.40	5.00	5.90	7.50	1.40	1.80	1.90	2.05
1188	Matheran	59.80	–	23.50	18.90	12.80	7.50	4.40	6.00	7.30	1.30	1.60	2.00	2.00
1443	Sanjay Gandhi Natl. Park 19° 16' 11"N; 72° 57' 35"E	64.70	32.50*	29.40	20.30	13.30	7.60	4.70	6.10	7.90	1.80	2.00	2.20	2.40
1547	Koyna Wildlife Sanctuary	53.30	47.30	21.50	16.00	10.30	5.40	4.00	4.60	6.70	1.50	1.30	1.20	1.50
1560	Koyna Wildlife Sanctuary	67.30	53.10	28.20	19.30	13.40	7.60	4.50	6.80	8.00	1.80	2.00	2.10	2.20
1583	Phansad Wildl. Sanctuary 18° 06' 14"N; 73° 06' 28'E	43.30	34.40	19.00	13.50	9.10	4.40	3.10	4.30	5.50	1.00	1.20	1.00	1.10

TABLE 2: Morphometric data of *Geckoella albofasciata* (* indicates regenerated tail). Coordinates provided to the nearest minute are approximate only.

BNHS Reg.No.	LOCALITY	SVL	TL	AG	HL	HW	HD	ED	EE	ES	ScB	ITB	IITB	SB
66	Castle Rock, Karnataka 15° 25'N; 74° 19'E	51.00	–	20.30	16.40	10.20	5.60	4.00	5.00	7.30	0.90	1.15	1.20	1.30
67	Castle Rock, Karnataka	53.90	–	24.10	16.80	11.70	6.40	4.50	5.60	7.20	1.30	1.50	1.45	1.55
67/1	Castle Rock, Karnataka	52.10	–	25.20	17.20	11.00	6.90	3.40	5.60	6.90	1.20	1.30	1.25	1.20
1447	Amboli, Maharashtra 15° 57' 37"N; 73° 59' 58"E	73.50	61.80*	30.70	22.50	15.00	8.70	5.50	7.00	9.30	1.60	1.55	1.20	1.20
1448	Amboli, Maharashtra	54.50	42.10	21.50	17.40	11.40	7.00	4.10	5.60	7.10	1.00	1.00	0.80	0.95
1480	Amboli, Maharashtra	76.10	–	30.00	22.10	15.30	8.90	5.10	8.10	9.10	1.60	1.50	1.60	1.80
1481	Amboli, Maharashtra	65.10	63.00	26.00	20.60	13.50	8.10	5.30	5.90	8.80	1.00	1.10	1.00	1.10
1482	Amboli, Maharashtra	75.80	–	30.10	23.10	15.10	8.90	5.50	6.70	9.50	1.50	1.50	1.60	2.00
1483	Amboli, Maharashtra	38.10	35.40	16.40	12.10	8.00	5.20	3.10	3.00	5.50	0.70	0.70	0.60	0.80
1484	Amboli, Maharashtra	38.30	–	16.30	12.10	8.00	5.00	3.30	3.20	5.10	0.70	0.80	0.60	0.50
1543	Amboli, Maharashtra	56.50	–	22.50	18.70	11.60	6.80	4.20	5.20	7.40	0.90	1.00	1.00	0.80
1544	Amboli, Maharashtra	55.30	52.20	21.40	17.30	11.50	6.80	4.30	5.70	6.70	1.20	1.10	1.20	1.10
1578	Amboli, Maharashtra	52.30	28.60*	22.10	15.50	11.10	6.90	4.20	4.30	6.80	1.10	1.20	1.00	1.00

and Sharma, 1992; Sharma, 2002). Smith (1935) used the criteria of broader subdigital lamellae and yellow (rather than white) bands to distinguish *albofasciata* (note that agreement in gender necessitates the use of the feminine form of the specific epithet when used in combination with *Geckoella*, as in the remainder of this paper). In addition, Smith (1935) appears to have introduced the spelling *dekkanensis*, incorrectly crediting it to Günther (1864). This spelling has subsequently been employed by many later authors (e.g., Daniel, 1983, 2002; Murthy, 1985b, 1990; Tikader and Sharma, 1992; Das, 1994, 1996, 1997, 2001, 2002; Das and Andrews, 1997; Sharma, 2002).

Cornelissen (1971) noted that he found both heterogeneous dorsal scales (an *albofasciata* character) and broad *deccanensis*-like bands in specimens supposedly from Bombay. On this basis, he favoured the synonymizing of the two forms, although the paper was not a taxonomic one and no formal action was taken. More recently Kluge (1991, 1993, 2001) explicitly included *albofasciata* in the synonymy of *deccanensis*, whereas this was implicit in the works of Das (1994, 1996, 1997, 2001), Das and Andrews (1997), and Rösler (2000).

Because no consensus exists among herpetologists as to the validity of *Geckoella albofasciata* as a species distinct from *G. deccanensis*, we take this opportunity to present some new data on these geckos and to present evidence bearing on their taxonomic status.

METHODS

Twelve specimens of *Geckoella deccanensis* and 13 specimens of *G. albofasciata* in the collection of the Bombay Natural History Society (BNHS) were examined (Tables 1-2). The following measurements were taken to the nearest 0.05 mm with a Mitutoyo dial caliper: snout-vent length (SVL), tail length (TL),

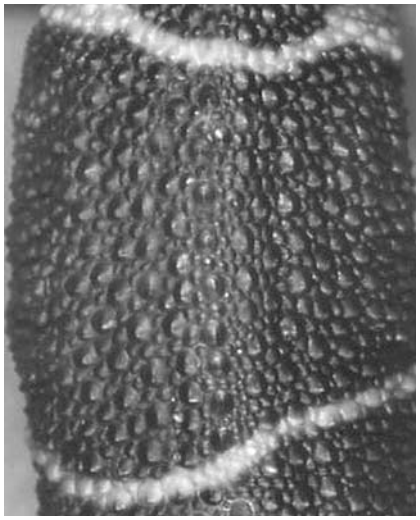

FIGURE 1: Close up of the dorsal trunk of *Geckoella albofasciata* (BNHS 1481), showing the heterogeneous scalation. Photo by A. Captain.

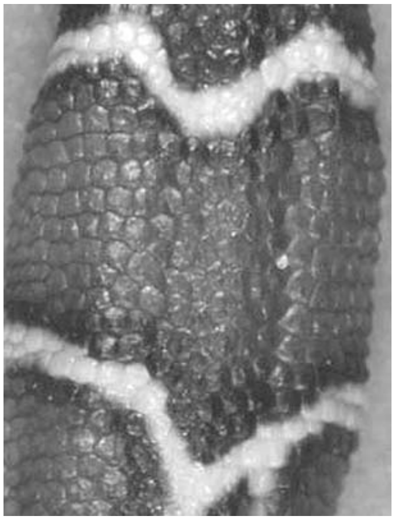

FIGURE 2: Close up of the dorsal trunk of *Geckoella deccanensis* (BNHS 1547), showing the flattened, juxtaposed scalation. Photo by A. Captain.

axilla-groin length (AG), head length (HL), head width (HW), head depth (HD), diameter of the eye (ED), distance between anterior border of eye and tip of snout (ES), and distance between posterior border of eye and anterior margin of ear opening (EE). In addition, the width of each of the four dorsal body bands was recorded: scapular band (ScB), anterior (ITB) and posterior trunk (IITB) bands, and sacral band (SB). General body scalation was also noted.

Life colouration was assessed on the basis of field observations by the junior author and on a series of photographs of live specimens of known locality.

RESULTS AND DISCUSSION

The traditional character of dorsal scale form (flattened and homogeneous in *G. deccanensis* vs. conical and heterogeneous in *G. albofasciata*) does appear to be a stable and reliable diagnostic trait. Although the degree of heterogeneity in *G. albofasciata* is variable, specimens of this species are always characterized by larger conical to keeled tubercles with much smaller interstitial scales (Fig. 1). In comparison. Those of *G. deccanensis* are always conspicuously flattened and juxtaposed (Fig. 2).

Morphometric data for specimens of *Geckoella deccanensis* and *G. albofasciata* are presented in Tables 1 and 2, respectively. The two forms have very similar body proportions and cannot be discriminated on the basis of any mensural data. This result is typical of closely related geckos in general. However, there were differences in the relative width of the body bands of the two species (Fig. 3). The body bands in our sample of *G. albofasciata* are consistently narrower than those in *G. deccanensis*, usually being one scale row in width (vs. two scale rows in *G. deccanensis*). This difference is statistically significant for all bands, both absolutely and when corrected for body size ($P < 0.0001$; Student's t-test), thus confirming Annandale's (1913) observations on band width (although relatively broad-banded *G. albofasciata* do occur, as at Amboli).

Prior to India's independence, it appears that the only author to have actually observed either species in life was Beddome (1870), who reported "*Gymnodactylus Deccanensis*" "in South Canara at Hospet (nearly sea level), and at the top of the Codachy Parwat (5,000 feet)" with "brilliant yellow" bands. That yellow bands were present in either species was unknown to museum workers due to the rapid loss of colour in preservative. Smith (1935), based on Beddome's (1870) localities, interpreted his comments to apply to *G. albofasciata*. Thus, both Smith (1935) and subsequently Tikader and Sharma (1992) and Sharma (2002) reported that yellow bands characterised this more southern species.

In fact, the characterisations made by some of these these authors are incorrect. The dorsum of *Geckoella deccanensis* is reddish-brown in life with five yellow bands on the back and six to seven bands on the tail, all of which have dark brown edges (Fig. 4). These edges are especially conspicuous in light-coloured specimens. The portion of the dorsum between scapular band and anterior trunk band, just behind the forelimbs, is often lighter than the rest of the body and the lateral aspect of the same region may even be whitish. A pair of yellow spots is present on the dorsum of the thighs, close to the tail base. The nape band is also yellow (not black as described by Tikader and Sharma, 1992). In some specimens from Phansad Wildlife Sanctuary and Sanjay Gandhi National Park, the limbs are lighter in colour than the dorsum. In addition to the dorsal bands, the supralabial scales may be yellowish and this colouration may continue posteriorly as a line, reaching about the level of the ear. The venter is whitish. The pupil is vertical with a golden iris. Juveniles of this species may display paler posterior bands, and those on the tail may be cream-coloured (Fig. 5).

The body colouration of adult *Geckoella albofasciata* is similar to that of *Geckoella deccanensis*, with yellowish bands on the trunk and tail (Fig. 6). However, these bands are often somewhat paler in *G. albofasciata* and the yellow markings on the supralabials and stripe on the side of the head are typically lacking or these markings may be whitish. Juveniles of this species, however, have white bands on the trunk and tail and only the nape band is yellow (Fig. 7). Specimens from Amboli are lighter than those from Castle Rock, but both share a yellow nape band.

The consistent scalation differences between *Geckoella deccanensis* and *G. albofasciata* and their differing juvenile colouration support their continued recognition as distinct, albeit closely related species. Although colour variation alone might well be expected to vary geographically across a widespread species, the significant differences in scalation, particularly that of the body dorsum are more typical of specifically distinct congeners.

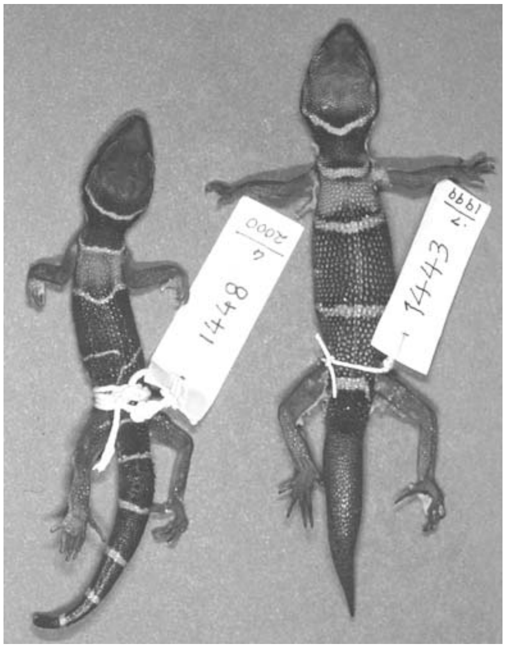

FIGURE 3: Preserved specimens of *Geckoella albofasciata* BNHS 1448 (left) and *G. deccanensis* BNHS 1443 (right) illustrating the typical difference in width of pale dorsal cross bands. Photo by A. Captain.

The specimens reported by Cornelissen (1971) with "mixed" characteristics "should" be *G. deccanensis* if they originated from near Mumbai as the author claimed. Indeed the specimens in his photograph have the broad yellow bands with dark edges that are typical of this form. However, the specimens appear to have conical scales, rather than flattened, and are thus similar to *G. albofasciata*. Given that we are aware of no cases of conical scales in true *G. deccanensis*, we suggested that Cornelissen's specimens are referable to a broad-banded population of *G. albofasciata* and that they originated from a location in extreme southern Maharashtra. As they were commercially obtained, the locality "Bombay" probably reflects the point of the animals shipment, rather than their capture.

Based on our material, as well as previously published locality data, *G. deccanensis* is a more

FIGURE 4: Adult specimen of *Geckoella deccanensis* in life, showing the typical yellow banding and head markings of this species. Near Rajmachi fort, near Lonavla, Maharashtra, India. Photo by A. Captain, J. Kadapatti and M. Deshpande.

FIGURE 5: Juvenile specimen of *Geckoella deccanensis* in life, showing the typical yellow banding, tending to cream on the tail. Koyna, Maharashtra. Photo by V. Giri and S. Kehimkar.

FIGURE 6: Adult specimen of *Geckoella albofasciata* in life, showing the typical yellow banding of this species. Note the absence of yellow pigmentation on the supralabial scales. The yellow trunk bands of this specimen are unusually wide for this species. Amboli, Maharashtra. Photo by V. Giri, S. Kehimkar and I. Agarwal.

FIGURE 7: Juvenile specimen of *Geckoella albofasciata* in life, showing the white banding of the trunk and tail. Only the nape band is yellow. Castle Rock, northern Karnataka, India. Photo by A. Captain.

northerly distributed species that is apparently endemic to western Maharashtra, occurring from at least Tungareshwar in the north to Koyna in the south (Fig. 8). In addition to those localities represented by material reported in Table 1, we are aware of the occurrence of this species at Bhimashankar Wildlife Santuary (19° 07' 56"N; 73° 33' 17"E), Karnala Wildlife Sanctuary (18° 53' 10"N; 73° 09' 40"E), and Panchgani (17° 54'N 73° 48'E). It is possible that *G. deccanensis* extends north of the Maharashtra border into extreme southern Gujarat at the northern extent of the Western Ghats, but it has not yet been recorded from this state (Gayen 1999; Sharma 2000; Vyas 2000). *Geckoella albofasciata* extends from at least as far north as Amboli, Maharashtra (this paper) and Godachi, Karnataka (Beddome, 1870), both near 16° north latitude. Southwards it continues through Goa (e.g., Bhagwan Mahavir Sanctuary, 15° 19' 48"N; 74° 00' 00"E; Mollem, 15° 21' 35"N; 74° 16' 48"E) and into northern Karnataka as far south as at least Karwar (14° 48'N; 74° 08'E) and as far inland as Hospet (15° 16'N; 76° 24'E) (Beddome, 1870; Sharma, 2002) (Fig. 8). The two forms are not known to occur in sympatry but it is likely that the ranges of the two taxa do approach one another (perhaps in the Kolhapur district) and that they are sister species formed as a result of allopatric speciation. Sharma (2002) provided a shaded map showing the basic distribution of the two species which indicated that the boundary between them is roughly coincident with the Maharashtra-Goa border, corresponding well with the localities we identified. He illustrated the southern boundary of *G. albofasciata* as occurring in southern Karnataka. While this may be the case, we did not examine any specimens or locate any literature records from south of Karwar. Although many reptile

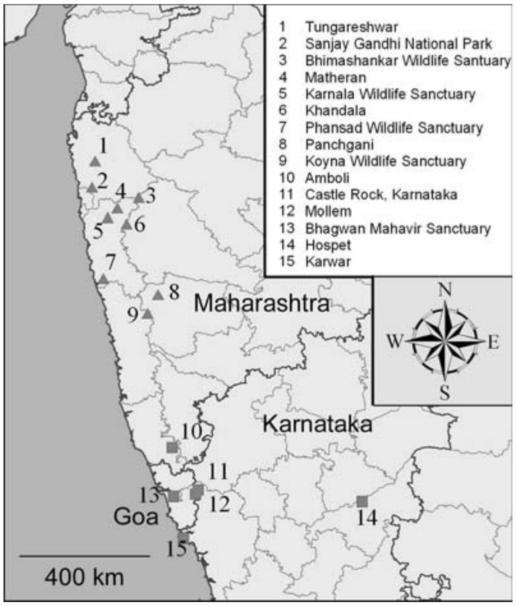

FIGURE 8: Distribution of *Geckoella deccanensis* (triangles) and *G. albofasciata* (squares) based on specimens examined and literature records.

taxa are endemic to the Western Ghats (Das, 1996) none are known to have distributions strictly coincident with the *G. deccanensis/albofasciata* species pair. This, however, may be an artifact of limited collecting of these cryptic, nocturnal species. Additional field work will be necessary to ascertain the actual northern and southern limits of distribution of both species and to verify if a zone of sympatry or parapatry exists in southern Maharashtra and if the range of *G. albofasciata* actually does extend into southern Karnataka. Molecular studies may also suggest the approximate age of the cladogenetic event that resulted in the separation of these two gecko species.

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We are thankful to J. C. Daniel, Honorary Secretary, Naresh Chaturvedi, Curator and Asad R. Rahmani, Director, all of the Bombay Natural History Society, for permission to carry out this study. Sameer Kehimkar, Vithoba Hegde and Vinod Patil assisted in the fieldwork and G. Maheshwaran helped in the statistical analysis. We are thankful to Ashok Captain for his suggestions and for photographing the specimens, to Isaac Kehimkar, Kedar Bhide and Ishan Agarwal, who kindly provided photographs of *Geckoella deccanensis* from their collections, and to Gopi Naidu for his assistance. The map was prepared by Shyam Davande, to whom we are grateful. VG is thankful to Satyajeet Mane, Ashwini Mane, Vrushali Nikam and Harshal Nikam for their kind support and encouragement. L. Lee Grismer provided helpful comments on the manuscript.

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A NEW TOAD OF THE GENUS *ANSONIA* (AMPHIBIA, ANURA, BUFONIDAE) FROM SUMATRA, INDONESIA

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(with two text figures)

ABSTRACT.– *Ansonia glandulosa* is described as a new species, and represents a new record of the genus from the island of Sumatra. *A. glandulosa* is a large species, diagnosed in having enlarged rounded tubercles arranged in pairs of rows extending from snout through the interorbital space to the rear end of head and another pairs extending from the scapular area curving through dorsolateral area and ending at the sacrum. The dorsal skin is covered with rounded tubercles. The finger tips are not expanded. The occurrence of this genus in the flat area in eastern Sumatra and not along the Barisan mountains ridge raises the possibility that *Ansonia* is a late invader, arriving around the Pleistocene, crossing the Bangka-Belitung Karimata land bridge to reach Sumatra.

KEY WORDS.– Amphibia, Bufonidae, *Ansonia glandulosa*, new species, biogeography, Sumatra, Indonesia.

SARI.– Kodok *Ansonia glandulosa* dipertelakan di bawah ini sebagai jenis baru berasal dari daerah Sumatra Selatan, dan merupakan catatan baru untuk marga ini di pulau Sumatera. Jenis ini merupakan anggota yang berukuran relatif besar. Ia dapat dengan mudah dibedakan dari kerabat dekatnya dengan memperhatikan adanya sepasang alur kulit berkelenjar yang terbentang dari ujung moncong hingga ke bagian belakang kepala. Sepasang alur kulit berkelenjar lainnya terbentang dari daerah belikat dan melebar ke daerah sisi atas badan dan berakhir di daerah pinggul. Kulit punggungnya berbintil membulat dan ujung jari tangannya tidak melebar. Keberadaan marga ini di daerah hutan dataran rendah di sebelah Timur Sumatera dan tidak pada Pegunungan Bukit Barisan mengisyaratkan bahwa marga *Ansonia* tiba di Sumatera melalui jalur Bangka Belitung Karimata dari Kalimantan pada zaman Pleistosen.

KATA KUNCI.– Amphibia, Bufonidae, *Ansonia glandulosa*, jenis baru, biogeografi, Sumatera, Indonesia.

INTRODUCTION

Sumatra is a large Sundaic Island which has not been explored intensively since the work of van Kampen (1923). However, the records of Iskandar and Colijn (2000) increased the size of the known fauna of the island by 50%, and about 102 species have been recorded from Sumatra, some of which await formal description (Inger and Voris, 2001). A considerable number of genera that have been recorded from the Malay Peninsula and Borneo, have not yet been reported from Sumatra.

In 1998, we received a single example of a bufonid with relatively slender limbs from southern Sumatra for identification. Upon dissection, it was found to be an adult male. It additionally shows no parotoid gland, characteristic of the genus *Bufo* and subarticular tubercles at the base of each toe not enlarged, as is characteristic of members of the genus *Leptophryne*, leading us to place it in the genus *Ansonia*. Unfortunately, as it is represented by a single specimen, we are reluctant to dissect its skull to examine the quadratojugal and parasphenoid bone in order to confirm its generic position. The genus itself is widely distributed in south and south-east Asia, the greatest diversity being in Borneo and the Malay Peninsula, the genus being unrepresented in other Sundaic regions (Inger, 1960; Frost, 1985; Inger and Stuebing, 1997; Iskandar and Colijn, 2000). This specimen represents the first record of the genus from Sumatra. The Sumatran *Ansonia* representative is a large species, believed to be closely related to species known from Borneo such as *A. anotis, A. fuliginea, A. leptopus, A. longidigita, A. torrentis* and *A. spinulifer* or to species known from Peninsular Malaysia such as *A. penangensis*. Although morphologically close to *A. leptopus* and *A. longidigita*, the presence of a continuous pair of glandular ridges between the eyes, combined with a similar one along the sides are not recorded in any species of the genus, supports our conclusion that this specimen represents an undescribed species.

Measurements that follow Inger et al. (2001), include SVL = snout-vent length; UA = Upper arm length; LA = lower arm length; Palm = length of proximal edge of outer palmar tubercle to tip of third finger; Fe = Femoral length; TIB = Tibial length; TAR = Tarsal length; Foot = length of proximal edge of inner metatarsal to tip of fourth toe; HL = Head length; HW = Head width; SNL = Snout length; EN = Eye to nostril distance; NT= Nostril to tip of snout: IO = Interorbital distance: EYE = Eye diameter and TYM = Tympanum diameter.

Materials referred in this study are housed in Muzium Zoologicum Bogoriense, Research and Development Center for Biology, Indonesian Institute of Sciences, Cibinong (MZB).

SYSTEMATICS

ANSONIA GLANDULOSA NEW SPECIES (FIG. 1)

Holotype.- MZB Amph. 4239, an adult male from Napal Licin, Kabupaten (= District) Musi Rawas, South Sumatra (02°43'S; 102°22'E) by Andiek and Adjat, 23-IX-1998.

Etymology.- Specific name from *glandula* (L.) noun in apposition meaning gland, referring to the glandular ridges at the interorbital and head region as well as the paired rows of glandular ridges on the body.

Diagnosis.- *Ansonia glandulosa* is distinguished from congeneric species in having a pair of rows of interorbital, rounded tubercles extending to tip of snout from occiput and another glandular ridge beginning at the scapular region passing along the sides of the body, fourth toe webbed at base, three phalanges free of webbing, fifth toe webbed at base, tympanum exposed. A light spot is present between the scapulae.

Description.- A medium or large sized species of *Ansonia*, male SVL 39.67 mm, females unknown but presumably larger, habitus slender, head about as wide as long, tympanum small, oval in diameter, eye moderate, slightly smaller than snout length, snout triangular, canthus rostralis distinct, nostril much closer to tip of snout than to eye, lower jaws not extending to tip of snout. Fingers slender and smooth, tips rounded, not expanded and much narrower than tympanum diameter, first finger longer than eye diameter, about as long as second, third longest, fourth finger longer than second, subarticular tubercles barely distinct. A pair of rows of rounded tubercles extending from occiput, passing interorbital area to tip of snout.

Toes webbed at the base, reaching base of disk of first two, third toe with one phalange free of extensive webbing, fifth toe with one and a half phalanges free of web, fourth toe with three phalanges free of extensive webbing, subarticular tubercles obscure, tarsal tubercles small, indistinct, no tarsal ridge. All meristic measurements of the holotype are in Table 1.

Skin above covered with rounded tubercles, no parotoids, a pair of large rounded tubercles extending from occiput to tip of snout, ventral surfaces coarsely granular. Along the body, a pair of rows of rounded tubercles, extending behind the interorbital tubercle rows, from behind head, passing through the scapular region along the dorsolateral margin and ending in the sacral area, not continuing to inguinal region.

Secondary sex characteristics: There is a series of black tubercles beneath the lower jaw, but no distinct spines. The specimen has a subgular vocal sac with one long slit-like opening, located on the left side of the mouth, nuptial pad is a mass of small dark brown spines on the dorsomedial surface of the first finger basal phalange. The left testis is elongated, measuring ca. 7 mm.

COMPARISONS

Among all known *Ansonia* species, there are six large ones from Borneo and the Malay Peninsula that share the general habitus of the new species, and most have a light spot between the scapula, suggesting a close relationship. These are: *A. leptopus, A. fuliginea, A. longidigita, A. spinulifer A. torrentis* and *A. anotis.* Other species are smaller, hence cannot be confused with the new Sumatran species. *A. glandulosa* differs from *A. leptopus* by having only the fifth toe basally webbed. *A. leptopus* has no rows of tubercles between the eyes. *A. longidigita* is similar to *A. glandulosa* in having a pair ridges of skin covered with larger tubercles between the eyes, but such ridges are continuous in *A. glandulosa*, and broken into separate tubercles in *A. longidigita*. In addition, *A. longidigita* has no glandular rows of enlarged tubercles along the sides of the body, and its skin has small pointed tubercles instead of rounded tubercles. *A. glandulosa* and *A. spinulifer* share the light scapular spot, however *A. spinulifer* is distinct in having a large number of large spiny and conical tubercles on the back, but tubercles are relatively smaller, flattened and rounded in *A. glandulosa*. *A. fuliginea* is about the same size of *A. glandulosa*. This species is considered as distinct in the absence of interorbital rows of tubercles. *A. glandulosa* also shares the light scapular spot with the foregoing species, but differs from *A. torrentis* by having a single pair row of tubercles between eyes and from the glandular ridge at the body margins. Another, the sixth large species has been described recently, *A. anotis* by Inger et al. (2001). Judging from the hidden tympanum and the expanded finger tips, it is clearly distinct from *A. glandulosa*. *A. glandulosa* has a pair rows of tubercles between eyes, a feature lacking in *A. penangensis*. Although *A. glandulosa* has similarly dark coloured venter with white spots as in *A. penangensis*, by having first finger as long as second separates *A. glandulosa*. In addition, *A. penangensis* is much smaller and has a weak tarsal ridge, a characteristic that is absent in *A. glandulosa*. *A. malayana* is a smaller species and lack glandular ridges on flanks and also have a short first finger. *A. tiomanica* is also a smaller species, with black colouration and shows a number of tubercles and spines under the lower jaw and a short first finger. Dring (1979) reported two *Ansonia* specimens from Terengganu to an as yet undescribed species, related to *A. leptopus,* but later included them in that species (Inger and Dring, 1988). This form differs from *A. glandulosa* in having a single row of keratinized tubercles under the mandible and by the presence of rows of tubercles between the eyes and along the sides of the body. *A. siamensis* and *A. inthanon* are two species from Thailand (Kiew, 1984; Matsui et al., 1998). Both attain smaller size as adults, so that no confusions could originate. Based on morphological similarities, we believe that *A. glandulosa* is most closely related to *A. leptopus*. Differences between the closely related large *Ansonia* species are summarized in Table 2.

BIOGEOGRAPHY

The number of amphibian genera that have not been found earlier in Sumatra although well represented in Borneo and Peninsular Malaysia, is growing. At one point, we believed that their absence was due only partially to inadequate sampling, but mainly to natural causes such as volcanism and to the time of separation of the Sunda Shelf into distinct islands related to the ability of frogs to disperse among land masses.

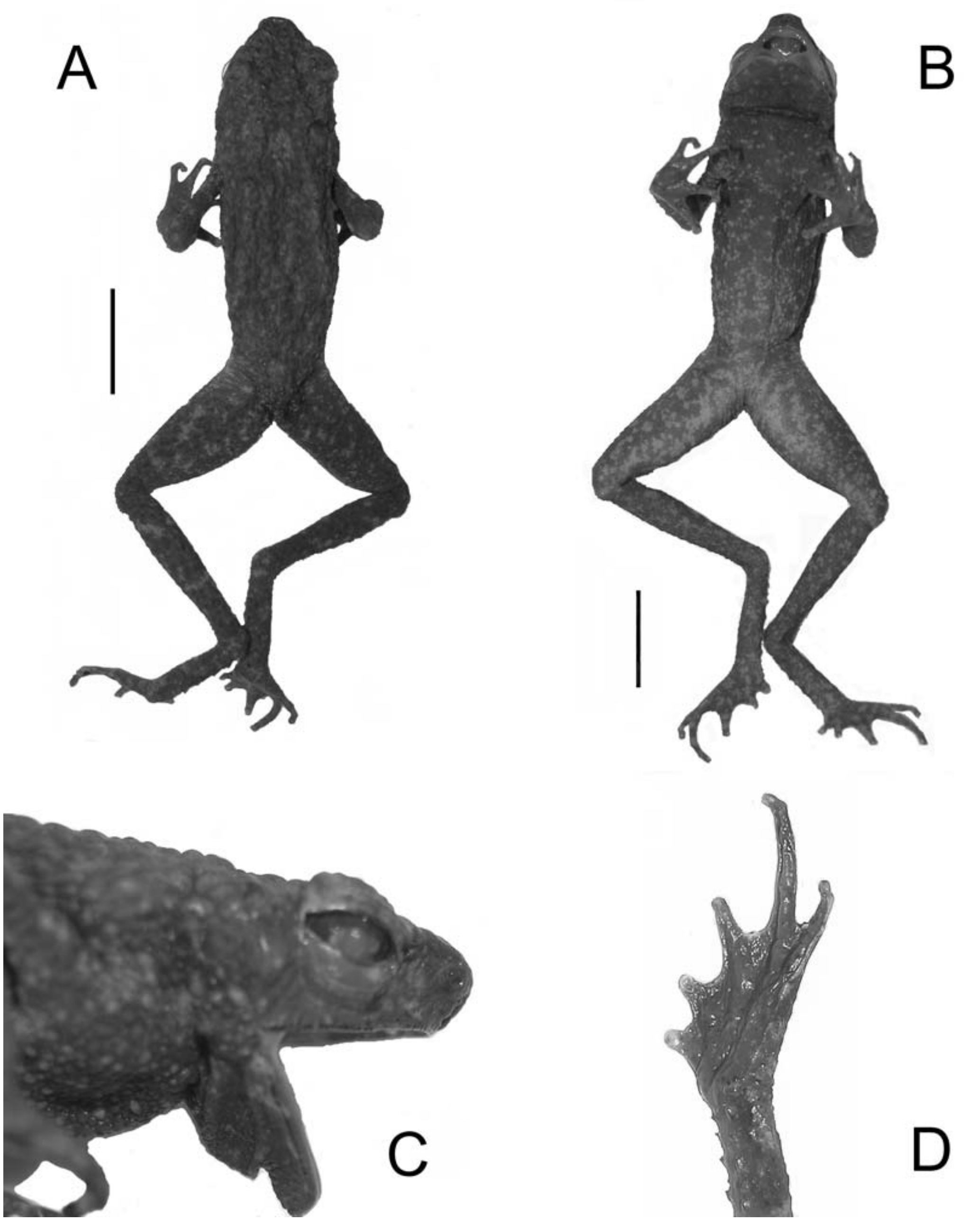

FIGURE 1: The holotype of *Ansonia glandulosa* n. sp. (MZB Amph. 4239). A. dorsal view; B. ventral view. C = lateral view of the head. D = Left foot. Bars = 10 mm.

We believe that Borneo is most probably the source for the Sumatran *Ansonia*, because the Sumatran species appears to be more likely closely related to *Ansonia* of the Bornean component than to the species of the Malay Peninsula. This suggestion is based on the assumption that Borneo is the main centre of *Ansonia* and most lowland species that supposed to be closely related to *A. glandulosa* occurs in Borneo. As the Sunda Shelf is geologically dynamic, land bridges among the several land masses developed several times during the Miocene-Pleisto-

TABLE 1: The morphometric measurement of the holotype (mm) of *Ansonia glandulosa* n. sp. (MZB Amph. 4239).

SVL	39.67	SNL	4.87
HL	11.56	EN	2.95
HW	11.24	NT	0.82
FE	17.18	IO	4.56
TIB	20.16	EYE	4.08
TAR	12.51	TYM	1.83
Foot	14.02	UA	10.86
Palm	11.12	LA	11.21

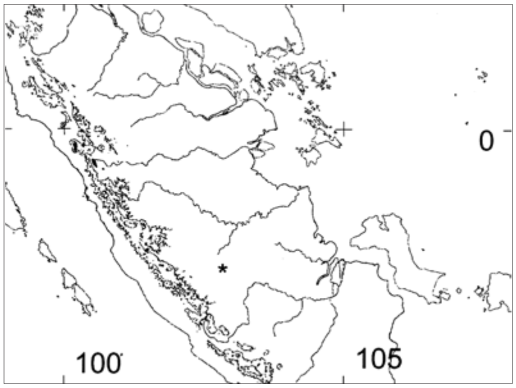

FIGURE 2: The approximate type locality of *Ansonia glandulosa* in Sumatra, indicated by a star.

cene, and for several genera, this provided opportunities to reach Sumatra. This land bridge existed during the Pliocene, ca. 2.3-1.5 million years b.p. (Satir fauna). During this period, the land bridge area is assumed to have been covered with forests, as no land mammals adapted to arid conditions reached Java (Zhi et al., 1996). During this period, it is postulated that orang utans (*Pongo*) could pass the land bridge to Borneo or vice versa to Sumatra and eventually reached Java (Medway, 1972).

The other land bridge stage occurred ca. 1.5-1.2 million years b.p. (Ci-Saat period, Pleistocene) (Voris, 2000). During this period, the vegetation was diverse, mosaic of forest, scrubland and possibly savanna (Heaney, 1991; van den Bergh et al., 1996; Meijard, 2000, pers. comm.). This forest type along the land bridge provide suitable habitat for *Ansonia* to reach Sumatra.

Voris (2000) indicated that during the last 250.000 years b.p., there was a long period when the sea level was as low as 120 to 40 m below the present level, allowing fauna to traverse these land bridges. A distinct land bridge occurred ca. 190-135.000 years b.p. (Meijard, 2000, pers. comm.). However during this period, apparently the land bridge area consisted of pine-grassland savanna and open woodland fauna which resulted in the extinction of the Ngandong fauna, indicating dry conditions (Heaney, 1991; van den Bergh et al., 1996). This condition seems unsuitable for amphibians to pass the land bridge.

More recent land bridges occurred between Sumatra and the Malay Peninsula. Although *A. glandulosa* is superficially most closely related to *A. leptopus*, a species also known from Malay Peninsula, we exclude that option, because we believed that during the last 250 years b.p., the climatic condition was relatively dry (Heaney, 1991; van den Bergh, 1996). If the Malay Peninsula is the main source for the Sumatran *Ansonia*, we expect the genus to be more widely distributed in Sumatra and the species should be found further north at least in the Riau Province and for sure in the North Sumatra Province as well (see Fig. 2).

The invasion of *Ansonia* in Sumatra is speculated to have happened as a later invasion that used the Bangka-Belitung-Karimata land bridge. This contrasts with three other bufonid genera, *Leptophryne*, *Pelophryne* and *Pedostibes*, which, though represented in Sumatra by a single species each, have known, wide distributions in this island. We suggest that these genera occurred in Sumatra much earlier in geologic time. Our preliminary hypothesis that *Ansonia* reached Sumatra from Borneo by a relatively recent land bridge needs to be tested by exploring the area of the land bridge for further evidences, using morphological or molecular characters.

The material that forms the holotype of *Ansonia glandulosa* was sent by non-herpetologist collectors from Napal Licin, Musi Rawas District, northern South Sumatra Province and near the southern border of Jambi Province, and was collected during a short-term expedition for bird study (Fig. 2). It is an area that has never

TABLE 2: Comparative diagnostic characteristics of seven large *Ansonia* species. Abbreviations: + = present; - = absent. Measurements in mm.

Species	Spines under chin	Nuptial pads	Tubercles between eyes	Light spot between scapula	4^{th} toe phalanx free of wide webbing	Dorsal skin tubercles	Ventrum colouration	Altitudinal distribution	SVL (males)	SVL (females)
anotis	-	-	-	-	2	small	cream	lowlands to midhills	37	52
fuliginea	2-3 rows	black	-	+	2	small	cream	highlands	35	39-42
glandulosa	1 row	dark brown	continuous	weak	3	rounded	grey-brown with light spots	lowlands	40	-
leptopus	2-3 rows	dark brown	-	-	2	rounded	yellowish-brown	lowlands	30-40	45-65
longidigita	3-6 rows	yellow	broken	weak	1-2	pointed	yellowish-brown	lowlands to midhills	35-50	45-70
spinulifer	3 rows	dark brown	-	+	2	enlarged	black with cream spots	lowlands	35-40	40-45
torrentis	1-3 rows	-	-	-	> 2	rounded	grey-brown with light spots	highlands	30-33	-

a lowland tropical rainforest and influenced by regular flooding during the rainy season. According to the collector, the specimen was collected from near a small stream and only observed during wet season along small streams. J. Holden (Flora Fauna Indonesia, pers. comm., 2000) informed the first author that he has seen a small toad, presumably of the genus *Ansonia* in Sipurak, Mt Kerinci (around 400 m asl.) It is possibly similar to the new species, but voucher specimens are needed, because members of the genus *Ansonia* can be confused with *Leptophryne*. Another convincing record based on a picture, has been transmitted recently from Telentam, Bangko, Jambi Province (Mistar, pers. comm., 2003) reenforced our previous conclusion that the species should be present close to the Bangka Belitung Karimata land bridge.

Unfortunately, this material was not made as a formal museum collection, and only six specimens, including the holotype of this new species, were sent to us for identification. Except for this new species, they represent undescribed material of the families Ranidae and Megophryidae and will be dealt with elsewhere.

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STUDIES ON PAKISTAN LIZARDS: OBSERVATIONS ON THE SCINCID LIZARD *MABUYA DISSIMILIS* (HALLOWELL, 1860) WITH COMMENTS ON TWO OTHER SPECIES IN THE GENUS

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(with three text-figures)

ABSTRACT.– **Specimens of *Mabuya* in the University of Florida's herpetological collections from Pakistan were examined. *M. carinata* (n = 1) from the extreme south-eastern part of the country is the first record of the species for Pakistan. *M. dissimilis* (n = 45) has: a positive correlation between the number of maxillary teeth and head length; paravertebral scales and snout-vent length relative to head length significantly greater in females than in males; snout-vent length in positive allometry with head length; gravid females with snout-vent length 74.5-95 mm (mean = 84.0 mm) and 3-8 (mean = 5.9) oviducal eggs, and female reproductive activity extending from late summer until early winter, i.e., roughly the first half of the dry season. *M. macularia* (n = 3) probably hatches during the end of summer or very early autumn, i.e., the end of the wet season and the number of keels on the individual body scales probably increase with size.**

KEY WORDS.– **Lizards, *Mabuya*, Pakistan, Scincidae, skinks.**

INTRODUCTION

The herpetological collections at the Florida Museum of Natural History, University of Florida (UF) contain a large amount of material from Pakistan collected primarily by S. R. Telford, Jr. in the mid-1970s and by W. Auffenberg and the Zoological Survey of Pakistan from the mid-1980s to mid-1990s. This material has never been fully examined, and it is our intention to review it for important taxonomic and ecological features. Here we report the results of our examination of three species of *Mabuya*. The most well-represented species is *M. dissimilis* (Hallowell, 1860) (n = 45) and it forms the bulk of our report. This species occurs from West Bengal, westward across the northern plains of India, and into eastern Afghanistan (Smith, 1935; Minton, 1966; Clark et al., 1969; Mertens, 1969; Sahi and Duda, 1989; Khan, 2002). Although it has been recorded from several localities in central and northern Punjab Province (Smith, 1935), *M. dissimilis* was not encountered there during these recent surveys and we did not examine the previously collected material. It is apparently relatively common in Pakistan in moist grassy areas and scrub land at low elevations up to about 1000 m above sea level. Of the other two species, *M. macularia* (Blyth, 1853) is known from much of mainland south-east Asia, throughout Sri Lanka and peninsular India, and west to lower Sindh Province, Pakistan (Smith, 1935; Minton, 1966; Mertens, 1969; Khan, 2002). Although it is apparently common in grassy lowland habitats in the portion of Pakistan where it occurs (Minton, 1966), the species is represented by only three specimens in these collections. *M. carinata* (Schneider, 1801) occurs throughout much of the Indian peninsula and Sri Lanka (Smith, 1935). This species is a new record for Pakistan and is represented herein by one specimen.

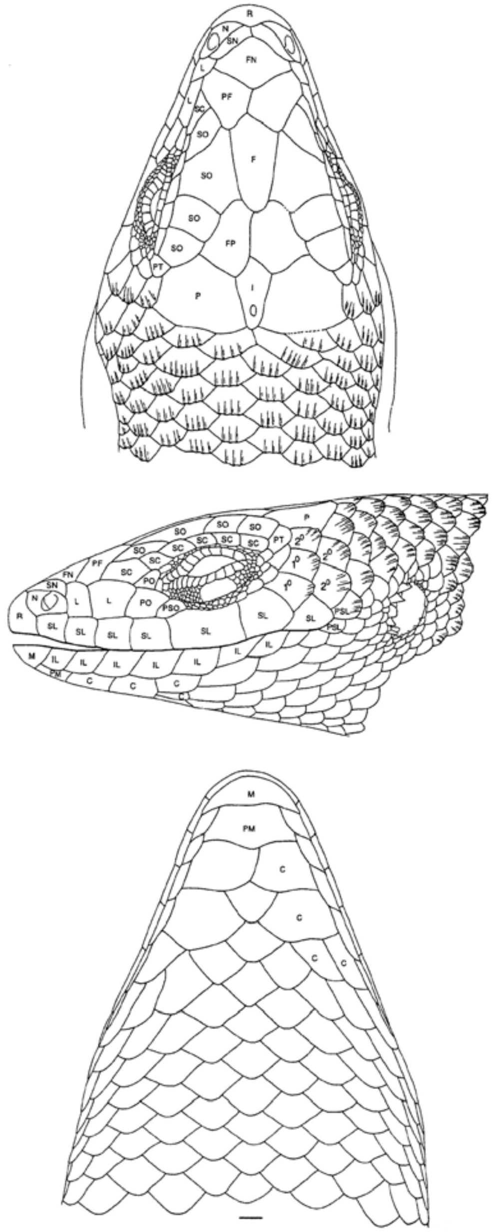

FIGURE 1: The head of *Mabuya dissimilis* (UF 72795) with the taxonomically important head scales labeled. Abbreviations are as follows: c - chin scale; f - frontal; fp - frontoparietal; i - interparietal; il - infralabial; l - loreal; m - mental; n - nasal; p - parietal; pf - prefrontal; po - preocular; psl - postsupralabial; pso - presubocular; pt - pretemporal; r - rostral; sc - supraciliary; sl - supralabial; sn - supranasal; so - supraocular; 1º - primary temporal; 2º - secondary temporal; fn - frontonasal; pm - postmental. Illustration: H. Finlay.

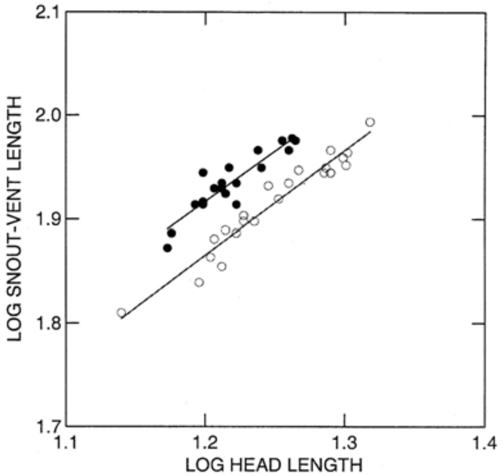

FIGURE 2: Scatter plot of log snout-vent length on log head length for male (open circles) and female (dots) *Mabuya dissimilis*, showing the relatively larger snout-vent length of females.

FIGURE 3: Map of Pakistan showing the localities of the specimens of the three species of *Mabuya* examined in this work: *M. dissimilis* = black dot; *M. macularia* = circle; *M. carinata* = black square.

MATERIALS AND METHODS

Snout-vent length was measured to the nearest 0.5 mm by pressing the ventral surface of the specimen to a steel ruler. Head length was measured to the nearest 0.1 mm by applying digital calipers to the distance between the tip of the snout and the centre of the external ear opening.

Most head scales can be identified by reference to Fig. 1. The nuchals, which are not typical of the species, are defined as the single very wide scale on each side of the dorsal midline just posterior to the parietals and extending laterally to the upper tertiary temporal.

Paravertebral scales were counted in one row starting with the first paravertebral falling posterior to an imaginary line connecting the posterior surfaces of the rear legs (held normal to the body) forward to and including the anteriormost nuchal.

Midline characters and single sides of a bilateral character are reported as "n"; both sides of a bilateral character are reported as cases.

Polarity of characters was determined by reference to the subgenus *Pariocela* of the genus *Eumeces*. This outgroup seems reasonable for the following reason. *Mabuya* is a relatively primitive lygosomine and the relationships of the lygosomines to non-lygosomines are unclear. Under these circumstances the most generally primitive non-lygosomine is the taxon with the least ambiguous relationship to *Mabuya*. That taxon is *Pariocela*. A recent molecular analysis indicated that *Mabuya dissimilis* was the sister group of *Apterygodon*-*Dasia* (Mausfeld and Schmitz, 2003). However, this relationship was deemed "probably misleading" by the authors themselves and hence is not used here to make inferences about character polarity.

The recent generic subdivsion of *Mabuya* based on molecular evidence (Mausfeld and Schmitz, 2003) is not used here for three reasons. First, it is not clear that *Mabuya* is paraphyletic, which would indeed compel a review of the generic concept of *Mabuya* were it true. In the preferred tree, the two non-*Mabuya* genera (*Apterygodon* and *Dasia* along with *Mabuya dissimilis* - see above) that nest within *Mabuya* in some trees actually form an unresolved trichotomy with the two other *Mabuya* groups (Mausfeld and Schmitz, 2003: fig. 2). Second, the depth of genetic divergence is not a particularly compelling basis on which to base supraspecific categories. A combination of distinctive morphology and ecology seems more useful. And third, the branching points in the molecular trees seem highly susceptible both to method of analysis and to species content. In the latter regard, phylograms using only 26 (23 percent) out of the approximately 113 species have been presented. There is no doubt that molecular analysis is revealing important insights into the relationships within *Mabuya*, but it seems premature at this time to change the generic taxonomy of the group.

All statistical analysis was done with Systat Version 9. Tests are indicated in the text. The level of significance was 0.05. Logarithms are base 10.

RESULTS

Mabuya dissimilis

Morphology.- Some of the characters that are of taxonomic significance in *Mabuya* that are not already well established are summarised below for the species.

Snout-vent 37-98.5 mm (n = 44), although most of the specimens are large; only one measures less than 64.5 mm SVL.

Supranasals in contact on the midline (n = 45); prefrontals in contact on midline (n = 45); most posterior supraocular contacted by frontal, second (n = 45); parietals usually separated posterior to interparietal (n = 39) occasionally in contact (n = 4) and rarely in four point contact with interparietal and a nuchal (n = 1); nuchals usually none (n = 28) but occasionally one on one side and none on other (n = 10), or one on each side (n = 5); supraciliaries usually six (n = 43) or rarely five (n = 2), the latter number achieved by the fusion of supraciliaries 1 and 2 in one specimen and supraciliaries 2 and 3 in the other; upper palpebrals and supraciliaries separated by a field of smaller scales; pretemporals contacted by parietal usually one (79 cases) or two (10 cases); primary temporals usually two (n = 44) or rarely one (n = 1); secondary temporals separated by usually one tertiary temporal (n = 44) or rarely two (n = 1) (the 2S configuration of Greer and Broadley, 2000); upper secondary temporal overlaps parietal (n = 45); supralabials usually seven (n = 43) but rarely eight (n = 2).

Number of longitudinal scale rows at midbody 32-38 (mean = 35.1, n = 44); number of subdigital lamellae 12-17 on fourth digit of pes (mean = 14.8, n = 45).

Osteology.- The number of premaxillary teeth is usually nine (n = 10) but occasionally eight (n = 1). The number of maxillary teeth ranges 21-28 (mean = 24.6, n = 28). There is a significant positive correlation between the number of maxillary teeth and head length ($r = 0.77$, $P < 0.0001$, $n = 28$).

A distinct postorbital bone is evident on the damaged side of one specimen (UF 70896).

The number of presacral vertebrae ranges 25-27 (mean of 26.0, n = 42). The specimen with the most complete tail has 54 postsacral vertebrae. The phalangeal formula for the manus/pes is 2.3.4.5.3/2.3.4.5.4.

Colour in preservative.- Tongue dark grey distally, pale proximally; parietal peritoneum streaked with pale grey (not appreciably dark).

Sexual dimorphism.- There is no sexual dimorphism in snout-vent length (Mann Whitney = 185, P = 0.27, n = 22 males and 21 females), longitudinal scale rows at midbody (Mann Whitney = 179, P = 0.19, n = 22, 21) or subdigital lamellae (Mann Whitney = 259, P = 0.66, n = 23, 21). However, in terms of the number or paravertebral scales, females have significantly more scales than males (range and mean: 48-60, 50.9 vs 46-53, 48.7, respectively; Mann Whitney = 121, $P < 0.02$, n = 21, 22).

Snout-vent length relative to head length is larger in females (n = 20) than in males (n = 22) (F for residuals = 1.04, $P > 0.25$; F for slopes = 0.12, P = 0.73; F for elevations = 166.6, $P < 0.0002$ for log transformed data) (Fig. 2).

Allometry.- Snout-vent length is in isometry with head length in both males and females. The relevant equation for males is: log snout-vent length = 1.01 log head length + 0.65 (95 percent confidence interval for slope = 0.12, $r^2 = 0.94$, $P < 0.001$, n = 22) and for females: log snout-vent length = 0.97 log head length + 0.75 (95 percent confidence interval for slope = 0.20, $r^2 = 0.83$, $P < 0.001$, n = 20) (Fig. 2).

Reproduction.- Specimens in the collection contain leathery shelled eggs, confirming that the species is oviparous (Smith, 1935; Minton, 1966; Sahi and Duda, 1986). Twelve females with large yolking follicles or oviducal eggs measure 74.5-95 mm (mean = 84.0 mm) in snout-vent length and contain 3-8 (mean = 5.9) follicles or eggs. There is no significant correlation between female snout-vent length and clutch size ($r^2 = 0.006$, P = 0.81, n = 10).

The four females with large ovarian follicles were collected on 15 September, 30 November, 20 December and 12 January. The six females with oviducal eggs and collection dates were collected on 17 October (n = 2), 19 November (n = 1), 30 November (n = 1) and "November" (n = 2). Minton (1966) found that females collected in early November contained "large eggs".

These data suggest that females, at least, are reproductively active from late summer through until early winter (12 January female with ovarian follicles). This period coincides roughly with the first half of the dry season.

Mabuya carinata

The single specimen (UF 88370) is an immature male measuring 58 mm in snout-vent length. The parietal peritoneum is pale.

This specimen represents the first record of the species for Pakistan. This largely Indian species is generally not known in the north-western part of the country, that is, west of a line drawn between Kathiawar and western Nepal, according to Smith (1935). The Pakistan locality is in an area of isolated hills in the extreme south-eastern part of the country some 200 km NW of Smith's imaginary line. According to the UF database, the specimen was apparently collected in "slaty cliffs 10-15 ft high, provided with scattered herbs & small grass tufts".

Mabuya macularia

There are three specimens, two very small and one large. The smallest specimen (UF 70900) measures 16.5 mm in snout-vent length. To judge from its small size, everted hemipenes and torn umbilical cord, it is a near-term embryo. The second smallest specimen (UF 70899) measures 22 mm in snout-vent length, and to judge from its small size and just evident umbilical scar, it is a hatchling probably less than a week old. Both these specimens were collected in September, suggesting that hatching occurs during the end of summer or very early autumn, that is, the end of the wet season. Minton (1966) reports that females "heavy with eggs" were collected from

July to September and that immature specimens were seen from late June to early October. The largest specimen (UF 70917) measures 59 mm snout-vent length and is a mature male to judge by its large testes.

The two smallest specimens have no more than three keels per dorsal body scale whereas the largest specimen has a mode of seven keels per scale. This indicates that the number of keels may increase with size.

The parietal peritoneum in the largest specimen, the only one examined, is pale.

DISCUSSION

Mabuya dissimilis has a number of derived characteristics within its genus. These include: postnasal absent; lower eyelid with transparent spectacle; pretemporals contacted by parietal modally one; primary temporals two; secondary temporals separated by an intervening tertiary temporal; upper secondary temporal overlaps parietal; nuchals usually absent, and digits of the pes relatively short (reflected in the relatively low number of subdigital lamellae). These features should be useful in inferring the nearest relatives of the species. However, in our survey of *Mabuya* to date, this combination of derived characters is unique. Hence, the nearest relative of *M. dissimilis* will presumably show only a subset of these features.

The significant positive correlation between head length and the number of maxillary teeth in *Mabuya dissimilis* is not surprising, given the fact that new teeth can be seen erupting at the open, posterior end of the maxillary tooth row. A similar positive relationship has been found in the only other skink species examined for this character to date, *Ctenotus essingtoni* (Greer, 1991).

The pale parietal peritoneum (lining of the body cavity) of all three species of *Mabuya* examined here is surprising as, like all other *Mabuya*, they are active during the day in relatively open habitats (e.g., Minton, 1966). Most skinks active in the open sun have a very dark peritoneum, presumably to protect them from UV radiation. The pale peritoneum in this species would suggest that the species may have some other compensating UV screen elsewhere, most likely in the dermis. The parietal peritoneum is dark in certain other species of *Mabuya*, e.g., those on Madagascar (Andreone and Greer, 2002). Interestingly, a pale parietal peritoneum is a feature of *Eumeces* (Hunsaker and Johnson, 1959), which suggests that such a peritoneum may be a primitive character in *Mabuya*.

The significant sexual dimorphism in size in *Mabuya dissimilis*, with females being larger than males, is the predominant trend in skinks in general and in *Mabuya* in particular, although not universally so in either taxon (AG, pers. obs.).

The significant sexual dimorphism in *Mabuya dissimilis* in both snout-vent length relative to head length (longer in females) and in number of scales in a paravertebral row (greater in females) are probably related to the greater trunk length in females, which is probably related, in turn, to that sex's unique role as bearers of the eggs/young. The fact that there is no significant difference in the number of presacral vertebrae suggests that the relatively longer trunk in females is probably achieved through a slight increase in the relative length of some or all of the presacral vertebrae.

The positive allometry of snout-vent length on head length in both sexes of *Mabuya dissimilis* is probably a reflection of the widespread trend in vertebrates for body size to increase relative to increasing head size.

The apparent increase in the number of keels on each dorsal body scale in *Mabuya macularia* is common trend in many species of *Mabuya* (AG, pers. obs.) but not yet reported for this species. The function of the keels, let alone why they should increase in number with increasing body size, is unknown.

The clutch size reported here, 3-8 (mean = 5.9), is close to the 6-7 noted by one earlier observer (Smith, 1935) but below the 11-15 reported by another (Sahi and Duda, 1986). This discrepancy seems significant and is worth investigating further.

The lack of a significant relationship between the clutch size and female size in *Mabuya dissimilis* is unusual in skinks with a large and variable clutch size. However, the result could be due to the relatively small sample size (n = 10).

The fact that female *Mabuya dissimilis* are carrying shelled eggs at the beginning of the dry season suggests that they may be laying their eggs in the dry season in anticipation of hatching in the wet season, when the seasonal increase in productivity would best support the hatchlings. In contrast, *M. macularia* eggs seem to be hatching at the end of the wet season, which will require the hatchlings to feed and grow during the dry season.

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APPENDIX 1

Material Examined

We have examined the following material (all UF). The localities are shown in Fig. 3.

Mabuya carinata

88370: 0.5 km S Forestry Rest house, Nagar Parkar, Mitthi, Sindh Province.

Mabuya dissimilis

135127: Pakistan (no specific locality); 79048: Modepur, about 30 km S Koti, Azad Kashmir Province; 72790: Islamabad (city), Punjab Province; 78941: Maira, Charsadda District, North-West Frontier Province; 82108-82109: 5.8 km NW Khaki, Manshera District, North-West Frontier Province; 79228: 200 m below top of Ambala Pass, 10 km SW China, Swat District, North-West Frontier; 72791-72904: near Khadeji Falls, Dadu District, Sindh Province;81011: Khadeji Falls, Dadu District, Sindh Province;

70916: near Dokri, Larkana District, Sindh Province; 70883: Babra Village, Thatta District, Sindh Province; 70884-70895: Sujawal, Thatta District, Sindh Province; 70896-70898: 1.5 mi S and 2.0 mi W Mirpur Sakro Road, Thatta District, Sindh Province; 70901-70902, 70910-70915: Thatta District, Sindh Province, Ex: Yogi tribesmen; 70903-70909: 3 mi S Gharo, Thatta District, Sindh Province; 72795: 8 mi N Kotri, Thatta District, Sindh Province.

Mabuya macularia

70917: near Dokri, Larkana District, Sindh Province; 70899-70900: Gharo, Thatta District, Sindh Province.

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MOLECULAR STUDIES ON THE GENUS *EUMECES* WIEGMANN, 1834: PHYLOGENETIC RELATIONSHIPS AND TAXONOMIC IMPLICATIONS

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(with three text-figures)

ABSTRACT.– **After the taxonomic status of the genus *Eumeces* Wiegmann, 1834 had been neglected for more than half a century, a recent publication split *Eumeces* into four genera. Based on a molecular data set, we provide evidence suggesting that the recently named taxonomic units represent monophyletic radiations. Since some of the previously proposed names for the genera violate the rules of the International Code of Zoological Nomenclature (ICZN), the nomenclatural situation is clarified and new names are proposed. The genus *Neoseps* Stejneger, 1910 is synonymised with *Pariocela* Fitzinger, 1843.**

KEY WORDS.– ***Eumeces*, *Eurylepis*, *Mesoscincus*, *Neoseps*, *Novoeumeces*, *Scincopus*, *Scincus*, mtDNA, phylogeny, nomenclature.**

INTRODUCTION

Until recently, the genus *Eumeces* Wiegmann, 1834 was one of the most speciose scincid genera known, with about 50 species recognized (Taylor, 1935; Eiselt, 1940; Mertens, 1946; Lieb, 1985; Hikida and Motokawa, 1999), being surpassed only by *Sphenomorphus* Fitzinger, 1843, *Mabuya* Fitzinger, 1826, *Ctenotus* Storr, 1964, *Lerista*, Bell, 1833 and *Emoia*, Gray, 1845. Many of the larger skink genera have been regarded as repositories (e.g., *Lygosoma* Hardwicke and Gray, 1827) or have been identified as non-monophyletic groups (e.g., *Mabuya*, *Sphenomorphus*) with the consequence that most large scincid genera have been subject to attempts to split them into smaller taxonomic groups. Only recently have attempts been convincingly proposed (e.g., *Mabuya*; comp. Mausfeld et al., 2002) or are currently being reviewed (e.g., *Sphenomorphus*).

The first comprehensive revision of the genus *Eumeces* was carried out by Taylor (1935). On the basis of shared colour patterns and scalation features he differentiated no less than 50 species (and 14 subspecies) in 15 species-groups within *Eumeces*, which he assigned to three major groups (group I consisting of the *schneiderii*-, *schwartzei*- and *taeniolatus* species-groups; a monotypic group II with only *E. longirostris* included; and group III consisting of all other eleven species-groups sensu Taylor, 1935). But still he had "no intention in mind of considering them of the status of genera or subgenera" (Taylor, 1935: 36), even though the species of the genus *Eumeces* are not only widely distributed (occurring throughout large parts of the Holarctic region) thus indicating possible barriers for a continuous gene flow, but they also display a considerable amount of morphological and ecological diversity (e.g., Taylor, 1935; Fitch, 1955; Bobrov, 1993; Kato and Ota, 1994; Hosono and Hikida, 1999; Griffith et al., 2000; Lazell and Ota, 2000).

Several generic names have been proposed for various subgroups within *Eumeces*, but only two serious attempts have been made to split the

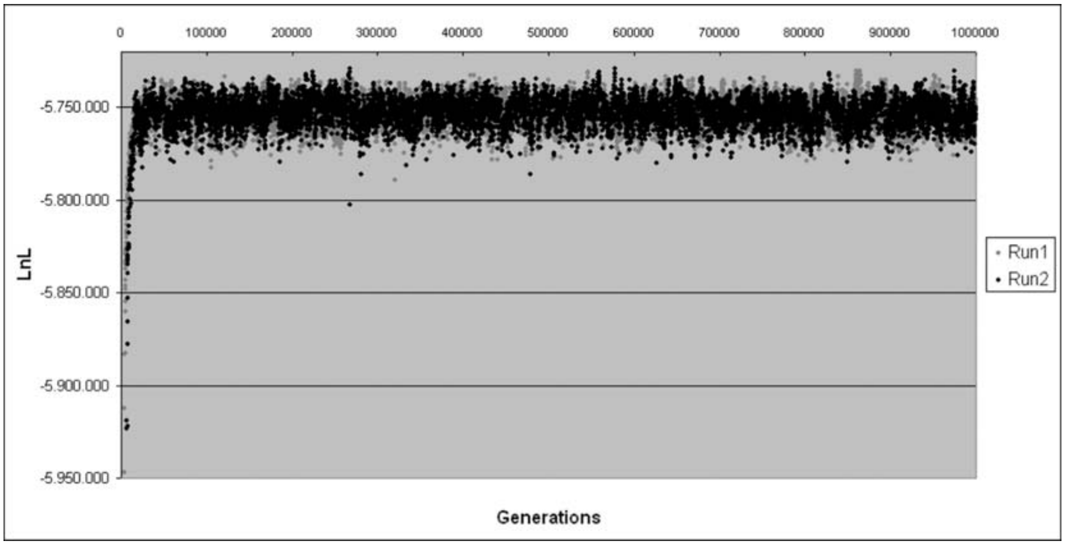

FIGURE 1: The log probability of the observed combined 16S and 12S DNA sequences through time for both of the chains run in this study. Each chain started from a different random tree. The samples taken from the first 100,000 generations were discarded as the burn-in for the chain, and inferences are based on samples from the remaining parts of the chain.

genus. One was carried out just before the revision of Taylor (1935) by Dunn (1933), who placed two Central American species (*E. managuae* and *E. schwartzei*) and the Southwest Asian species *E. taeniolatus* (as well as *E. scutatus*, now considered a synonym of *taeniolatus*) in a separate genus, *Eurylepis* Blyth, 1854. This view was subsequently rejected by Taylor (1935) who regarded the genus *Eumeces* as a natural, monophyletic group ("The likelihood that further generic or subgeneric divisions of the genus will ever be considered for species now known is extremely remote. [….] I feel quite certain that any breaking up of the present group here treated as a generic entity is unwise, since, if begun, it would necessitate the erection and recognition of several genera, four of which (including *quadrilineatus*, *egregius*, *taeniolatus*, *lynxe*) would be monotypic and would in no measure have the same generic significance as even the genera (subgenera) formed from the genus "*Lygosoma*" as used by Boulenger"; Taylor, 1935: 37).

Taylor (1935) also placed the species of *Eumeces* occurring in West Asia, Cyprus and Africa (comp. Mertens, 1920, 1924, 1946; Göçmen et al., 2002) in the *schneideri*-group, then comprising six species and one subspecies. At present, however, most authorities consider the *schneideri*-group to be composed of only two species with five subspecies [*E. s. schneideri* (Daudin, 1802); *E. s. pavimentatus* (Geoffroy-Saint-Hillaire, 1827); *E. s. princeps* (Eichwald, 1839); *E. s. zarudnyi* Nikolsky, 1899; *E. s. blythianus* (Anderson, 1871); *E. a. algeriensis* (Peters, 1864); *E. a. meridionalis* Domergue, 1901]. The type species of the genus *Eumeces* (*E.* (*s.*) *pavimentatus*) is included in the *schneideri*-group.

Two closely related genera, *Scincopus*, Peters, 1864 and *Scincus*, Laurenti, 1768, are known to be partly sympatric with the species of the *schneideri*-group. Arnold and Leviton (1977) thought of them to be descendants of *E. schneideri*, but their exact phylogenetic relationships with respect to each other and to *Eumeces* remain unresolved.

The three proposed subgroups of Taylor (1935) have undergone rather different subsequent treatments (e.g., Eiselt, 1940; Mertens, 1920, 1924; Lieb, 1985; Kato et al., 1994; Hikida and Motokawa, 1999; Richmond and Reeder, 2002) and are now regarded as representing four different groups with taxonomic hierarchies that differ substantially from those of the groups proposed by Taylor. While groups II and III (sensu

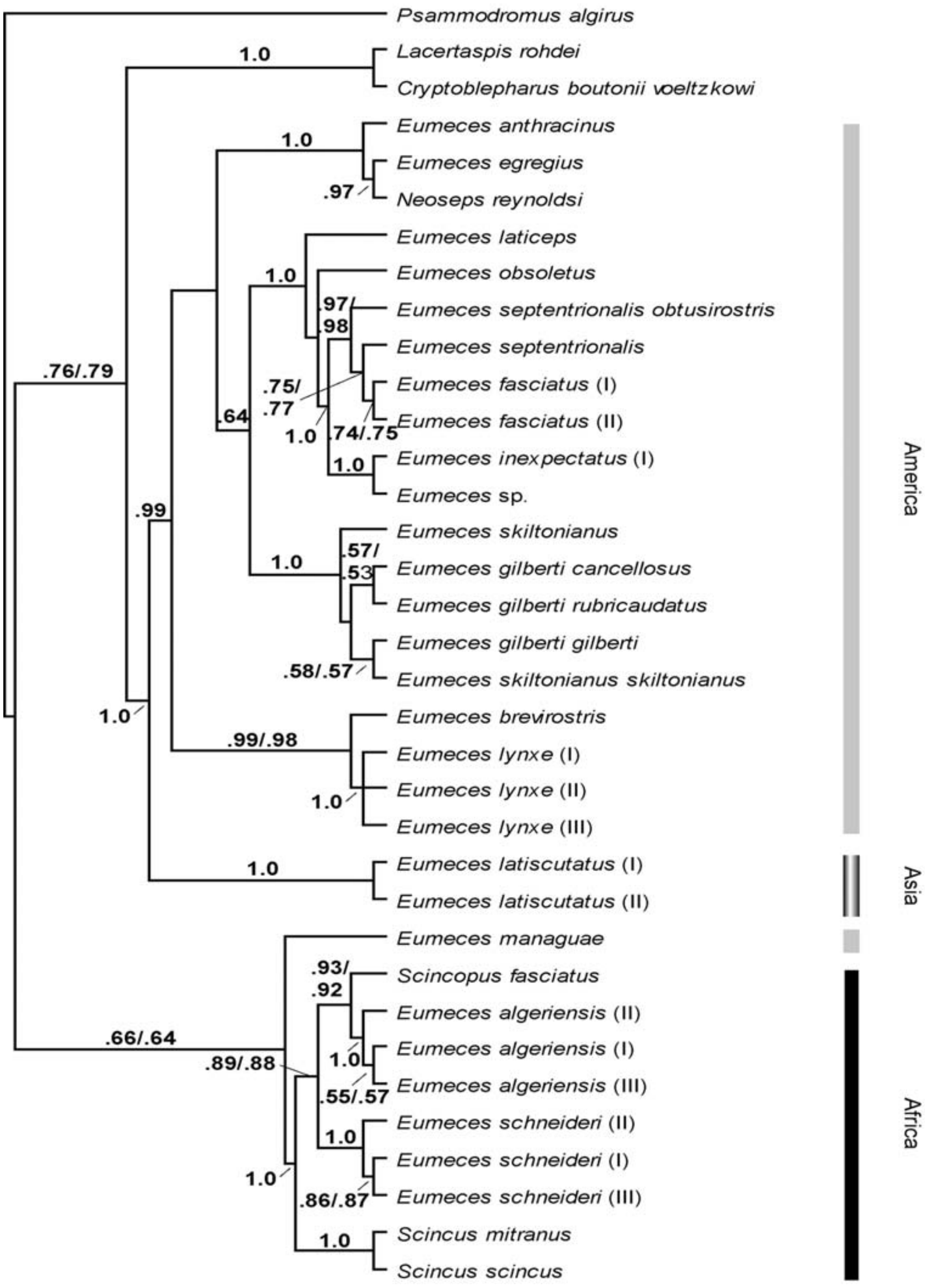

FIGURE 2: Cladogram of the maximum-likelihood tree based on 928 bp of the combined mitochondrial 16S and 12S ribosomal RNA gene sequences. Values (bold) at the nodes are Bayesian posterior probabilities (values below 0.5 not shown).

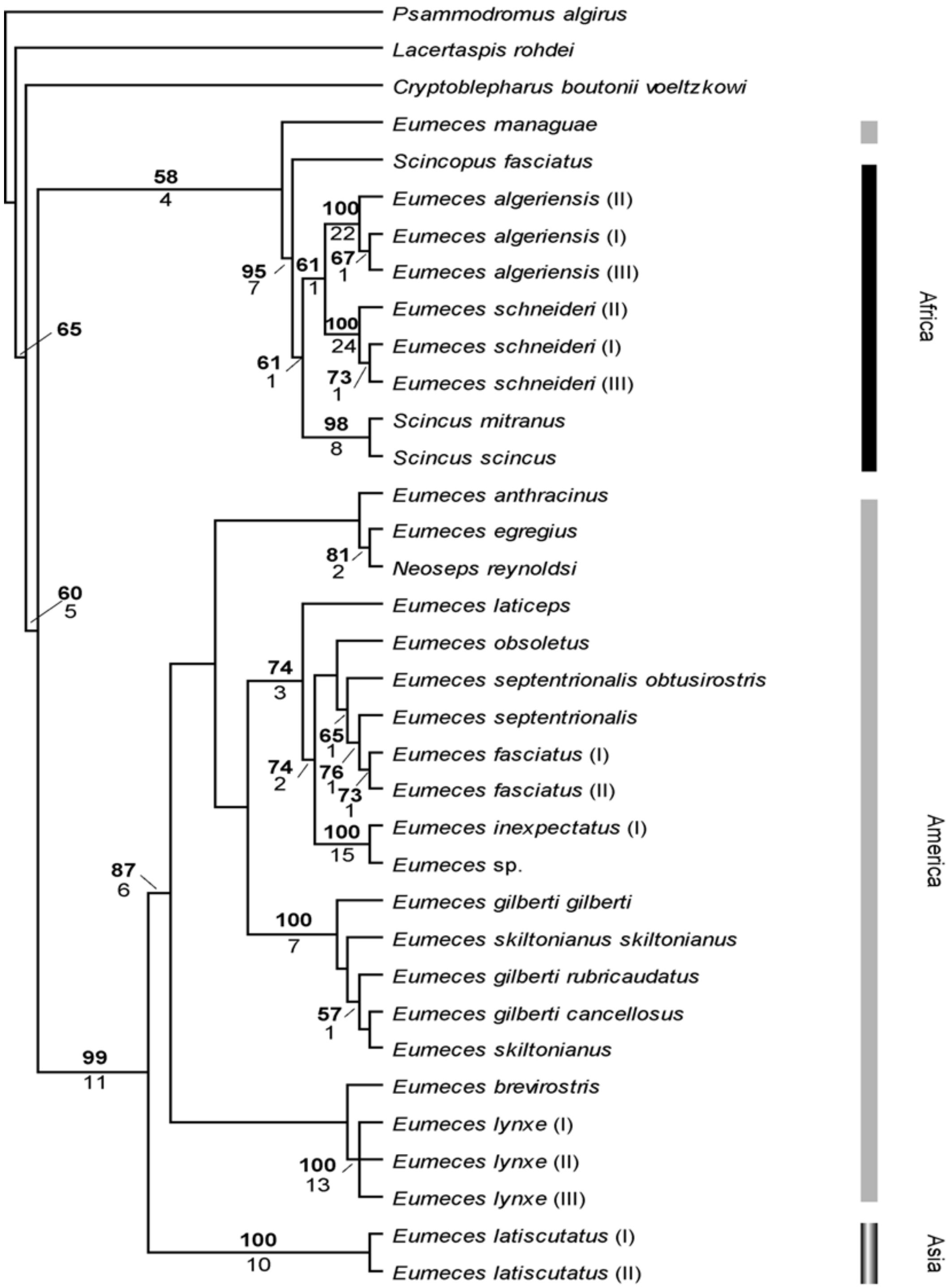

FIGURE 3: Cladogram of the maximum-parsimony tree based on 928 bp of the combined mitochondrial 16S and 12S ribosomal RNA gene sequences. Upper (bold) values at the nodes are bootstrap values in percent (2000 replicates with 100 random additions; values below 50 % not shown); lower values are Bremer decay indices.

Taylor, 1935) have been pooled to form the so-called *Pariocela* section (sensu Fitzinger, 1843), group I has been split into three independent sections, which are considered to be of equal taxonomic rank as the *Pariocela* section.

The *Eumeces taeniolatus*-group consists of only two species (*E. poonaensis* Sharma, 1970 and *E. taeniolatus*, [Blyth, 1854]), which have a rather limited distribution area in Pakistan, Afghanistan and the bordering countries (Boulenger, 1890; Taylor, 1935; Haas, 1957; Sharma, 1970; Szcherbak, 1990; Leviton et al., 1992; Griffith et al., 2000).

The *Eumeces schwartzei*-group is now considered to comprise three species (*E. altamirani* Dugès, 1891; *E. managuae* Dunn, 1933; and *E. schwartzei* Fischer, 1884), and is only known from Central America (Dugès, 1891; Taylor, 1935, 1936, 1956; Smith and Taylor, 1950; Cruz et al., 1979; McCoy et al., 1986).

The most recent attempt to split *Eumeces* has been in the framework of a morphological re-analysis of the genus by Griffith et al. (2000). On the basis of a rather small morphological character matrix (which includes several characters with an underlying ecological basis or which are based on highly labile features like colour) they proposed the most radical taxonomic changes for the genus yet. They recognized the four groups mentioned above, and raised them all to a generic status. As these authors intended to keep the name *Eumeces* for the North American *Pariocela* section of the genus, they have filed a petition with the ICZN to designate *Lacerta fasciata* Linnaeus 1758 as type species of *Eumeces*, which would preserve the genus name *Eumeces* for the *Pariocela* section (Murphy et al., submitted). They argue that this way the majority of species (which is correct) and the "vast majority of literature" (which is far from being correct) could be kept connected to the name *Eumeces*. Following their line of thought, they propose a new generic name "*Novoeumeces*" for the *schneideri* species-group, revalidate the name *Eurylepis*, Blyth, 1854 for the *taeniolatus* species-group, and propose the new generic name *Mesoscincus* for the *schwartzei* species-group. This last step was necessary, since the generic name *Platypholis* proposed by Dugès (1891), is preoccupied by *Platypholis* Boulenger 1890 (a gekkonid genus), and is therefore unavailable. Additionally, based on only two skull characters, they regarded the *Pariocela* species-group as the most basal group of all skinks worldwide, and thus they described a new subfamily, *Eumecinae*, for this assemblage.

The present analysis uses molecular sequence data to reanalyze the phylogenetic relationships, to answer questions regarding the monophyly of the proposed genera and the proposed new subfamily *Eumecinae*, and to extend our knowledge of the placement of the different genera with respect to the closely related genera *Scincopus* and *Scincus*.

MATERIAL AND METHODS

Thirty-five combined, 16S and 12S, sequences (Table 1) comprised 1016 bp (lengths referring to the aligned sequences including gaps) were obtained. Five short sections (together 88 bp) (71 bp from the original 16S data set and 17 bp from the 12S data set) were too variable to be reliably aligned, and were excluded from the analyses, resulting in a total of 928 bp which were used in the analyses. For the likelihood calculations, an additional 32 sites (positions containing gaps) were excluded. *Psammodromus algirus* (Lacertidae), *Lacertaspis rohdei* and *Cryptoblepharus boutonii voeltzkowi* (Scincidae: Lygosominae) were used as outgroup taxa.

DNA was extracted from the tissue samples using QuiAmp tissue extraction kits (Quiagen). The primers 16sar-L (light chain; 5' - CGC CTG TTT ATC AAA AAC AT - 3') and 16sbr-H (heavy chain; 5' - CCG GTC TGA ACT CAG ATC ACG T - 3') of Palumbi et al. (1991) were used to amplify a section of the mitochondrial 16S ribosomal RNA gene. PCR cycling procedure was as follows; an initial denaturation step of 90 s at 94°C followed by 33 cycles of denaturation for 45 s at 94°C, primer annealing for 45 s at 55°C and extension for 90 s at 72°C. Additionally, a section of the mitochondrial 12S ribosomal RNA gene was amplified using the primers 12SA-L (light chain; 5' - AAA CTG

TABLE 1: List of voucher specimens for each species included in the present study, with their respective localities, collection numbers and accession numbers (12S, 16S). Abbreviations: ZFMK for Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany; LSUMZ for Louisiana State University, Museum of Zoology, Louisiana, USA; and CAS for California Academy of Sciences, San Francisco, USA.

Species	Locality	Collection number	Accession number
Eumeces algeriensis (I)	North Africa	ZFMK 72254	AY308344 / AY308195
Eumeces algeriensis (II)	Tafraoute, Morocco	voucher not collected	AY308345 / AY308196
Eumeces algeriensis (III)	Tiznit, Morocco	GenBank	AF054526 / AF054540
Eumeces algeriensis (IV)	Africa	GenBank	EAY14451 / -
Eumeces anthracinus	Natchitoches Parish: Lonleaf Vista, USA	LSUMZ H-2881	AY308346 / AY308197
Eumeces brevirostris	Tamaulipas, Mexico	LSUMZ H-14817	AY308347 / AY308198
Eumeces egregius	USA	GenBank	AB016606 / AB016606
Eumeces fasciatus (I)	Mississippi, Covington Co., USA	CAS 207212	AY308348 / AY308199
Eumeces fasciatus (II)	USA	voucher not collected	AY308349 / AY308200
Eumeces gilberti cancellosus	California, Alameda Co., USA	CAS 208654	AY308350 / AY308201
Eumeces gilberti gilberti	California, Fresno Co., USA	CAS 208719	AY308351 / AY308202
Eumeces gilberti rubricaudatus	California, Kern Co., USA	CAS 205791	AY308352 / AY308203
Eumeces inexpectatus (I)	Georgia, Liberty Co., USA	voucher not collected	AY308353 / AY308204
Eumeces inexpectatus (II)	USA	GenBank	- / MTEINX16S
Eumeces laticeps	Florida, Washington Co., USA	CAS 203093	AY308354 / AY308205
Eumeces latiscutatus (I)	Japan	ZFMK 70469	AY308355 / AY308206
Eumeces latiscutatus (II)	Kyoto City, Japan	GenBank	AB028770 / AB028781
Eumeces lynxe (I)	Hidalgo, Mexico	LSUMZ H-14969	AY308356 / AY308207
Eumeces lynxe (II)	Hidalgo, Mexico	LSUMZ H-14970	AY308357 / AY308208
Eumeces lynxe (III)	Veracruz, Mexico	LSUMZ H-14980	AY308358 / AY308209
Eumeces managuae	Guanacaste, Costa Rica	ZFMK 57771	AY308433 / AY308281
Eumeces obsoletus	USA	ZFMK 77248	AF548781 / AF549169
Eumeces schneideri (I)	North Africa	ZFMK 77812	AY308361 / AY308212
Eumeces schneideri (II)	Egypt	ZFMK 77478	AY308362 / AY308213
Eumeces schneideri (III)	West Africa	GenBank	AB028800 / AB028812
Eumeces septentrionalis	Wisconsin, USA	LSUMZ H-1231	AY308363 / AY308214
Eumeces septentrionalis obtusirostris	Kansas, Sumner Co., USA	GenBank	AY046420 / AY046462
Eumeces skiltonianus	Nevada, Washoe Co., USA	CAS 202952	AY308364 / AY308215

Eumeces skiltonianus skiltonianus	California: Riverside Co.: Diamond Valley, USA	CAS 200629	AY308365 / AY308216
Eumeces sp.	Florida, Broward Co., USA	CAS 208643	AY308366 / AY308217
Neoseps reynoldsi	Florida, USA	voucher not collected	AY308360 / AY308211
Scincopus fasciatus	ca. 30 km NW Rosso, Mauritania	ZFMK, uncatalogued	AY308453 / AY308302
Scincus mitranus	Al Ain, United Arab Emirates	BMNH, uncatalogued	AY308454 / AY308303
Scincus scincus	Israel	ZFMK 72239	AY308455 / AY308304
Cryptoblepharus boutonii voeltzkowi	St. Augustin, Madagascar	voucher not collected	AY308336 / AY308187
Lacertaspis rohdei	Mt. Nlonako, Cameroon	ZFMK 75382	AY308386 / AY308236
Psammodromus algirus	Tanger, Cap Spartel, Morocco	GenBank	AF206588 / AF206588

GGA TTA GAT ACC CCA CTA T - 3') and 12SB-H (heavy chain; 5' - GAG GGT GAC GGG CGG TGT GT - 3') of Kocher et al. (1989). Cycling procedure was as follows: 35 cycles of denaturation 45 s at 94°C, primer annealing for 60 s at 50°C and extension for 120 s at 74°C (12S). PCR products were purified using Qiaquick purification kits (Qiagen). Sequences were obtained using an automatic sequencer (ABI 377). Sequences have been submitted to Genbank; for accession numbers compare Table 1.

Sequences were aligned using ClustalX (Thompson et al., 1997; default parameters). The alignment was subsequently adjusted manually using the program BioEdit (Hall, 1999). To determine the statistical validity of combining the 16S and 12S data sets for phylogenetic analyses, we performed the partition homogeneity (PH) test. We used PAUP*4.0b10 (Swofford, 2002) to generate a null-distribution of length differences using 1000 same-sized, randomly generated partitions from the original data with replacement.

Prior to phylogenetic reconstruction, we tested for homogeneity of base frequencies among taxa using the χ^2 test as implemented in PAUP*4.0b10 (which ignores correlation due to phylogenetic structure): (1) over all sites, (2) over parsimony-informative sites only, (3) without constant sites (parsimony-uninformative and constant sites will mislead the χ^2 test; Misof et al., 2001). All phylogenetic reconstructions were conducted with the combined data set of the 16S and 12S gene fragments.

We performed maximum parsimony (MP), maximum likelihood (ML) and Bayesian reconstructions. For ML and Bayesian analysis parameters of the model were estimated from the data set using Modeltest 3.0 (Posada and Crandall, 1998) and MrModeltest 1.1b (Nylander, 2002), respectively.

As ML bootstrap calculations are extremely time-consuming and a recent simulation study suggested Bayesian posterior probabilities represent much closer estimates of true clade probabilities, we used Bayesian analysis to estimate posterior probabilities for the phylogenetic relationships inferred in the ML analyses. Clades with PP ≥ 95% were considered strongly (significantly) supported.

Additionally, we used bootstrap analyses with 2000 pseudoreplicates for MP and Bremer Decay Indices (BDI) to evaluate the relative branch support in phylogenetic analysis. For the MP analysis, we used the "heuristic search" with the "random addition" option of PAUP* (Swofford, 2002) with 10 replicates, using the TBR (tree bisection-reconnection) branch swapping option.

All Bayesian (Rannala and Yang, 1996; Larget and Simon, 1999; Mau et al., 1999; Li et al., 2000; Huelsenbeck et al., 2001) analyses were performed with MrBayes, version 3.0b4

(Huelsenbeck and Ronquist, 2001), which approximates the posterior probabilities (PP) of trees. We ran two MCMC analyses for 10^6 generations each. The initial 100,000 (10%) trees were disregarded as "burn-in" (Fig. 1). We consider probabilities of 95% or greater to be significantly supported. The exact parameters used for the Bayesian analyses followed those described in detail by Reeder (2003) and Table 2.

RESULTS

Of the 1016 characters from the combined 16S and 12S rRNA genes 449 sites were variable and 241 were parsimony-informative. The matrix for the uncorrected p-distances for all nucleotide sites is presented in Table 3.

TABLE 2: Combined 16S + 12S. Parameter estimates of the substitution model (GTR + I + G), sampled after the burn-in phase of the chain. The columns indicate the parameter, mean and 95% credible interval for the parameter. The parameters are TL, the tree length; r_{ij}, rate of substitution between nucleotides *i* and *j* measured relative to the rate between G and T ($\rho GT = 1$); πi, base frequencies; α, gamma shape parameter for among-site variation; and *Pinvar.*, proportion of invariable sites. Upper values in each pair correspond to the 1. run; lower values correspond to the 2. run.

Parameter	Mean	95% Credity Interval
TL	2.144995 2.155316	(1.831000, 2.520000) (1.816000, 2.575000)
r_{GT}	1.000000 1.000000	1.000000, 1.000000 1.000000, 1.000000
r_{CT}	28.056685 28.219089	(13.532508, 63.873212) (12.689248, 59.780160)
r_{CG}	1.126511 1.132002	(0.288083, 2.815524) (0.363334, 2.875285)
r_{AT}	2.695892 2.694440	(1.167896, 6.388330) (1.060047, 5.957160)
r_{AG}	13.601788 13.652822	(6.285310, 29.632246) (6.100779, 28.483158)
r_{AC}	4.278407 4.291890	(1.873923, 9.979367) (1.846635, 9.467517)
π_A	0.331984 0.332206	(0.305361, 0.358863) (0.305480, 0.359952)
π_C	0.255699 0.255511	(0.231757, 0.279378) (0.232286, 0.280094)
π_G	0.188326 0.188072	(0.165085, 0.211881) (0.165570, 0.212244)
π_T	0.223991 0.224210	(0.201785, 0.247360) (0.202472, 0.247175)
α	0.637758 0.631050	(0.363735, 1.000408) (0.353439, 0.982877)
Pinvar.	0.406778 0.404888	(0.250790, 0.507954) (0.239500, 0.506734)

In the data set, a phylogenetic signal is clearly present (g1 = -0.7194, p = 0.01; 12S: -0.6033, p = 0.01; 16S: -0.7928, p = 0.01). When all characters were included, we found no significant deviation from the homogeneity of base frequencies among taxa ($\chi^2 = 22.8058$, p = 1.0000, df = 102). The same was true without constant sites ($\chi^2 = 57.8606$, p = 0.9999, df = 102) and for the parsimony-informative sites only ($\chi^2 = 77.3902$, p = 0.9669, df = 102).

The heuristic search of the MP analysis produced 20 equally most-parsimonious trees (tree length = 905; CI = 0.434; RI = 0.692; RC = 0.301). The MP strict consensus tree with bootstrap support is shown in Fig. 3, the optimal ML tree and the MrBayes tree are shown in Fig. 2. The comparison between the different likelihood scores for each model showed that the GTR + I + Γ model (Yang, 1994) was determined to be the optimal model for the combined data set. This model incorporates unequal base frequencies [$\pi(A) = 0.32720$, $\pi(T) = 0.22170$, $\pi(C) = 0.25520$, $\pi(G) = 0.19590$], a proportion of invariable sites ($I = 0.4916$), and a gamma distribution shape parameter ($\alpha = 0.6688$). The optimal ML tree had a log-likelihood of -lnL = 5708.25.

The partition homogeneity test failed to detect significant incongruence between the two data sets (P = 1 - (869/1000) = 0.131), suggesting that the two mtDNA fragments could be combined.

All phylogenetic methodologies used agree in the resulting general topology. In the trees resulting from the combined data sets, two major monophyletic groups can be detected, which are both strongly supported. The first clade (called the African clade from here onwards) includes all African *Eumeces* species as well as the genera *Scincopus* and *Scincus* (MP: 95 / PP: 1.0 / BDI: 7). In the MP analysis *Scincopus fasciatus* is placed as the most basal taxon, although with low bootstrap support (MP: 61 / BDI: 1). In the Bayesian analyses this species is found as sister species to the *Eumeces algeriensis* cluster, with rather strong support (PP: .92|.93). The two included *Scincus* species are sister species in all analyses with very strong support (MP: 98 / PP:

1.0 / BDI: 8) and are placed either basal to a clade containing all included vouchers of *Eumeces algeriensis* and *E. schneideri* (MP: 61 / BDI: 1) or basal to the remaining species of the African clade (PP: .89|.88) each with low bootstrap support. The several included voucher specimens for each of the latter two species are grouped together and both are strongly supported [(MP: 100 / PP: 1.0 / BDI: 22) and (MP: 100 / PP: 1.0 / BDI: 24), respectively].

Eumeces managuae is the sister-group to the African clade in both the MP and the ML analyses, though with very low bootstrap support (MP: 58 / PP: .66|.64 / BDI: 4).

The second major clade contains the Asian and all American members of *Eumeces* and *Neoseps reynoldsi*. *Eumeces latiscutatus* is the sister-group to the American subclade in all trees with strong bootstrap support (MP: 87 / PP: .99 / BDI: 6). The American subclade is further subdived into several smaller monophyletic terminal groups. Nonetheless, all analyses show at least three strongly supported clades within this polytomy: the first consists of all included (sub-)species of *E. skiltonianus* and *E. gilberti* (MP: 100 / PP: 1.0 / BDI: 7); the second includes *E. laticeps*, *E. obsoletus*, *E. septentrionalis*, *E. fasciatus*, *E. inexspectatus* and *Eumeces* sp. (MP: 74 / PP: 1.0 / BDI: 3); and the third contains just two species (*E. egregius* and *Neoseps reynoldsi*), and surprisingly, shows strong support for a close relationship of these two taxa (MP: 81 / PP: .97 / BDI: 2). Additionally, the Bayesian analysis gives very strong evidence for a fourth clade, which contains the Mexican *Eumeces* species, *E. brevirostris* and *E. lynxe* (PP: .99|.98), though none of the other search algorithms give any bootstrap support for this grouping.

DISCUSSION

The systematic relationships of the species of the genus *Eumeces* have been mostly neglected since the major revision of Taylor (1935). Perhaps the apparent stability implied by such a comprehensive work and the self-confidence with which Taylor (1935) argued in his monumental review, tempted subsequent researchers to only examine the group structure within this large genus, since the general integrity of *Eumeces* seemed to be out of question for most researchers.

This arrangement was long kept despite several compelling findings, which reveal clear differences between zoogeographically independent groupings (especially between African and American species-groups). These differences were primarily based on analyses of chromosomes numbers in the different groups. While a large number of studies showed that all species of the American *Pariocela* section have 2n = 26 chromosomes (e.g., Deweese and Wright, 1970; Wu, 1983; Capriglione, 1987; Guo and Dong, 1988; Kato et al., 1998), several papers showed that all African species of the genus *Eumeces* are unique in having a constant 2n = 32 chromosomes (Gorman, 1973; Kupriyanova, 1973; DeSmet, 1981; Kupriyanova, 1986; Eremtschenko et al., 1992; Caputo et al., 1993, 1994; Hassan, 1996). The *E. taeniolatus* group also could be differentiated from either group, being unique in having 2n = 28 chromosomes (Ivanov and Bogdanov, 1975; Kupriyanova, 1986; Eremtschenko et al., 1992).

Taxonomic nomenclature should reflect genealogical associations, and given the non-monophyletic position of the different subgroups of *Eumeces* revealed by previous analyses, a revision of the genus *Eumeces* is long overdue. As all molecular analyses clearly support the independent origin of several groups (see below), a taxonomic recognition of these groups as full valid genera is recommended.

Despite the comparatively low number of the characters used in the morphological analyses of Griffith et al. (2000), the phylogenetic independency of three of their proposed four groups (no member of the *E. taeniolatus* species-group could be included in the present analysis) is supported in all molecular analyses. This is somewhat surprising since a close examination of the characters used to discriminate the species-groups in the Griffith et al. (2000) paper reveals several characters that are ecologically labile (e.g., the general colour pattern, the number and shape of the ear lobules, the scale thick-

TABLE 3: Summary of the uncorrected p-distances for the combined 16S and 12S data sets.

	Taxon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	*Psammodromus algirus*	-														
2	*Panaspis rohdei*	0.1853	-													
3	*Cryptoblepharus boutonii voeltzkowi*	0.1969	0.1362	-												
4	*Eumeces algeriensis* (I)	0.1858	0.1531	0.1512	-											
5	*Eumeces algeriensis* (II)	0.1902	0.1558	0.1527	0.0037	-										
6	*Eumeces algeriensis* (III)	0.1939	0.1600	0.1567	0.0128	0.0146	-									
7	*Eumeces anthracinus*	0.1845	0.1405	0.1516	0.1330	0.1362	0.1390	-								
8	*Eumeces brevirostris*	0.1915	0.1345	0.1515	0.1424	0.1483	0.1507	0.0726	-							
9	*Eumeces egregius*	0.1812	0.1602	0.1493	0.1391	0.1410	0.1468	0.0650	0.0824	-						
10	*Eumeces fasciatus* (I)	0.1848	0.1352	0.1474	0.1419	0.1465	0.1463	0.0711	0.0649	0.0781	-					
11	*Eumeces fasciatus* (II)	0.1840	0.1410	0.1479	0.1442	0.1469	0.1458	0.0744	0.0685	0.0787	0.0024	-				
12	*Eumeces gilberti cancellosus*	0.1721	0.1327	0.1399	0.1414	0.1460	0.1471	0.0675	0.0625	0.0708	0.0532	0.0570	-			
13	*Eumeces gilberti gilberti*	0.1773	0.1373	0.1364	0.1426	0.1473	0.1474	0.0731	0.0692	0.0766	0.0624	0.0664	0.0222	-		
14	*Eumeces gilberti rubricaudatus*	0.1732	0.1315	0.1375	0.1426	0.1473	0.1484	0.0664	0.0614	0.0696	0.0521	0.0559	0.0055	0.0189	-	
15	*Eumeces inexpectatus* (I)	0.1868	0.1481	0.1498	0.1373	0.1422	0.1433	0.0794	0.0698	0.0829	0.0451	0.0460	0.0582	0.0640	0.0558	-
16	*Eumeces laticeps*	0.1867	0.1347	0.1362	0.1470	0.1493	0.1543	0.0675	0.0658	0.0719	0.0433	0.0453	0.0543	0.0598	0.0532	0.0616
17	*Eumeces latiscutatus* (I)	0.1897	0.1489	0.1461	0.1437	0.1329	0.1384	0.1114	0.0963	0.1059	0.1040	0.1061	0.1014	0.0993	0.0981	0.1034
18	*Eumeces latiscutatus* (II)	0.1877	0.1431	0.1374	0.1411	0.1384	0.1369	0.0969	0.0796	0.0993	0.0800	0.0782	0.0785	0.0826	0.0746	0.0959
19	*Eumeces lynxe* (I)	0.1747	0.1294	0.1423	0.1343	0.1387	0.1418	0.0520	0.0537	0.0754	0.0578	0.0605	0.0610	0.0665	0.0576	0.0724
20	*Eumeces lynxe* (II)	0.1760	0.1316	0.1435	0.1343	0.1387	0.1418	0.0520	0.0537	0.0754	0.0578	0.0605	0.0632	0.0687	0.0599	0.0724
21	*Eumeces lynxe* (III)	0.1749	0.1309	0.1423	0.1332	0.1375	0.1405	0.0546	0.0537	0.0755	0.0559	0.0581	0.0635	0.0691	0.0602	0.0724
22	*Eumeces managuae*	0.1672	0.1372	0.1358	0.1198	0.1228	0.1231	0.1024	0.1188	0.1205	0.1152	0.1189	0.0980	0.1003	0.0958	0.1123
23	*Eumeces obsoletus*	0.1939	0.1435	0.1523	0.1398	0.1413	0.1452	0.0824	0.0718	0.0847	0.0411	0.0420	0.0706	0.0766	0.0683	0.0533
24	*Eumeces schneideri* (I)	0.1803	0.1527	0.1502	0.0873	0.0888	0.0976	0.1316	0.1351	0.1280	0.1344	0.1360	0.1280	0.1269	0.1256	0.1381
25	*Eumeces schneideri* (II)	0.1731	0.1443	0.1449	0.0839	0.0860	0.0964	0.1216	0.1259	0.1203	0.1245	0.1300	0.1183	0.1172	0.1160	0.1328
26	*Eumeces schneideri* (III)	0.1822	0.1560	0.1543	0.0905	0.0909	0.0972	0.1347	0.1386	0.1309	0.1378	0.1387	0.1315	0.1304	0.1292	0.1417
27	*Eumeces septentrionalis*	0.1843	0.1360	0.1470	0.1412	0.1458	0.1456	0.0687	0.0670	0.0766	0.0067	0.0071	0.0555	0.0622	0.0522	0.0486
28	*Eumeces septentrionalis obtusirostris*	0.1827	0.1373	0.1365	0.1225	0.1246	0.1312	0.0741	0.0644	0.0645	0.0182	0.0169	0.0491	0.0577	0.0491	0.0494
29	*Eumeces skiltonianus*	0.1805	0.1326	0.1363	0.1402	0.1448	0.1457	0.0631	0.0636	0.0684	0.0566	0.0605	0.0121	0.0255	0.0132	0.0618
30	*Eumeces skiltonianus skiltonianus*	0.1775	0.1365	0.1356	0.1358	0.1403	0.1421	0.0688	0.0638	0.0697	0.0548	0.0572	0.0200	0.0245	0.0167	0.0620

31	*Eumeces* sp.	0.1850	0.1455	0.1486	0.1454	0.1502	0.1510	0.0767	0.0662	0.0839	0.0412	0.0445	0.0512	0.0567	0.0490	0.0107
32	*Neoseps reynoldsi*	0.1829	0.1470	0.1502	0.1404	0.1430	0.1430	0.0640	0.0754	0.0500	0.0629	0.0627	0.0569	0.0662	0.0558	0.0749
33	*Scincopus fasciatus*	0.1820	0.1499	0.1466	0.1000	0.1031	0.1041	0.1338	0.1372	0.1372	0.1341	0.1359	0.1348	0.1350	0.1326	0.1387
34	*Scincus mitranus*	0.1761	0.1449	0.1386	0.0882	0.0881	0.0898	0.1186	0.1399	0.1232	0.1242	0.1303	0.1272	0.1277	0.1239	0.1245
35	*Scincus scincus*	0.1738	0.1380	0.1253	0.0882	0.0910	0.0964	0.1227	0.1273	0.1345	0.1171	0.1191	0.1215	0.1252	0.1168	0.1196

	Taxon	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	*Eumeces laticeps*	-														
17	*Eumeces latiscutatus* (I)	0.0947	-													
18	*Eumeces latiscutatus* (II)	0.0781	0.0187	-												
19	*Eumeces lynxe* (I)	0.0631	0.0948	0.0745	-											
20	*Eumeces lynxe* (II)	0.0631	0.0925	0.0718	0.0022	-										
21	*Eumeces lynxe* (III)	0.0635	0.0927	0.0716	0.0022	0.0022	-									
22	*Eumeces managuae*	0.1125	0.1205	0.1162	0.1070	0.1093	0.1084	-								
23	*Eumeces obsoletus*	0.0551	0.1039	0.0994	0.0766	0.0742	0.0766	0.1208	-							
24	*Eumeces schneideri* (I)	0.1314	0.1377	0.1284	0.1316	0.1316	0.1304	0.1181	0.1323	-						
25	*Eumeces schneideri* (II)	0.1239	0.1401	0.1203	0.1217	0.1217	0.1211	0.1049	0.1268	0.0012	-					
26	*Eumeces schneideri* (III)	0.1346	0.1519	0.1283	0.1349	0.1349	0.1337	0.1207	0.1368	0.0000	0.0012	-				
27	*Eumeces septentrionalis*	0.0421	0.1027	0.0784	0.0588	0.0566	0.0569	0.1149	0.0411	0.1303	0.1198	0.1328	-			
28	*Eumeces septentrionalis obtusirostris*	0.0417	0.0671	0.0699	0.0589	0.0588	0.0575	0.1088	0.0378	0.1216	0.1202	0.1213	0.0209	-		
29	*Eumeces skiltonianus*	0.0554	0.0992	0.0772	0.0576	0.0576	0.0602	0.0969	0.0730	0.1244	0.1137	0.1279	0.0544	0.0532	-	
30	*Eumeces skiltonianus skiltonianus*	0.0588	0.1017	0.0788	0.0578	0.0600	0.0603	0.0960	0.0649	0.1260	0.1174	0.1294	0.0545	0.0534	0.0233	-
31	*Eumeces* sp.	0.0556	0.1085	0.0895	0.0656	0.0656	0.0660	0.1153	0.0556	0.1359	0.1279	0.1403	0.0445	0.0466	0.0546	0.0559
32	*Neoseps reynoldsi*	0.0626	0.1049	0.0822	0.0743	0.0720	0.0743	0.1093	0.0672	0.1239	0.1167	0.1257	0.0593	0.0532	0.0604	0.0582
33	*Scincopus fasciatus*	0.1360	0.1353	0.1285	0.1222	0.1246	0.1234	0.1205	0.1422	0.1041	0.1011	0.1068	0.1350	0.1273	0.1313	0.1400
34	*Scincus mitranus*	0.1230	0.1506	0.1323	0.1199	0.1199	0.1207	0.1013	0.1329	0.0830	0.0759	0.0862	0.1234	0.1191	0.1261	0.1257
35	*Scincus scincus*	0.1155	0.1301	0.1218	0.1158	0.1157	0.1157	0.1046	0.1223	0.0781	0.0734	0.0800	0.1180	0.1106	0.1204	0.1219

	Taxon	31	32	33	34	35
31	*Eumeces* sp.	-				
32	*Neoseps reynoldsi*	0.0724	-			
33	*Scincopus fasciatus*	0.1403	0.1370	-		
34	*Scincus mitranus*	0.1280	0.1267	0.1035	-	
35	*Scincus scincus*	0.1245	0.1226	0.0954	0.0437	-

ness and the general shape of the head are all different in the *E. schneideri*-group). These characters could therefore easily be of convergent origin (and in case they have no heritable components, they would be phylogenetically uninformative). Nonetheless, even if the character matrix of Griffith et al. (2000) should be regarded with utmost caution, its general results regarding the different major species-groups are proven valid by our molecular data, and therefore making taxonomic consequences highly warranted.

Of the four independent genera proposed Griffith et al. (2000), only the revived genus *Eurylepis* could not be confirmed in our molecular analyses. Still, regarding its unique number of chromosomes and the many morphological differences (e.g., Taylor, 1935), a preliminary assignment of this species-group to a distinct genus seems justified. Future molecular studies, which include sequence data of its members, should corroborate this arrangement.

The newly erected genus *Mesoscincus* Griffith, Ngo and Murphy, 2000 (*schwartzei*, *altamirani*, *managuae*) was only represented by an individual of the last species in our analysis. As this species is not grouped with the American subgroup (as one might have expected from a zoogeographical perspective) and it appears as sister taxon to the African clade (with only low bootstrap support) in the cladograms this is a clear indication of its generic distinction. While Taylor (1935) thought this species-group to be closely related to the Asiatic forms, the results of the molecular analyses indicate a closer relationship to the African species. An analysis with a more comprehensive taxon sampling may reveal differing affinities, and we presently cannot judge the validity of such a relationship.

Although the type species of *Eumeces*, *E. pavimentatus*, is part of the African radiation of the genus, Griffith et al. (2000) ignored this fact and installed the subfamily *Eumecinae* (which incorporated all species of the *Pariocela* section), which they thought to be the most basal of all Scincinae. Implying a dispersalist hypothesis, this would imply that all known species of skinks originated in North America. Regarding the low number of synapomorphies for this subfamily, and the fact that one of the two used characters is the general shape of the head (which is, of course, strongly ecologically influenced; but compare discussion below), this is a rather daring approach.

They additionally tried to suppress the correct nomenclatural situation by applying to the ICZN to designate *Lacerta fasciata* Linnaeus, 1758 as the type species of *Eumeces* (Murphy et al., submitted). That way, they would be able to keep the name *Eumeces* for the species of the *Pariocela* section, while giving a new generic name, *Novoeumeces*, to the former *E. schneideri* species-group. Because a polarity decision of the used molecular data cannot be made unambiguously, the recovered topologies can neither confirm nor refute the validity of such a subfamily. The positioning of the two non-*Eumeces scincines* varies throughout the different molecular analyses, partly supporting (Fig. 3) the proposed subfamily but also refuting it (Fig. 2).

However, even if the subfamily *Eumecinae* represents a true monophyletic group, Griffith et al.'s (2000) justification to "preserve the genus for most of the species […] and the vast majority [of] literature", expresses only a "personal preference" of these authors and does not represent any taxonomical problem, which is of concern for the ICZN. While in the Code all kinds of exceptional taxonomic situations are presented (ICZN, 1999), the situation discussed above is not related to any of them. Therefore the name *Novoeumeces* Griffith, Ngo and Murphy, 2000 must be considered an objective junior synonym of *Eumeces* Wiegmann, 1834 (comp. also Bauer et al., 2003: 269). From the results discussed above, the name *Eumeces* must be restricted to the African *E. schneideri* species-group of *Eumeces* sensu lato, while the North American and the remaining Asian species must be renamed. Since this whole group has always been referred to as the *Pariocela* species-group and to avoid further taxonomic confusion, a designated type species for the group should be chosen so that this name can be elevated to genus rank.

The close relationships of the species of the genera *Scincopus* and *Scincus* with respect to

Eumeces sensu stricto (see above) is corroborated by the respective genetic distances (Table 3). While among the specimens of *E. algeriensis* (0.3-1.3%) and *E. schneideri* (0.0-0.1%) respectively, only low to very low differences are present, there is a strong interspecific differentiation between the two (8.4-9.1%). As the intergeneric differences of both species to *Scincopus* (10.0-10.4% and 10.1-10.7%, respectively) and even more to the two species of *Scincus* examined (8.8-9.6% and 7.3-8.6%, respectively) are at the same level as the intrageneric differences, the taxonomic status of both *Scincopus* and *Scincus* as independent genera appears questionable.

Within the *Pariocela* section, the analysis shows that "*E.*" *egregius* and *Neoseps reynoldsi* are sister species. The genetic differentiation between the two species (5%), both of which are endemic to Florida, is at the same general level as between the other species of the section, and therefore *N. reynoldsi* is a specialized member of the *Pariocela* section of *Eumeces* sensu lato, which has developed a distinct morphology (Schmidt, 1955) as a consequence of its burrowing mode of living. This is another striking example, that ecologically variable morphological characters should only be used in any phylogenetic analysis if they are interpreted with the utmost caution. As a consequence, the name *Neoseps* Stejneger, 1910 must be synonymised. If the name *Pariocela* Fitzinger, 1843 should be retained for the group, *Neoseps* would become its objective junior synonym (see also Telford, 1959; Richmond and Reeder, 2002).

Despite the incompleteness of the taxon sampling, the recovered topologies support some of the proposed subgroups within the *Pariocela* section. The *laticeps* species-group (*laticeps*, *inexpectatus*, *fasciatus*) as already defined by Taylor (1935) is part of a well supported clade, which also includes the species of the *obsoletus*- and *anthracinus* species-groups (*obsoletus*, *septentrionalis*, *obstusirostris*). This former group is supposed to be closely related to some Asian species (Taylor, 1935), which cannot be confirmed here due to the lack of Asiatic voucher species. "*Eumeces*" *anthracinus* itself is not part of this group, since it is consistently placed outside the latter clade, and is mostly recovered as sister species to "*E.*" *egregius*.

Lieb (1985) regarded "*E.*" *latiscutatus* as a member of the *laticeps* species-group. This arrangement is not confirmed by the present work, since the *laticeps*-group is always placed far from the two specimens of *latiscutatus* in the cladograms. Nonetheless, it is interesting to note that the position of the latter species is inconsistent in the different trees. All analyses place *latiscutatus* as sister-group to the *Pariocela* species-group. Since a biochemical analysis by Kato et al. (1994) shows *latiscutatus* to be deeply embedded in an East Asian radiation, and several studies about the origin of the North American scincid fauna propose an Asian origin for all scincid species, a positioning of *latiscutatus* in a basal position to the rest of the *Pariocela* section appears possible.

The included species of the *skiltonianus* species-group (*skiltonianus*, *gilberti*, *rubricaudatus*) form a strongly supported clade. However, the expected clustering of the included species and subspecies of the group is not as expected by the respective taxonomic status given to the different forms, as one would expect true subspecies to be related closest to the respective nominate form. The shown topologies are explained by the observed genetic differences between the included forms. "*Eumeces*" *gilberti rubricaudatus* is more closely related to *s. skiltonianus* (2.0%) than to its nominate species *g. gilberti* (2.2%). A comprehensive genetic analysis by Richmond and Reeder (2002), which included 53 populations of the different morphospecies of the *skiltonianus* species-group, found that the current distribution and morphotypes are the result of an ecological speciation, and that the evolutionary changes in body size are correlated with differences in adult colour pattern. They conclude that body size was likely the target of natural selection and that differences in colour pattern are probably "secondary consequences of evolving large body size". This is a good example that, despite the undisputed usefulness of morphological differences and mitochondrial DNA in taxonomic classifications, the utmost care must be taken when dealing with recently evolved and closely related parapatric species-groups.

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TAXONOMIC STATUS OF THE COLUBRID SNAKE *SIBYNOPHIS SUBPUNCTATUS* (DUMÉRIL, BIBRON & DUMÉRIL, 1854)

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ABSTRACT.– **There is confusion in the literature regarding the taxonomic status of the colubrid snake *Sibynophis subpunctatus* (Duméril, Bibron & Duméril, 1854). Originally described from the Western Ghats of India, occasionally *S. subpunctatus* has been considered a junior synonym of its north-eastern Indian congener *S. sagittarius*. Our preliminary re-examination of material, including type specimens, is consistent with the view that the two species are morphologically distinct. The two species appear to be geographically disjunct, with *S. subpunctatus* occuring in Sri Lanka and western peninsular India, and *S. sagittarius* in North and North East India. A more detailed reassessment is required.**

KEYWORDS.– **Sibynophis, Colubridae, India, Sri Lanka, Western Ghats.**

INTRODUCTION

The colubrid snake genus *Sibynophis* Fitzinger, 1843 comprises some nine species (Appendix I) distributed in southern and south-eastern Asia. Up to three species are known from mainland India, *S. collaris*, *S. subpunctatus*, and *S. sagittarius* (Das, 1994, 1997), though the taxonomy of the latter two is confused. *Sibynophis subpunctatus* (sensu Smith, 1943) was first referred to and figured by Seba (1734: plate XI). Jerdon's (1853: 528) mention of "*Calamaria sagittaria*" in peninsular India probably also corresponds to *S. subpunctatus* (see Wall 1921: 84). Duméril et al. (1854) described *Oligodon subpunctatum* based on a single specimen from "Malabar" in the Western Ghats region of peninsular India. Boulenger (1890) transferred the species to his new genus *Polyodontophis*, and this was followed by Wall (1907, 1921 and 1923), Prater (1924) and Fraser (1936-7). Schmidt (1926) may have first used the combination *Sibynophis subpunctatus*, and later workers, including Smith (1943) and Taylor (1950) followed this.

In a revision of *sibynophiines*, Morgan (1973) considered *Sibynophis subpunctatus* a synonym of *Sibynophis sagittarius* (Cantor, 1839), a species originally described from Bengal, NE India. Morgan (1973: 71) wrote, "Although Wall (1907) suggested that *Polyodontophis subpunctatus* (= *S. subpunctatus*), the name applied to specimens from southern India and Ceylon, should be considered a synonym of *P. sagittarius* (= *S. sagittarius*), most workers have continued to follow Boulenger's arrangement recognizing 2 species (e.g. Bourret, 1936; Taylor, 1950). In view of the clinal variation exhibited in ventral numbers and dorsal coloration, I feel that the recognition of only 1 species is warranted."

Wall's (1907: 824) proposed suppression of *S. subpunctatus* was based on a single specimen with eight supralabials on the left side (with the fourth and fifth contacting the eye) and nine supralabials on the right (with the fourth, fifth and sixth contacting the eye). Boulenger (1890) had considered the number of supralabials to be a key character for distinguishing *Polyodontophis* (now *Sibynophis*) *subpunctatus* from *P.* (= *S.*) *sagittarius*. After sending his specimen to London for examination, Wall (1907: 824) followed Boulenger's advice and united the two taxa. However, Wall (1923: 599) later changed his view: "Note.- In the Bombay Natural History Journal (Vol. XVII, p 823) I referred to a specimen, that appeared to unite the characters of *subpunctatus* and *sagittarius*, and which suggested the union of the two species under the latter and older name. I am now in a position to show that the two species previously held as such are both valid, and that the specimen referred to is an aberrant *subpunctatus*. This view is based on skulls in my collection. The dentition is as follows:- *subpunctatus*. Maxillary 44 to 45. Palatine 23 to 24. Pterygoid 21. Mandibular 40. – *sagittarius*. Maxillary 32. Palatine 14 to16. Pterygoid 13. Mandibular 30. The specimen referred to was probably from the Northern part of the Western Ghats as it was preserved in the same bottle as a *Lycodon flavomaculatus*, which has a very limited distribution. (q. v.)" Morgan (1973) neither referred to Wall's (1923) revalidation nor otherwise cited this publication.

Wall's (1907) earlier proposed synonymy and later (1923) revalidation may have caused some taxonomic instability. For example, Daniel & Shull (1964: 740) noted that "There appears to be confusion in collection records between this species and *S. sagittarius*." Morgan's proposed synonymy has received a varying reception, being both ignored/rejected (though not explicitly by e.g. Whitaker, 1978; P. De Silva, 1980; Deoras, 1981; Mahendra, 1984; Murthy, 1985, 1986, 1990; Welch, 1988; A. De Silva, 1990, 1996, 1998; Das, 1994, 1996; Sharma, 1998, 2002, 2003; Schleich & Kästle, 2002) and followed (e.g., implicitly by Murthy and Sharma, 1978; Das, 1997; Vyas, 2000).

REASSESSMENT

We briefly reassessed Morgan's proposed synonymy by examining material of *S. subpunctatus* and *S. sagittarius*, including the types stored in the Museum National d'Histoire Naturelle, Paris (MNHN) and The Natural History Museum, London (NHM), respectively. Tooth counts for seven specimens are presented in Table 1. Where observations overlap, our counts essentially match those given by Wall (1923). Morgan (1973: table 33) also presented data on the variation in the number of maxillary teeth (32 to 48) in 22 specimens matching his concept of *S. sagittarius*. The majority (18) of these specimens had counts of 42 or greater, while two (32 and 35 maxillary teeth) match Wall's counts for his concept of *S. sagittarius*. Only two specimens (37 and 39 maxillary teeth) fall between these values. Morgan did not explicitly link maxillary tooth counts with locality, but there is nothing to suggest that the specimens with low tooth counts comprised anything other than the few available northern Indian specimens, that can be putatively identified as *S. sagittarius*.

Morgan (1973) also considered variation in putative *S. subpunctatus* and *S. sagittarius* in terms of scalation (numbers of supralabials, infralabials, temporals, ventrals, and subcaudals) and coloration, and concluded that only a single species should be recognized. The majority (37 of 48) of the specimens examined by Morgan (1973: table 9) are from Sri Lanka and peninsular India, and no substantial differences in mean ventral scale counts was detected between the samples from these two areas (contrary to De Silva, 1969, who proposed Sri Lankan *S. subpunctatus* to comprise a distinct subspecies, *S. s. ceylanicus*). Thus, the supposed clinal variation in *S. sagittatius* (*sensu* Morgan) is unevenly distributed across its range, being absent across Sri Lanka and peninsular India, but present between these areas and North/North East India. Importantly, Morgan (1973: 66) noted that "Analysis of geographic variation in *S. sagittarius* is impeded by a low number of specimens from the northern areas of the range."

Morgan (1973) discussed only maxillary tooth counts, but there are also substantial differences in tooth counts for the palatal and mandibular elements between putative *S. subpunctatus* and *S. sagittarius* (Table 1). Sample sizes remain small, but we consider these differences to be

TABLE 1: Left/right tooth counts (made by DJG and PD) for *Sibynophis subpunctatus* and *S. sagittarius*. Counting was difficult for wet, whole specimens, so that values represent estimates based on repeated counts. The three dried skulls are part of Wall's collection. Abbreviations: - = count not made; ? = element missing or incomplete; * = holotype, † = lectotype (see Kramer, 1977: 747).

Species	Specimen	Locality	Preparation	Tooth Counts (left/right)				
				Maxilla	Palatine	Pterygoid	Palatine + Pterygoid	Mandible
S. subpunctatus	MNHN 3240*	"Malabar"	wet, whole specimen	42/>42?	-/-	-/-	44/42	37/38
S. subpunctatus	MNHN 1885.628	"Ceylon"	wet, whole specimen	44/45	-/-	-/-	47/46	38/39
S. subpunctatus	MNHN 7503	no data	wet, whole specimen	44/47	-/-	-/-	45/44	41/40
S. subpunctatus	BMNH 1930.5.8.163	Galle, Sri Lanka	dried skull	46/44	24/23	21/21	45/44	?/40
S. sagittarius	BMNH 60.3.19.12.68†	Bengal	wet, whole specimen	~32/32	-/-	-/-	<30/27	29/>26
S. sagittarius	BMNH 1930.5.8.161-162	Uttar Pradesh, N India	dried skull	35/?	16/16	18/15	34/31	?/?
S. sagittarius	BMNH 1930.5.8.161-162	Uttar Pradesh, N India	dried skull	?/?	16/16	15/13	31/29	?/30

substantial and taxonomically significant. Wall was an avid and insightful counter of teeth, and he considered the differences he observed between putative *S. subpunctatus* and *S. sagittarius* to be indicative of separate species.

Smith (1943) listed some other differences in the external morphology of these two species, most notably the number of supralabials (seven or eight in *S. sagittarius*, nine or rarely eight in *S. subpunctatus*) and anterior temporals (usually one in *S. sagittarius*, two in *S. subpunctatus* - where the lower 'anterior temporal' is not in contact with a postocular). These differences hold true for the type specimens of *S. sagitttarius* and *S. subpunctatus*, which have seven and nine supralabials, and one and two anterior (and posterior) temporals, respectively, on each side (PD, DJG, pers. obs.).

In conclusion, we do not find Morgan's (1973) evidence to be sufficient basis for the suppression of *Sibynophis subpunctatus*, and thus we recognise this species as valid pending a more detailed reassessment. *Sibynophis subpunctatus* and *S. sagittarius* appear to be geographically disjunct, with the former species occurring in Sri Lanka and western peninsular India, and the latter in central and northeastern India and neighbouring countries. Abdulali (1948) reported a specimen from Ambarnath, near Bombay (Mumbai) at the northern end of the Western Ghats of peninsular India as *S. sagittarius*. However, examination (by AC and Varad Giri) of the only Ambarnath specimen of *Sibynophis* in the collections of the Bombay Natural History Society (BNHS S.1312, deposited by Abdulali in 1956), found its supralabial and temporal scalation to agree with that of the holotype of *S. subpunctatus*. Other Western Ghats specimens catalogued in collections as "*S. sagittarius*" will need to be reassessed in future. Smith (1943: 279) understood the distribution of *S. subpunctatus* to occur in two major zones, North of 18° and South of 14°, with differing, though overlapping ranges of numbers of ventral scales. Assessment of intraspecific variation and possible geographic disjunction within *S. subpunctatus* should also be subject to future evaluations.

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APPENDIX I

CURRENTLY RECOGNISED SPECIES OF THE GENUS *SIBYNOPHIS* FITZINGER, 1843

Sibynophis bistrigatus (Günther, 1868)
Sibynophis bivittatus (Boulenger, 1894)
Sibynophis chinensis (Günther, 1889)
Sibynophis collaris (Gray, 1835)
Sibynophis geminatus (Boie, 1826)
Sibynophis melanocephalus (Gray, 1853)
Sibynophis sagittarius (Cantor, 1839)
Sibynophis subpunctatus (Duméril, Bibron & Duméril, 1854)
Sibynophis triangularis Taylor & Elbel, 1958

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ADDENDA AND CORRIGENDA TO THE CATALOGUE OF REPTILE TYPES IN THE COLLECTION OF THE ZOOLOGICAL SURVEY OF INDIA

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ABSTRACT.– **This paper lists types of reptile species in the Zoological Survey of India that have been added to the collection or identified since the the catalogue of the institution was published by Das et al. (1998). It includes the following species: *Tachydromus sikkimensis* Günther, 1888, *Anguis Melanosticta* Schneider, 1801, and *Lycodon zawi* Slowinski, Pawar, Win, Thin, Gyi, Oo & Tun, 2001.**

The paper also corrects a few errors and summarises updates on taxonomy of species listed in the older catalogue: the type locality of *Calotes bhutanensis* Biswas, "1975" 1976, the correct allocation of the nomen *Chamaeleo verrucosus* Blyth, 1853 and of *Dipsas nigromarginata* Blyth, 1854, the current status of *Lygosoma mitanense* Annandale, 1905, the correct spelling of the current status of *Varanus macrolepis* Blanford, 1881 and of *Elaps personatus* Blyth, 1854, the correct type catalogue numbers of *Varanus salvator andamanensis* Deraniyagala, 1944, ? *Dendraspis hannah brunnea* Deraniyagala, 1961 and of *Typhlops braminus* var. *arenicola* Annandale, 1906, the nature of type of *Oligodon erythrogaster* Boulenger, 1907, and the fact that no types of *Coronella taeniolata* Jerdon, "1853" 1854 were ever designated.

KEY WORDS.– **Zoological Survey of India, reptiles, type catalogue, addenda and corrigenda.**

INTRODUCTION

An annotated list of the reptile types in the collection of the Zoological Survey of India (subsequently, ZSI) was provided by Das et al. (1998). Two other papers dealing with the herpetological types of the ZSI have appeared subsequently: Chanda et al. (2000) enumerated the amphibian types of the same institution and Bauer and Das (1999) listed some North American herpetological material of historical importance in this collection, including the types of two snake species.

The present paper lists types of reptile species in the ZSI that have been added or identified since these papers were published, and corrects a few errors. Original names as proposed are regarded as valid unless otherwise noted under 'Current name'.

COMMENTS ON TYPES

SAURIA

Agamidae

Calotes bhutanensis Biswas, "1975" 1976. J. Bombay nat. Hist. Soc. 72(3): 775.

Type locality: Spelt as 'Janjurmane' in both the original description and in the catalogue of Das et al. (1998), should be spelt 'Panjurmane' (see Bauer and Günther, 1992).

Chamaeleonidae

Chamaeleo verrucosus Blyth, 1853. J. Asiatic Soc. Bengal 22(7): 646.

Current name: Subjective synonym of *Furcifer verrucosus* (Cuvier, 1829)

Reference: Böhme and Das (2001).

Lacertidae

Tachydromus sikkimensis A. C. L. G. Günther. 1888. Ann. & Mag. nat. Hist. ser. 6 1: 167.

Type: "Sikkim" [in eastern India]; based on the description by Ferdinand Stoliczka on ZSI 5368, which is here considered the holotype.

Current status: Questionably treated as synonymous with *Takydromus sexlineatus* Daudin, 1802 by Arnold (1997).

Scincidae

Anguis Melanosticta J. G. Schneider. 1801. Hist. Amph. Nat.: 323.

Type: ZSI 20627 (neotype designation by Das, 2000), "Visakhapatnam (17º 42'N; 83º 18'E), Andhra Pradesh State, South-eastern India, 47.8 m above mean sea level".

Lygosoma mitanense Annandale, 1905. J. & Proc. Asiatic Soc. Bengal n.s. 1(5): 144.

Remarks: Yamasaki et al. (2001) treated this nomen as a valid subspecies of *Sphenomorphus maculatum* (Blyth, 1853), instead of a synonym.

Varanidae

Varanus macrolepis Blanford, 1881. J. Asiatic Soc. Bengal 1(4): 239.

Remarks: *Varanus dumerilii* for *Varanus dumerili*, the current name for *Varanus macrolepis* Blanford, 1881.

Varanus salvator andamanensis Deraniyagala, 1944. Spolia Zeylanica 24(1): 61.

Types: ZSI 2176 for ZSI 22176 (holotype); ZSI 2174 for ZSI 22174 (paratype), from "Port Blair, Andaman Islands" (in the Bay of Bengal, India).

SERPENTES

Colubridae

Coronella taeniolata Jerdon, "1853" 1854. J. Asiatic Soc. Bengal 22(6): 528.

Remarks: Bauer (2003) provided extensive discussions on the name, and concluded that no types were ever designated.

Dipsas nigromarginata Blyth, 1854. J. Asiatic Soc. Bengal 23(3): 294.

Current status: Subjective synonym of *Boiga cyanea* (Duméril, Bibron & Duméril, 1854).

Lycodon zawi Slowinski, Pawar, Win, Thin, Gyi, Oo & Tun, 2001. Proc. California Acad. Sci. 52(20): 398.

Types: ZSI 25346 (paratype), "Ngenpui Wildlife Sanctuary (NgWS; 22°29'N, 92°48'E), Mizoram, Northeast India"; ZSI 25347 (paratype), "Nongkhyllem Wildlife Sanctuary (NWS; 25°56N, 91°31'E), Meghalaya, Northeast India"; ZSI 25348 (paratype), "Garbhanga Reserve Forest (GRF; 26°09'N, 91°33'E), Assam, Northeast India".

Other types are: CAS 2103023 (holotype), "Alaungdaw Katapha National Park (AKNP) (22°19'N, 94°29'E), Sagaing Division, Myanmar"; CAS 210223 (paratype), "AKNP (22°19'N, 94°29'E), Sagaing Division, Myanmar"; CAS 215494 (paratype), "AKNP (22°19'N, 94°29'E), Sagaing Division, Myanmar"; CAS 215570, "AKNP (22°19'N, 94°29'E), Sagaing Division, Myanmar"; CAS 215599 (paratype), "AKNP (22°19'N, 94°29'E), Sagaing Division, Myanmar"; CAS 216505, "Gwa Township (17°39N, 94°39'E), Rakhine State, Myanmar".

Oligodon erythrogaster Boulenger, 1907. Rec. Indian Mus. 1(3): 216.

Type: ZSI 15850 is the holotype, rather than a syntype.

Elapidae

? *Dendraspis hannah brunnea* Deraniyagala, 1961. Spolia Zeylanica 29(2): 229.

Type: ZSI 8294 for ZSI 8924 (holotype), "Darjeeling" (in West Bengal State, eastern India).

Elaps personatus Blyth, 1854. J. Asiatic Soc. Bengal 23(3): 297.

Current status: Subjective synonym of *Sinomicrurus macclellandii* (Reinwardt, 1844), generic allocation by Slowinski et al. (2001).

Typhlopidae

Typhlops braminus var. *arenicola* Annandale, 1906a. Mem. Asiatic Soc. Bengal 1(1): 192.

Types: ZSI 15457-58 for ZSI 5457-58 (syntypes), from "Rámanád" (in Tamil Nadu State, southern India).

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AN OVERVIEW OF THE BIODIVERSITY OF INDIAN CAECILIANS (AMPHIBIA: GYMNOPHIONA)

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ABSTRACT.– **A brief overview of the caecilian diversity of India is presented. The fauna consists of 21 species in three families, concentrated primarily in the Western Ghats, but also in the Eastern Ghats and in north-eastern India. The taxonomy, distribution, ecology, and life history of caecilians in India, as elsewhere, are inadequately studied, but some recent progress is reviewed. Studies are hampered by the small sample size available for most species. Improved taxonomy is urgently required, and this can form the basis for other studies, including conservation assessments.**

KEY WORDS.– **Ichthyophiidae, Uraeotyphlidae, Caeciliidae, Western Ghats, natural history, conservation.**

INTRODUCTION

Caecilians (Order Gymnophiona) are elongate, limbless, primarily burrowing amphibians, some of which are secondarily aquatic. They can be superficially mistaken for snakes or, because of annuli on their bodies, large earthworms. The global distribution pattern of Gymnophiona reveals that many of the species and some of the families are restricted in their distribution. Even in the four continents and a few island groups in which the families are found, they are mostly confined to moist areas in the tropical and equatorial regions at both lower and higher altitudes. India is relatively rich in caecilian biodiversity. With an area encompassing 2.2% of the land surface of the Earth, India is known to be home for 21 of the 158 or so caecilian species thus far named (Nussbaum and Wilkinson, 1989). Three of the six recognised families occur in India- Ichthyophiidae, Uraeotyphlidae, and Caeciliidae. The species known today may at best represent only a portion of the final total, and the biology of most of the Indian species is yet to be revealed. The taxonomy, phylogeny, biology and ecology of Gymnophiona have a busy future. The objective of this paper is to provide an overview of the caecilian diversity of India, ready for much needed future studies.

DIVERSITY AND DISTRIBUTION

India has a rich and generically more diverse amphibian fauna than any other part of the Oriental Region. Caecilians comprise about 10% of the 229 known Indian amphibian species (Inger and Dutta, 1986; Dubois, 1987,1992; Dutta, 1997; Das and Dutta, 1998; Pillai and Ravichandran, 1999; Dutta and Ray, 2000; Dutta et al., 2000; Das, 2000; Krishnamurthy et al., 2001; Dubois et al., 2001; Das, 2002). Of the six families, 34 genera and 158 nominate species of Gymnophiona recognized globally, three families, four genera and 21 species are known from India. Thus India is home to about 13% of the caecilian species of the World. Of the three families found in India, Uraeotyphlidae with its five species in the monotypic genus *Uraeotyphlus* is endemic to the southern ranges of the Western Ghats. Ichthyophiidae, distributed in India, Sri Lanka and south-east Asia (Taylor, 1968; Gower et al., 2002), is known in India from 11 species of *Ichthyophis*. The most speciose caecilian family Caeciliidae is distributed also in tropical and cen-

TABLE 1: Summary of taxonomy and distribution of Indian caecilians, based on Pillai and Ravichandran (1999).

	Distribution			Remarks
	North-east	Eastern Ghats	Western Ghats	
I. FAMILY: ICHTHYOPHIIDAE				
1. Genus: *Ichthyophis* Fitzinger				
I. beddomei Peters	-	-	+	Endemic to Western Ghats
I. bombayensis Taylor	-	-	+	Endemic to Western Ghats
I. garoensis Pillai & Ravichandran	+	-	-	Endemic to North-east India
I. glutinosus (Linnaeus)	+	-	-	Sri Lanka, and India?
I. husaini Pillai & Ravichandran	+	-	-	Endemic to North-east India
I. longicephalus Pillai	-	-	+	Endemic to Western Ghats
I. malabarensis Taylor	-	-	+	Endemic to Western Ghats
I. peninsularis Taylor	-	+	+	Eastern & Western Ghats
I. sikkimensis Taylor	+	-	+	North-east India & Western Ghats.
I. subterrestris Taylor	-	+	+	Eastern & Western Ghats.
I. tricolor Annandale	-	-	+	Endemic to Western Ghats
II. FAMILY: URAEOTYPHLIDAE				
2. Genus: *Uraeotyphlus* Peters				
U. interruptus Pillai & Ravichandran	-	-	+	Endemic to Western Ghats
U. malabaricus (Beddome)	-	-	+	Endemic to Western Ghats
U. menoni Annandale	-	-	+	Endemic to Western Ghats
U. narayani Seshachar	-	-	+	Endemic to Western Ghats
U. oxyurus (Duméril & Bibron)	-	-	+	Endemic to Western Ghats
III. FAMILY: CAECILIIDAE				
3. Genus: *Indotyphlus* Taylor				
I. battersbyi Taylor	-	-	+	Endemic to Western Ghats
4. Genus: *Gegeneophis* Peters				
G. carnosus (Beddome)	-	-	+	Endemic to Western Ghats
G. fulleri (Alcock)	+	-	-	Endemic to North-east India
G. krishni Pillai & Ravichandran	-	-	+	Endemic to Western Ghats
G. ramaswamii Taylor	-	-	+	Endemic to Western Ghats

tral South America, Africa (including an island in the Gulf of Guinea) and the Seychelles, and is represented in India by five species in two genera - *Indotyphlus* and *Gegeneophis.* The three caecilian families not found in India are the South American Rhinatrematidae and Typhlonectidae and the African Scolecomorphidae (Taylor, 1968). A summary of the caecilian fauna of India, based on the latest revision (Pillai and Ravichandran, 1999), is given in Table 1.

ENDEMISM AND SPECIES PACKING

Of the 21 caecilian species reported from India, a remarkable 20 are endemic. *Ichthyophis glutinosus* was originally described from Sri Lanka. At one time this species was considered to be widespread through southern and south-eastern Asia, but Nussbaum and Gans (1980) claimed that it is endemic to Sri Lanka. In the most recent revision, Pillai and Ravichandran (1999) reported one specimen from Assam in north-east India, based on external morphological features. Other workers think this is unlikely (Dutta, 2002; M. Wilkinson, pers. comm., 2001), and a more detailed reassessment is probably required.

From distributional records it is apparent that the hot spot of known caecilian diversity in India is the Western Ghats of peninsular India, harboring 17 species (81% of the Indian fauna) of which 14 species are endemic to these Ghats. Of the 17 Western Ghats species, 14 are known from the southern part of the range, including seven species endemic to this area. Two of the Indian endemic species, *Ichthyophis peninsularis* and *I. subterrestris* have been claimed to be distributed in both the Eastern and Western Ghats. As for the five species reported from northeastern India, *I. garoensis, I. hussaini* and *Gegeneophis fulleri* are endemic to this area while *I. sikkimensis* is also believed to occur in the Western Ghats (Pillai and Ravichandran, 1999). The fifth species *I. glutinosus* (if confirmed) is found in both India and Sri Lanka. Thus, while *Ichthyophis* is distributed in the Eastern and Western Ghats and also northeastern India, *Gegeneophis* is found only in the Western Ghats and north-eastern India. All five species of *Uraeotyphlus* and the only species of *Indotyphlus* are endemic to the Western Ghats. For caecilians, the Western Ghats are better explored than the Eastern Ghats or the North East, so it is difficult to draw firm conclusions on patterns of diversity from current, probably incomplete knowledge.

PHYLOGENY AND EVOLUTION

Few explicit analyses of caecilian phylogeny have been undertaken. The first study to include Indian species in analyses of DNA sequence data was that by Wilkinson et al. (2002). They found support for a sister-group relationship of Ichthyophiidae + Uraeotyphlidae (also recovered in some studies of morphology, e.g., Wilkinson and Nussbaum, 1996; Wilkinson, 1997), and hypothesised that, among taxa sampled, Indian caeciliids (represented by *Gegeneophis ramaswamii*) are most closely related to the Seychellean caecilians. Gower et al. (2002) sampled more ichthyophiids from southern and south-eastern Asia and more uraeotyphlids. They found that Ichthyophiidae (and *Ichthyophis*) might not be a natural group, with some unstriped Indian *Ichthyophis* possibly being more closely related to *Uraeotyphlus* than to other *Ichthyophis*. Unstriped and striped *Ichthyophis* probably do not represent natural groups within the genus. Gower et al. (2002) and Wilkinson et al. (2002) found support for the hypothesis that caecilians reached present-day Asia from the Indian subcontinent after it broke away from Gondwana and connected with the rest of Asia during the Mesozoic.

HABITS AND HABITATS

Their subterranean habits have led many biologists to believe that terrestrial caecilians are rare, and there are few places where they are known to be common. To see many one has to search carefully (usually by digging) and be at the right place at the right time. This is usually some days after the onset of the rainy season (Hofer, 2000), when they may become more conspicuous for just a few weeks. A few Indian species like *G. ramaswamii*, up to a certain degree, adapt to changes in the habitat and are found in cleared land used to raise paddy, coffee, tea, rubber and cardamom as well as in “natural” habitats (Oommen et al., 2000). Some caecilian species are even attracted to human dumping sites. While a few terrestrial caecilians live under decaying vegetation, many of them spend much of their time in tunnels burrowed in soil (Himstedt and Simon, 1995).

No fully aquatic Indian caecilians are known. The majority of the Indian species are known from the hill regions of the Western Ghats, and to a lesser degreee in the Eastern Himalaya and the Eastern Ghats. A few species are found in lower elevations, such as *Gegeneophis ramaswamii* which is found from sea level to an altitude of at least 600 m (Oommen et al., 2000). Other species, such as *Ichthyophis sikkimensis* found in Darjeeling, occupy higher elevations even beyond 2150 m. Gundappa et al. (1981) suggested acidic soil to be possible prerequisite for caecilians, but Oommen et al. (2000) found this not to be the case for *G. ramaswamii, Ichthyophis tricolor* and *Uraeotyphlus* sp. in some localities in the southern Western Ghats.

There are few estimates of the abundance of caecilians in India or elsewhere. However, there are quantitative data for collections of a few species from the Western Ghats. Bhatta (1997) reported a mean abundance of 0.037 individuals per m^2 based on his surveys covering several species at 24 sites at 8 localities in the Western Ghats. Oommen et al. (2000) estimated populations of *G. ramaswamii* to vary locally from 0.44-0.89 individuals per m^2 near Punalur to 1.13 per m^2 at Bonaccord, further South, both in the southern Western Ghats. Measey et al. (2003a, b) also recorded high local densities of this species.

Few studies of the diet of Indian caecilians have been carried out. Pillai and Ravichandran (1999) pointed out that despite a lack of studies, their diet probably includes earthworms and soil arthropods. Recently, more detailed studies have shown *Gegeneophis ramaswamii* to be an opportunistic generalist predator of soil invertebrates and occasionally vertebrates (Presswell et al., 2002; Measey et al., 2004).

Indian caecilians are probably primarily inhabitants of moist forests. These habitats are threatened in India as elsewhere. Some species might adapt to agriculture, but it might be that more intensive farming with the use of agrochemicals is detrimental to caecilians (Hofer, 2001).

LIFE HISTORY

Life history details of few Indian species are known. As far as is known, all ichthyophiids are oviparous and have a free-living, aquatic larval stage. As for Uraeotyphlidae, the only species for which information is available (*Uraeotyphlus oxyurus*) has a larval stage with some morphological features also found in ichthyophiids (Wilkinson, 1992). In contrast, the majority of caeciliids are either oviparous with direct development or are viviparous. Where known, *Gegeneophis* are oviparous, and to date no viviparous caecilians are known from India.

Some scanty information is available on the eggs, embryos and parental care of a few species of *Ichthyophis* and *Gegeneophis* represented in India. Seshachar (1942) observed a clutch of 15 eggs in *Gegeneophis carnosus* (Beddome), superficially resembling such clusters more well known in the Sri Lankan *Ichthyophis glutinosus* (e.g., Sarasin and Sarasin, 1887-1890). The largest number of eggs in one clutch of an Indian caecilian was observed by Seshachar et al. (1982) at Sringeri in Karnataka, where a female *Ichthyophis malabarensis* was found guarding 100 eggs. Another female of this species with a clutch of 82 eggs was collected by Balakrishna et al. (1983) from the same locality. Tikader (1965) and Pillai and Ravichandran (1999) each reported females of *Ichthyophis beddomei* coiled round clutches of 15 eggs.

Of the Indian species of *Ichthyophis*, Ramaswami (1947) reported the larvae of *I. peninsularis* from Kambakkam in Tamil Nadu, in the southern part of the Eastern Ghats. Bhatta (1999) reported briefly on captive breeding in *I. beddomei* and *I. malabarensis*, where the egg clutches of *I. beddomei* contained 19 ± 8 eggs and those of *I. malabarensis* 86 ± 8 eggs. Larvae of *I. longicephalus,* a species for which only one adult specimen (the holotype) was available at the time of the original species description, were not uncommon in the small streams joining the Kunti river in Silent Valley, from where 40 young ones in various stages of development were collected in January 1979 (Pillai, 1986).

CONSTRAINTS

There are several hurdles that face herpetologists pursuing studies of Indian caecilians. Firstly the taxonomy and phylogeny of this group are still poorly defined owing to a limited understanding of key characters distinguishing species. The characters presently in vogue (e.g., numbers of annuli and teeth) are incompletely understood in their intra- and interspecific variation. The paucity of available material compounds this, and makes comparative studies difficult, especially examination of skeletal and internal anatomical characters. Many of the available museum specimens, including important type material, are more than 100 years old and often lack explicit locality data, being labeled 'Travancore-Cochin', 'Malabar', 'South India', 'Lower India' and so on. New fieldwork as well as museum and laboratory work is required.

CONCLUSIONS

The audit of caecilian diversity in India is far from complete. Because of their subterranean and secretive habits, and their sometimes restricted distribution and possibly limited home ranges, information on the richness and diversity of the caecilian fauna of India and the conservation status of those species so far known is totally inadequate. With the tragic biodiversity crisis the world is facing today, taxonomy is the starting point for conservation efforts. Despite this, taxonomy has long been a 'Cinderella' science, underfunded and understaffed. The fact that 20% of the Indian taxa, all new to science, were revealed by the study of a limited collection in the recent past (Pillai and Ravichandran, 1999) speaks for our limited information on even the alpha taxonomy of this group, leave alone the wider issues of conservation. It is reasonable to presume that the Indian taxa known so far may at best represent only a fraction of the final total. Intensive exploration of the vast, presumably species rich areas of northeastern India as well as the Eastern and Western Ghats, is needed to assess the faunal diversity and present day conservation status of this group.

Taxonomy has been changing. The conventional methods of pure morphological analysis are now supplemented by studies of molecular data. Detailed analysis using these new tools may force reappraisals of caecilian taxonomy at many levels. Some taxa named in past years, when variation of shape and colour and minor features might have distinguished new species, might be questioned, as has happened with some other vertebrate groups, including even supposedly better studied ones such as primates (e.g., Barnett, 2001).

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NOTE ADDED IN PROOF

Two new species of *Gegeneophis* have recently been described from the Western Ghats region of Maharashtra, *G. seshachari* Ravichandran, Gower and Wilkinson, and *G. danieli* Giri, Wilkinson and Gower.

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Long distance dispersal by a Travancore tortoise, *Indotestudo travancorica*

The Travancore tortoise (*Indotestudo travancorica*) is endemic to the Western Ghats of India and is considered 'Vulnerable' (IUCN, 2002). However, information on this species is sparse and mainly consists of incidental observations and locality records (Vijaya, 1983; Frazier, 1989; Das, 1991; Bhupathy and Choudhury, 1995; Radhakrishnan, 1998). The first field study of this species was carried out by the biologist, J. Vijaya in Chalakudy (Kodasseri Reserve Forest), Kerala, in 1983, but the results were not published and much of the raw data have been lost (Harry Andrews, pers. comm.). The next field study was carried out 20 years later in the neighbouring state of Tamil Nadu in the Indira Gandhi Wildlife Sanctuary (Ramesh, unpubl.). In this note, I report the first verified record of long-distance travel by the species.

In March 2003, I found a male *Indotestudo travancorica* in Karian Shola that had been marked by J. Vijaya. The tortoise had been double notched– two parallel strips of shell had been removed from the second marginal from the right (2R). It was measured (straight carapace length 266 mm, straight carapace width 168 mm, plastron length 192 mm, plastron width 155 mm, shell height 96 mm, anal fork 42.5 mm, anal notch 47.9 mm, weight 2.27 kg), and released. After examining Vijaya's data sheets, tortoise 2R was found to have been captured and notched on 1 October 1983 as a juvenile (carapace length 84 mm, carapace width 74 mm, plastron length 75 mm, shell height 44 mm, weight 189 g), and released on 15 November 1983. At the time of release, it had a body mass of 130 g.

Based on straight-line distance calculated from a map (Kerala, Tamil Nadu 58 B/15, scale 1: 50,000), the Kodasseri Reserve Forest is ca. 19.7 km from Karian Shola. However, the tribals in the sanctuary use a trail about 50 km in length to travel from Karian Shola to Kodasseri via the Parambikulam Wildlife Sanctuary. Tortoise 2R appears to have travelled at least 19.7 km to reach its present locality over the course of the last 20 years; if it followed human-made trails, it may have travelled as much as 50 km or more. Since dispersal distances by tortoises are poorly documented, the possibility of long-distance dispersal by this marked individual is noteworthy.

I would like to thank the Tamil Nadu Forest Department for permission to work in IGWLS; Centre for Herpetology, Madras Crocodile Bank for funding a field study on the species and Harry V. Andrews, Director, Centre for Herpetology, Madras Crocodile Bank Trust, for access to J. Vijaya's field records. I am grateful to the reviewers, especially C. Kenneth Dodd, Jr. for strengthening the manuscript.

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A first report on the herpetofauna of Pulau Besar, Johor, West Malaysia

The Seribuat Archipelago is composed of approximately 32 islands in the southern section of the South China Sea off the east coast of peninsular Malaysia. Only nine of these islands have had their herpetofauna documented: Pulau Tioman (Day, 1990; Grismer et al., 2002; Hien et al., 2001; Hendrickson, 1966a; Hendrickson, 1996b; Lim and Lim, 1999), Pulau Aur (Escobar et al., 2003a; Grismer et al., 2000), Pulau Sibu (Wood et al., 2004), Pulau Dayang (Wood et al., 2003), Pulau Tulai (Grismer et al., 2001; Grismer et al., 2002; Hendrickson, 1966a; Hendrickson, 1966b), Pulau Pemanggil (Youmans et al., 2000), Pulau Seribuat and Pulau Sembilang (Wood et al. 2003) and Pulau Tinggi (Escobar et al., 2003b).

Pulau Besar (103º 59’E; 02º 26’N) is a 5 x 2 km island located 18 km off the coast of Mersing, Johor, West Malaysia. It is dominated by a steep sided ridge extending the length of the island covered by primary and reinvaded secondary forest. Few granitic boulders are present. Two higher peaks occur along the ridge; Bukit Berot in the south, reaching 251 km and Bukit Atap Zink in the north, reaching 208 km.

Collections were made along a cross-island trail through the middle of the island from Kampung Aseania in the west to the crest of the island between 1800 and 0100 h on 22-23 July 2003 and from 0900 and 1130 h on 23 July 2003. Another collection along the coast south of Kampung Aseania was made on 30 August between 2000 and 2330 h and on 31 August between 2000 and 2300 h. Liver tissues were taken from representative specimens and preserved in 100% ethanol. Specimens were preserved using 10% formalin and stored in 70% ethanol. Specimens collected and observed are listed below and deposited in the Forest Research Institute Malaysia (FRIM), Kepong, Kuala Lumpur, Malaysia and the La Sierra University Herpetological Collection (LSUHC) of the Department of Biology, La Sierra University, Riverside, California. Photographic vouchers are deposited in the La Sierra University Photographic Collection (LSUPC).

ANURA (FROGS)

Ranidae

Fejervarya cancrivora (Gravenhorst, 1829).– Many individuals were observed sitting in and around brackish water near the inlet of an estuary. Another individual was observed sitting in a puddle of fresh water in a grassy field near the Coconut Island resort. Voucher specimen FRIM 0708.

Rhacophoridae

Polypedates leucomystax (Gravenhorst, 1829).– Many individuals were observed on the forest floor and on low-lying vegetation ranging 1-2 m above the forest floor. All individuals were observed at night. Voucher specimen FRIM 0702.

SQUAMATA (LIZARDS)

Agamidae

Aphaniotis fusca (Peters, 1864).– Several hatchlings, sub adults, and adults were observed at night sleeping on leaves and small twigs 1-3 m above the forest floor. Voucher specimen FRIM 0697.

Bronchocela cristatella (Kuhl, 1820).– One specimen was collected at 2300 h sleeping in a small tree approximately 2 m above the forest floor. Voucher specimen FRIM 0707.

Draco sumatranus (Schlegel, 1844).– One specimen was collected during midday on a large coconut palm approximately 6 m above the ground on the beach in Kampung Aseania. Voucher specimen FRIM 0695.

Gekkonidae

Cnemaspis kendallii (Gray, 1845).– Three specimens were observed. One was approximately 1.5 m above the ground facing head down on a medium sized dipterocarp (0.75 m in diameter) at 2230 h. Another was hanging upside down on the underside of a leaf in the typical sleeping position at 2345 h. Another was collected at 1120 h on another medium size dipterocarp approximately 1.2 m above the ground. Others were seen active on trees ranging in size from 0.5-1.3 m in diameter. Voucher specimen FRIM 0704.

Gekko monarchus (Duméril & Bibron, 1836).– One individual was observed at 2143 h on a granitic rock near the beach. Voucher specimen FRIM 0709.

Gehyra mutilata (Wiegmann, 1834).– One specimen was observed on a large tree trunk approximately 2.5 m above the ground at 2330 h. Voucher specimen FRIM 0693.

Hemidactylus frenatus (Duméril & Bibron, 1836).– Many individuals were seen on houses and under old coconut husks. Voucher specimen FRIM 0703.

Ptychozoon kuhli (Stejneger, 1902).– One adult specimen was collected 1.2 m above the ground at 2052 h on a wooden cottage. Several pairs of eggs and egg scars were observed on medium to large sized trees in primary forest 1-6 m above the ground. The embryos were in various stages of development. Voucher specimen FRIM 0700.

Scincidae

Eutropis multifasciata (Kuhl, 1820).– One large adult was collected at 2211 h in the leaf litter. Voucher specimen FRIM 0699.

Lygosoma bowringii (Günther, 1864).– Individuals were observed at approximately 1100 h on the beach under coconut husks. All attempted to escape by burrowing into the sand. Voucher specimen FRIM 0696.

Varanidae

Varanus salvator (Laurenti, 1768).– One individual was observed sitting in brakish water near the beach at approximately 2100 h. Voucher photograph LSUPC 7805.

SQUAMATA (SNAKES)

Colubridae

Ahaetulla prasina (Boie, 1827).– One individual was observed at 2137 h on the ground moving towards small vegetation near the crest on the cross island trail. Voucher specimen FRIM 0706.

Boiga dendrophila (Boie, 1827).– One juvenile was collected at 2229 h. The specimen was observed crawling in low vegetation approximately 1 m above the ground. Voucher specimen FRIM 0701.

Dendrelaphis caudolineatus (Gray, 1834).– Three individuals were observed at night between 2100 and 2400 h. All were sleeping at the ends of branches approximately 2-4 m above the ground. Voucher specimen FRIM 0698 and 0705.

Dendrelaphis pictus (Gmelin, 1789).– One individual was observed sleeping at the tip of a small branch in a secondary shrub at 2108 h approximately 3 m above the ground. Voucher specimen FRIM 0694.

Lycodon capucinus (Boie, 1827).– One individual was observed active in the leaf litter along a trail immediately behind the beach at approximately 2100 h. Voucher specimen FRIM 0710.

Unconfirmed species

Dasia olivacea (Gray, 1839).– Several individuals were seen on large coconut trees along the beach at midday basking in the sun. No individuals were collected.

Lipinia vittigera (Boulenger, 1894).– One individual was seen on a medium sized tree 3 m above the ground at 1020 h.

This report on the herpetofauna of Pulau Besar is considered preliminary, being that only a small portion of the island was surveyed for only short periods of time. Thus, the species reported are only a subset of the presumed total diversity of the island. Many common species such as *Bufo melanostictus, Limnonectes blythii, Acanthosaura armata, Draco melanopogon, Cosymbotus craspedotus, Cosymbotus platyurus, Cyrtodactylus consobrinus* and *Sphenomorphus scotophilus* were not seen but are expected to be present. The amphibians and reptiles of Pulau Besar are similar to Pulau Tinggi and Pulau Sibu.

Pulau Besar is located 15 km north west of the larger (17 km^2) Pulau Tinggi (Escobar et al. 2003b). Species found on Pulau Besar and Pulau Tinggi are *Polypedates leucomystax, Aphaniotis fusca, Bronchocela cristatella, Draco* *sumatranus, Cnemaspis kendallii, Dasia olivacea, Gekko monarchus, Hemidactylus frenatus, Eutropis multifasciata, Ptychozoon kuhlii* and *Ahaetulla prasina* (Escobar et al. 2003b). Pulau Sibu (6 km^2) located 23.1 km south-east of Pulau Besar, shares *Fejervarya cancrivora, Polypedates leucomystax, Aphaniotis fusca, Bronchocela cristatella, Cnemaspis kendallii, Gehyra mutilata, Gekko monarchus, Hemidactylus frenatus, Dasia olivacea, Eutropis multifasciata, Lygosoma bowringii, Varanus salvator* and *Boiga dendrophila* with Pulau Besar (Wood et al. in prep). These islands are relict mountaintops of a previous north-south tending range that became submerged with the latest rise in sea level 8-15 thousand years ago (Voris, 2000). Additional fieldwork is planned to investigate the biogeographical relationships of this island's herpetofauna to that of the neighbouring islands.

We are most grateful to Sahir bin Othman of the Department of Wildlife, Jabatan Perlindungan Hidupan Liar dan Taman Negara (PERHILITAN) for permission to conduct fieldwork in the Seribuat Archipelago. Collections were made under an Environmental Planning Unit (EPU) permit number 1012 issued to L. Lee Grismer. This research was conducted as part of a field biology course Biology 487G: Tropical Field Biology taught by L. Lee Grismer, Hinrich Kaiser, Jesse L. Grismer, and Timothy M. Youmans at La Sierra University Riverside, California, USA.

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Uropeltis ellioti in the diet of *Naja naja*

As a part of the biodiversity monitoring of Anaikatty Hills, being undertaken by the Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore, we are conducting investigations on the herpetofauna since 2001. Anaikatty (11º 05´30.9"N; 76º 47´36.2E’’) is a part of the Western Ghats hill range, and is also in close proximity to the Eastern Ghats. The forest type of this area is tropical dry deciduous (Champion and Seth, 1967), but is largely in a degraded state due to anthropogenic activities such as agriculture and the brick industry. The hills facing east and contiguous to the plains are covered with tropical thorn forest (scrub jungle).

On 29 October 2003, at 1400 h, we were informed of a dead snake adjacent to the SACON campus on the Coimbatore- Anaikatty State Highway Road, which was run over by a vehicle, and was a juvenile *Naja naja*. Closer examination revealed that the cobra had swallowed a *Uropeltis ellioti*, as the tail of the prey was protruding out of the cobra’s mouth. *N. naja* is known to feed on a variety of prey species. According to Whitaker (1978), juveniles feed on insects, lizards, amphibians and snakes, while larger individuals prefer rodents, amphibians and birds. This species is also known to feed on the eggs and chicks of birds (Wüster, 1998; Daniel, 2002). Das (2002) reported fish in the diet of *N. kaouthia* and *N. naja* in India.

Ophiophagy is reportedly common in *Ophiophagus hannah, Bungarus* and *Maticora*, and occasional in other species such as *Ptyas, Ahaetulla, Dendrelaphis, Elaphe* and *Naja* (Daniel, 2002). This is perhaps the first record of an uropeltid being taken as prey by *Naja naja*. It is impossible to conclude from this single incident how important these snakes are in the diet of a cobra. The present observation indicates that both the predator and prey species were active during the day. Uropeltid snakes are reportedly nocturnal, but may be found active during day hours during the rainy season (Rajendran, 1985).

Total length of the dead cobra and its prey measured 406 mm and 418 mm (snout-vent length 406 mm, tail length 12 mm), respectively. As Smith (1935) recorded the total length of *U. elliotí* as 250 mm and Rajendran (1985) reported 247 mm (snout-vent length 234 mm, tail length 13 mm), the present record is the highest recorded length reported for this species. The impact of road traffic on the herpetofauna is poorly documented in this region. A study on the herpetofaunal mortality due to road traffic in Anamalai Hills, Western Ghats by Vijayakumar et al. (2001) showed that more than 80% of the road kills comprised snakes. Studies on similar lines would provide us further insights in designing roads and traffic that pass through wildlife habitats.

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Duration of meiosis and spermiogenesis in *Euphlyctis cyanophlyctis* (Schneider, 1799)

(with one text-figure)

The duration of meiosis and spermiogenesis in *Euphlyctis cyanophlyctis* as estimated autoradiographically by following the progression of labelled spermatocytes from the onset of meiosis till the formation of radioactive spermatozoa. 34 mature males were collected all at a time in June from Duillya, Howrah, West Bengal. Following a 3 day acclimatization in a glass aquarium of the laboratory each was injected intraperitoneally with 5 µCi of ^{3}H- thymidine (sp.act. 9.00 mCi/mM; Bhaba Atomic Research Centre, Trombay, Mumbai, India). The testes of frogs, killed at intervals covering a period from 0.42 d. to 25.00 d. post injection, were collected. Both histological and squash preparations were made, stained with delafield haematoxylin and 2% aceto-orcein respectively, autoradiographed with Kodak AR-10 stripping film (Ghosal et al., 1993) and most advanced radioactive stages were recorded (Table 1). Specific activity of ^{3}H-thymidine is low enough not to inflict radiation jnjury, nor any alteration in the meiotic cycle. Vertebrate permatocytes, unlike mitotic

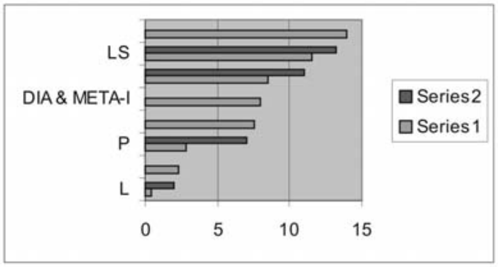

FIGURE 1: Histogram showing individual duration of meiotic and spermiogenetic stages. The top of each blue column indicates the time of the first appearance of radioactivity in any stage whereas that of the red one indicates that the labelling continued until that period over the same stage.

cells,lack a G_2 period (Heller and Clermont 1963). The present investigation reiterates the same event since the first frog killed as early as 0.42 d.p.i. displayed radioactivity overlying leptotene. The leptotene remained "hot" until 2.00 days. In the specimen sacrificed at 2.29 d.p.i., zygotene was the most advanced labelled stage. Due to the absence of G_2, the duration of leptotene is seemingly neither less than 2.00 d., nor more than 2.29 days. At 2.79 d.p.i. pachytene appeared radioactive for the first time. Zygotene duration is thus short, and never exceeds 0.79 day (2.79-2.00). The pachytene stage, which was observed labelled for the first time at 2.79 d.p.i., continued to remain radioactive up to 7.00 days, while labelled diplotenes were detected at 7.50 d.p.i. It is apparent that at any time between 2.00 and 2.79 d. post injection, zygotene reached the pachytene stage and also that these pachytenes were converted to diplotenes some time between 7.00 and 7.50 d.p.i. Therefore, the duration of pachytene would neither exceed (7.50-2.29=) 5.21 days, nor fall short of (7.00- 2.79 =) 4.21 days. One may either (a) conclude simply that the pachytene duration ranges between 4.21 and 5.21 or (b) conventionally state that the pachytene duration is 4.71 ± 0.50 days. Hence, pachytene has a relatively longer duration. Diakinesis was found labelled initially at 8.00 d.p.i. and mataphase-I is short, but also that the succession of these stages is incredibly rapid. The total duration of these stages appears to be less than a day.

Labelled early spermatids having characteristically circular outline were detected as early as 8.50 d.p.i. Spermatids representing various stages of spermiogenesis were labelled until 13.25 d.p.i. Spermatozoa, that had yet been unlabelled, appeared "hot" at 14.00 d.p.i. and continued to remain the most advanced radioactive elements later. The duration of spermiogenesis could be neither less than (13.25-8.50 =) 4.75 days, nor more than (14.00-8.00 =) 6.00 days. The meiosis and spermiogenesis must have been completed between 3.25 and 14.00 days (Fig. 1).

It is interesting to note that the individual duration of zygotene, diplotene, diakinesis and metaphases are exceedingly short among the vertebrates (Table 2). Moreover, a comparative pro-

TABLE 1: Most advanced labelled stages of meiosis and spermiogenesis detected at various intervals following ^{3}H-thymidine injection into the frogs (*Euphlyctis cyanophlyctis*). Asterisk refers to the number in parentheses refer to the serial number of the frog sacrificed.

Most advances label detected initially at days post injection	Labels detected initially at days post injection	Continued to remain labelled in later testes at the following days post injection
Leptotene	0.42(1)*	1.04(2), 1.50(3), 1.75(4), 2.00(5)
Zygotene	2.29(6)	
Pachytene	2.79(7)	3.25(8), 3.75(9), 4.50(10), 5.00(11), 5.88(12), 6.33(13), 7.00(14)
Diplotene	7.50(15)	
Diakinesis & Metaphase-1	8.00(16)	
Early spermatids	8.50(17)	9.25(18), 9.75(19), 10.50(20), 11.00(21)
Spermatozoa	11.50(22)	12.00(23), 12.75(24), 13.25(25)
	14.00(26)	14.75(27), 15.00(28), 16.00(29), 17.00(30), 18.00(31), 20.00(32), 21.00(33), 22.00(34), 25.00(35)

TABLE 2: Duration (in days) of individual stages of meiosis and spermiogenesis in selected vertebrates as interpreted from the date of respective authors.

Animals	Lepto.	Zygo	Pachy.	Diplo. to Meta-II	Spermio-genesis	Total	Reference
Fish							
Colisa fasciata	0.45	0.10	1.98	0.81	6.01	9.68	Sinha et al., 1979
Channa punctata	0.45	0.12	2.15	0.80	8.33	11.25	Sinha et al., 1983
Amphibians							
Euphlyctis cyanophlictis	2.00	0.79	4.71	?	?	14.00	This study
Fejervarya limnocharis	1.75	0.92	2.50	0.40	4.01	10.00	Mallick & Ghosal, 1999
Polypedates maculatus	1.88	0.40	4.72	0.66	9.82	17.25	Ghosal et al., 1981
Reptile							
Calotes versicolor	1.66	0.55	2.60	0.50	13.50	18.00	Ghosal & Bandyopadhyay, 1983
Bird							
Columba livia	2.80	0.40	5.40	0.60	17.00	26.00	Joardar & Ghosal, 1977
Mammals							
Canis familiaris	4.33	0.80	15.61	1.22	22.16	42.15	Ghosal et al., 1983
Homo sapiens	5.7	2.6	13.5	2.5	23.8	48.0	Heller & Clermont, 1963

file of the duration of stages indicates a tendency for the expansion of these duration concurrent with the vertebrate evolution. For example, the leptotene, conspicuous for a brisk duration in fishes being as short as 0.45 d. in *Channa punctata* (Sinha et al., 1983), extends for 5.7 days in man (Heller and Clermont, 1963). In fact, as a basic pattern in the vertebrate series (Ghosal, 1998), the pachytene has a procrastinatinatingly longer span, next being leptotene (Chaudhuri and Ghosal, 1997). Spermiogenesis almost invariably overspans pachytene. The tendency for elongation of the duration of these stages is manifested when the combined duration of meiosis and spermiogenesis, as deciphered from the first appearance of "hot" spermatozoa after ^{3}H-thymidine administration is taken into account. In sharp contrast to 9.68 days in *Colisa fasciata* (Sinha et al., 1979), the meiosis and spermiogenesis have an incredibly longer total duration of 48 days, longest in vertebrates explored so far, in man (Heller and Clermont, 1963).

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On the grammar of the gender of *Ptyas* Fitzinger, 1843 (Serpentes: Colubridae)

The colubrid genus *Ptyas* Fitzinger, 1843 constitutes a conspicuous component of the snake fauna of central, southern and south-eastern Asia. It includes the largest colubrid in the world, *Ptyas carinata* (Günther, 1858), with a maximal size of 3.80 m, and at least two other species reach and sometimes exceed 3 m in total length. A second species, *Ptyas korros* is abundant within its range, rather anthropophilous, and an important control agent of rodents. These impressive snakes are colloquially known as ‘Oriental rat snakes’.

As these snakes are conspicuous members of the Oriental snake fauna, they received attention in nearly all works on the herpetofauna of tropical Asia. To the best of our knowledge, the generic nomen *Ptyas* has always been treated as a masculine noun (see, for example, the chresonymies given in David and Vogel, 1996). Recently, Dr. Werner Kästle (pers. comm. to the second author, April 2000) pointed out that the gender of this genus is, in fact, feminine.

The word *Ptyas* derives from the ancient Greek noun πτυας, meaning “a spitter”. The origin of this name is unclear. According to Stejneger (1907: 345, footnote), this name was applied to a species of snake known to the ancient Greeks for its hissing or spitting behaviour, probably evoked when annoyed. Gotch (1986: 136) mentioned that the *Ptyas* was a serpent which could supposedly spit venom into the eyes of an aggressor. Our dictionaries reveal *Ptyas* as a venomous Asp which was capable of spitting saliva. The word πτυας was derived from the word πτυω, meaning “the saliva”. According to the dictionaries of classical Greek language we consulted, the noun πτυας is indeed of feminine gender. The noun *Ptyas* (gen. *Ptyadis*) was also adopted by the ancients who spoke Latin, also with a feminine gender. According to Plinius the Elder (23-79 A.D.), who wrote the monumental work entitled “Natural History” in 37 volumes (the first 10 volumes published in 77 A.D.), it was a kind of venomous snake. Therefore, whether the generic nomen derives from the Greek or Latin languages, this noun is indeed of feminine gender, which has been largely overlooked in the herpetological literature.

In fact, Stejneger (1907: 345, footnote) did notice the feminine gender of the nomen, but nevertheless regarded it as masculine, since Cope (1861) and all subsequent authors after him treated it as such. The genus *Ptyas* was established by Fitzinger (1843: 26; Type species: *Coluber blumenbachii* Merrem, 1820 [a subjective junior synonym of *Coluber mucosus* Linnaeus, 1758] by original designation) as a subgenus of *Macrops* Wagler, 1830 (a synonym of *Chironius* Fitzinger, 1826, see Williams and Wallach, 1989: 91). Therefore, the original description does not cast light on the grammar of the gender, to which it is at present allocated. Nevertheless, as the noun *Ptyas* was used as a genus-group name unmodified from the Greek language, it must match the gender of the Greek noun, according to Article 30.1.2 of the International Code of Zoological Nomenclature (ICZN, 1999; referred to subsequently as the *Code*).

The nomenclatural consequence is that, as species-group names which end in a Latinized adjective must agree in gender with the generic nomen according to the Article 31.2 of the *Code*, all specific nomina included in the genus *Ptyas* which are based on such an adjective must have their termination changed accordingly, in agreement with Art. 34.2 of the *Code*.

Listing the specific names which must be changed require some comments, as the systematics of the Oriental rat snakes at the generic level continue to be without consensus (see Lazell, 1998; Pinou and Dowling, 2000, for conflicting viewpoints). The genera *Ptyas* Fitzinger, 1843 and *Zaocys* Cope, 1861 (p. 563. Type species *Coluber dhumnades* Cantor, 1842 by original designation) have been recognized as distinct by Günther (1864) and subsequent authors, before being synonymised by Wall (1923) and again by Taylor (1965). However, this synonymy was not subsequently accepted by all authors (see, for example, Smith, 1943). The suggestion by Lazell et al. (1991) to synonymize both *Ptyas* and *Zaocys* with *Coluber* Linnaeus, 1758 was generally not followed by other authors. Even in three recent works on the snake fauna of south-eastern Asia, these genera were either considered synonymous (David and Vogel, 1996; Chan-ard et al., 1999) or valid (Manthey and Grossmann, 1997). According to V. Wallach (in David and Vogel, 1996: 104), anatomical data support the synonymy of *Zaocys* with *Ptyas* (see also Wallach, 1998); we follow this interpretation here.

According to the preceding commentary, the feminine genus *Ptyas* currently includes the following species: *Ptyas carinata* (Günther, 1858), *Ptyas dhumnades* (Cantor, 1842), *Ptyas dipsas* (Schlegel, 1837), *Ptyas fusca* (Günther, 1858), *Ptyas korros* (Schlegel, 1837), *Ptyas luzonensis* (Günther, 1873), *Ptyas mucosa* (Linnaeus, 1758), and *Ptyas nigromarginata* (Blyth, 1854).

These list call for some additional comments. The specific nomen *dhumnades* (created as *Coluber dhumnades*) appeared to Stejneger (1907: 352), to be an adjective indicating similarity to *Coluber dhumna* Cantor, 1839. However, it may also be regarded as a modern Greek noun formed from a stem to which was added the Greek suffix -(*oi*)*des*, meaning "similar to". In this case, this derivative may be regarded as a noun in apposition. According to Art. 31.2.2 of the *Code*, such a nomen of uncertain origin must be treated as a noun in apposition, which retains its original spelling. The specific nomina *dipsas* and *korros* are clearly nouns in apposition, which remain unmodified. Stejneger (1907: 348) stated that the noun *korros* has been erroneously applied to a member of the genus *Ptyas*, as, according to Schlegel himself, it was the Javanese vernacular name (literally meaning 'thin' or 'slender') of another snake, *Elaphe melanurus* (Boie, 1827), at present referred to as *Elaphe flavolineata* (Schlegel, 1837) or *Coelognathus flavolineatus* (see Helfenberger, 2001a, 2001b). In fact, vernacular names provided in Hoesel (1959: 32) make it clear that the Indonesian name "*koros*" is indeed applied to *Ptyas korros* and *Ptyas mucosa*. Lastly, Dixon et al. (1993: 92) have shown that the taxon *Ptyas tornieri* Werner, 1896 (see David and Vogel, 1996: 108) was based on a misidentified specimen *Chironius exoletus*, a South American species which must therefore be removed from the Asian fauna.

Future studies may prove that the genus *Zaocys* Cope, 1861 is a valid taxon. Although the dictionaries are useful in confirming the grammar of the gender of *Ptyas*, the matter is more complicated with the etymology of *Zaocys*. According to Stejneger (1907: 352, footnote), this nomen is based on the Greek words ζα a prefix meaning "very", and οξυς, meaning "swift". According to our dictionaries of classical Greek language, οξυς may mean "acute, pointed, sharp", or "keen", or "swift, prompt, agile", all qualifications appropriate for these long-headed, agile snakes. Consequently, this genus-group name is an adjective regarded as a noun, the gender of which is variable. According to the *Code*, Art. 30.1.4.2, such genus-group names must be treated as masculine. If this genus is regarded as valid, it will include the following species: *Zaocys carinatus* (Günther, 1858), *Zaocys dhumnades* (Cantor, 1842), *Zaocys fuscus* (Günther, 1858), *Zaocys luzonensis* (Günther, 1873), and *Zaocys nigromarginatus* (Blyth, 1854).

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First report of the herpetofauna of Pulau Sibu, Johor, West Malaysia

The Seribuat Archipelago is composed of approximately 32 islands located in the southern portion of the South China Sea, off the east coast of Peninsular Malaysia. Only nine of these islands have had their herpetofauna documented: Pulau Tioman (Day, 1990; Grismer et al., 2002; Hien et al., 2001; Hendrickson, 1966a; 1966b; Lim and Lim, 1999), Pulau Aur (Escobar et al., 2003a; Grismer et al., 2000), Pulau Besar (Wood et. al., in prep), Pulau Dayang (Wood et al., 2003), Pulau Tulai (Grismer et al., 2001; Grismer et al., 2002; Hendrickson, 1966a; 1966b), Pulau Pemanggil (Youmans et al., 2002), Pulau Seribuat and Pulau Sembilang (Wood et al., 2003) and Pulau Tinggi (Escobar et al., 2003b).

Pulau Sibu (104º 45'E; 02º 13'N) is 6 x 1 km wide hour-glass shaped island, located 12 km off the east coast of Peninsular Malaysia. It is composed of lowland coastal vegetation and mangrove swamps in its central section and lowland forest on both ends. The southern end reaches an elevation of 151 m, which gives way to an extensive alluvial beach to the west dominated by coconut palms and smaller beach vegetation.

Collections were made along a cross-island trail through the centre of the island from the west coast to the east coast from 1400-0100 h on 23 July 2003. Collections were also made on 1 September 2003 from 1100-1700 h near Telok Busong along the beach on the central western side and the adjacent mangrove swamps as well as around Kampung Duku along the beach to the cross island trail between 2000-0100 h. Liver tissue was taken from representative specimens and preserved in 100% ethanol. Specimens were preserved using 10% formalin and stored in 70% ethanol. Specimens collected and observed are listed below and deposited in the Forest Research Institute Malaysia (FRIM), Kepong, Kuala Lumpur, Malaysia and the La Sierra University Herpetological Collection (LSUHC) of the Department of Biology, La Sierra University, Riverside, California. Photographic vouchers are deposited in the La Sierra University Photographic Collection (LSUPC).

ANURA (FROGS)

Microhyla borneensis (Parker, 1928).– Individuals were heard calling during the evening of 1 Sep. from a flat area where water from an intensive afternoon down poor had formed a small pond. Three individuals were observed within 0.5 m of the pond. Voucher specimen FRIM 0726.

Polypedates leucomystax (Graenhorst, 1829).– Many individuals were observed on small trees, on low-lying vegetation, and on the forest floor. Individuals were observed between 2000 and 2400 h. Voucher specimen FRIM 0718.

Fejervarya cancrivora (Gravenhorst, 1829).– One specimen was collected at approximately 2300 h in a mangrove swamp sitting near a brackish puddle. Voucher specimen FRIM 0717 and 0730.

SQUAMATA (LIZARDS)

Aphaniotis fusca (Peters, 1864).– Several individuals were observed on variously sized trees and small shrubs between 1400 and 1700 h. Individuals were observed sleeping on small leaves and branches at night. Voucher specimen FRIM 0711.

Bronchocela cristatella (Kuhl, 1820).– Three individuals were observed and two were collected. Both were 1-3 m above the ground on small trees with an approximate diameter of 0.3 m. Voucher specimen FRIM 0723.

Draco melanopogon (Boulenger, 1887).– Several males and females were observed 2-6 m above the ground on trees ranging from 0.2 to 0.5 m in diameter between 1400 and 1600 h. Voucher specimen FRIM 0712.

Cnemaspis kendallii (Gray, 1845).– Two individuals were observed approximately 1-2 m above the ground on medium sized trees 0.2-0.5 m in diameter. Voucher specimen FRIM 0713.

Cyrtodactylus sp.– One specimen was observed on a large tree with rocks at its base on the edge of a mangrove swamp between 2300 and 2400 h. Another was approximately 1.5 m above the ground. This undescribed species was previously reported from Pulau Seribuat and Pulau Sembilang (Wood et al. 2003) and its description is in process (Youmans, in prep). Voucher specimen FRIM 0724.

Gehyra mutilata (Wiegmann, 1834).– One individual was collected from a medium sized tree with an approximate diameter of 0.5 m and was approximately 2-3 m above the forest floor. It was observed facing head down. Voucher specimen FRIM 0729.

Gekko monarchus (Duméril & Bibron 1836).– One individual was collected near the beach on a dead tree 1-3 m above the ground beneath a piece of exfoliating bark. Voucher specimen FRIM 0728.

Hemidactylus frenatus (Duméril & Bibron 1836).– Many individuals were observed on buildings and beneath debris near the beach. Voucher specimen FRIM 0714.

Hemiphyllodactylus typus (Bleeker, 1860).– One specimen was observed on a wooden handrail of a bridge approximately 1 m above the base of the bridge. The bridge crosses through a mangrove swamp. Voucher specimen FRIM 05797.

Lepidodactylus lugubris (Duméril & Bibron 1836).– One gravid female was collected on a palm leaf 1 m above the ground at approximately 2230 h. A second individual was observed between two boards on a bridge near the mangroves. Voucher specimen FRIM 0732.

Ptychozoon lionotum (Annandale, 1905).– Three individuals were observed one at night and two during the day. All were found on small trees 1-2 m above the ground. Voucher specimen FRIM 0727.

Dasia olivacea (Gray, 1839).– Many individuals were seen on medium to large sized trees. Most were seen basking head down and others were climbing upwards. Voucher specimen FRIM 0722.

Emoia atrocostata (Lesson, 1830).– Individuals were observed and collected in the intertidal zones where mangrove trees and volcanic rocks were present. Voucher specimen FRIM 0720.

Eutropis multifasciata (Kuhl, 1820).– One large individual was observed active in the leaf litter near the side of the cross-island trail during the day. Another was observed in the forest floor on a hillside along the trail. Voucher specimen FRIM 0721.

Lygosoma bowringii (Günther, 1864).– Two individuals were observed beneath old coconuts and debris in sandy areas. Voucher specimen FRIM 0715.

Sphenomorphus sp.– One specimen was collected beneath a rotting log in a dark moist area near the side of the cross-island trail at approximately 1530 h. This represents an undescribed species whose description is in progress (Grismer, in prep). Voucher specimen FRIM 0716.

Varanus salvator (Laurenti, 1768).– Individuals were observed in mangrove trees, in the intertidal zones, and in or around small vegetation. Voucher specimen LSUPC 7806.

SQUAMATA (SNAKES)

Boiga dendrophila (Boie, 1827).– An individual observed during the day was approximately 3 m above the ground coiled around a small tree branch. Another was observed at night crossing the trail and another was observed crawling near brackish water on the floor of the mangrove swamp. Voucher specimen FRIM 0719.

Dryocalamus subannulatus (Duméril, Bibron & Duméril, 1854).– One juvenile was observed at night crawling on the handrail of a bridge crossing a mangrove swamp. A second was observed at approximately 2030 h, approximately 2 m up in small coastal vegetation. Voucher specimen FRIM 0733.

Ramphotyphlops braminus (Daudin, 1803).– One individual was collected beneath a log in the sand at approximately 1200 h. Upon capture it attempted to burrow in the sand. Voucher specimen FRIM 0725.

This report is considered preliminary because only a limited portion of the island was surveyed; the cross-island trail, the beaches near the Cabanas at Sibu Resort on the northeast side of the island southeast of Telok Berduri, the southwest side of the island along the coast and the mangroves near Kampung Duku and Telok Busong. We expect *Acanthosaura armata, Draco sumatranus, Cosymbotus craspedotus, Cosymbotus platyurus, Ahaetulla prasina, Cerberus rynchops, Chrysopelea paradisi, Dendrelaphis caudolineatus* and *Dendrelaphis pictus* to be present as well. These species were not seen but are expected owing to the similarity of habitat and their presence on the nearby islands of Pulau Besar (Wood et al., 2004) or Pulau Tinggi (Escobar et al., 2003b).

Pulau Besar (5 km^2) located 23.1 km northwest of Pulau Sibu, shares *Fejervarya cancrivora, Polypedates leucomystax, Aphaniotis fusca, Bronchocela cristatella, Cnemaspis kendallii, Gehyra mutilata, Gekko monarchus, Hemidactylus frenatus, Dasia olivacea, Eutropis multifasciata, Lygosoma bowringii, Varanus salvator* and *Boiga dendrophila* with Pulau Sibu (Wood et al., 2004). Pulau Sibu is located 5.28 km south-west of the larger (17 km^2) Pulau Tinggi (Escobar et al., 2003b). Species found on Pulau Sibu and Pulau Tinggi are *Polypedates leucomystax, Aphaniotis fusca, Bronchocela cristatella, Draco melanopogon, Cnemaspis kendallii, Dasia olivacea, Gekko monarchus, Hemidactylus frenatus,* and *Eutropis multifasciata* (Escobar et al., 2003b). Additional fieldwork is planned to better understand the relationships of the island's herpetofauna.These species were not seen but are expected owing to the similarity of habitat and their presence on the nearby islands Besar (Wood et al., 2004), Seribuat and Sembilang (Wood et al., 2003b). Additional fieldwork is planned to better understand the relationships of the island's herpetofauna.

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Trionychid turtle miscellany

Some information included in a long-time, ongoing account of trionychid turtles (not including natural history information), initially instigated by a publishing contract in the now-defunct *Das Tierreich* series via Heinz Wermuth in the 1960s, is deemed best disposed of separately. This information deals with various kinds of issues, including the rectification of some errors, stemming from previously published accounts. The capsulations below involve two museum codes for specimen repository, the traditional BMNH (The Natural History Museum, London) and MNHN (Muséum National d'Histoire Naturelle, Paris).

1. Errata: Illustrations in Wermuth and Mertens (1961, reprint 1996; hereafter as W&M). The influential book of W&M contains three mislabeled illustrations of trionychid skulls. Their illustrations of *Cyclanorbis elegans* and *C. senegalensis* are copies of those in Loveridge and Williams (1957), but the skull legends for Figs 181e and 182d in W&M are reversed; their skull drawings of *C. elegans* (p. 250, Fig. 181e) represent *C. senegalensis*, and those of *C. senegalensis* (p. 252, Fig. 182d) represent *C. elegans*. The illustrations of the skull (BMNH 1868.2.12.15) of *Trionyx formosus* in W&M (1961: 270, Fig. 191c), copied from Gray (1873a: 46, Figs. 2a-d, as *Nilssonia formosa*) represent *Aspideretes hurum* (Boulenger, 1889: 250, synonymy; Meylan, 1987: 95). The specimen depicted in Plate LI as *Trionyx gangeticus* in Sowerby and Lear (1872) is the holotype of *Trionyx bellii* (Gray, 1872: 337; 1873a: 51), a name treated as a synonym of *T. hurum* by Boulenger (1889: 250), Smith (1931: 171), and W&M (1961: 272); however, W&M captioned their copy of Sowerby and Lear's Pl. LI (1961: 271, Fig. 192a, b) as *T. gangeticus*. Also, the illustration of *Trionyx sinensis* in W&M (1961: 277, Fig. 196a) is a copy of the holotype of *Oscaria* (= *Rafetus*) *swinhoei* (Gray, 1873c: 157 and Pl. V).

2. Type material of *Trionyx ocellatus* Lesueur. Three specimens comprised Lesueur's description of *Trionyx ocellatus* (1827: 261-263). Bour et al. (1995: 81) noted the previous designation of MNHN 6957 as the lectotype, and MNHN 1949 as a paralectotype. The recognition of the other paralectotype that was sent to the BMNH has been troublesome. This BMNH specimen is first mentioned by Gray ("1855"[1856]: 69, specimen "d" under *T. ferox*) as "Very young (in spirits). Back with small dark rings. North America; Wabash River. From the Paris Museum." This same specimen is listed by Gray in his Handlist (1873b: 83, as *Callinia spinifera,* and cross-referenced to specimen *"*d*"* in his Catalogue) as specimen *"*d. Animal, in spirits, Dorsal disk, about 6 in., with many small spots...N. America. Parzudaki. 59.9.20.26." But Gray (1873b: 83) confused the issue by associating the Wabash River ("N. America, Wabock.") with another listed specimen "e" noted as "uniformly colored" (in fluid, 61.5.21.24) and with its skull extracted (61.5.21.74); this same specimen and skull was associated with the Wabash River by Boulenger (1889: 260, specimen "b"), and was thus accepted as a paralectotype by Bour et al. (1995). Answers to inquiries and information received (Colin J. McCarthy, in litt., March-April, 2002) indicate that BMNH 61.5.21.24 has a plastron length of about 15 cm but a carapace length about 23 cm with small ocelli (specimen number in original register assigned to a lizard, *Norops auratus* from Mexico; removed skull, BMNH 61.5.21.74, listed as *Gymnopus spiniferus*). This specimen is too large to be the paralectotype of "6 in." sent from Paris to the BMNH.

BMNH 1859.9.20.26 was (Colin McCarthy, in litt.) "Purch: Braconier (according to register) but Purch: Parzudaki (according to label on jar)"; Émile Parzudaki was a dealer of natural history specimens in Paris (Kellogg, 1932: 46). The carapace length is about 6 inches with dark rings. Thus, BMNH 1859.9.20.26 (corresponding to Gray's specimen "d" in both his Catalogue ("1855"[1856]: 69) and Handlist (1873b: 83 [and seemingly one of Boulenger's "yg" specimens "c", "d", or "e", 1889: 260]) is regarded as the second paralectotype of Lesueur's *Trionyx ocellatus* from the Wabash River.

3. Illustrations of *Tyrse argus*. It is well-known that Gray's *Tyrse argus* is a junior subjective synonym of *Trionyx spiniferus* Lesueur, but little-known that a rarely seen, privately published illustration of the holotype of *T. argus* (BMNH 1947.3.6.18, stuffed female) was recently reproduced.

Gray (1844: 48) alluded to an illustration of the holotype of his *Tyrse argus* as "Lear, Icon. ined. t.," and later ("1855"[1856]: 68, *Trionyx argus*) as "Knowsley Menag. t.," with the original erroneous type locality of West Africa, Sierra Leone? The corrected locality of North America was noted by Gray (1873b: 83, *Callinia spinifera*, specimen "a"). Boulenger (1889: 260, synonymy, *Trionyx spinifer*, specimen "f" but no locality) also referred to the drawing of *Tyrse argus* as "Knowsley Menag. Pl. — (1846)." In 1831 Edward Lear was invited by Lord Stanley to make drawings of the animals in his menagerie at Knowsley Hall just outside Liverpool (Noakes, 1985); the Lear drawings were ultimately collated in "Gleanings..." (see Gray and Lear, 1846). One of the included 17 drawings (others of nine birds and seven mammals) was published by Noakes (1985: 58, full page in colour) but with no commentary that it represented the holotype of Gray's *Tyrse argus*; inscriptions on the Noakes reproduction read "Tyrse Argus, Gray, Western Africa. Brought home, alive, by Mr. Whitfield. The original of the figure in the 'Gleanings'...[and along posterior edge of carapace]...Edward Lear, May 1836."

I thank Colin J. McCarthy (BMNH, London) for answering queries regarding the paralectotype of *Trionyx spiniferus* Lesueur.

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An accidental importation of *Gekko monarchus* into Africa

Several common species of tropical Asian house geckos (e.g., *Hemidactylus frenatus*, *Gehyra mutilata*) have expanded their ranges eastward into the Pacific through human agency (Lever, 2003). Many more lizard species are occasionally imported into areas extralimital to their natural ranges, but are intercepted by customs or shipping personnel or fail to establish themselves (Gill et al., 2001; Lever, 2003). We here report an accidental introduction (though not establishment) of a tropical gecko into the temperate-subtropical climate zone of South Africa. On 1 July 2002, an adult male (83.13 mm SVL) *Gekko monarchus* (Duméril and Bibron, 1836) (Bayworld - Port Elizabeth Museum [PEM] R5412) was found in a warehouse at the Everready Factory in North End, Port Elizabeth, Eastern Cape Province, Republic of South Africa (33°57’S, 25°37’E). The specimen was typical of this species in having 36 precloacal-femoral pores in continuous series, 18 rows of dorsal tubercles across the midbody, and seven pairs of dark dorsal markings from the nape to the sacrum (De Rooij, 1915; Schäfer and Grossmann, 1993).

Gekko monarchus is widespread in south-east Asia, occurring in southern Thailand, Peninsular Malaysia, Singapore, the Philippines, and much of the Indo-Australian Archipelago as far east as the Kei Islands (Schäfer and Grossmann, 1993; Manthey and Grossmann, 1997; Chan-Ard et al., 1999) and at Fakfak in Papua Propinsi (Irian Jaya), New Guinea (Bauer and Henle, 1994). In its native range, *G. monarchus* occurs both in forest and in human modified environments, including buildings (De Rooij, 1915; Schäfer and Grossmann, 1992), where they may be present at extremely high densities (Grossmann, 1993; Youmans et al., 2002). Although the species has been considered “uncommon” in Singapore (Lim and Lim, 1992), this is apparently an artifact due to a shift in building construction style and materials away from those, such as wooden huts, that provide adequate sheltering sites for these relatively large geckos, towards more modern structures lacking suitably large crevices (Chou, 1978).

The edificarian tendencies of *Gekko monarchus* make it a likely candidate for accidental translocation in association with international goods shipments, and it has recently been intercepted from two cargo ships arriving in New Zealand from Singapore (Gill et al., 2001). The Everready Factory warehouse had received container shipments from New Zealand and Singapore shortly before the discovery of the gecko and it is assumed that the specimen arrived in Port Elizabeth from the latter port. Although the specimen may have originated elsewhere in Asia and have been transshipped through Singapore, the dorsal pattern of the Port Elizabeth specimen matches that of Singaporean geckos especially closely (Lim and Lim, 1992).

Unlike many tropical Asian house geckos, *Gekko monarchus* has not been recorded as a naturalized species (Lever, 2003) and there is no evidence to suggest that it has become established in Port Elizabeth. However, its importation into both South Africa and New Zealand demonstrates the facility with which this gecko may be transported and suggests the possibility that it may be a candidate for naturalization in other extralimital areas. Although tropical areas are the most likely sites for such a successful establishment, Port Elizabeth, which is characterized by a mild climate, already supports introduced populations of several geckos of tropical or subtropical origin (Branch, 1998) and could also be at risk.

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First record of *Lytorhynchus paradoxus* (Günther, 1875) (Serpentes: Colubridae) from the Republic of India, with notes on its distribution

(with two text-figures)

In August 2003, two of the authors came across an unusual looking colubrid snake in Ramgadh (Sikkar district, Rajasthan, western India). The snake was found at night, photographed the next morning and released immediately thereafter. The only scalation data recorded was the number of midbody scale rows. No voucher specimen was collected, but two photographic slides of the snake- a dorsal view of the entire body (Fig. 1) and another in which the left lateral aspect of the head is visible, enabled us to identify the snake as *Lytorhynchus paradoxus*.

After consulting literature, especially comprehensive checklists of Indian snakes by Whitaker (1978) and Das (1997, 2003), we find this snake represents the first record of this genus and species from within the political boundaries of present day India. High resolution scans of the aforementioned images have been deposited at the Centre for Herpetology, Madras Crocodile

FIGURE 1: Dorsal view of entire body of *Lytorhynchus paradoxus* from Ramgarh, Sikar district, Rajasthan, India.

FIGURE 2: Desert habitat of *Lytorhynchus paradoxus* ca. 2 km from Ramgarh, Sikar district, Rajasthan, India.

Bank Trust, Mamallapuram 603 104, Tamil Nadu, India.

Scalation, morphological details and colour pattern based on field observations as well as those gleaned from scanned images of the Indian specimen- Scales smooth, in 19 rows at midbody. Head slightly broader than neck; snout declivous; body mildly, but noticeably triangular in cross section; tail short, tip pointed. Rostral rhomboidal; pointed in front, angular behind. Eye large with vertically elliptical pupil; nostril - narrow slit between two large scales; frontal expanded anteriorly; touching upper preocular; prefrontals larger than internasals; preoculars 3; loreal 1; postoculars 2. Pale brown above; midline of back with a series of at least 40 'H' or 'X'- shaped dark brown marks connected by a white, ribbon-like stripe. Sides of body with smaller, less distinct brown spots which alternate with those on the mid-back. Back of head with large brown, elongate blotch; broad brown streak from eye to angle of mouth; a similar coloured mark below eye. Underside glossy white. We were unable to determine the number and condition of the supralabials from the images with any certainty, as sand particles had adhered to and obscured some of their margins.

The snake was identifiable as a member of the genus *Lytorhynchus* on the bases of its midbody scale rows; awl-shaped head; uniquely shaped rostral scale; oblique, slit-like nostril and moderately short tail.

Identification to species was made after comparing scanned dorsal and lateral views of the head with descriptions and figures in Günther (1875: 576), Boulenger (1890: 322-3), Smith (1943: 189-192), Minton (1966: 130-1, plate 29), Leviton and Anderson (1970: 255, 268-270) and Khan (2002: 111, 143). It should be noted that though captioned correctly, Fig. 59 depicting dorsal and ventral aspects of the head of *L. maynardi* has been placed under the description of *Lytorhynchus paradoxus* Smith (1943: 191). Boulenger (1890: 322) provided dorsal and lateral views of the head of *L. paradoxus*. Comparisons of the scanned images with the holotype BMNH 1946.1.14.75 (formerly BMNH 72.4.17.162) revealed no notable differences in dorsal colour pattern or scalation of the head, consistent with the identification as *Lytorhynchus paradoxus*.

We follow Smith (1943: 189-192) who used the shape and condition of the rostral scale to distinguish between the three species of *Lytorhynchus* that are known to occur in this region. The rostral scale of the snake from Rajasthan is neither "truncate anteriorly- *L. ridgewayi*"; nor is it "anchor-shaped when viewed from above- *L. maynardi*". The rostral is undoubtedly, "pointed anteriorly, angular posteriorly" and separates the internasals for between half to one-third of their length - key characters for *L. paradoxus*.

The following key characters used by Leviton and Anderson (1970: 255, 270) to diagnose *Lytorhynchus paradoxus* are also evident in scans of the snake from Ramgadh, Rajasthan, India– rostral shield narrowed and pointed, not truncate, broader at its base than at its anterior most projection; prefrontals paired; ground colour greyish brown with series of darker brown, not black, blotches, not cross bars. We were unable to determine the number of ventrals, subcaudals and the condition of the anal (also used by the aforementioned in their key to members of this genus). Dorsal body pattern closely resembles Leviton and Anderson's depiction of a specimen from the California Academy of Sciences– CAS 101412. However the dorsal aspect of the rostral scale of the Rajasthan snake is distinctly unlike that of *Lytorhynchus paradoxus* as depicted by Leviton and Anderson in figure 21 (1970: 269) and Khan (2002: 111). Despite this glaring discrepancy, it compares well with figures and descriptions in other literature cited above as well as the holotype BMNH 1946.1.14.75 (formerly BMNH 72.4.17.162) and we are convinced that the abovementioned snake from Ramgadh (Sikkar district, Rajasthan, western India) is indeed *Lytorhynchus paradoxus*.

Natural history notes.- The snake was found lying straight on a sand dune (Fig. 2) at approximately 2130 h after a spell of rain. When first handled, it coiled up like a cylindrical spring with its head on the uppermost coil. This behaviour was not repeated subsequently. Whilst photographing the snake, it persistently burrowed into the sand with its snout. It made no attempt to bite when handled.

Günther (1875), who first described this species as *Acontiophis paradoxa* wrote, "A single specimen, twelve inches long (tail 1½ inches); is in the late Dr. Jerdon's collection. It is rather shrivelled and unfortunately no record as regards the locality where it was found was placed on the bottle. He obtained it probably within the Himalayan region or in Khassya (= the Khasi Hills of the modern Meghalaya State, north-eastern India)". This is incorrect as the snake is a desert species. Boulenger (1890) recorded "Sind" (at present a Province in Pakistan) as a locality and rightly commented that these were desert snakes, adapted for burrowing in the sand. Wall (1923) recorded *L. paradoxus* from Sind, Punjab, Multan (all in Pakistan). Smith (1943) gave the range of this species as "Sind (Zangipur); W. Punjab (Multan)"- based on four specimens. These localities are also in Pakistan. He also cited "N. India" as the type locality for *Acontiophis paradoxa* (= *Lytorhynchus paradoxus*) presumably condensing Günther supposition that Jerdon's specimen came from "within the Himalayan region or in Khassya". Though Khan (2002) also cites the type locality as "Northern India", he goes on to write that this species is "restricted to Zangipur, northern Sindh, Pakistan". Minton (1966) examined specimens from Dadu or Hyderabad; Muzaffargar; Sanghar and Thar Parkar districts- all localities in Pakistan. The Bombay Natural History Society has a single, undated specimen from Thar, Parkar collected by E. Priestly. A typographical error noticed by us was that Minton (1966: 131) cites the type as *Aconitophis paradoxus* Günther, 1875. Khan (2002) also follows this spelling. The actual citation is *Acontiophis paradoxa*- this was followed by both Boulenger (1890: 323) and Smith (1943: 191).

The record of this species from Ramgadh (Sikkar district, Rajasthan, western India) is an approximate range extension of approximately 725 airline kilometers (330 km westward) from Muzzafargar, in Pakistan.

We thank the Bombay Natural History Society for allowing us to examine their collection and the extensive use of their library. We are extremely grateful to David Gower of the Natural History Museum, London for comparing our scanned images with the holotype of *Lytorhynchus paradoxus*; Aaron Bauer of Villanova University for providing us with literature and Sujoy Chaudhuri for estimating the range extension. We also thank Van Wallach, Alan Leviton and Patrick David for comments on earlier drafts which greatly enhanced the content of this note.

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On an abnormal specimen of *Calotes emma* and notes on *Japalura planidorsata*

A collection of reptiles from the Narpuh Reserve Forest Block 1 in the Jaintia Hills District, Meghalaya, was made available for study. It included an abnormal specimen of *Calotes emma* Gray and *Japalura planidorsata* Jerdon collected by S.J.S. Hattar and party during January, 2003. The female specimen of *Calotes emma* measuring snout to vent 90 mm and tail 225 mm, has only four digits on either hands. The 1st and 2nd fingers are fused; that on the right hand even the claws are fused. Olive brown with dark vertebral row of ocellate spots, indistinct dark markings on flanks, limbs and tail. Head above on prefrontal area with a dark diamond shaped spot; a black bar from eye to tympanum; black streaks radiating from eye; a small vertebral spot between supraorbital spines; black marking in front of shoulder continue anteriorly to form a slanting V-shaped marking. One supraorbital spine, another spine above tympanum; four enlarged scales in a line above tympanum towards eye; two enlarged scales above tympanum obliquely on its posterior side; 65 scales round the body; labials 11/11.

Smith (1935) dealt with 23 species of *Japalura* from Eastern and Western Himalayas, northern Myanmar and Yunnan in southern China. Only *J. andersoniana* and *planidorsata* were reported from north-eastern India. Das (1997) in his checklist records six species from the Indian region. Ahmed and Dasgupta (1992) reported *tricarinata* and *variegata* from West Bengal. Husain and Ray (1995) reported *kumaonensis* and *major* from Western Himalayas. Although Khasi Hills is the type locality of *Japalura planidorsata*, no collection of this species has been made since the publication of the Fauna of British India volume on saurians by Smith (1935). A juvenile *Japalura planidorsata* was collected from a bamboo thicket in the Narpuh Reserve Forest Block I. It measures snout to vent 36 mm, tail 66 mm. Tympanum hidden, a broad black bar from tip of snout to the hind limb along the flanks, faded towards the posterior one third, a white line from snout covering the upper labials and adjacent 2-3 rows of scales, to the shoulder. Vertebral row of scales enlarged; 8th row of scales on either side of the vertebral row enlarged, white; a series of six V shaped markings touching the vertebral and lateral rows of scales: Dorsal scales unequal, head with unequal scales and ridges; top of head and snout concave; tail with transverse black markings. Lower labials and adjacent 2-3 rows of scales black extending to join the black flank markings, white oblique stripe on supra ocular region.

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On the giant Javanese softshelled turtles (Trionychidae)

McCord and Pritchard (2003 “2002”) described a new species of *Chitra* from Myanmar and named the Javan (and Sumatran) populations of *C. chitra* as a new subspecies, *C. chitra javanensis*. When examining McCord and Pritchard’s paper, some errors were found and are rectified here to avoid confusions in the future. Additional data on the nomenclature and occurrence of this subspecies are provided here.

This taxon, referred to by Iskandar and Mumpuni (2003 “2002”) as *C. chitra javanica* is clearly an error, hence it should be considered as an incorrect subsequent spelling of *javanensis* or invalid emendation of the original proposed name.

In addition to Müller’s (1923) specimen “collected” by Dr. J. Elbert from Buitenzorg (now Bogor) and which is at present in the Bavarian State Museum, another specimen of *Chitra* from Java which is in the Museum Zoologicum Bogoriense (MZB) collection has been acquired during the same period (around 1908), from Tandjoeng (now spelled Tanjung) Priok, harbour of Jakarta, West Java (Ouwens, 1914). The collector mentioned on the tag is A. C. Buisson. Dr. Elbert actually led at least one of the numerous “Sunda Expedition Rensch” to the Lesser Sunda Islands, especially Timor, but not to Java, and is not known to have collected any specimen from outside the Lesser Sunda Islands (Roux, 1911, 1912). At that time, the results of most faunistic as well as floristic collecting activities were brought to Buitenzorg (in this case to MZB) which served as temporary or permanent deposition centre. These two records are interesting because Tanjung Priok is actually at the mouth of the Ciliwung River that flows through Bogor to Jakarta. While it will be difficult to determine if these two specimens were actually collected together, it is almost certain that the Bavarian State Museum specimen of *C. chitra javanensis* was not collected by Dr. Elbert.

This first MZB *Chitra* specimen from Tanjung Priok (MZB Test 027, dry preserved and displayed in the exhibition hall) measured 1,290 mm (TCL, completely stuffed specimen, measured after being stuffed). In early 1977, after a heavy flooding of Ciliwung River that affected Jakarta, a second giant specimen of *Chitra,* of 1,170 mm (TCL, carapacial length including the cartilage, measured when still alive, MZB Test 294) was caught at Jalan Radio Dalam, southern Jakarta and handed to the Ragunan Zoological Park. The reptile keeper, not knowing the identity of this specimen promptly contacted me and I found that it represents the first capture of *Chitra* in about 70 years, after the first specimen was found. The next year, at around the same time of the year, another (the third) giant *Chitra* specimen, 1,100 mm (TCL) appeared after heavy flooding that affected Jakarta not far from the place when the first specimen was caught. This specimen (MZB Test 293) died after three months in captivity, and after being skeletonized, the skull was found to have a hole originating from a 22 mm gunshot. The specimen from 1977 (MZB Test 294) survived for five years and thereafter, was also skeletonized. A fourth specimen (MZB Test 295, also skeletonized, not measured when alive), acquired in the year 1987, has been added to the collection and originated from Bengawan Solo River, Central Java. Webb (1995) also recorded a skull from Java in the Leiden museum (RMNH 7054), but unfortunately without exact provenance. These four Javanese specimens in MZB are comparable to PCHP records of giant *C. chitra* specimens (Pritchard, 2001). The four MZB records in addition to the "Elbert's" specimen of *C. chitra* are substantiated by specimens and their provenance is clear, and the records of *Chitra* from western Java is confirmed, and the distribution essentially covers the whole northern parts of the island.

It is unfortunate that the type locality of the holotype is in error. The catalogue entry mentioned Bengawan Solo, near the border to Central Java, most probably between Kalitidu and Padangan, Bojonegoro District, East Java, donated by F. B. Yuwono, June 1999, and did not come from Pasuruan "River". In addition, the "type" locality from where most of the paratypes originated, is actually within Leces, Probolinggo district (F. B. Yuwono, 2004, pers. comm.) Pasuruan "river", is in the Pasuruan District, and not in the Probolinggo District. Here, I take the opportunity to correct the type locality to Bengawan (= river) Solo, between Kalitidu and Padangan, Bojonegoro District, East Java (see Table 1 for further details of the MZB specimens).

The specimen from Tanjung Priok was identified and reported under the name of *Pelochelys cantori* by Ouwens (1914). This paper has been overlooked by many authors, but eventually used by de Rooij (1915) although she did not examine the specimen. Unfortunately McCord and Pritchard (2003 "2002") overlooked Iskandar's (2000) comment, where he states that the only record of *Pelochelys* from Java is based on Ouwens' publication. Their treatment of *Chitra minor* Jaekel, 1911 as conspecific with Javan *Pelochelys cantorii*, a record that was based on de Rooij's monograph, is questionable. The sole

TABLE 1: Detailed information about *Chitra chitra javanensis* specimens in MZB. Abbreviations.- TCL = total carapacial length; CL = carapacial bone length at the vertebrae region; CW= capacial bone width at the widest part. CWR= total carapacial bone width including the ribs measured at the widest part; *) specimens no 029 and 199 were measured after being stuffed, so that CL and CW could not be measured accurately, CWR of these specimens were measured at the widest part of the stuffed carapace.

MZB Test.	Locality	Donor	Date	Notes	Measurement (mm*)
027 whole mount	Tanjong Priok	A.C. Buisson	1908 (no exact date)	Caught at harbour (sea)	TCL: 1290; CL:?; CW: 735; CWR: 740
199 (Holotype) whole mount	Bengawan Solo, between Kalitidu and Padangan, Bojonegoro District, East Java	F.B. Yuwono	1999 (no exact date)	Caught during dry season	TCL: 570; CL: ?; CW ?; CWR: 470
264, 265, (paratypes) alcoholic	Leces, near Pasuruan, Probolinggo District, East Java	W. McCord & party	July 1997	Caught during dry season	
266, 267 (paratypes) skeleton	Leces, near Pasuruan, Probolinggo District, East Java	W. McCord & party	July 1997	Caught during dry season	
293 skeleton	Jalan Radio Dalam, South Jakarta	Jack West (Ragunan Zoological Park)	December 1977	Caught after Ciliwung river flooding	TCL: 1100; CL: 540; CW: 560 CWR: 630
294 skeleton	Kebayoran Baru, South Jakarta	Jack West (Ragunan Zoological Park)	November 1978	Caught after Ciliwung river flooding	TCL: 1170; CL: 560; CW: 590; CWR: 660
295 skeleton	Bengawan Solo, between Kalitidu and Padangan, Bojonegoro District, East Java	F.B. Yuwono	1987 (no exact date)	Caught during dry season	TCL: >1200; CL: 640; CW: 650; CWR 720

presumed Javanese *Pelochelys* ever recorded from Java is actually a specimen of *C. chitra javanensis*. At present, there is no evidence of the occurrence of *Pelochelys* in Java.

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Notes on the distribution and natural history of *Ichthyophis bombayensis* (Gymnophiona: Ichthyophiidae)

In about 1888, F. Gleadow obtained a 390 mm caecilian from the forests of Waghii (= Waghai), Surrat (= Surat) District (now Dangs District, Gujarat State), Bombay Province, India, the specimen now deposited in The Natural History Museum, London, BMNH 1888.6.11.1. Subsequently, Boulenger (1890) identified it as *Ichthyophis monochrous*. Eventually, the specimen was described as a new species, *Ichthyophis bombayensis* Taylor, 1960. Despite the instability of caecilian taxonomy (see Nussbaun and Wilkinson, 1989), *I. bombayensis* has consistently been considered a valid species (e.g., Taylor, 1968; Wake, 1986; Nussbaum and Wilkinson, 1989; Dutta, 1997; Bhatta, 1998).

For 65 years, there were no subsequent reports of the species. Daniels and Shull (1963) surveyed entire south Gujarat , but did not recorded *I. bombayensis* among the 12 species of amphibians they encountered in the region. Naik and Vinod (1993) also did not find *I. bombayensis* from southern Gujarat during the survey. Until recently, the type specimen was thought to be the only known material (e.g., Dutta, 1997; Chanda, 2002). However, the recent literature includes reports of two more specimens collected in Karnataka State, some 900 km to the south of the type locality. Pillai and Ravichandran (1999) referred a specimen (ZSIM= Zoological Survey of India, Southern Regional station Madras VAG 12) from Sringeri, Karnataka to *I. bombayensis* and Ravichandran and Krishnamurthy, (2001) reported a further specimen (KUES= Kuvempu University, Environmental Science, APODA-1.) from the same area. The identity of the Karnataka specimens remains controversial (see below), but prior to this report, *I. bombayensis* was known only from three voucher specimens, only one of which was from the vicinity of the type locality. Some workers (e.g., Krishnamurthy, 1996; Bhatta, 1998 and Krishnamurthy and Hussain, 2000) have reported *Ichthyophis bombayensis* from Chikmangalur and Kudremukh National Park, Karnataka State but without voucher specimen or photographs. In view of taxonomic uncertainty, and the presence of at least three other nominate species of at least superficially similar, unstriped *Ichthyophis* (*I. malabarensis, I. peninsularis* and *I. subterrestris*) in the Western Ghats, these report require confirmation.

The northern most part of the Western Ghats (WG) of Gujarat is the area between Surat (south to River Tapi) and Valsad Districts (between the latitude 21° 12' N - 20° 12' N). WG of Gujarat state covers about 14655.00 sq. km including two important Protected Areas of Vansda National Park and Purna Wildlife Sanctuary (23.99 and 160.84 sq. km, respectively).

The eastern part of the WG is hilly with 250 to 1,100 m altitude above the sea level. Western part of plains is formed by the various perennial rivers, namely Tapi (= Tapti), Mindhol, Purna, Ambika, Auranga, Par, Kolak and Daman Ganga which flow east to west from mountains of WG finally meeting in the Arabian Sea. The mountain range is well covered with forests with high diversity of plant species and is undeveloped rural area but plains are quite different, mostly agricultural, industrial and highly urbanized area. The Vansda National Park and Purna Wildlife Sanctuary together form 4.2% of the total protected geographical area of the forests of Western Ghats zone in Gujarat State. Both the protected areas are situated in hilly areas.

Vansda National Park (VNP): Vansda National Park is located between 20° 51' 16" and 21° 21' 22" N latitudes and 73° 20' 30" and 73° 31' 20" E longitudes in Vansda Taluka of Navsari District. The are a of the park has hilly terrain with hills of moderate altitudes from 110 to 360 meters above sea levels.

Purna Wildlife Sanctuary (PWS): Purna Wildlife Sanctuary is located between 20° 51' 15" and 21° 31' 22" N latitude and 73° 32' 20" E longitudes in northern part of Dangs District. The sanctuary has hilly terrain with altitude ranging from 130 to 574 meters above MSL.

The study area of Western Ghats of Gujarat was explored during January 2000 to December 2002, using search techniques appropriate for caecilians. Additionally, some pockets within the Protected Area were selected for further, repetitive intensive and extensive survey.

Direct count: This method was used in riverine forests of PAs (VNP and PWS). During day, searches were carried out in potential habitats by walking along small streams, rivulets, rivers and moist forest pockets. The same treks were repeated on rainy nights with the help of a torch.

Pitfall trap: This method was used for caecilian at various locations of VNP and PWS. Ten 20 cm wide and 25 cm deep plastic bucket were spaced in a row at one m intervals.

Road kills: Both the protected areas have a road network. These are used by locals, visitors and interdistrict and state transporters. During rainy nights, roads were surveyed repeatedly at night and early morning and dead specimens collected.

Patch sampling: In summer, most water bodies and small rivulets were dry and there remained only large river pools. These river pools were surrounded by loose black clay/soil and big boulders. The black clay topsoil was sampled by digging 1 x 1 m quadrats (50 cm deep).

Some streams were explored for sampling of caecilian larvae. Streams of Gira and Purna rivers were explored with the help of dipnet (a 'D'-shaped fine nylon-mosquito net with 1.5 meters long handle) in the first week of August, September and October.

All specimens collected were preserved in 10% formalin solution and examined and measured with a dial vernier calipers (to nearest 0.02 mm) and metal scale (to nearest 0.5 g). The body weight of fresh specimen was measured with a Pesola scale.

The number of annuli was counted manually and finalized in directly scanned, enlarged images on computer screen. This method was used for greater precision. The number of vertebra of

TABLE 1: List of collection dates and sites* of *Ichthyophis bombayensis* within the study area of northern Western Ghats, Gujarat, India. PA = Protected Area, PWS = Puna Wildlife Sanctuary, VNP = Vansda National Park. The location of each specimen is indicated on Figure 2.

Catalogue number	Date of Collection	Collection Locality (Distance of near by running river stream in m)	District & PA	River catchment Area	Habitats and Remarks
RAJ-AA-01	23 Sep.1994	Dhuldha Bus stop (45)	Dangs, PWS	Gira	Found in garbage pit. The species identified on base of colour photographs Surat Nature Club.
RAJ-AA-02	18 July 1998	Sadad-devi Settlement village (30)	Navsari, VNP	Ambika	Railway trek, VNP
RAJ-AA-03	20 June 1999	Dungarda (250)	Navsari, Nr. VNP	Ambika	Road killed, Near VNP
RAJ-AA-04	20 June 1999	Nani Waghai (30)	Navsari, Nr. VNP	Ambika	Road killed, Near VNP
RAJ-AA-05	20 June 1999	Kilad (35)	Navsari, VNP	Ambika	Road killed, Near VNP
RAJ-AA-06	19 July 1999	Mango farm (500)	Navsari, VNP	Ambika	Collected Live from pit VNP
RAJ-AA-07	20 July 1999	Kala Amba (80)	Navsari, VNP	Ambika	Collected Live under woodn logs, VNP
RAJ-AA-08	11 Sep. 1999	Vankla (500)	Surat	Malan (Ambika)	Collect Live at night on road near Vankala village, Surat Surrounding area agricultural fields
RAJ-AA-09	4 Nov. 1999	Between Dhuldha -Bandh pada (300)	Dangs, PWS	Gira	Road killed, PWS
RAJ-AA-10	28 Oct. 2001	Nr. Bandh Pada (450)	Dangs PWS	Gira	Road killed, PWS
RAJ-AA 11	28 May 2002	Sawarda Kassad (2)	Dangs, PWS	Purna	On the river edge, Nr. PWS
RAJ-AA 12	28 May 2002	Nr. Wankan (1)	Dangs	Purna	On the river edge, Nr. PWS
RAJ-AA 13	30 May 2002	Nr. Chikar (opp.Bhujad), (1)	Dangs	Purna	On the river edge, Nr. PWS
RAJ-AA 14	2 June 2002	Nr. Sakarpatal (10)	Dangs	Ambika	On the river edge
RAJ-AA 15	2 June 2002	Nr. Dhodhal-pada (2)	Dangs	Khapari (Ambika)	On the river edge
RAJ-AA 16 to AA-23	3 June 2002	Bardipada A(0)	Dangs, Nr. PWS	Gira	On the river edge, Nr. PWS
RAJ-AA 24 & 25	3 June 2002	Bardipada (0)	Dangs Nr. PWS	Gira	On the river edge Nr. PWS
RAJ-AA 26	23 June 2002	Between Bheshkatri-Ambapani (480)	Surat, Nr. PWS	Purna	Road killed, Nr. PWS

each specimen was counted from radiographs produced by x-ray machine (Siemens Pheophost B 300mA/7kW and exposure: 42kW/6.4ms with grid).

A total of 26 *I. bombayensis* were collected examined, including seven (RAJ-AA-02 to RAJ-AA-05; RAJ-AA-09, 10 and RAJ-AA-26) (RAJ-AA= author's catalogue number) specimens found dead, and a specimen (RAJ-AA-01) examined on the basis of colour photographs only. No caecilian larvae were found.

All specimens of *I. bombayensis* were found in the mountains of the Ghats, particularly in dry riverine forests, and were collected in and around the PAs and reserved forest, except a specimen (RAJ- AA-08) found from Vankla village, 35 km from the PAs. The data suggest that the species is patchily distributed in roughly 3,000 sq. km area of Dangs, Surat and Navsari districts of Gujarat.

Most specimens were found or sighted under loose soil on the banks of rivers and under decayed wood and humus in riverine forest, with a few from nearby agricultural areas. Twenty specimens (76.92%) of the species were found close (0 to 80 m) to river stream, while six specimens (31.57%) were found from the distances of 250 to 500 m from water bodies (Table 1). Those found far from the river streams were sighted only during the rainy days, except the specimen RAJ-AA-09 and 10 which were found dead on the road during the cooler season.

Nineteen specimens (73%) were found live. Fifteen of these were dug from loose soils at the edges of rivers, and especially pools. The loose soil was often exposed at times when water remained in summer. The pool bottoms were covered with mud and rotting leaves, and these provide both lotic and lentic aquatic habitat. Most of the specimens were found in or besides crab burrows, which open vertically 30 to 40 cm high above the edge of water.

One specimen was found under decayed wood log and one was found on the road at night during the heavy rain. Two specimens were collected from garbage pits (Table 2). Two specimens were collected by G. K. Bhatta (pers. comm.) from under logs of wood at a timber yard in Dungarda village, Dangs on 27 August 2002.

TABLE 2: Microhabitat of live collected specimens of *Ichthyophis bombayensis*.

No	Microhabitat	Number of specimens	%
1	Loose soil & porous at the edges of river stream	15	78.63
2	Decayed wood loges & humus	01	05.63
3	On road	01	05.63
4	Garbage pit	02	10.52

All specimens were found during the months May to November, except August (Table 3). Of these 15 (57.6%) specimens were found between the last week of May and first week of June, dug out on rivers banks, and remaining eleven specimens (42.3%) were found between mid-June to mid-November as road kills, in garbage pits, under logs and live on the road. Seven specimens were found in month of mid-June and July. Only 7.69% of specimens were found in October and November. These data can be explained by various hypotheses including 1) *I. bombayensis* congregates around receding pools in the dry season and are flushed outfrom these retreats with the first heavy rains, 2) The onset of the rains prompts dispersal, for foraging, and/or for breeding activity.

I. bombayensis is relatively uncommon in the area and its specific primary habitats seem to be limited in riverine forests of Purna and Ambika rivers systems. An average of one potential habitat patch (ca. 50 m)/kmr is usually found on river stretches in both the PAs. A total of 70 km river stretches pass through the PAs and about over 150 such kind of the habitat patches of the caecilian species are recorded (river stream pools) are known in and around protected areas. Extrapolation from the preliminary data obtained in this study given a crude estimate of about 3,000 animals in the study area.

Little information on *I. bombayensis* diet was obtained. During the study, one caecilian (RAJ-AA-08) was found chasing an earthworm (*Lumbricus sp.*) on the road surface near Vankla village during heavy rain at 0300 h (11 September, 1999). A dead termite (probably *Odontermes* sp.) and remains of arthopod larvae were recovered from the buccal cavity of caecilians RAJ-AA- 07 and RAJ-AA-11, respectively.

Some of local tribesmen, especially those who fish traditionally and collecting crab in the area, are aware of *I. bombayensis.* Some of Dangi tribals have an excellent knowledge about the species habitat and availability of *I. bombayensis,* including which types of bank habitat and soil it is most readily found in. The tribal people living around the VNP, know it locally as 'Dhasude' (= ?) and some times they confuse it with worm snakes (*Typhlops* sp.). Dangi tribals call it 'Pani nu jivadu' (Pani = water; nu = of; jivadu = small living creature) or 'Pani no Jivado' (Pani = water; Jivado = small living creature).

Only 18 specimens that were collected alive and in good condition were investigated for gender. The anterior part of vent was pressed, to ascertain whether the male phallodeum could be everted. Four specimens were found to be male and the remaining 14 were assumed to be females, immature males and possibly males in which the phallodeum did not evert.

Potential conservation threats to *I. bombayensis* were considered during the study. One direct threat is road-kills on highways, especially during the rainy season. This threat can be reduced by closing roads through Protected Areas during night in the rainy season. In this study, road killed *I. bombayensis* were found close to perennial rivers and where typical caecilian habitat is close to the road (for example: near Kilad check post at VNP and Bus stand at Bandhpada village, PWS). Such spots might be further studied, and devices for ensuring the safe passage of caecilians (and other animals) tested. Road killed caecilians have been reported from several other Indian localities (Tikader, 1964; Pillai and Ravichandran, 1999; Singh et. al., 2000; Vijayakumar et. al., 2001).

Pillai and Ravichandran (1999) and Ravichandran and Krishnamurthy (2001) presented some external morphometric data of specimens from Sringeri, Karnataka that they referred to *Ichthyophis bombayensis*. If both the specimens from Karnataka are correctly identified, it is possibile that the species is widely distributed from Gujarat south to Karnataka in the central Western Ghats. However, to date there are no records of the species from intervening 900 km, including in the states of Maharashtra and Goa. This suggests three possibilities: i) the specimens from Karnataka are not the same species as in Gujarat, ii) two widely separate popula-

TABLE 3: Date and habitat data for *Ichthyophis bombayensis*.

	Month	Dug out	Road killed	Garbage pit	Wood logs	Live on road	Total (%)
Summer	March						—
	April						—
	May	03					03 (11.5)
	June(1st half)	12					12
Monsoon	June(2nd half)		4				04
	July		1	1	1		03 (11.5)
	7August		0				00
	September		0	1		1	02 (07.7)
	October		1				01 (3.84)
Winter	November		1				01 (3.84)
	December						—
	January						—
	February						—
	Total (%)	15 (56.6)	7 (26.92)	2 (7.69)	1 (3.84)	1 (3.84)	26

tions of *I. bombayensis* occur, or iii) *I. bombayensis* occurring between southern Gujarat and Sringeri have not yet been discovered. These hypotheses can be tested with future fieldwork and a detailed reassessment of taxonomy.

Resolving the taxonomy of the Karnataka species is a priority. The information given by Pillai and Ravichandran (1999) and Ravichandran and Krishnamurthy (2001) for their Karnataka material does not match the original description of *I. bombayensis*, and information such as sex and numbers of vertebrae were not presented, limiting the comparisons that can be made. Indian amphibian workers hold diverse views regarding the reports of *I. bombayensis* from Karnataka. For example, S. K. Dutta examined one of the reported specimens (VAG-12 ZSIM) wrote "…I examined that specimen at Madras, which seems to be some other species not *I. bombayensis*." (letter dated 10 July 2000). G. K. Bhatta (pers. comm.) also disagree with the published claims of Karnataka records. Unfortunately, I have not been able to examine either of the reported specimens from Karnataka.

The first report of *I. bombayensis* from Karnataka was probably given by Balakrishna et al. (1982). However, no voucher specimen or photograph was recorded, so that this distributional record of the species must remain in question, especially considering that there are at least a further three species of unstriped *Ichthyophis* known from the Western Ghats (Taylor, 1968; Pillai and Ravichandran, 1999). Balakrishna et al. (1982) presented data on the mobility in gel of muscle proteins, and showed that this was substantially different for their '*I. bombayensis'* (presumably from Karnataka) compared to three species of striped *Ichthyophis* and *Uraeotyphlus*. A comparison of such data from the Gujarat *I. bombayensis* and other unstriped Western Ghats *Ichthyophis* might offer further data of use in a reassessment of taxonomy.

More field data are required, but this preliminary study suggests that *Ichthyophis bombayensis* may be patchily distributed in riverine forest of Dangs, Navsari and Surat districts of southern Gujarat, but that they can also occur in some disturbed habitats. During summer, *I. bombayensis* can be found congregated in the banks of perennial river pools. In the monsoon, the species is found more widely dispersed in riverine forest. In the absence of detailed information on the distribution of the species, it is difficult to evaluate its present conservation status. The areas in which *I. bombayensis* is found are under anthrogenic pressures including habitat degradation, alteration and pollution. More taxonomic and ecological work is required to determine conservation measures that might be required.

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First record of *Mabuya allapallensis* from Gujarat State, India

Mabuya allapallensis was described by Schmidt (1926) on the basis of single specimen from Allapalli forest, near Chanda, Maharashtra. In the next review of the saurofauna of the Subcontinent, Smith (1935) considered it as a variatal form of *Mabuya macularius.* Subsequently, Sharma (1935, 1973) found *M. allapallensis* to be sympatric with *M. macularia* in Goa, and concluded that the two are distinct, an opinion followed by Das (1991). *M. allapallensis* is distributed in deciduous forests of central India, including Andhra Pradesh, Bihar, Goa, Karnataka and Madhya Pradesh (Tikader and Sharma, 1992). More recently, Thomas et al. (1998) recorded the species from Muthanga

Range of Wayanad Wildlife Sanctuary, Kerala, representing an extension of the range further south into peninsular India.

I have been able to collect six specimens of *Mabuya allapallensis* during a herpetofaunal study of Vansda National Park (VNP; 20° 51' 16" and 21° 21' 22"N; 73° 20' 30"- 31' 20"E), Navsari District and Purna Wildlife Sanctuary (PWS; 20° 51' 15" and 21° 31' 22"N; 73° 32' 20"E), Dangs District, southern Gujarat. The protected areas lie between 110 to 570 m above MSL and are covered with grassland with tree cover, dominated by *Tectona grandis, Terminalia crenulata, Albizia procera, Dalbergia latifolia, Adina cordifolia, Madhuca indica* and *Butea monosperma*. Champion and Seth (1968) classified the area as a tropical moist and dry deciduous forest. The lizard species is commonly found on the slopes of forested area under dry leaves. The species was observed to forage from morning to evening up to 1900 h during the winter.

A total of six specimens are collected in and around the protected areas for the confirmation, all of which were deposited in the museum of Bombay Natural History Society [BNHS 1567-72], Mumbai. Data on measurements and pholidosis are in Table 1.

The species is widely distributed and sympatric with *M. macularia* in the forest areas of Valsad, Navsari, Dangs and some of the eastern parts of Surat District (south to River Tapi) in

TABLE 1: Morphometric and meristic details of *Mabuya allapallensis* from Vansda National Park (VNP) and Purna Wildlife Sanctuary (PWS), Gujarat, India. Measurements in mm. (N.D. = Not determined; Bombay Natural History Society = BNHS).

	BNHS 1567	BNHS 1568	BNHS 1569	BNHS 1570	BNHS 1571	BNHS 1572
	VNP, Kevadi Aug 06, 1998	VNP, Kala Amba Aug 25, 1998	VNP, Dungarada Apr 04, 1999	PWS, Mahal Oct 02, 2001	PWS, Besh Katri Jun 23, 2002	PWS, Subir Sep 06, 2002
snout-vent length; SVL	50.00	44.00	46.00	45.00	38.00	36.00
tail length; TL	46.00	67.00	60.00	61.00	28.00+	12.00+
distance between angle of jaws and snout tip; HL	07.76	06.68	06.84	07.80	07.40	05.42
angle of jaws; HW	06.62	06.32	07.56	06.82	06.60	06.22
distance between posterior edge of fore limb to anterior edge of hind limbs; A-G	26.46	27.74	21.70	22.02	19.22	17.32
greatest diameter of eyes; ED	01.70	01.22	01.46	01.42	00.86	00.90
distance between anteriormost point of eye and nostrils; E-N	02.12	02.86	02.66	03.14	02.28	01.82
distance between anteriormost point of eyes and tip of the snout; E-S	04.00	03.96	04.38	03.98	03.52	03.04
anterior edge of ear opening to posterior-most point of eyes; E-E	03.90	03.64	03.68	04.14	03.60	02.68
greatest diameter of ear opening; EL(S)	00.96	00.80	01.00	00.90	00.94	00.60
least distance between upper eyelids; IO	00.68	00.86	00.68	00.70	00.62	00.62
distance between nostril; IN	01.82	01.80	02.00	02.12	02.00	01.40
upper labials R/L; UL R/L	7 / 7	7 / 7	7 / 7	7 / 7	7 / 7	7 / 7
lower labials R/L; LL R/L	7 / 7	7 / 7	7 / 7	7 / 7	7 / 7	7 / 7
dorsal scale rows DSR	30	28	26	26	28	28
lamellae on 4th finger; L 4th D	12	12	14	12	12	12
lamellae on 4th toe; L 4th T	15	15	15	15	14	15
sex	F	M	N. D	N. D	N. D	N. D

southern Gujarat, including the two protected areas of Vansda National Park and Purna Wildlife Sanctuary, southern Gujarat.

The present record of the species from the forests of the south Gujarat is at a distance of 1,500 km from type locality of Chanda, Maharashtra and is a further western extension range of the species.

The various recent reports of the species from different parts of Peninsular India support the earlier statements of Smith (1935) that the frontopariental scutes may be fused into a single shield, of which he had seen seven examples from different parts of India. Schmidt's *allapallensis* was based on such a variation." Unfortunately, Smith does not mention localities for these specimens.

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GUIDE TO THE REPTILES OF THE EASTERN PALEARCTIC

by Nikolai Szczerbak

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Before getting into the species descriptions and illustrations I immersed myself in the author's description of the topography of the Eastern Palearctic, the area that was until recently known as the Union of Soviet Socialist Republics. Covering a total of 22 million sq. km (the entire USA is 5.5 million sq. km), half of the region is covered by permafrost, some of it 1500 metres thick! This obviously limits speciation and distribution of ectotherms though the extremes of topography support 168 reptile species. This includes 7 species of turtles and tortoises, 98 species of lizards and 63 species of snakes.

The former USSR consists of 50% lowlands, 45% high plateaus and 5% mountains including the Pamirs and Tien Shan which rise to over 7400 m. Three rivers, Amur, Lena and Yenisei are over 4000 km long and Lake Baikal is the deepest in the world at 1620 m. Two deserts, Karakum and Kyzylkum are over 300,000 sq. km in extent and the rainfall for the entire area ranges from 250 to 3000 mm.

The range maps (one for every species) show a dramatically staggered reptile distribution. Only 20 taxa are found in the eastern "Himalayan/Manchurian sub-region;" while a mere 10 are from the south central "Arid Mediterranean" Asiatic sub-region. Reptile diversity is concentrated in the southwestern "Mountain – Asiatic and Steppes region." Only one reptile, the lizard *Lacerta vivipara*, is found right across the former USSR.

The species descriptions are good (and include keys to the genera) with interesting notes on habits and habitats. There are 10 good colour plates of tantalizing habitats and 184 reptile plates. Most of these are good enough for identifying the species but about 35 are either fuzzy or otherwise sub-standard.

There are a few typos and use of the word "district" is sometimes odd but in general the text is concise and well edited. The bibliography consists of over 200 references, many of them Russian. The author rightly points out that much of the herpetological work published in Russian has been overlooked by Western herpetologists. The book ends with an Index to scientific names.

The author, Nikolai Szczerbak (1927-1998) was one of Russia's foremost herpetologists with hundreds of scientific articles, 24 monographs and 12 books to his credit. He described over a dozen new reptile species and under his guidance the Zoological Museum at the Ukrainian Academy of Sciences amassed a collection of over 40,000 specimens (though these days we wonder about the wisdom of repetitious collection).

This is a valuable reference book, with tough binding and easy-to-use format; a vital contribution to the herpetology of the vast region.

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Omission:

The following table was inadvertently omitted from *Hamadryad* Vol. 27, No. 2, pp: 276-280, "A report on sexual dimorphism in *Rana temporalis* (Günther, 1864) by K. Vasudevan":

TABLE 1: Rotated component matrix using Principal Component Analysis of data on the morphological measurements of *Rana temporalis* to differentiate sexes. The component loadings of the variables used in the analysis (n = 24), component loadings above 0.5 indicated with values.

Variable	Component	
	1	2
FAMS	-0.937	
SVL in mm	0.931	
HH/TD	0.894	
228 SVL/FAD	0.754	
TS	-0.695	
FAD in mm	0.624	-0.608
COLS		0.814