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SPECIES GROUPS IN THE INDIAN CAECILIAN GENUS *URAEOTYPHLUS* PETERS (AMPHIBIA: GYMNOPHIONA: URAEOTYPHLIDAE), WITH THE DESCRIPTION OF A NEW SPECIES

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Abstract: A new species of *Uraeotyphlus* (Gymnophiona: Uraeotyphlidae) is described on the basis of a single, distinctive specimen from the Western Ghats of southern Kerala, India. This species is most similar to *U. malabaricus* (Beddome) in that it lacks a clear differentiation between primary annuli and their higher-order (secondary or tertiary) subdivision. The pattern of annulation among species of *Uraeotyphlus* falls into two clear types based on the differentiation of primary and higher-order annuli, and the number of annular divisions per vertebra and whether this varies along the body. This difference is reflected in our recognition of *oxyurus*-group (*U. interruptus*, *U. menoni*, *U. narayani*, *U. oxyurus*) and *malabaricus*-group (*U. malabaricus* and a new species described herein) species within *Uraeotyphlus*.

Key words: Caecilians; India; Systematics; Western Ghats

As currently conceived (Wilkinson and Nussbaum, 2006), the monogeneric caecilian (Amphibia: Gymnophiona) family Uraeotyphlidae Nussbaum is endemic to the southern part of the Western Ghats of peninsular India (e.g., Nussbaum, 1979; Pillai and Ravichandran, 1999; Ravichandran, 2004). *Uraeotyphlus* Peters currently includes five nominate species (Pillai and Ravichandran, 1999), *U. interruptus* Pillai and Ravichandran, *U. malabaricus* (Beddome), *U. menoni* Annandale, *U. narayani* Seshachar, and *U. oxyurus* (Duméril and Bibron). Here we describe a sixth species from a single specimen from the Western Ghats of Kerala. This taxon most closely resembles *U. malabaricus*, and the two species share a distinct annulation pattern that clearly distinguishes them from other *Uraeotyphlus*. Consequently, we subdivide the genus into two species groups to reflect this fundamental difference in morphology.

Species Description

Uraeotyphlus **oommeni** *sp. nov.*
(Fig. 1, Table 1)

Holotype.—Bombay Natural History Society, Mumbai, India (BNHS) 4178, collected at Bonaccord, Thiruvanathapuram District, Kerala on 3 November 1987, probably by local inhabitants for V. S. Josekumar, then of the University of Kerala, Thiruvananthapuram.

Diagnosis.—A *Uraeotyphlus* differing from all other species in the genus except *U. malabaricus* in lacking a clear external distinction between primary and higher-order annuli. Differs from *U. malabaricus* in having fewer than 220 annuli, fewer (one or two versus five in the type specimens) annuli between the vent and terminal cap, and fewer teeth on all tooth-bearing bones, most notably in the inner mandibular (= splenial) series (five versus 14).

Description of the holotype.—Some morphometric and meristic data are given in Table 1. The specimen is a mature female. It is in fair condition, with a few exceptions. The body is preserved in a coil, and it has an artifactual, middorsal, longitudinal groove from the back of the collar (nuchal) region to halfway along the length of the body. A broader midventral concavity extends along the same part of the body. Halfway along its length, the body is soft and creased irregularly, and the vertebral column has probably become disarticulated. The outermost layer of skin has come away in patches on the posterior half of the dorsal surface of the body, and this is more pronounced posteriorly. A very small patch of skin is also missing just anterior to the mouth, and a larger bare patch lies just behind and below the right jaw angle. The skin overlying the lower edge of the right mandible is split. The right anterolateral tip of the snout is a little squashed so that the snout is slightly asymmetrical. Some

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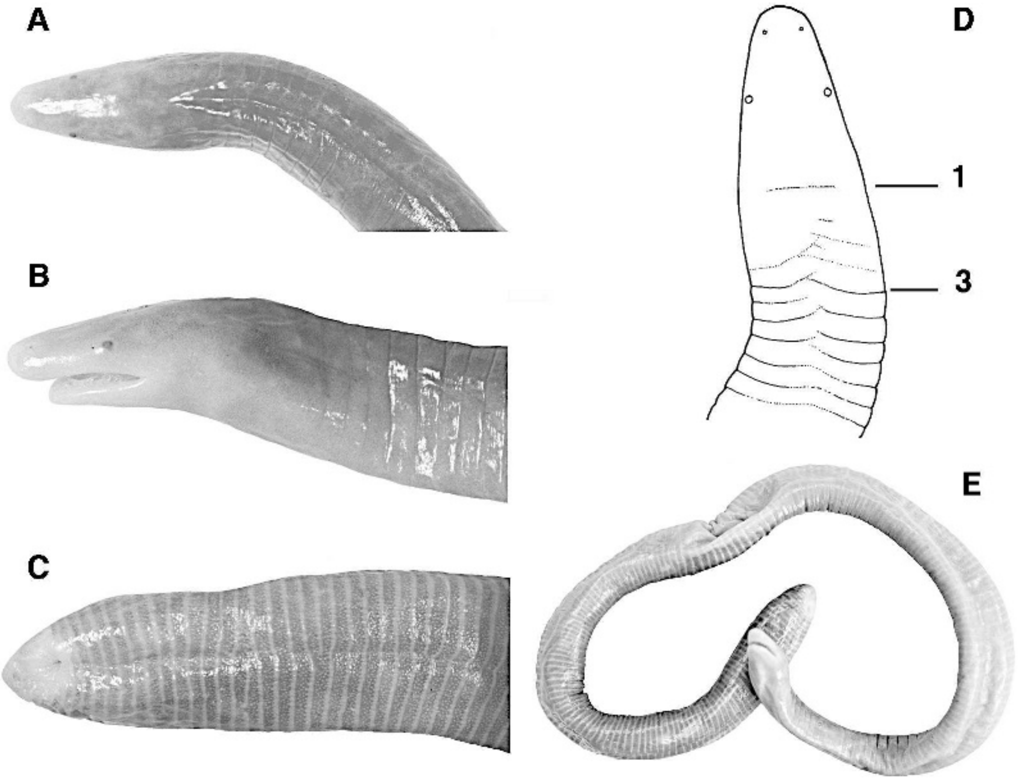

FIG. 1.—Morphology of holotype (BNHS 4178) of *Uraeotyphlus oommeni* sp. nov. Photographs are shown of head and anterior of body in (A) dorsal and (B) left lateral view, (C) vent region in ventral view, and (E) whole body. D) figure (from camera lucida drawing) of dorsal view of head and anterior of body showing interpretation of position of first (1) and third (3) nuchal grooves demarcating the collar region. Total length of specimen is 164 mm; for other dimensions, see Table 1.

teeth are missing, and there is slight damage to the lower jaw gingivae. Several annular scale pockets are open dorsally, a few at midbody, and approximately eight in the posterior third. A longitudinal midventral incision, made to determine sex, extends forward for 11 mm from appproximately 30 mm in front of the body terminus. The posteriormost 10 mm of the body is slightly and irregularly shrivelled.

The body is fairly uniform apart from its gently tapering anterior quarter. It is strongly dorsoventrally compressed throughout, perhaps at least partly artifactually. The head is small, narrow and pointed. In dorsal view it tapers steadily from the back of the head to in front of the nares; the sides of the head are very slightly convex. Only in front of the nostrils does the outline of the head taper more abruptly to a narrow, rounded tip. In dorsal view, each eye is less than its diameter from the edge of the head. The eyes are marginally closer to the snout tip than to the back of the head. The nares are set back some way from the tip of the snout and far from the lateral edges, only marginally closer to the lateral edges than to the midline.

In lateral view, the margin of the upper lip is distinctly arched. The eye is slightly closer to the straight top of the head than to the edge of the mouth. The snout tip is rounded and projects prominently in front of the mouth. The nares lie just in front of the mouth, the anteroventral tentacles are approximately halfway between the snout tip and a point level with the anterior margin of the mouth. The tentacles are visible only in lateral, ventral and anterior views. In anterior view they are marginally more lateral than the nares. The eyes, including a silvery, circular lens are

TABLE 1.—Some meristic and morphometric (mm) data for the holotypes of *Uraeotyphlus oommeni* sp. nov. (BNHS 4178) and *Uraeotyphlus malabaricus* (BMNH 1946.9.5.16, formerly 74.4.29.181). (l) and (r)–left and right respectively.

	Uraeotyphlus oommeni	*Uraeotyphlus malabaricus*
Sex	f	f
Total length	164	144
Total annuli	207 (l), 214 (r)	237 (l), 245 (r)
Annuli interrupted by vent	5	4.5
Annuli posterior to the vent (including terminal cap)	2 or 3	5
Distance between eyes	2.4	2.4
Distance between eye and tentacle	2.6	2.5
Distance between eye and naris	2.2	2.4
Distance between eye and margin of upper lip	0.6	0.6
Distance between eye and tip of snout	3.2	3.3
Sagittal distance between anterior level of eyes and snout tip	3.0	3.1
Distance between eye and jaw angle	1.2	1.5
Distance between nares	1.2	1.4
Distance between naris and tentacle	0.7	0.7
Distance between naris and jaw angle	3.5	3.8
Distance between tentacles	1.3	1.6
Distance between tentacle and jaw angle	3.8	4.0
Distance between tentacle and tip of snout	1.1	1.0
Distance between tentacle and margin of upper lip	0.7	0.5
Projection of tip of snout beyond anterior margin of upper lip	1.2	1.2
Head width at jaw angles	3.2	3.4
Head width at occiput (lateral edge of 1st nuchal groove)	4.4	3.8
Distance between tip of snout and jaw angle	4.3	4.8
Distance between tip of snout and 1st nuchal groove	6.6	6.2
Distance between tip of lower jaw and jaw angle	3.4	4.0
Length of collar region (measured laterally)	4.5 (l), 5.0 (r)	c.4.6 (l), 3.3 (r)
Width at midbody	7.0	5.2
Circumference immediately behind collar region	16	14
Circumference at midbody	21	15
Circumference 10 annuli anterior to vent	20	12
Width at anterior of vent	4.1	2.7
Length of tail (from posterior end of vent)	2.6	3.3
Length of disc surrounding vent	2.0	1.7
Width of disc surrounding vent	1.8	0.8
Premaxillary-maxillary teeth	25	33
Vomeropalatine teeth	27	35
Dentary teeth	25	35
Inner mandibular teeth	5	14

clearly visible through the skin. The eyes and narrow rings encircling them are very slightly raised. The nares are subcircular and small, substantially smaller than the eyes. Each tentacular aperture is set in a small, slightly raised area, and is visible as a tiny slit filled with the subtriangular tentacle tip.

The lower jaw has a downturned anterior tip. Behind this, most of the upper margin of the lower jaw is straight in lateral view. In lateral view, the distance between the jaw angle and the ventral edge of the anterior part of the throat (2 mm) is about half that between jaw angle and the top of the head. In ventral view, the lateral edges of the lower jaws are straight for about half the length from the jaw angles to the anterior tip, anterior to which they form an approximately semicircular tip of the chin. In ventral view, the upper jaw circumscribes a slightly broader arc than the lower jaw. A midventral longitudinal ridge lies between the ventral surfaces of the lower jaws, extending from the level of the jaw angles to a point near the middle of the collar region.

The teeth are recurved and bicusped, at least anteriorly where most readily observed. The premaxillary-maxillary tooth crowns are much larger laterally than anteriorly. A similar pattern occurs in the dentary series, where the largest teeth exceed the largest premaxillary-maxillary teeth. Posteriorly, both these outer tooth rows become a little more widely separated from the lateral edges of the mouth. The inner mandibular teeth are small, and the anteriormost vomeropalatine teeth are very small. The narrow, pointed tip of the tongue is free. The only notable feature on the tongue's surface are a pair of slight swellings in the position where narial plugs occur in some other caecilians. The subtriangular choanae are large, separated by a distance marginally greater than (less than one and a half times) the transverse width of each choana. Choanal valves are not clearly visible.

The collar region is poorly circumscribed and, although not notably thicker than the anterior of body, it is marginally less dorsoventrally compressed. In dorsal view, the broadening of the back of the head continues more gently toward the back of the collar region. The first (anteriormost) nuchal groove, separating the head from the collar region, is not visible ventrally, is very faint dorsally, and clearest laterally. The dorsal part of the groove lies slightly further anterior than the ventral-most visible portion. This groove is very shallow and is slightly paler than the adjacent areas, except for the right ventral part where there is a slightly darker line.

Most caecilians have two collars delimited by three nuchal grooves. In *Uraeotyphlus*, the second nuchal groove between the two collars is often only visible ventrally and, to a lesser extent, laterally. In BNHS 4178, a second nuchal groove, between two collars, cannot be confidently detected at any point around the circumference of the neck. The dorsal surface of the posterior part of the nuchal region bears several faint, perhaps incomplete creases (Fig. 1D), but it is not possible to determine a clear pattern of how these might relate to subdivision of the nuchal region. These faint, subtransverse nuchal grooves are subparallel to the anterior annular grooves, and similarly spaced.

The posteriormost (third) nuchal groove (which is also the anterior groove of the anteriormost annulus) forms a pale line ventrally (where it is narrowly incomplete) and ventrolaterally. It is also discernible dorsally, where it curves forwards increasingly towards the midline. We identify this structure as the third nuchal groove because there are no clear grooves immediately anterior to it, and because it marks the anterior limit of the regularly bulging annuli that give the lateral edges of the body behind this a corrugated appearance in dorsal view (Fig. 1D).

There is no clear external organisation of the annulation system into primary and secondary folds or rings so that, in this respect, *U. oommeni* resembles *U. malabaricus* and differs from *U. interruptus*, *U. menoni*, *U. narayani*, and *U. oxyurus* (see below). Some annular grooves merge irregularly with adjacent grooves, so that the counts of total annuli on the left (207) and right (214) do not match. The annular grooves are expressed as shallow creases edged in a whitish colour. Middorsally, the anteriormost annular grooves bend forward, decreasingly so up to the 10th annulus where they are approximately orthoplicate, and remain so up to the terminus. The grooves are very faint middorsally and are possibly narrowly incomplete on the anteriormost quarter, where the free ends of some of the grooves are offset (Fig. 1). Posteriorly, the creases are deeper and more conspicuous middorsally. Midventrally, the grooves are orthoplicate, fainter, and intermittently narrowly incomplete. The grooves are only clearly and consistently complete midventrally for the posteriormost 40 annuli.

In dorsal view, the terminus tapers for about the final 11 annuli (6 mm), and ends in a blunt tip with convex margins. The terminus, including the vent region, is slightly upturned. There is only one midventrally complete annular groove posterior to the disc surrounding the vent. This groove forms a spiral around the body, so that the tip of the body is not circumscribed by a continuous final groove. There are thus one or two annuli between the vent and terminal cap. The consequently irregular, short terminal 'cap' is a little longer than the preceding annulus. The essentially longitudinal vent is approximately bilaterally symmetrical, with six main denticulations on each side. The disc surrounding the vent is a little distorted by preservation, and is poorly circumscribed. It is flat and subcircular, with no sign of papillae.

Dorsally, the head is paler than the pale lilac-brown anterior body. The tip of the snout, a ring around eyes and the region below level of eyes to the lip are cream coloured. A similar color is present on the underside of the snout, lower jaws and collars. The pale color of the snout tip extends irregularly back to the nares, so that these lie in a region that is paler than the middle of the dorsal surface of the head. The midventral longitudinal ridge on the chin and anterior throat is paler than the background color. The anterior half of the body is a darker lilac-brown dorsally, which gradually blends to a lighter brown, laterally, and a cream-tan, ventrally. The dorsal surface is brown with grey lilac tones where the external layer of skin is missing, with pale off-white spots (glands) clearly visible. Ventrally, the body is slightly browner posteriorly, but is never as dark as the dorsum at the same position. The cream disc is paler than the brownish colour surrounding it. The terminal cap is much paler, but is possibly faded.

We searched for scales at five points along the body. None was found dorsally at the back of the collar region. Dorsolaterally at the 33rd annular groove behind the collars, there are scattered, oval (up to 0.5 mm long, transversely) scales. At midbody, there are two or three rows of oval scales dorsally. At the 32nd annular groove anterior to the body terminus, there are three rows dorsally, and the scales here are much larger (1.7 mm × 1 mm) than those in the single ventral row (1 mm × 0.6 mm). Ten annular grooves further posteriorly, there are also three rows of scales dorsally.

Etymology.—Named in honor of Oommen V. Oommen, Professor and Head of Zoology, University of Kerala, Thiruvanathapuram, in recognition of his contribution to the understanding of the physiology, systematics, ecology, and reproductive biology of the caecilians of the southern Western Ghats of India. As a suggested 'common' name, we prefer "Oommen's *Uraeotyphlus*".

Habitat and conservation biology.—It is unknown from which part of Bonaccord the holotype was collected. Other than this specimen, the only caecilians that we know to have been collected at this locality are specimens of the caeciliid *Gegeneophis ramaswamii* from an altitude of approximately 600 m within the tea plantation (e.g., Measey et al., 2003; Oommen et al., 2000). The holotype of *U. oommeni* was most probably found by locals or estate workers while they were helping to collect *G. ramaswamii* for physiological studies at the University of Kerala (O. V. Oommen, personal communication; see Gower and Wilkinson, 2005). Previous collections of hundreds of *G. ramaswamii* at Bonaccord by personnel from the University of Kerala have mostly occurred in agricultural land within the tea estate (estate workers' gardens and small coconut groves), and it is possible that *U. oommeni* occurs more frequently in other habitats in the area, including adjacent forest and/or higher altitude sites. Previous caecilian collections within the tea estate at c. 600 m do not include any of the uropeltid snakes reported at 960 m at Bonaccord by Rajendran (1985). With only a single specimen collected from unknown habitat, *U. oommeni* is very poorly known and is currently of 'data deficient' conservation status. Clearly, further fieldwork is needed to better investigate the distribution and abundance of this species, and additional insights into any aspects of its biology will depend upon an enhanced sampling.

SPECIES GROUPS IN THE GENUS *URAEOTYPHLUS*

Based on differences in annulation, two main species groups of *Uraeotyphlus* can be tentatively identified. The majority of species (*U. interruptus*, *U. menoni*, *U. narayani*, *U. oxyurus*) and individuals held currently in museum collections have a pattern of annulation that is more similar to some 'advanced caecilians' (sensu Nussbaum, 1991, equivalent to Teresomata of Wilkinson and Nussbaum, 2006) than to ichthyophiids, in having some/all primary annuli each subdivided by a single secondary annular groove (Fig. 2A), with the primary annuli corresponding to vertebrae throughout most of the body, and the primary and secondary grooves distinguishable at least anteriorly (Nussbaum and Wilkinson, 1989; D. J. Gower and M. Wilkinson, personal observation). The pattern of annulation in other *Uraeotyphlus* (*U. malabaricus*, *U. oommeni*) is superficially more similar to that of

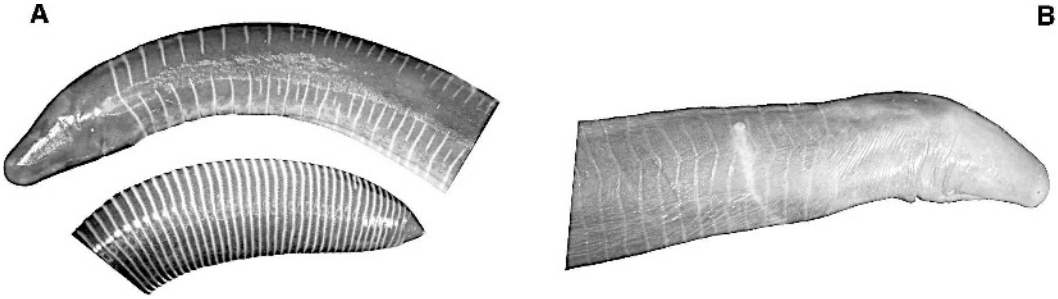

FIG. 2.—Difference in the pattern of annulation in A) the *oxyurus*-group *Uraeotyphlus* cf. *narayani* (University of Kerala, field tag MW 217), and B) the *malabaricus*-group *U.* cf. *malabaricus* (University of Kerala, field tag MW 1711). In *U.* cf. *narayani* (A), the anteriormost part of the body is characterised by primary annuli, some of which are partially divided by one (incomplete) secondary annular groove per annulus. Primary annuli become more completely divided by secondary grooves posteriorly, so that primaries and secondaries are superficially indistinguishable at the posterior end of the body. In *U.* cf. *malabaricus* (B), there is no clear external differentiation between primary and higher-order annuli, even at the anterior end of the body.

ichthyophiids in that there is no obvious external differentiation of primary and higher-order annuli (Fig. 2B). Where we have been able to investigate this pattern, by radiography after marking annuli with pins at regular intervals, there are on average more than two annular units per vertebra in *malabaricus*-group *Uraeotyphlus* (Fig. 3). Ad-

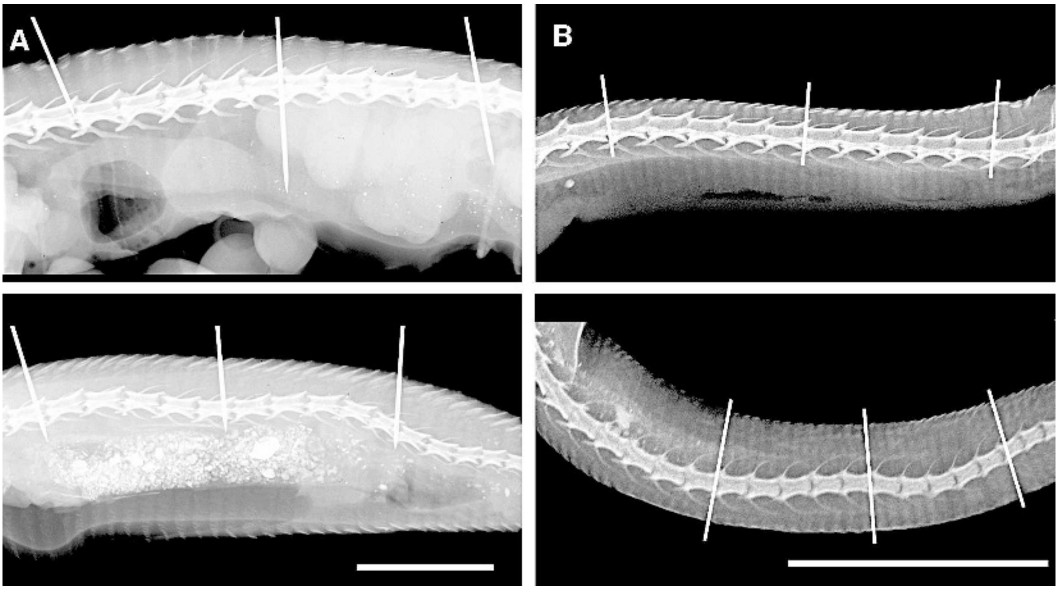

FIG. 3.—Radiographs illustrating the difference in the relation of vertebrae to dermal annuli between type specimens of the earliest described species of *oxyurus*-group and *malabaricus*-group *Uraeotyphlus*. A) *U. oxyurus* (MNHN, Paris 4271; syntype) and B) *U. malabaricus* (BMNH 1946.9.5.16; holotype). For *U. oxyurus* (left pair), the sections shown cover the 52nd to 64th (upper) and 84th to 99th (lower) of a total 111 vertebrae. For *U. malabaricus* (right pair), the sections shown cover the 52nd to 65th (upper) and 74th to 93rd (lower) of a total of 104 vertebrae. The dermal annular grooves are indicated by radio-opaque scales (most clearly seen along the edges of the body) and less opaque transverse lines. In *U. oxyurus*, there are two annular grooves per vertebra along both body sections (20 grooves corresponding to the 10 vertebrae lying between outer pair of inserted pins). In *U. malabaricus*, there are 2.9 (section shown in upper picture: 29 annular grooves corresponding to the 10 vertebrae between outer pair of superimposed white lines) or 2.6–2.7 (lower picture: 26 or 27 annular grooves corresponding to the 10 vertebrae marked by outer pair of superimposed white lines) grooves per vertebra. Anterior is to the left. Scale bars represent 1 cm.

ditionally, the relation between annuli and vertebrae is not constant along the body (Fig. 3). Thus, it appears that there is not a simple, regular system of primary annuli, each divided in two by a single secondary groove. Externally at least, this second type of annulation is similar to that of rhinatrematids and ichthyophiids (Nussbaum and Wilkinson, 1989), although it differs from the latter family most notably in that the annular grooves are largely orthoplicate throughout the length of the ventral surface, and are broadly incomplete midventrally, at least anteriorly. The "erratic" nature of the annuli described for *U. malabaricus* by Taylor (1968:698), where some annular grooves merge with adjacent grooves throughout the length of the body (see also *U. oommeni*, Fig. 1D), is also perhaps more characteristic of rhinatrematids and ichthyophiids than higher caecilians or other *Uraeotyphlus*, in which this feature is usually restricted to the posterior of the body, where secondary annular grooves are most complete. *Uraeotyphlus* specimens with annulation patterns similar to *U. oommeni* have been mistakenly described previously as having subequal numbers of primary and secondary annuli (e.g., Pillai and Ravichandran, 1999; Taylor, 1968).

Annulation characters are important at all levels of caecilian systematics (Nussbaum and Wilkinson, 1989; Taylor, 1968), but the precise relations between annuli, vertebrae, and trunk muscles are incompletely known across the group (Nussbaum and Naylor, 1982). Current understanding suggests that the annulation pattern of *oxyurus*-group *Uraeotyphlus* is derived, and supports the group's monophyly, whereas the possibility that the annulation pattern of the *malabaricus*-group is ancestral for *Uraeotyphlus* highlights the possibility that this species group is paraphyletic and the need for a consideration of additional characters. Previous workers studying the anatomy of *Uraeotyphlus* have almost exclusively reported observations made of specimens referred to either *U. narayani* or *U. oxyurus* (e.g., Nussbaum, 1979; Nussbaum and Naylor, 1982; Peters, 1881; Ramaswami, 1941, 1944; Wake, 2003; Wilkinson, 1992; Wilkinson and Nussbaum, 1996), most likely because of the greater availability of these species in collections (see Discussion). Parker (1927) included observations of skull material that he referred to *U. malabaricus*, but his very brief report focused on similarities shared with *U. oxyrurus* that distinguish *Uraeotyphlus* from the West African caeciliid *Geotrypetes*. Thus, we are largely ignorant of anatomical variation within *Uraeotyphlus* and of any additional features that might support the monophyly of the two subgeneric groups we recognise. Further study should establish whether the partitions comprise monophyletic groups that might warrant recognition as distinct genera. For now, we define and describe the two groups of species identified within *Uraeotyphlus* under the names of the oldest named species for each group.

oxyurus-*Group*

Diagnosis.—*Uraeotyphlus* with a clear external distinction between primary and secondary annuli and annular grooves, at least at the anterior extent of the secondaries (Fig. 2A). A correspondence of one primary annulus per vertebra occurs throughout the precloacal region of the body (Fig. 3A). The proportion of primary annuli subdivided by secondary annular grooves is variable. Posteriorly, where grooves are complete, the distinction between primaries and secondaries is not immediately clear but, at their anteriormost occurrence, secondary annular grooves generally incompletely subdivide primary annuli (Fig. 2A).

Content.—Four species, *U. interruptus*, *U. menoni*, *U. narayani* and *U. oxyurus*.

Remarks.—We have x-rayed 100+ specimens of *oxyurus*-group *Uraeotyphlus*, and are confident that the annulation pattern is consistent and diagnostic. Contrary to Pillai and Ravichandran (1999) and Dutta (2002), *U. interruptus* is not distinguished from other species of *Uraeotyphlus* by having middorsally incomplete primary annular grooves towards the anterior of the body. We have observed incomplete anterior primary grooves in specimens of other species of the *oxyurus*-group, including the types of *U. menoni* and *U. narayani* (not apparent in figures given by Seshachar, 1939). Despite this, *U. interruptus* might still be a valid species (D. J. Gower and M. Wilkinson, personal observation), although more work is required to characterise and diagnose it adequately. Apart from Pillai and Ravichandran's (1999) description of *U. interruptus*, the descriptions of other species of *Uraeotyphlus* have not included details of annulation patterns. Even for *oxyurus*-group species, early reports often gave total numbers of annular grooves instead of distinguishing between numbers and patterns of primary and secondary grooves (Annandale, 1913; Duméril and Bibron, 1841; Seshachar, 1939). This limitation and the lack of vertebral counts in most other studies (see also Dutta, 2002) has probably contributed to the previous lack of recognition of fundamental differences in annulation within *Uraeotyphlus*.

malabaricus-*Group*

Diagnosis.—*Uraeotyphlus* lacking a clear external distinction between primary and higher-order annuli (Fig. 2B). Where investigated, specimens of this species group also have more than two annular divisions per vertebra and the number is not constant along the body (Fig. 3B). Thus, there is not a system in which single primary annuli per vertebra may or may not each be divided in two by a single higher-order (secondary, in this case) groove. It might also be that *malabaricus*-group *Uraeotyphlus* are characterised by their possession of a weakly demarcated posterior border of the collar region, with the posterior end of the dorsal surface of the collars bearing transverse grooves similar to the anteriormost annular grooves of the anterior of the body, but this needs to be verified with additional material. The holotypes of *U. malabaricus* and *U. oommeni* (Fig. 1E) are relatively slender-bodied when compared with typical specimens of *oxyurus*-group species (personal observation).

Content.—Two species, *U. malabaricus* and *U. oommeni*.

Remarks.—We have been unable to obtain good radiographs of the holotype of *U. oommeni*, but we have found the described annuli-vertebrae relations in the holotype of *U. malabaricus* and in five specimens of *U.* cf. *malabaricus* that may represent other undescribed species referable to the *malabaricus*-group, and we predict the same pattern for the new species described here. The specimen reported as "*Uraeotyphlus* sp." by Wilkinson et al. (2002, 2003) and as "*Uraeotyphlus* cf. *malabaricus*" by Gower et al. (2002) is probably an undescribed species of *Uraeotyphlus* of the *malabaricus*-group from an imprecise locality in the Sabari Hills near Vandiperiyar, Idukki District, Kerala. This specimen (Fig. 2B) is untidily preserved, has a very large, widely open ventral incision and lacks most of its viscera, and we have elected to refrain from describing its species until further material is collected.

Taylor (1968) reported morphological differences among the specimens that he referred to *U. malabaricus*. The Natural History Museum, London (BMNH) specimens for which Taylor (1968) reported data (including the type of *U. malabaricus*) are all from the imprecise locality of "Malabar", which potentially covers a large region of the Western Ghats (e.g., Biju, 2001:5). A detailed reassessment of the *malabaricus*-group is needed based on type material, historical collections and more recently collected material with more precise locality data. In lieu of such reassessment, workers should view earlier reports of the occurence of *U. malabaricus* as requiring further verification. Although known only from a single specimen, *U. oommeni* is clearly not a member of the same species as the type of *U. malabaricus*, and the holotype is in reasonable condition and is of known provenance. We hope our description of this new taxon highlights uraeotyphlid diversity and stimulates further study of the radiation of uraeotyphlid caecilians in the Western Ghats.

DISCUSSION

Species of the *malabaricus*-group are apparently less common and abundant than *oxyurus*-group *Uraeotyphlus*, at least in agricultural habitats of Kerala and Tamil Nadu (O. V. Oommen, personal communication), and are generally represented by fewer specimens in collections. The type locality of *U. malabaricus* is imprecise ("Malabar"), but the material referred to this species and *U.* cf. *malabaricus* by Taylor (1968); Pillai and Ravichandran (1999); Gower et al. (2002) and Wilkinson et al. (2002), as well as the holotype of *U. oommeni*, are seemingly from higher altitude localities than the types of any of the *oxyurus*-group species. It is unclear if the relative rarity or possible habitat and altitude differences between species of the *oxyurus*- and *malabaricus*-groups are real, or simply a consequence of uneven and/or insufficient sampling.

Previous statements that uraeotyphlids have only one, secondary subdivision per primary annulus (i.e., no 'tertiary' higher-order annular grooves) or have a 1:1 correspondence between primary annuli and vertebrae (Nussbaum, 1979; Nussbaum and Naylor, 1982; Nussbaum and Wilkinson, 1989; Taylor, 1968; Wilkinson and Nussbaum, 1996) or other generalisations about their anatomy apply with certainty or high probability only to the *oxyurus*-group, and should be taken to apply to this group only unless known for *U. malabaricus* and/or *U. oommeni* also. The diagnoses of Uraeotyphlidae and *Uraeotyphlus* have been amended to reflect this new knowledge (Wilkinson and Nussbaum, 2006). Nussbaum and Wilkinson (1989) presented a model of the development of annuli in rhinatrematids in which initial primary annuli corresponding to the muskuloskeletal segmentation of the trunk are subdivided into secondary annuli that are subsequently subdivided into tertiary annuli, with the subdivisions eventually rendering the annuli indistinguishable and being accompanied with a breakdown of the correspondence between external and internal segmentation. Under this model, caecilians in which primary and other annuli cannot be distinguished are expected to have approximately four times as many annuli as vertebrae. However, ichthyophphiids and *malabaricus*-group *Uraeotyphlus*, depart substantially from this expectation suggesting a more complicated model of annular development.

Gower and Wilkinson (2002) described and figured closely similar phallodeal anatomy in the *oxyurus*-Group *U.* cf. *narayani* and *U.* cf. *oxyurus*. Gower and Wilkinson (2002:152) stated that the *malabaricus*-Group *U.* cf. *malabaricus* had a different phallodeal anatomy in terms of the number and arrangement of major longitudinal ridges and their ornamentation. Although phallodeal anatomy of *malabaricus*-Group *Uraeotyphlus* have yet to be figured or described in detail, it represents a further possible morphological distinction from the *oxyurus*-Group.

The recognition of two species groups within *Uraeotyphlus* furthers understanding of the diversity of uraeotyphlid caecilians. Based on nucleotide sequences of partial mitochondrial genes, a single specimen referred to *U.* cf. *malabaricus* is sister to a clade including *U. narayani* and *U.* cf. *oxyurus* (Gower et al., 2002). Thus, the limited evidence available is consistent with the monophyly of the *oxyurus*-group. Branch lengths for Gower et al.'s (2002) optimal trees are consistent with there being a deep split between the *malabaricus*- and *oxyurus*-groups. The closest relatives of uraeotyphlids are ichthyophiids (Gower et al., 2002; San Mauro et al., 2004; Wilkinson and Nussbaum, 1996; Wilkinson et al., 2002). Uraeotyphlids are clearly distinguished from ichthyophiids by their anteroventrally positioned tentacles, more strongly recessed mouths, and relatively dorsal external nares. Species of the *oxyurus*-group are further distinct in their possession of an annulation pattern that is similar to that of 'advanced' (teresomate) caecilians. The observation that some *Uraeotyphlus* (the *malabricus*-group) have a more ichthyophiid-like annulation, and the paraphyly of ichthyophiids with respect to uraeotyphlids (Gower et al., 2002; see also Frost et al., 2006), indicates that these two caecilian families are linked by potentially intermediate, extant morphologies. Although annulation has been used extensively in caecilian systematics, understanding of the anatomical variation and its importance in the biology of caecilians is very limited. We believe this would be enhanced by further study of ichthyophiid and uraeotyphlid annulation and its development, and that there is considerable potential for this to yield additional useful systematic characters.

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