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A new caecilian *Ichthyophis davidi* sp. nov. (Gymnophiona: Ichthyophiidae): the largest striped caecilian from the Western Ghats

The Western Ghats, a hill chain of 1600 km running parallel to the west coast of India, is one of the amphibian hotspots. Gymnophiona in the Western Ghats is represented by 23 species¹, of which 12 belong to Ichthyophiidae and 11 species to Caeciliidae. Under Ichthyophiidae, *Ichthyophis* and *Uraeotyphlus* are the two genera containing five and seven species respectively. In the genus *Ichthyophis*, two forms of species are categorized: monocoloured species and species with yellow stripes. A total of four striped caecilians, namely *Ichthyophis beddomei* Peters, 1879 (Karnataka, Kerala and Tamil Nadu), *Ichthyophis tricolor* Annandale, 1909 (Kerala), *Ichthyophis longicephalus* Pillai, 1986 (Kerala) and *Ichthyophis kodaguensis* Wilkinson, Gower, Govindappa and Venkatachalaiah, 2007 (Karnataka and Kerala), and a monocoloured species *Ichthyophis bombayensis* Taylor, 1960 (Gujarat, Maharashtra, Goa, Karnataka

and Kerala) were described from the Western Ghats.

During our search for these subterranean, secretive vertebrates in the North Karnataka parts of the Western Ghats, we collected five specimens resembling each other which fit the generic diagnosis by Pillai and Ravichandran² for *Ichthyophis*, but differ from all known striped caecilians of the Western Ghats, including the recent description by Wilkinson *et al.*³. Our collections from northern Karnataka have a distinctive combination of features that distinguish them from all other described striped *Ichthyophis*, and here we describe this form as a new species.

Ichthyophis davidi sp. nov. (Table 1; Figures 1–3).

Holotype: Zoological Survey of India, Calicut (ZSI/WGRC/V/A/776), an adult female, collected on 7 September 2010

from Chorla village (15°39'N, 74°08'E), Khanapur Taluk, Belgaum District, Karnataka.

Paratypes: ZSI/WGRC/V/A/792, an adult female collected with holotype; ZSI/WGRC/V/A/850 and ZSI A 11327 adult males were collected in July 2010 from the surrounding Chorla village; Bombay Natural History Society, Mumbai, India (BNHS 5535), adult male collected from Chorla Ghats in August 2008.

Diagnosis: Largest among the known striped *Ichthyophis* from the Western Ghats, lateral yellow stripe wider (4.05 mm), stripe extending from tentacle to the tail tip with an incurvature (not broken) across the collars, strongly indicated on the lower jaw from the level of tentacle, body uniform brown above and light below. Known range in total length of metamorphosed animals 268–370 mm,

SCIENTIFIC CORRESPONDENCE

Table 1. Morphometric and meristic data (in mm) for the holotype and paratypes of *Ichthyophis davidi*. Measurements were made to the nearest 0.1 mm with vernier calipers. For measuring the length and circumference, a ruler and piece of thread were used

	WGRC/ V/A/776	WGRC/ V/A/792	BNHS/ 5535	WGRC/ V/A/850	ZSI A 11327
Sex	Female	Female	Male	Male	Male
Total length	370	276	314	268	296
Total number of annuli	336	328	328	321	336
Annuli interrupted by vent	7	7	7	7	7
Tail folds (post vent)	3	3	3	2	2
Dorsal transverse grooves on second collar	4	3	4	3	4
Distance from eye to tentacle (TE)	3.00	4.15	3.10	2.91	3.12
TN/TE	1.39	1.02	1.09	1.02	0.91
Distance from eye to nostril	6.10	4.14	6.25	5.29	5.87
Distance from eye to snout tip	7.05	6.43	7.10	6.35	6.63
Distance from eye to jaw angle	4.04	3.37	4.20	3.53	4.15
Distance between nostril and snout tip	1.83	1.21	1.10	0.86	1.07
Distance between nostril to jaw angle	11.95	7.80	8.37	7.92	9.20
Distance between tentacle and snout tip	6.03	3.43	4.02	4.53	3.94
Distance between tentacle and jaw angle	4.09	4.49	5.64	5.72	5.76
Distance between tentacle and nostril (TN)	4.19	2.92	3.40	2.98	2.84
Distance from snout tip to jaw angle (HL)	12.54	7.70	10.96	9.11	10.40
Distance from snout tip to first nuchal groove	17.04	11.31	12.73	11.71	11.87
Distance from snout tip to second nuchal groove	16.83	13.80	15.96	14.92	13.84
Distance from snout tip to third nuchal groove	25.57	16.58	19.20	18.58	16.06
Distance from jaw angle to first nuchal groove	5.50	3.01	2.60	3.22	2.96
Projection of snout beyond anterior margin of upper lip	1.45	1.09	0.95	0.72	1.06
Head width at jaw angle (HW)	12.00	7.47	8.22	7.26	7.88
Length of first collar (measured laterally) (C1)	2.93	2.55	2.41	2.87	2.25
Length of second collar (measured laterally) (C2)	4.23	2.87	3.17	3.75	3.41
Width of the body at first annular groove	12.63	7.87	9.73	7.93	8.51
Width at midbody	16.70	11.52	12.95	10.45	11.59
Width at anterior of vent	5.89	4.27	4.18	4.03	4.07
Width of lateral stripe at midbody	4.05	3.41	3.79	3.03	3.60
Circumference at midbody	58	40	48	33	46
Length of tail from anterior end of vent	8.16	5.66	4.43	5.02	4.17
Length of tail from posterior end of vent	4.60	3.09	2.51	3.02	2.06
Length of disc surrounding vent	3.08	2.67	2.60	1.91	2.69
Width of disc surrounding vent	2.70	1.54	1.01	1.22	1.16
Denticles	17	14	14	13	13
Length by width	22.15	23.95	24.24	25.64	25.53
Number of premaxillary–maxillary teeth	51	36	50	46	40
Number of vomeropalatine teeth	60	30	48	46	40
Number of dentary teeth	48	31	47	40	37
Number of splenial teeth	40	29	40	30	32



Figure 1. Photograph of the holotype (WGRC/V/A/776) of *Ichthyophis davidi* in life.

about 22.15–25.64 times midbody width; 321–336 body annuli; 31–48 dentary, 29–40 splenial, 36–51 premaxillary and maxillary, and 30–60 prevomeropalatine teeth; number of teeth count increasing with the total length of the species, splenials shorter than dentary row; tentacle near to eye, much less than twice as far from naris (TN/TE 0.91–1.39). Scales as far anterior as collars in six rows, increasing to ten rows near the vent; scale size decreases from collar region to vent region.

Description of holotype: Some morphometric and meristic data are given in Table 1. Holotype mature female in good

condition, except for mid ventral incisions at the posterior third for sexing and few annular scale pockets opened in search of scales.

Body subcylindrical, head, nuchal region and neck dorsoventrally compressed, width maximum at midbody, decreasing towards the tapering pointed tail ending in a small knob-like terminal cap. In dorsal view head broader at first collar and narrowing at jaw angle, head length sub-equal to head width (HL/HW = 1.04), snout slightly rounded; in ventral view, head wider at the region of tentacles and tapering towards the tip of the head bluntly; in lateral view head straight-edged, snout tip of upper lip extending 1.45 mm beyond the lower lip, head tapering towards mouth tip; jaw angle equidistant from top and ventral surface of lower jaw; ventral surface flat. Eyes equidistant between mouth and top of head, whitish ring absent. Tentacles nearer to the eye (3.00 mm) than to the naris (4.19 mm), close to lip, visible both in dorsal and lateral views. In life tentacles are globular, thin and long, with a yellowish dot on the upper surface (Figure 3). Teeth slender, bicuspid and

strongly recurved; dentary 48, splenial 40, premaxillary and maxillary 51, and prevomeropalatine 60; dentaries slightly larger than other series, dentary teeth posterior to last splenial teeth on each side. Tongue strongly plicate, margin overlying all except anterior-most splenials.

Collar region little (12.63 mm) wider than head (12.00 mm) in dorsal view; first nuchal groove well marked with the separation of head and neck region; second nuchal groove absent dorsally, incomplete laterally and complete ventrally; third nuchal groove complete dorsally and laterally, but incomplete ventrally; on second collar four dorsal transverse grooves; collar region strong with constrictions, second collar (4.23 mm) longer than first (2.93 mm), and second collar one and a half times longer than first collar ($C2/C1 = 1.44$).

Annular count 336; first annular groove incomplete ventrally and recurved posteriorly, subsequent grooves complete ventrally and are recurved posteriorly and becoming transverse by 304th annulus; dorsally, annular grooves curve slightly anteriomedially in the first quarter of the body.

Scales on the dorsal surface of the first annulus six rows and ventrally four rows, ventral scales are smaller than dorsal scales; at about 177th annulus six rows of scales both dorsally and ventrally; scales at 304th annulus ten rows both dorsally and ventrally. In general, scales at the posterior part of the body are smaller than those at the anterior part of the body.

Longitudinal vent lies within small, whitish, centrally subcircular disc, cream-whitish in life, 17 denticles clearly visible; 7 annuli interrupted by vent; body ends in a knob-like, hard terminal cap.

Colour in preservative, dorsal body uniform dark brown, snout anterior to eyes slightly lighter, venter light brown with yellowish lateral bands. In life, dorsally, body uniform metallic chestnut brown, snout anterior to eyes slightly paler, venter light lilac and tail tip darker. Shining metallic yellow lateral stripe of upper lip originates as faint dot on the tentacle. This joins the yellow stripe originating from the tip of the lower jaw at the mouth commissure and continues till the knob-like terminal tail cap with an incurvature on the second collar. Yellow stripe wide all along the body, except on the upper and lower lips and with a small incurvature on the second collar. Tentacles and tentacular apertures whitish.

Additional information from paratypes: The paratypes are in good condition generally, except for mid-ventral incisions made at the posterior third for sexing. Paratypes, one female and three males are at different stages of their sexual maturity, size ranges from 268 to 314 mm, and annular count from 321 to 336. Morphometric and meristic data are given in Table 1. Teeth count in types showed consistency, except for 60 vomeropalatine teeth in holotype, when compared to paratypes (30 to 48).

Ecology, habitat and conservation:

Found below the decaying straw heaps accumulated in the backyards of homestead areas and below the decaying organic content. We have searched for specimens of the species during a span of four years periodically in and around the type locality and found this species to be rare. Since more information is needed on the range and habitat requirement, we suggest assigning the status by IUCN criteria as 'Data Deficient'.



Figure 2. Photograph of ventral region of head and tail of holotype *I. davidi*.



Figure 3. Photograph of holotype *I. davidi* (head region) in life.

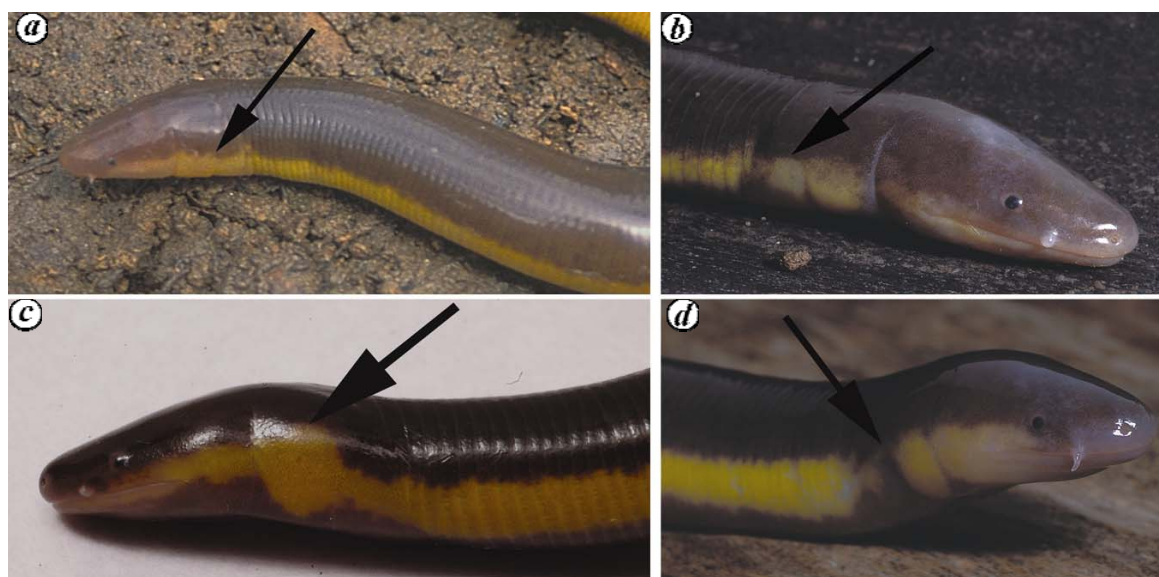


Figure 4. Images of head region (collar region marked with black arrow) in the striped caecilians of the Western Ghats. *a*, *Ichthyophis beddomei*; *b*, *I. tricolor*; *c*, *I. kodaguensis* and *I. longicephalus*.

Etymology: The species is named in honour of David Gower, Department of Zoology, The Natural History Museum, London, in recognition of his contributions to Indian caecilian studies and we suggest the common name ‘Chorla giant striped *Ichthyophis*’.

Discussion: We compared *Ichthyophis davidi* sp. nov. with museum specimens and original descriptions of four valid, striped *Ichthyophis* species of the Western Ghats. Larger body size, width and extent of the yellow lateral stripe (starting from the tentacle) and greater number of annular grooves are unique to *I. davidi*. In addition, we compared the new species to congeners, listing only key diagnostic characters of the respective species.

I. beddomei (Figure 4 *a*), total length up to 247 mm (total length 370 mm in *I. davidi*); snout pointed (slightly rounded in *I. davidi*); head wider than long (head length sub-equal to head width in *I. davidi*); tentacle equidistant to eye and nostril (tentacle nearer to eye than to nostril in *I. davidi*); body annuli up to 296 (body annuli up to 336 in *I. davidi*); 34–40 dentary, 35–44 splenial, 34–40 premaxillary and maxillary, and 40–50 prevomeropalatine teeth (31–48 dentary, 29–40 splenial, 36–51 premaxillary and maxillary, and 30–60 prevomeropalatine teeth in *I. davidi*); yellow lateral stripe narrow (3.0 mm), starting from eye to

tail tip uniformly (yellow lateral stripe wide (4.0 mm), starting from the tentacle and continuing to the tail tip with a small incurvature on the second collar in *I. davidi*).

I. tricolor (Figure 4 *b*), total length up to 325 mm (total length 370 mm in *I. davidi*); snout pointed (slightly rounded in *I. davidi*); head longer than wide (head length sub-equal to head width in *I. davidi*); body annuli up to 284 (body annuli up to 336 in *I. davidi*); 25–38 dentary, 46–57 splenial, 27–38 premaxillary, and maxillary, and 39–59 prevomeropalatine teeth (31–48 dentary, 29–40 splenial, 36–51 premaxillary and maxillary, and 30–60 prevomeropalatine teeth in *I. davidi*); yellow lateral stripe narrow and discontinuous on the collar, broken at first nuchal groove (yellow lateral stripe wide and continuous, with a small incurvature on the second collar in *I. davidi*); whitish midventral stripe present (whitish midventral stripe absent in *I. davidi*).

I. longicephalus (Figure 4 *d*), total length up to 192 mm (total length 370 mm in *I. davidi*); snout tip blunt (slightly rounded in *I. davidi*); head longer than wide (head length sub-equal to head width in *I. davidi*); body annuli up to 348 (body annuli up to 336 in *I. davidi*); 32–35 dentary, 30–38 splenial, 35–36 premaxillary and maxillary, and 46–49 prevomeropalatine teeth (31–48 dentary, 29–40 splenial, 36–51 premaxillary

and maxillary, and 30–60 prevomeropalatine teeth in *I. davidi*); yellow stripe narrow (2.5 mm), which runs from the vent to beginning of the annular groove, absent on the second collar and as a spot on the first collar, and bifurcates equally on the upper and lower lips to the level of the eye (yellow lateral stripe wide (4.0 mm), starting on the tentacle continuing to the tail tip with a small nick on the second collar in *I. davidi*).

I. kodaguensis (Figure 4 *c*), total length up to 274 mm (total length 370 mm in *I. davidi*); snout rounded (slightly rounded in *I. davidi*); head longer than broad (head length sub-equal to head width in *I. davidi*); body annuli up to 306 (body annuli up to 336 in *I. davidi*); 33–44 dentary, 25–31 splenial, 38–49 premaxillary and maxillary, and 41–52 prevomeropalatine teeth (31–48 dentary, 29–40 splenial, 36–51 premaxillary and maxillary, and 30–60 prevomeropalatine teeth in *I. davidi*); yellow lateral stripe narrow (2.3 mm) appears as a distinct spot on the first collar and later tapers along the upper jaw fading out at the level of the eye, but weakly indicated in the lower jaw merging with the whitish lip border, posteriorly, stripes terminate quite abruptly on the anterior margin of the first complete annulus anterior to the vent (yellow lateral stripe wide (4.0 mm), starting on the tentacle continuing to the tail tip in *I. davidi*).

Modified key to the striped *Ichthyophis* of the Western Ghats after Wilkinson *et al.*³

1. Whitish midventral stripe; body annuli up to 284 ... *I. tricolor*.

No whitish stripe on venter; body annuli more than 284 ... 2.

2. Tentacle more than twice as far from the naris than from the eye; head length 1.5 times more than head width; body annuli up to 348 ... *I. longicephalus*.

Tentacle less than twice as far from the naris than from the eye; head length 1.5 times less than the head width; body annuli 296 to 336 ... 3.

3. Tentacle almost as close to the naris as to the eye; head narrow and pointed; broad lateral stripe continuous on the collar region; inner mandibular tooth row not much shorter than dentary row; body annuli 296 ... *I. beddomei*.

Tentacle much closer to the eye than the naris; head broad and rounded; narrow lateral stripe on the collar region not continuous; body annuli more than 300 ... 4.

4. Narrow lateral stripe indistinct on the lower jaw and without a yellow spot on the tentacle; splenial teeth medium (25–31); body annuli up to 306 ... *I. kodaguensis*.

Narrow lateral stripe distinct on the lower jaw with a yellow spot on the

tentacle; splenial teeth more (29–40); body annuli up to 336 ... *I. davidi* sp. nov.

Type locality of *I. beddomei* is from 'Nilgherries' (Nilgiri), Tamil Nadu (11°25'N, 76°30'E); *I. tricolor* is from 'Maddathorai', Travancore (Kerala) (11°58'N, 76°11'E); *I. longicephalus* is from 'Silent Valley', Kerala (11°13'N, 76°28'E); *I. kodaguensis* is from 'Venkidds Valley', Coorg, Karnataka (12°15'N, 75°41'E). Current description of new species *I. davidi* from northern Karnataka (15°39'N, 74°08'E) increases the striped caecilian diversity in the Western Ghats to five and also extends the distribution of striped caecilians further north (up to 15°39'N) of Karnataka in the Western Ghats. It is noteworthy that striped caecilian descriptions are concentrated in the central Western Ghats (between 11°13'N and 15°39'N) leaving scope for further research in the northern and southern Western Ghats.

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