Hamadryad Vol. 31, No. 2, pp. 315 – 329, 2007.

TAXONOMY OF THE INDIAN SNAKE *XYLOPHIS* BEDDOME (SERPENTES: CAENOPHIDIA), WITH DESCRIPTION OF A NEW SPECIES

David J. Gower and Jasmin D. Winkler

Department of Zoology, The Natural History Museum, London SW7 5BD, United Kingdom.
Email: d.gower@nhm.ac.uk

(with seven text-figures)

ABSTRACT.– A new species of the Western Ghats endemic caenophidian snake *Xylophis* is described based on a type series of 26 specimens from southernmost Kerala and Tamil Nadu. *Xylophis captaini* nov. sp. is most similar to *X. stenorhynchus* but is distinct from that species and *X. perroteti* in several scalation and dental characters. Although *X. indicus* might be a junior synonym of *X. stenorhynchus*, as previously suggested, its taxonomic status is in need of further reassessment. A new key to the species of *Xylophis* is presented.

KEY WORDS.– Western Ghats, Xenodermatinae, *Xylophis captaini, X. indicus, X. perroteti, X. stenorhynchus.*

INTRODUCTION

The caenophidian snake genus *Xylophis* Beddome, 1878, is endemic to the southern Western Ghats region of peninsular India, and is considered currently (Smith, 1943; Sharma, 2003; Whitaker and Captain, 2004) to comprise two nominate species, *X. perroteti* (Duméril, Bibron and Duméril, 1854) and *X. stenorhynchus* (Günther, 1875). Very little is known about the biology of *Xylophis*. The genus has been tentatively considered to be a member of the poorly known caenophidian (possibly colubroid) taxon Xenoderminae/Xenodermatinae (McDowell, 1987; Zaher, 1999; Dowling and Pinou, 2003; Lawson et al., 2005), whose phylogenetic position is currently unclear (e.g., Kelly et al., 2003; Lawson et al., 2005). Any additional data on *Xylophis* biology is thus of both immediate and potentially broader interest.

Here, we present a reassessment of the taxonomy of *Xylophis*, focussing on the small, *X. stenorhynchus*-like species (i.e., instead of the larger *X. perroteti*). We report that material previously referred to *X. stenorhynchus* comprises at least two species that differ substantially in external morphology, and we describe a new species. We also present a new key to the species of the genus, and discuss some of the implications of our findings, including the taxonomic status of *X. indicus* Beddome, 1878.

MATERIALS AND METHODS

Previous works on *Xylophis* have been few and brief. We attempt to improve the quantity and quality of the baseline taxonomic and ecological data by writing in more detail here than might be necessary for better-known taxa. We examined type and historical material in the collection of The Natural History Museum, London (BMNH) and mostly more recent material in the Bombay Natural History Society, Mumbai (BNHS). Photographs were examined of specimens in the California Academy of Sciences, San Francisco (CAS) and the Field Museum of Natural History, Chicago (FMNH).

Our ventral scale counts include all unpaired midventral scales lying between the mental and anal shield (as did those by Gans and Fetcho, 1982 for the potentially closely related *Aspidura*). The anteriormost of these midventral scales is adjacent to the first dorsal scale row and so qualifies as the first ventral under Dowling's (1951) scheme, even though this scale clearly lies anterior to the articulation between the skull and vertebral column (see Gower and Ablett, 2006, for discussion of a similar situation in anilioids).

Head length was measured from tip of snout to posterior edge of posteriormost supralabial; head height sagittally from level of corner of mouth to top of head. Numbers of vertebrae were determined by X-ray.

TAXONOMY

Xylophis captaini nov. sp.

(Figs. 1–6, Table 1)

Xylophis stenorhynchus (Günther, 1875): Smith, 1943:343 (part); Inger et al., 1984:566; Murthy, 1990:46 (part); Das, 2002:49 (part); Measey et al., 2003:47; Sharma, 2003:152 (part); Whitaker and Captain, 2004:274 (part).

Holotype.– BNHS 3375. Adult male, collected at Kannam, Kottayam District, in the state of Kerala at approximately 9º 32’ N, 76º 41’ E and 110 m a.s.l. Collected by O. V. Oommen and colleagues (University of Kerala), 14 August 2000. The specimen was dug from loose soil in a garden/small mixed plantation close to housing. The locality is situated between the Arabian Sea coast of peninsular India and the western foothills of the Western Ghats. This is also the type locality of the syntopic caecilian amphibian *Uraeotyphlus narayani* Seshachar.

Paratypes.– India: Kerala: Thiruvanathapuram District: Palod (8º 45’ N, 77º 01’ E, 150 m), BMNH 97.2.8.1, 97.2.8.2, 97.2.8.3 (collected before 1898); Cheranikara (8º 39’ N, 76º 57’ E, 120 m), BNHS 3376 (27.x.1999), 3388 (27.viii.1999), 3392 (12.viii.2000), 3397 (12. viii.2000); Mennookonom (8º 38’ N, 77º 02’ E, 100 m), BNHS 3389–3391 (29.vi.2000); Azhukkamoozhi, near Kattalakada (approximately 15 km East of Thiruvananthapuram), BNHS 3378 (11.viii.2000); Vanchuvam (8º 39’ N, 77º 01’ E, 80 m), BNHS 3381–82, 3396 (21. viii.2000); Potugani Junction (8º 28’ N, 77º 13’ E), BNHS 3383 (21.viii.2000); Chathankodu (8º 39’ N, 77º 09’ E, 120 m), BNHS 3385–87 (12. x.2005). Kollam District: near Punalur (8º 59’ N, 76º 57’ E, 150 m), BNHS 3377 (5.viii.1998), 3379 (17.viii.2000); Pathanapuram (9º 06’ N, 78º 51’ E, 50 m), BNHS 3384 (27.viii.2000). Pathanamthitta District: Mylam (9º 02’ N, 76º 48 E, 85 m), BNHS 3393 (13.viii.2000). Kottayam District: Chengalam (9º 37’ N, 76º 43’ E, 120 m), BNHS 3394 (15.viii.2000). Idukki District: Peralamattayam (9º 55’ N, 76º 40’ E, 48 m), BNHS 3395 (14.viii.2000). Tamil Nadu: Kanyakumari District: Aarukani (8º 29’ N, 77º 12’ E, 210 m), BNHS 3380 (19.viii.2000).

Referred material.– BMNH 1924.10.13.6 (female) is from a locality we have been unable to trace (Punakanaad, Travancore), and BNHS 1762 (female) from Ashambu Hills, Tinnevelley is in a very poor state of preservation. We include these two specimens among the referred rather than paratypic material. Several other specimens have not been examined directly by us. These are referred to the new species on the basis of ventral and subcaudal scale counts made by colleagues or recorded from photographs, and relative sizes of prefrontal and internasal scales assessed from photographs. In the absence of detailed comparisons, we refrain from designating them as paratype specimens. These are FMNH 217695 (female) and 217696 (male) from Ponmudi, Thiruvanthapuram District, Kerala (see Inger et al., 1984:566); CAS 17281 (male) from “India”.

Diagnosis.– A *Xylophis* resembling *X. stenorhynchus* (and its putative junior synonym *X. indicus* – see below), and differing from *X. perroteti* in having 15 instead of 13 dorsal scale rows at midbody. *X. captaini* differs from *X. stenorhynchus* (and *X. indicus*) in having internasal scales that approach being subequal in midline length to the prefrontal scales, rather than much shorter than them. *X. captaini* is smaller (up to 145 mm total length versus over 200 mm), has a proportionately shorter tail, and fewer ventral (106–122+ versus 120–135) and subcaudal (males 17–22 versus 24–29; females 10–14 versus 15) scales. *X. captaini* also has more teeth – approximately 27–30 in each maxilla and each dentary compared to approximately 18–21 in each in *X. stenorhynchus*. In *X. captaini*, the first and second infralabial scales are short, and together are shorter than the third infralabial, while in *X. stenorhynchus*, the second infralabial is notably longer than the first, and together the first and second approach the length of the third. In *X. captaini* the parietal scales make a much shorter midline contact than in *X. stenorhynchus*.

Figure 1. *Xylophis captaini*, photographs of holotype BNHS 3375. Scale in mm.

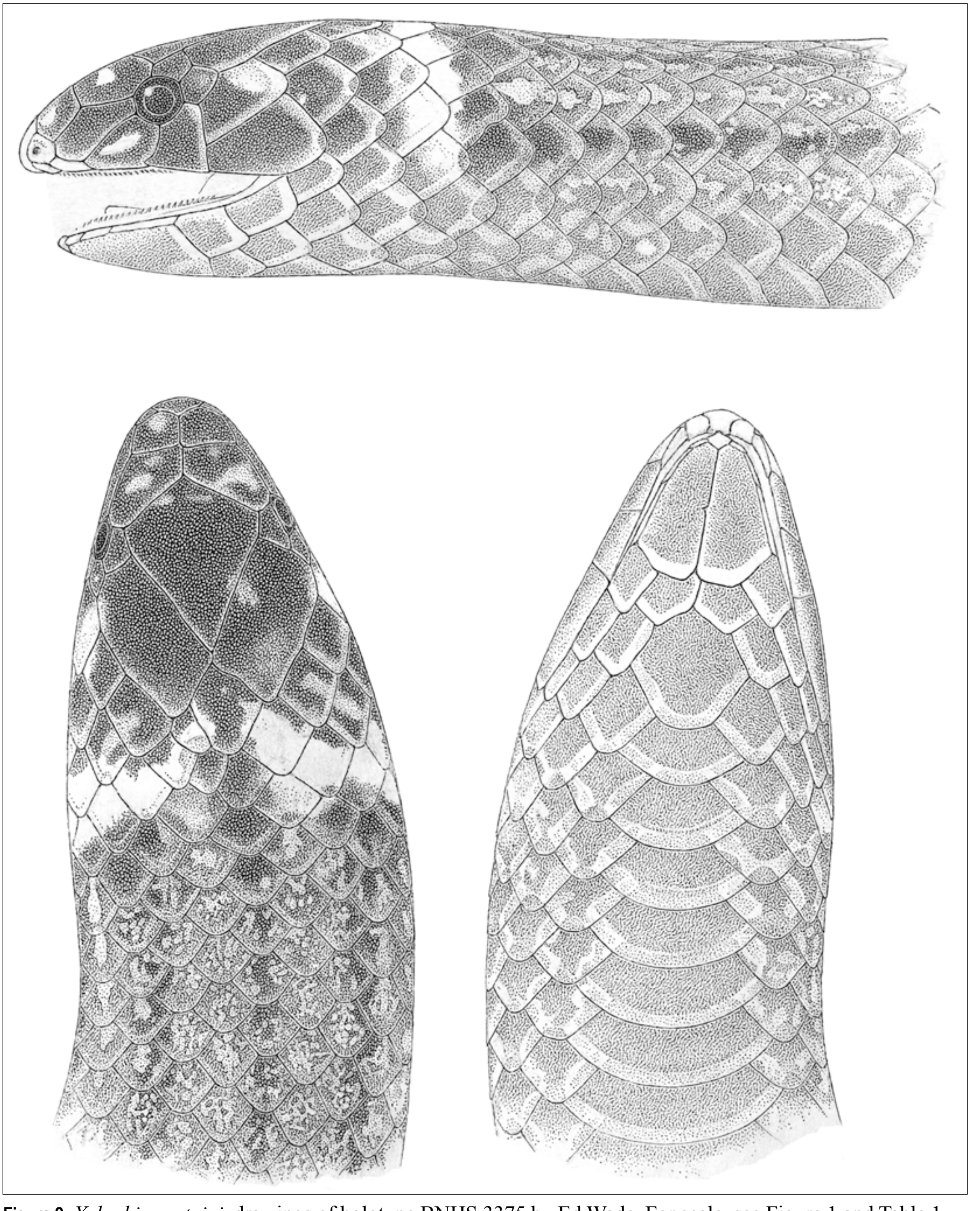

Figure 2. *Xylophis captaini*, drawings of holotype BNHS 3375 by Ed Wade. For scale, see Figure 1 and Table 1.

Description of holotype.– Some morphometric and meristic data are given in Table 1. Specimen in good condition without incisions. The body, preserved in a flat, loose U-shape, is a little dorsoventrally flattened, with a constriction at midbody caused by overly tight tying of a field tag. Colours have not noticeably faded.

No distinct neck, head instead narrowing steadily from uniform anterior of body. Head short, 4.2 mm, and high, 2.2 mm, with steeply domed snout in lateral view. Snout abruptly tapering to blunt, rounded tip in dorsal view. Rounded rostral short in dorsal view - much shorter than distance between it and prefrontal scales. Rostral falls short of level of ventral edges of anterior supralabials, resulting in small median notch at anterior margin of upper lip (Fig. 3). Nasals appear undivided, but some doubt remains because they are small with only thin extranarial margins. Left and right nasals not in contact (Fig. 3), each smaller than intervening rostral. Anteromedial margin of almost anteriorly-directed external naris semicircular, posterior part formed by countersunk, less curved rim. Paired internasals large, much larger than nasals and rostral, approaching dimensions of prefrontals. Although not longer than internasals along midline, prefrontals are greater in area due to elongate posterolateral wings.

Five supralabials, third and fourth entering orbit. First supralabial very small and, apart from second supralabial, contacts only rostral and nasal (Fig. 3). Second supralabial a small, thin strip contacting nasal, large scale between eye and nasal, and first and third supralabials. Third and fourth supralabial scales much larger, taller than long, and contacting approximately hexagonal spectacle. Fourth supralabial also contacts postocular and anterior temporal. Fifth supralabial the largest.

Single, conspicuous and long scale lying between eye and nasal and second supralabial – resembling a loreal (described as such by Günther, 1875; Smith, 1943) more than a preocular in size and shape, despite contacting eye. Kite-shaped diamond frontal notably longer (2.4 mm) than broad (1.7 mm), and about as long as paired parietals, the latter meet only briefly (much less than their and frontal's lengths) along midline behind frontal. Temporals 1 + 2, subequal in size, anterior one inserts deeply between last two supralabials. Small supraocular and postocular, subequal in size and shape.

Anterior of lower jaw dominated by large pair of anterior genials meeting along midline mental groove, prevented from reaching margin of mouth by small mental and three very thin infralabials. Mental short, broad, with tripartite anterior end (Fig. 3). Anterior two infralabials short and thin, second marginally larger. First two infralabials together shorter than long, narrow third, and in lateral view falling notably short of halfway along length of anterior genials. Fourth and fifth infralabials much larger, about same size as each of a pair of posterior genials. First unpaired midventral scale (= first ventral here) immediately behind posterior genials, with approximately equidistant transverse and longitudinal axes. Second ventral scale is first that is wider than long.

Inside of mouth uniform, pale off-white in preservation. Tongue only partially visible, deeply forked with slender, unpigmented tips. Teeth small, evenly sized, gently recurved with pointed tips, barely protruding from surrounding soft tissue. Counting teeth was difficult without further destructive preparation. Approximately 28 maxillary and 29 dentary teeth. No attempt was made to count palatal teeth because rows extend far back into mouth (perhaps twice as long as outer rows). No obvious heterodonty in form or size (including those in palate), but anteriormost teeth slightly smaller in each row.

Body subcylindrical, ventral surface a little flattened. Dorsal scales in 15 rows from at least as far anterior as fifth ventral, up to posteriormost ventral. Dorsals generally regularly arranged, evenly sized across rows at any given point along body, all imbricate. All body scales macroscopically smooth and glossy, lacking keels. Ventral scales 112 in number, all similarly proportioned except for anterior- (as long as broad) and posteriormost (small and offset, lying between right sides of preceding ventral and anal shield) members. Anal shield undivided, similar in size to last ventrals, its posterior margin overlaps four small, irregular scales on right and five on left, in addition to pair of larger subcaudals medially. Subcaudals paired, 18 in number. Tail terminates in bluntly tapering apical spine. Total length 137 mm, tail length 13.6 mm, tail/total length ratio 0.1. Tail with somewhat flattened venter. Anteriorly with 10 to 11 dorsal scale rows, reducing to about eight at mid tail, four surrounding base of terminal spine. Vertebrae 135 in number, 22 confined to anal and postanal region.

Body and tail scales all highly iridescent. Most head and tail scales match this, but very small, unpigmented anterior supra- and infralabials appear matt. Overall, specimen is in various shades of brown mottled with off-white. Collar region and several longitudinal body stripes paler. Ventral scales under head, body ventrals and subcaudals all very similar in colour – main body of each scale a fairly uniform, pale brown with occasionally darker outer edges just inside translucent scale margin. Venter generally paler and more evenly coloured than dorsum. Upper and sides of head are darkest parts of the animal, notably darker than body. Some of dark brown head scales have mottled, irregular, off-white spots, most notably in anterior temporal at juncture with parietal, and towards centres of prefrontal and internasal. Margins of scales contacting spectacle darker around eye, almost black. Otherwise, dorsal and lateral head scales generally with slightly darker bases and unpigmented distal margins. First supralabials, first and second infralabials, third right infralabial, and mental all unpigmented.

Pale, off-white collar band approximately one scale wide, spread across two or three adjacent scales, extending from third dorsal scale row towards dorsal midline, where it bends forward and is incomplete by less than width of single scale. Seven dark stripes run from behind collar to tail tip. Three dorsal stripes darkest, darker and broader just behind collar. Narrowest dorsal stripe mostly confined to midline (eighth) scale row. Pair of dorsolateral stripes slightly broader, extending across most of fifth and sixth dorsal scale rows on each side. Thin dark lateral stripe on third scale row. Paler ventrolateral stripe on first dorsal scale row, appearing slightly intermittent because each scale in row is slightly darker towards tip. Between dark longitudinal stripes, scales in various shades of mottled pale brown and off-white. Broadest and whitest stripes on fourth scale row on each side, each scale bearing large central irregular whitish blotch.

Etymology.– The species is named for Ashok Captain (Pune, India), in recognition of his contributions to the knowledge of Indian snakes.

Suggested common name.– We prefer 'Captain's *Xylophis*'. Alternatively, 'Captain's wood snake'. The etymology of *Xylophis* Beddome, 1878 was not explained on first usage, but probably derives from xylon, the Greek noun for wood (the substance, not an assemblage of trees), perhaps because of this snake's woody colour or its association with dead wood (see quote from Beddome, 1878 below in section on *X. indicus*). *Xylophis* have previously been referred to as "narrow-headed" (Das, 1987; Whitaker and Captain 2004), "small-headed" (Whitaker, 1978) or "dwarf" (Wall, 1919; Gharpurey, 1933) snakes.

Additional information from paratypes.– Twenty-five paratypes, 14 males, 10 females, and one incomplete unsexed specimen, total length 60–145 mm. Morphometric and meristic data for type series given in Table 1. All types share same complement of head scales. No subdivision of nasal scales detected. Distribution of tail length and number of subcaudal scales bimodal and non-overlapping, interpreted as strong sexual dimorphism. Thus, sex determined by counting subcaudal scales and measuring ratio tail:total length, and cross-referencing data with instances of hemipenial eversion in preservation. Males have longer tails.

Only in holotype is there a small preanal scale offset from midline, although last ventral is longitudinally subdivided in two males (BNHS 3379, 3382). One female (BNHS 3391) and two males (BNHS 3383, 3385) with single, partially divided anterior ventral. First supralabial unpigmented in most specimens – lightly pigmented in two females (BNHS 3392, 3394) and three males (BNHS 3382–84). First two infralabial scales unpigmented in all types except BNHS 3385, in which second infralabial is pigmented on left only. Third infralabial usually pigmented, generally greater than twice length of first two infralabials combined, although lengths are subequal in three males (BNHS 3377, 3381, 3384). Number of small scales contacting anal shield (excluding subcaudals, and first dorsal scales between anal and posteriormost ventral) 3–5 per side, totals not indicative of notable dimorphism between males (range 7–9, mean 8.5) and females (range 6–9, mean 7.9). Pale collar band present in all paratypes, matching holotype in being broadly incomplete ventrally, narrowly incomplete middorsally (where left and right sides bend forwards). Only six paratypes match holotype in having left and right parts of band complete, more typically one or both halves intermittent, with incompleteness resulting sometimes (e.g., BNHS 3395, 3384) in conspicuous pale lateral spot. Pale postocular spot present in all types, varying in size and intensity. All types have longitudinal, dark/pale body and tail stripes, varying in intensity and width - dorsal stripes can be inconspicuous (e.g., BNHS 3376, 3383) or accentuated (e.g., BNHS 3392, 3386).

Colour in life generally as described for preserved holotype. *X. captaini* is a light to dark brownish snake with an off-white collar band and other pale specks and blotches (Fig. 4). Based on photographs of one specimen (BNHS 3386) in life, taken in daylight with a flash, pupil is round.

Referred material.– Referred material fits generally within meristic and morphometric variation of type series (Table 1). No notable departures in scalation, although very poorly preserved BNHS 1762 has a high ventral count of c.125.

Hemipenis.– Hemipenes of BNHS 3376 were everted during preservation. One was subsequently cut off and prepared as per method given by Zaher (1999) and Zaher and Prudente (2003). Hemipenis small (c. 6 mm) and difficult to view and handle.

Hemipenis (Fig. 5) bilobed and deeply forked, with each subequal lobe approaching twice length of hemipenis body. Sulcus spermaticus bifurcates towards distal end of hemipenial body, close to lobular crotch. Sulcus branches centrolineal to weakly centrifugal, ending at tips of lobes. Hemipenial body and proximal ends of lobes naked. Most of proximal half of each lobe bears about eight, approximately transverse fleshy flounces that appear to have microscopically spinous or scalloped free edges. Distal half of each lobe bears about seven much less prominent and less complete flounces that might be partly oblique. No spines, papillae or calyces.

Hemipenial morphology was not documented in the original descriptions of other *Xylophis* species, and no information was given by Boulenger (1890). Smith (1943:343) described the hemipenis of *X. perroteti*: "hemipenis forked for 3/4 of its length; it is flounced throughout, the folds on the distal part being oblique, gradually changing until at the fork, where they are transverse; proximal to the bifurcation there are smooth longitudinal folds; there are no spines". Smith (1943:343) also described the hemipenis of *X. stenorhynchus*: "hemipenis deeply forked as in *perroteti*; the proximal end has transverse flounces; distally these are united and form calyces." McDowell (1987:35) described the hemipenis of *Xylophis* (no species mentioned) as "deeply to very deeply forked, with forked sulcus that is partially centrolineal… …without spines". Apart from the purported calyces of *X. stenorhynchus*, these descriptions resemble many aspects of the hemipenis of *X. captaini*. As far as we are aware, Figure 5 is the first published picture of a *Xylophis* hemipenis.

Ecology.– Almost all specimens of *Xylophis captaini* were collected in shady plantations and other disturbed or secondary habitats, and were dug from moist soil at depths of up to about 10 cm. The species is also found in compost or leaf litter in the same habitats. These environments have replaced primary moist forests, which may have been the original habitat of *X. captaini*. Inger et al. (1984:566) reported two *X. captaini* (as *X. stenorhynchus*) from leaf litter in evergreen forest. Other syntopic vertebrates found with *X. captaini*, at least outside forest, include the caecilian amphibians *Gegeneophis ramaswamii, Ichthyophis* cf. *tricolor*, *I.* cf. *bombayensis* and *Uraeotyphlus* spp., small typhlopid snakes, and the uropeltid snakes *Melanophidium* sp. and *Uropeltis* spp. (Measey et al., 2003; DJG, pers. obs.; SD Biju, pers. comm.; OV Oommen, pers. comm.). Measey et al. (2003) found *X. captaini* (reported as *X. stenorhynchus*) occurring at a density of 0.07 m^{-2} in plantations in southern Kerala.

Xylophis captaini are highly iridescent, which is probably a by-product of a dirt-shedding surface microornamentation, an adaptation to life in moist soil (Gower, 2003). When dug out of soil *X. captaini* sometimes play dead (DJG, pers. obs.).

The gut contents of two specimens were examined. BNHS 3392 contained two long (c. 55 and 30+ mm) earthworms, and BNHS 3377 only the digested remains of earthworms. BNHS 3392 holds two large (8.5 x 4 mm), ovoid, yolky ova, BNHS 3377 has turgid testes and enlarged efferent ducts. Both specimens were collected in August, in the wet season. BNHS 3387, collected in October at the end of the wet season, contains four ovoid ova (up to 1.6 mm in length) in each of its well developed oviducts.

Distribution.– Specimens of *Xylophis captaini* have been recorded thus far only from low altitudes (300 m or less) on the western side of

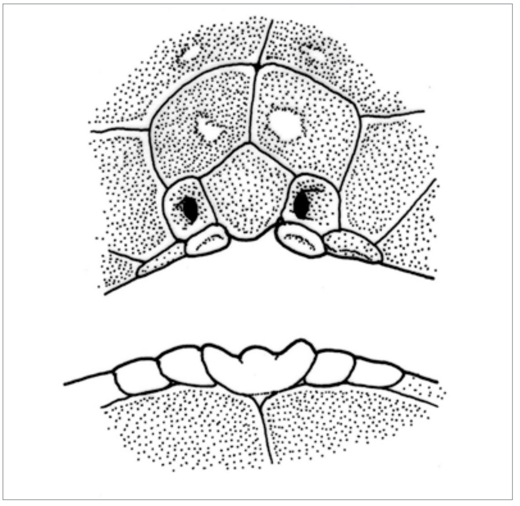

Figure 3. *Xylophis captaini*. Anteriormost scales of snout and lower jaw of holotype (BNHS 3375) in anterior view, showing scalation pattern and distribution of pigmentation. From a drawing made with camera lucida.

Figure 4. *Xylophis captaini*. Photograph of paratype BNHS 3386 in life. Total length of specimen is 135 mm.

the southern part of the Western Ghats (Fig. 6), south of the Palghat Gap– an important biogeographic barrier in the distribution of many taxa (e.g., Gower et al., in press). This is a generally cryptic and inconspicuous snake, so that the known distribution might be expanded both horizontally and altitudinally through new fieldwork.

Conservation.– Although its range of occurrence is not enormous, *Xylophis captaini* occurs in plantations, gardens and other disturbed habitats as well as evergreen forest at low altitudes. Locally, at least, it can be common. Given that agricultural practices will not change markedly, *X. captaini* might be considered 'least concern' under IUCN criteria.

Figure 5. *Xylophis captaini*. Sulcate view of hemipenis of paratype BNHS 3376. Total length of hemipenis c. 6mm.

Xylophis stenorhynchus (Günther, 1875)

Geophis stenorhynchus Günther, 1875:230

Xylophis stenorhynchus (Günther, 1875): Boulenger, 1890:284; Smith, 1943:343 (part); Murthy, 1990:46 (part); Das, 2002:49 (part); Sharma, 2003:152 (part); Whitaker and Captain, 2004:274 (part)

Xylophis stenorynchus [emend.] Wall, 1923:610

Xylophis sterorhynchus [err. Typo.] Whitaker, 1978:116

Xylphis sterorhynchus [err. Typo.] Sharma, 1998:93

Xylophis indicus Beddome, 1878:576

Syntypes.– BMNH 1946.1.14.13 (male), BMNH 1946.1.14.14 (male), and BMNH 1946.1.14.15 (female).

Type locality.– Travancore, India. Travancore is an historical political region corresponding approximately to the southern part of the current state of Kerala (Fig. 6; Biju, 2001).

Referred material.– BMNH 83.1.12.64 (female), Travancore; BNHS 1761, "Paralai, Anamallais" – probably Paralai tea Estate, Valparai, Tamil Nadu, specimen very poorly preserved. Depending on the status of *X. indicus* (see below), referred material of *X. stenorhynchus* possibly also includes BMNH 78.8.2.1 (holotype of *X. indicus* – see below for details), and CAS 17199 and 17200 (both males), Travancore.

Table 1. Morphometric and meristic data for holotype (**), paratypes (*), and referred specimens of *Xylophis captaini*. TL, total length; tL, tail length; w, midbody width; V, ventral scales; SC, subcaudal scales; HL, head length (snout tip to posterior margin of last supralabial scale); Hw, head width at posterior margin of last supralabial scale; F-Snt, midline distance between frontal scale and tip of snout; PrfL, length of prefrontal scales along midline; FL, frontal scale length; Fw, frontal width; PaL, maximum dimension of parietal scale. † data from photos and other colleagues; ‡ data from Inger et al. (1984).

Specimen	Sex	TL	tL	tL as % TL	w	w as % TL	V	SC	HL	Hw	F-Snt	PrfL	F-Snt ÷ PrfL	FL	Fw	PaL
BNHS 3375**	m	137	13.6	9.9	4.2	3.1	110	18	4.4	3.6	1.8	0.6	3	2.5	1.9	2.4
BNHS 3376*	m	125	11.9	9.5	4.6	3.7	108	18	4.2	2.9	1.8	0.5	3.6	2.1	1.6	2.2
BNHS 3377*	m	139	13.8	9.9	4.2	3	108	17	4.5	4	1.8	0.6	3	2.3	1.8	2.5
BNHS 3378*	m	114	11.0	9.6	3.7	3.2	107	17	3.8	2.7	1.5	0.5	3	1.9	1.7	2.1
BNHS 3379*	m	103	10.7	10.4	4.1	4	102	18	4.1	3.6	1.7	0.5	3.4	2	1.5	2
BNHS 3380*	m	115	11.7	10.2	4.6	4	105	17	4.4	3.1	1.7	0.7	2.4	1.9	1.7	2.4
BNHS 3381*	m	73	7.0	9.6	2.7	3.7	108	19	3.6	2.5	1.4	0.5	2.8	1.7	1.4	1.8
BNHS 3382*	m	110	10.5	9.5	3.9	3.5	104	17	3.9	2.8	1.6	0.4	4	1.8	1.5	2.1
BNHS 3383*	m	112	10.4	9.3	3.1	2.8	120	22	3.8	2.9	1.5	0.6	2.5	1.9	1.8	2
BNHS 3384*	m	98	10.3	10.5	4	4.1	106	18	3.8	3.1	1.6	0.5	3.2	1.8	1.5	1.8
BNHS 3385	m	130	14.1	10.8	4.8	3.7	109	18	4	3.7	1.7	0.5	3.4	2	1.6	2.2
BNHS 3386	m	135	15.1	11.2	4.8	3.6	107	20	4.3	3.6	1.8	0.6	3	2.2	1.7	2.4
BNHS 3387	f	145	10.4	7.1	5.4	3.7	112	13	4.6	4	1.9	0.7	2.7	2.2	1.7	2.2
BNHS 3388*	f	72	5.3	7.4	2.8	3.9	108	14	3.4	2.5	1.4	0.5	2.8	1.7	1.4	1.8
BNHS 3389*	f	60	4.4	7.3	1.9	3.2	112	14	3.4	2.2	1.3	0.4	3.3	1.7	1.3	1.9
BNHS 3390*	f	120	7.8	6.5	4.1	3.4	110	13	4.3	3.5	1.7	0.6	2.8	1.9	1.6	2
BNHS 3391*	f	106	6.9	6.5	3.3	3.1	113	13	4.2	3	1.6	0.5	3.2	1.9	1.5	2
BNHS 3392*	f	119	7.1	6	4.7	3.9	109	13	4.1	3.7	1.7	0.6	2.8	2.1	1.5	1.9
BNHS 3393*	f	132	9.2	7	4.8	3.6	108	13	4.7	3.7	2.1	0.7	3	2.2	1.7	2.1
BNHS 3394*	f	126	7.8	6.2	3.8	3	111	10	4.4	2.8	1.7	0.5	3.4	2	1.6	2.2
BNHS 3395*	f	128	8.7	6.8	4.3	3.4	110	12	4.3	3.2	1.7	0.4	4.3	2	1.6	2
BNHS 3396*	f	122	8.5	7	3.9	3.2	113	13	4.1	3.1	1.7	0.5	3.4	1.9	1.6	1.9
BNHS 3397*									3.5	2.9	1.4	0.5	2.8	1.7	1.3	1.9
BMNH 97.2.8.1*	m	118	12.6	10.7	4	3.4	108	18	4.2	2.9	1.6	0.5	3.2	2.2	1.8	2.1
BMNH 97.2.8.2*	m	113	10.8	9.6	4	3.5	110	20	4	2.9	1.4	0.6	2.3	2.1	1.7	2
BMNH 97.2.8.3*	m	79	8.5	10.8	2.7	3.4	110	18	3.6	2.6	1.3	0.5	2.6	1.9	1.5	1.7
BNHS 1762	m	115					c. 125	16								
BMNH 1924.10.13.6	f	139	10.0	7.2	5.5	4	111	13	4.4	3.5	1.7	0.5	3.4	2.2	1.7	2
CAS 17281	m	132	15.3	11.5			112	22								
FMNH 217695	f	135†	10†	7.4†			119‡									
FMNH 217696	m	115†	15†	13†			104‡									

Table 2. Morphometric and meristic data for *Xylophis stenorhynchus*. Abbreviations as for Table 1. * types of *X. stenorhynchus*, † holotype of *X. indicus*.

Specimen	Sex	TL	tL	tL as % TL	w	w as % TL	V	SC	HL	Hw	F-Snt	PrfL	F-Snt ÷ PrfL	FL	Fw	PaL
BMNH 1946.1.14.13*	m	159	20.7	13	4.6	2.9	120	24	5.4	4.9	2.1	1.1	1.9	2.3	2	3
BMNH 1946.1.14.14*	m	165	21.8	13.2	4.6	2.8	122	26	5.3	4	1.9	1	1.9	2.3	2	2.8
BMNH 1946.1.14.15*	f	185	12.7	6.9	5.1	2.8	131	14	6.6	4.6	2.2	1.2	1.8	2.7	2.1	3.2
BMNH 83.1.12.64	f	225	16	7.1	5.6	2.5	134	15	6.2	4.6	2.2	1.2	1.8	2.6	2.3	3.3
BNHS 1761	f	119					c. 130	14								
BMNH 78.8.2.1†	m	237	34	14.3	5.2	2.2	131	29	6.3	4.9	1.8	1.4	1.3	2.8	2.2	3.5
CAS 17199	m	235	34.1	14.5			134	29								
CAS 17200	m	228	32.9	14.4			135	28								

Distribution.– Only one of the known specimens (BNHS 1761) has precise locality information (but see discussion of *X. indicus*, below). Based on the relative sizes of its prefrontal and internasal scales, the specimen figured by Whitaker and Captain (2004:275; see also Das, 2002:49) is referable to *X. stenorhynchus* rather than our new species, and it has the more precise locality data of Valparai, a town at c. 1200 m in Coimbatore District, in the state of Tamil Nadu (Fig. 6). This agrees with the locality of BNHS 1761, and is outside the known altitudinal and horizontal range of *X. captaini*.

Comparison with *Xylophis captaini*.– Superficially, *X. captaini* and *X. stenorhynchus* (Figs. 6, 7, Table 2) are similar, small, brownish snakes with iridescent scales, longitudinal dorsal stripes and a pale collar. *X. stenorhynchus* is known from far fewer specimens, but the total length and tail length are greater in all specimens, and the overall body form is more slender (Table 2). Relative head length is similar in *X. captaini* and *X. stenorhynchus*. *X. stenorhynchus* has the same number and general arrangement of head scales (Fig. 7). Notable differences include a second infralabial that is more like *X. perroteti* (Boulenger, 1890:fig. 90; Smith, 1943:fig. 110) than *X. captaini* in being proportionately longer. The parietal scales of *X. stenorhynchus* are relatively longer and make a longer midline contact behind the frontal. The frontal has a relatively shorter, less pointed posterior part. The prefrontal scales are much longer than the internasals along the midline. The anterior temporal is relatively longer than in *X. captaini*, notably much longer than the posterior temporals. The fifth supralabial of *X. stenorhynchus* is more elongate and slender. Pigmentation of the labial scales is generally more extensive than in *X. captaini*, with some specimens having colour in all supralabials (e.g., BMNH 1946.1.14.15), or even all supra- and infralabials (BMNH 83.1.12.64). Despite being larger, *X. stenorhynchus* have fewer teeth in the maxillary and dentary rows. The dorsal longitudinal bands are less conspicuous in *X. stenorhynchus* than in *X. captaini*. Both species have a similar pale collar band. *X. stenorhynchus* is less likely to have notable pale spots on the head – for example, the type series all lack the pale postocular spot found in all examined *X. captaini*, but one is present in the referred specimen BMNH 83.1.12.64. Sexual dimorphism in tail length is pronounced in both species.

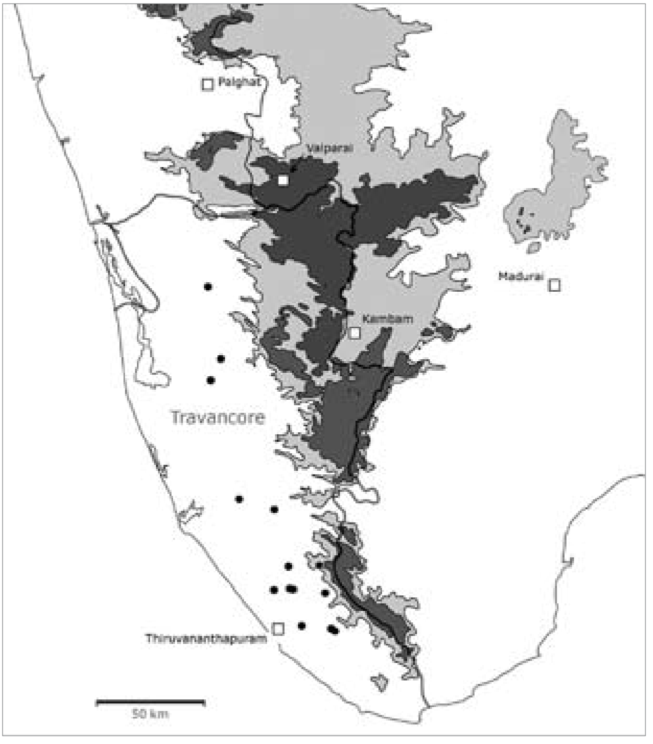

Figure 6. Map of south-western peninsular India (modified from Inger et al., 1984:fig. 1) showing position of localities for *Xylophis captaini* (black dots). Contours shown for 300 m and 1,000 m. The outline of the historical political region of Travancore is shown by a thick line. In the south, the border between the current states of Kerala and Tamil Nadu follow the eastern border of Travancore, but these depart from one another further north, near Valparai, where the Tamil Nadu – Kerala border continues northwards (shown by thinner line). Other than Travancore, the only known localities for *X. stenorhynchus* are in and close to the town of Valparai. The holotype of *X. indicus* is from ca. 1,600 m in the "Cumbum Valley", this is probably above the town of Kambam indicated on the map.

Ecology.– Almost nothing is known about the habitat or ecology (but see discussion of *Xylophis indicus*, below) of these species. Das (2002:49) reports "found in the leaf litter, in such places as buttresses of trees, within evergreen forests", and Whitaker and Captain (2004:274) state "probably a burrower. Found in leaf litter in wet forests. Probably eats earthworms", but some of this information may come from previous reports that have confused *X. stenorhynchus* and *X. captaini* (e.g., Inger et al., 1984).

Taxonomy.– Some previous conceptions of *Xylophis stenorhynchus* are based on material that includes specimens referable to at least two species. The type series of *X. stenorhynchus* represents a coherent species but by the time of Smith's (1943) work, reported ranges of variation include data for specimens that we now recognise as *X. captaini*. Subsequent works (e.g., Inger et al., 1984; Sharma, 2003; Whitaker and Captain, 2004) have followed Smith's taxonomy. Our analyses demonstrate that two main groups of specimens that can be detected based on numbers of ventral and subcaudal scales coincide with the same two groups circumscribed by the relative size of prefrontal/internasal scales as well as a host of other characters (Tables 1, 2). These two clearly diagnosed groups each include both male and female specimens, so that they can not be explained by sexual dimorphism, which nonetheless is pronounced. We conclude that material previously referred to *X. stenorhynchus* actually represents at least two species. In addition to recognising *X. captaini*, we believe a reassessment of X. *indicus* (treated as a junior synonym of *X. stenorhynchus* by Boulenger and subsequent workers) is warranted.

***Xylophis indicus* Beddome, 1878.–** *Xylophis indicus* Beddome was described on the basis of a single specimen (BMNH 78.8.2.1) that Beddome (1878:576) reported from "the dense heavy evergreen forests on the mountains at the south of the Cumbum Valley, Madura district; elevation 5000 feet. Under old logs with Uropeltidae." This locality (alternative spelling: Kambam) is now probably within the Teni District of Tamil Nadu, close to the state border with Kerala (Fig. 6). *X. indicus* was synonymised with *X. stenorhynchus* by Boulenger (1890:284), and this has been followed by subsequent workers (e.g., Smith, 1943). The type is superficially similar to *X. stenorhynchus* and *X. captaini* in being a small, brownish *Xylophis* with 15 dorsal scale rows. It is something of an outlier in being the longest *Xylophis* that has 15 dorsal scale rows, and in having a high number of subcaudals (29). Its teeth are


Figure 7. *Xylophis stenorhynchus*, head of one of three syntypes (BMNH 1946.1.14.14) in ventral, dorsal, and left lateral views. Scale bar in mm.

perhaps relatively larger, but this might be exaggerated by shrinkage of soft tissue in the mouth. The head might be longer and more pointed, but this is ambiguous because the snout of the holotype is notably squashed. The form of the prefrontals, internasals, and infralabials and the number of maxillary and dentary teeth are all close to those for the type series of *X. stenorhynchus*, and more similar to that species than to *X. captaini*. Beddome (1878) was correct in that subcaudals 3 and 4 are entire, but was wrong in reporting four supralabials (we observed five).

The type specimen of *Xylophis indicus* is a fairly uniform, pale brown in preservative. Although it seems to have retained some colour pattern (e.g., small darker spots on some dorsal scales, seen under magnification) there is no indication of a pale collar band or head blotches, or darker and paler, longitudinal body stripes. Interestingly, the two (CAS 17199, 17200) other specimens of *Xylophis* with 15 dorsal scale rows that are greatest in total length and have the longest tails (both relative to total length, and in terms of numbers of subcaudal scales) are also a uniform pale brown and lack a pale collar or any notable dorsal stripes (SP Loader, pers. comm.), and it might be that these pertain to *X. indicus* if this is a valid taxon. Finally, at least the holotype of *X. indicus* is even more slender than the types of *X. stenorhynchus*. We suggest that more material should be collected from the vicinity of the type locality of *X. indicus* and compared with a larger sample of *X. stenorhynchus*, so that the status of the former species can be reassessed in more detail. One of the specimens bearing greater superficial resemblance to the type of *X. indicus* than to those of *X. stenorhynchus* (CAS 17200) was the basis of Wallach's (1998) data on the lungs of *X. stenorhynchus*.

Although the taxonomic status of *Xylophis indicus* is in need of reassessment, it is currently only a question of whether or not this taxon is a junior synonym of *X. stenorhynchus*, because the type specimen of the former is distinguished easily from our new species, *X. captaini*. Thus, the questionable status of *X. indicus* does not challenge our hypothesis that *X. captaini* is a valid species.

Xylophis perroteti (Duméril, Bibron and Duméril, 1854)

Platypteryx perroteti Duméril, Bibron and Duméril, 1854:501

Rhabdosoma microcephalum Günther, 1858

Geophis microcephalus (Günther, 1858): Günther, 1864:200, pl. 18, fig. A; Theobald, 1868:43, 1876:142

Geophis perroteti (Duméril, Bibron and Duméril, 1854): Anderson, 1871:33

Xylophis perroteti (Duméril, Bibron and Duméril, 1854): Boulenger 1890:283, fig. 90

Xylophis perroteti is superficially the most distinctive species in the genus, having 13 as opposed to 15 scale rows and being much larger (Whitaker and Captain, 2004:272 report up to 630 mm, compared with the < 240 mm of the other species). *X. perroteti* is the best known *Xylophis* species in terms of numbers of specimens. Wall (1919:564, 583) summarised some morphological, ecological and reproductive data for a sample of 61 specimens from Wynaad in northern Kerala (beyond the northern limit of the map shown in Fig. 6), where it was reported to be common at altitudes above

c. 1,500 m. Wall (1923:398) provided some further data on five specimens from Shembaganur, near Kodaikanal, lying approximately between Valparai and Madurai at c. 2,000 m. Smith (1943:343) described the hemipenis of *X. perroteti* (see above). Wallach (1998) presented data on the lungs of *X. perroteti*. Specimens referred to *X. perroteti* vary notably in colour pattern, with animals having prominent dorsal longitudinal stripes on the body (pers. obs. of BMNH specimens) or being much more uniform (e.g., Whitaker and Captain, 2004:273). The taxonomy of *X. perroteti* was not reassessed for this study. Given that so little work has been done, that there is some notable variation in at least colour pattern, and that it seems to be an upland species occurring from both North and South of the Palghat Gap (e.g., BMNH catalogue), we suggest that a reassessment of the taxonomy of *X. perroteti* would be worthwhile.

Revised key to the species of *Xylophis*

1. Dorsal scales in 13 rows at midbody; supraoccular scale obviously larger than postocular scale; 6+ infralabial scales; one pair of genial scales between mental and first ventral . . . . *X. perroteti*
   Dorsal scales in 15 rows at midbody; supraoccular and postocular scales subequal; 5 infralabial scales; two pairs of genials, with anterior pair much the larger 2
2. Ventral scales 120–135; prefrontal scales much longer than internasals; second infralabial scale notably longer than first, the two together being about as long as the third infralabial. . . *X. stenorhynchus* (including its putative junior synonym *X. indicus*)
   Ventral scales 106–120+; prefrontal and internasal scales more or less subequal in midline length; second infralabial scale only marginally longer than first, the two together being shorter than the length of the third infralabial. . . . . *X. captaini*

DISCUSSION

Recognition of *Xylophis captaini* provides a compelling explanation for large ranges in the number of ventrals (c. 20% of total ventral count) and subcaudals in previous conceptions of *X. stenorhynchus* (Smith, 1943; Sharma, 2003; Whitaker and Captain, 2004), and Whitaker and Captain's (2004:274) pertinent observation of "internasals variable – very small or almost as long as prefrontals" in *X. stenorhynchus*. Some previously cited generic characters for *Xylophis*, including divided nasal scales (Smith, 1943) are possibly in error.

Hemipenial morphology of *Xylophis* matches that of better known, less equivocal xenodermatines, in terms of the deeply to very deeply forked form lacking spines, and the partially centrolineal (though tending to centripetal, rather than centrifugal) sulcus spermaticus (McDowell, 1987; Zaher, 1999). It is debatable whether there are convincing morphological characters diagnosing Xenodermatinae (Zaher, 1999:18–19; Dowling and Pinou, 2003) and there are few molecular data available to date (and none for *Xylophis*). Gans and Fetcho (1982) pointed out the superficial similarity between the Western Ghats *Xylophis* and Sri Lankan *Aspidura*, and we concur with Gans (1993) that in particular, *X. captaini* resembles *A. guentheri* in overall form, colour and habitus (DJG, pers. obs.). However, there are notable differences in scalation, and there are other superficially similar burrowing snakes of uncertain affinity in South Asia that should be considered (e.g., *Blythia, Haplocercus, Trachischium*, all of which are members, along with *Aspidura* and *Xylophis*, of Smith's, 1943 "Group 7"). Additionally, although *Xylophis* has been affiliated with the Xenodermatinae, *Aspidura* has been classified in the Natricinae by some recent workers (e.g., McDowell, 1987; Zaher, 1999; Lawson et al., 2005). Dowling and Pinou (2003) place *Aspidura* also in Xenodermatinae. Future work might explore the relationships of *Xylophis* and other small burrowing Asian caenophidians in more detail.

It is approaching 25 years since Gans and Fetcho (1982) argued that the taxonomy of Indian snakes as summarised by Smith (1943) is no more than a good platform from which much work remains to be done. We believe that for most species, this still remains the case. In particular, more attention might be paid to small, unassuming, burrowing snakes.

ACKNOWLEDGEMENTS

Many people collected valuable material, helped with fieldwork, provided facilities and support, and made useful observations for this project. Beyond the historical workers, special thanks go to S. D. Biju, J. George, R. Janardhanan, S. Mathew, G. J. Measey, Malan, O. V. Oommen, M. R. Sánchez-Villagra, S. Vishvambaran, M. Wilkinson, and many gardeners and farmers in Kerala and Tamil Nadu. For discussion, support, and help in working with the BNHS collections, we thank A. Captain and V. Giri. Fig. 2 was drawn by E. Wade, with skill and generosity. We are grateful to A. Resetar (FMNH), R. Drewes (CAS), and S. P. Loader (BMNH) for providing photographs and data for specimens out of our reach. DJG was able to visit BNHS, thanks to the NHM Zoology Research Fund, and a joint grant from The Royal Society and Indian Department of Science and Technology. V. Wallach provided constructive criticism on an earlier draft. Finally, DJG is thankful to the late G. Underwood for inspiration, and to him and M. Wilkinson for prompting an interest in *Xylophis*.

LITERATURE CITED

BEDDOME, R. H. 1878. Description of a new genus of snakes of the family *Calamaridae*, from southern India. Proceedings of the Zoological Society of London 1878:576.

BIJU, S. D. 2001. A synopsis to the frog fauna of the Western Ghats, India. Indian Society for Conservation Biology, Occasional Publication 1:1–24.

BOULENGER, G. A. 1890. The fauna of British India, including Ceylon and Burma. Reptilia and Batrachia. Taylor & Francis, London. 541 pp.

DAS, I. 1997. Checklist of the reptiles of India with English common names. Hamadryad 22:32–45.

_____. 2002. A photographic guide to the snakes and other reptiles of India. New Holland Publishers (UK) Ltd., London. 144 pp.

DOWLING, H. G. 1951. A proposed standard system of counting ventrals in snakes. British Journal of Herpetology 1:97–99.

_____ & T. PINOU. 2003. Xenodermatid snakes in America. Herpetological Review 34:20–23.

DUMÉRIL, A.-M.-C., G. BIBRON & A.-H.-A. DUMÉRIL. 1854. Erpétologie générale ou histoire naturelle complète des reptiles. Volume 7, part 1. Librairie Encyclopédique de Roret, Paris. xvi + 780 pp.

GANS, C. 1993. Fossorial amphibians and reptiles: their distributions as environmental indicators. In: Ecology and landscape management in Sri Lanka. pp:189–199. W. Erdelen, C. Preu, N. Ishwaran & C. M. Madduma Bandara (Eds). Magraf Scientific Books, Weikersheim.

_____ & J. R. FETCHO. 1982. The Sri Lankan genus *Aspidura* (Serpentes, Reptilia, Colubridae). Annals of Carnegie Museum 51:271–316.

GHARPUREY, K. G. 1933. The snakes of India. The Popular Book Depot, Bombay. 165 pp.

GOWER, D. J. 2003. Scale microornamentation in uropeltid snakes. Journal of Morphology 258:249–268.

_____ & J. D. ABLETT. 2006. Counting ventral scales in Asian anilioid snakes. Herpetological Journal. 16:259–263.

_____, M. S. DHARNE, G. BHAT, V. GIRI, R. VYAS, V. GOVINDAPPA, O. V. OOMMEN, J. GEORGE, Y. SHOUCHE & M. WILKINSON. IN PRESS. Remarkable genetic homogeneity in unstriped, long-tailed *Ichthyophis* (Amphibia: Gymnophiona: Ichthyophiidae) along 1500 km of the Western Ghats, India. Journal of Zoology.

GÜNTHER, A. 1875. Second report on collections of Indian reptiles obtained by the British Museum. Proceedings of the Zoological Society of London 1875:224–234.

INGER, R. F., H. B. SHAFFER, M. KOSHY & R. BAKDE. 1984. A report on a collection of amphibians and reptiles from the Ponmudi, Kerala, South India. Journal of the Bombay Natural History Society 81:406–427, 551–570.

KELLY, C. M. R., N. P. BARKER & M. H. VILLET. 2003. Phylogenetics of advanced snakes (Caenophidia) based on four mitochondrial genes. Systematic Biology 52(4):439–459.

LAWSON, R., J. B. SLOWINSKI, B. I. CROTHER & F. T. BURBRINK. 2005. Phylogeny of the Colubroidea (Serpentes): new evidence from mitochondrial genes. Molecular Phylogenetics and Evolution 37:581–601.

McDOWELL, S. B. 1987. Systematics. In: Snakes: ecology and evolutionary biology. pp:3–50.

R. A. Seigel, J. T. Collins & S. S. Novak (Eds). Macmillan, New York.

MEASEY, G. J., D. J. GOWER, O. V. OOMMEN & M. WILKINSON. 2003. Quantitative surveying of limbless endogeic vertebrates- a case study of *Gegeneophis ramaswamii* (Amphibia: Gymnophiona) in southern India. Applied Soil Ecology 23:43–53.

MURTHY, T. S. N. 1990. Illustrated guide to the snakes of the Western Ghats, India. Records of the Zoological Survey of India, Occasional Paper 114:1–69.

SHARMA, R. C. 2003. Handbook Indian snakes. Zoological Survey of India, Kolkata. xx + 292 pp + 69 plates.

SMITH, M. A. 1943. The fauna of British India. Reptiles and Amphibia Vol. III: Serpentes. Taylor and Francis, London. 583 pp.

WALL, F. 1919. Notes on a collection of snakes made in the Nilgiri Hills and the adjacent Wynaad. Journal of the Bombay Natural History Society 26:552–584.

_____. 1923. Notes on a collection of snakes from Shembaganur, Palnai Hills. Journal of the Bombay Natural History Society 29:388–398.

WALLACH, V. 1998. The lungs of snakes. In: Biology of the Reptilia. Volume 19 (Morphology G). pp:93–295. C. Gans & A. S. Gaunt (Eds). Society for the Study of Amphibians and Reptiles, Ithaca, New York.

WHITAKER, R. 1978. Common Indian snakes. A field guide. Macmillan India Ltd., Delhi. xiv + 154 pp.

_____ & A. CAPTAIN. 2004. Snakes of India, the field guide. Draco Books, Chennai. xiv + 481 pp.

ZAHER, H. 1999. Hemipenial morphology of the South American xenodontine snakes, with a proposal for a monophyletic Xenodontinae and a reappraisal of colubroid hemipenes. Bulletin of the American Museum of Natural History 240:1–168.

_____ & A. L. C. PRUDENTE. 2003. Hemipenes of *Siphlophis* (Serpentes, Xenodontinae) and techniques of hemipenial preparation in snakes: A response to Dowling. Herpetological Review 34:302–307.

Received: 15 July 2006.
Accepted: 30 October 2006.