Journal of Animal Diversity
Volume 2, Issue 3 (2020)
Online ISSN 2676-685X
Research Article
http://dx.doi.org/10.29252/JAD.2020.2.3.2

First records of the Long-headed Caecilian, *Ichthyophis longicephalus* Pillai, 1986 (Gymnophiona: Ichthyophiidae) from the states of Karnataka and Tamil Nadu, India with comments on its conservation status

Govindappa Venu[1*], Narayanappa Govinda Raju[2], Mark Wilkinson[3], Robert Kenneth Browne[4], Kulkarni Varadh[1], Gandlahalli Narasimaiah Balakrishna[1], Sompalem Ramakrishna[1] and Govindaiah Venkatachalaiah[1]

[1]*Department of Zoology, Centre for Applied Genetics, Jnana Bharathi Campus, Bangalore University, Bengaluru, Karnataka, 560056, India*
[2]*Department of Biotechnology, Karnataka State Open University, Mukthagangothri, Mysuru, Karnataka, 570006, India*
[3]*Department of Life Sciences, The Natural History Museum, London SW7 5BD, United Kingdom*
[4]*Sustainability America, La Isla Road, Sarteneja, Corozal District, Belize*
[*]*Corresponding author*: *venugcaecilian@gmail.com*

Received: 6 September 2020
Accepted: 27 September 2020
Published online: 9 October 2020

Abstract

In the present study, we report the discovery of the poorly known striped ichthyophiid caecilian *Ichthyophis longicephalus* from three new localities, each in three southern Indian states; Karnataka, Kerala and Tamil Nadu. Present records and available information on this species enable us to revise its IUCN Red List conservation status from Data Deficient (DD) to Least Concern (LC).

Key words: Anthropogenic influence, coffee and tea plantations, Kodagu, new site record, Peninsular India, range extension

Introduction

Caecilians are elongate, limbless amphibians, and although some species, including *Ichthyophis* Fitzinger, 1826, have an aquatic larval stage, most are burrowers or surface cryptic species as adults and are consequently inconspicuous. These apodan amphibians are often mistaken for giant earthworms and are relatively poorly known (Nussbaum and Wilkinson, 1989; Gower and Wilkinson, 2005; Wake and Koo, 2018; Mailho-Fontana et al., 2020).

The caecilian fauna of Peninsular India comprises 27 species, more than 10% of the global diversity for the group (Wilkinson, 2012), in four genera in the two families Ichthyophiidae Taylor, 1968 and Indotyphlidae Lescure, Renous and Gasc, 1986 (Frost, 2020). Of these, three genera, *Uraeotyphlus* Peters, 1880, *Indotyphlus* Taylor, 1960, and *Gegeneophis* Peters, 1880 are endemic to Peninsular India (Taylor, 1968). Whereas, the genus *Ichthyophis* includes 50 species with broad distribution across South and South East Asia, of which six, including one unicolored species and five species with yellow lateral stripes, are endemic to peninsular India, occurring mainly in the Western Ghats and surrounding areas (Gower et al., 2007; Wilkinson et al., 2007; Bhatta et al., 2011; Frost, 2020).

The unstriped ichthyophiid caecilian, *Ichthyophis bombayensis* Taylor, 1960 is distributed across the 1600 km expanse of the Western Ghats. But the striped ichthyophiids viz., *Ichthyophis beddomei* Peters, 1880, *I. davidi* Bhatta, Dinesh, Prashanth, Kulkarni, and Radhakrishnan, 2011, *I. kodaguensis* Wilkinson, Gower, Govindappa, and Venkatachalaiah, 2007, *I. longicephalus* Pillai, 1986, and *I. tricolor* Annandale, 1909 are restricted to the Southern states of Peninsular India (Gower et al., 2007; Wilkinson et al., 2007; Bhatta et al., 2011; Frost, 2020).

The Long-headed Caecilian, *Ichthyophis longicephalus* was described based on a single adult specimen collected in 1979 from the Silent Valley National

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[DOI: 10.29252/JAD.2020.2.3.2]

Park (Nilgiri Biosphere Reserve), Palghat district, Kerala, India. Subsequently in 1985, a second specimen collected from the Kalakkad Wildlife Sanctuary, Tirunelveli District, Tamil Nadu at the southern tip of the Western Ghats, about 320 km away from the type locality was referred to *I. longicephalus* by Pillai and Ravichandran (1999). This taxonomic referral was questioned first by Dutta et al. (2004) and again by Wilkinson et al. (2007) who noted the poor condition of both the specimens (including the Holotype).

In the subsequent review of the taxonomy and natural history of *I. longicephalus*, Kotharambath et al. (2012) reported nine additional specimens from several localities in Kerala, near the type locality, and concluded that the specimen from Kalakkad is not *I. longicephalus* but an undescribed species. Kotharambath et al. (2012) suggested that additional surveys to search for *I. longicephalus* beyond the border of Kerala and into adjacent Western Ghats regions of Karnataka and Tamil Nadu were needed to further assess the true distribution range of the species. During our surveys in the Karnataka, Kerala and Tamil Nadu have yielded three additional localities for the species, including the first reports for the states of Karnataka and Tamil Nadu.

Material and Methods

Field surveys were conducted during the Monsoon seasons of 2004 and 2017–2018 in plantations in the south Western Ghats located in the districts of Kodagu (=Coorg), Karnataka; Nilgiris, Tamil Nadu and Wayanad, Kerala (Fig. 1). Specimen sampling was a part of cytogenetic analysis of caecilians of Western Ghats (Venu, 2008; Venu and Venkatachalaiah, 2012). Surveys were conducted in daylight with the assistance of local people, mostly by digging soft, humus rich soil especially along the sides of streams and other water bodies in the coffee and tea plantations. Collected specimens were transported to Bangalore University (Jnana Bharathi Campus, Bengaluru, Karnataka) in polythene bags along with soil and earthworms (as food source) collected from the sampling sites.

Specimens of *I. longicephalus* were euthanized with MS222, photographed in broad daylight using a Canon EOS 1200D DSLR camera and the lengths of the fresh specimens were measured using thread and ruler. Euthanized specimens were fixed in 10% formalin solution, followed by thorough washing under tap water overnight to remove formalin, and then stored in 70% alcohol. All other measurements were taken using Mitutoyo Digimatic caliper to the nearest 0.1 mm. Sexes of the specimens were identified by making a midventral incision and observing the presence of testes and ovaries under a Nikon SMZ-10 binocular Stereo microscope. Voucher specimens (BUB1175, BUB1379, BUB1442, BUB1587 and BUB1617) are deposited in the collections of the Museum of Department of Zoology, Bangalore University, Bengaluru (BUB).

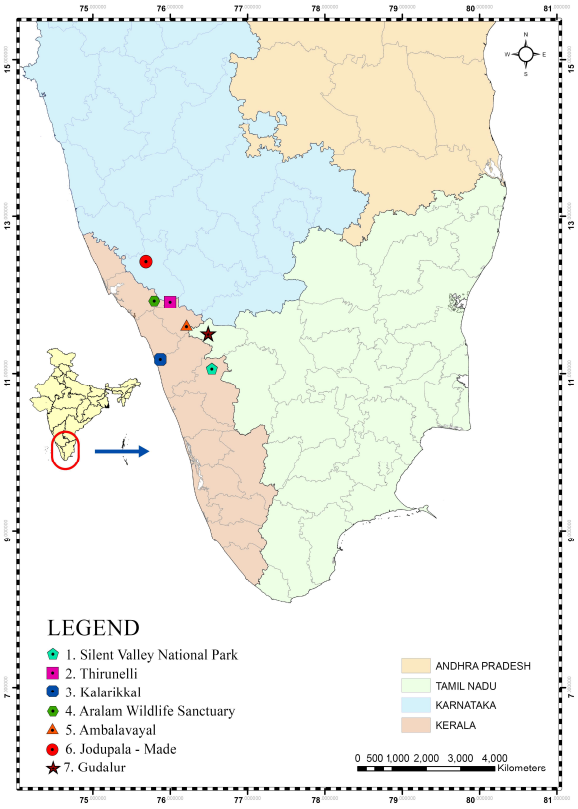

Figure 1: Map of peninsular India showing the past and currently described locality data for *Ichthyophis longicephalus*.

Five female specimens referable to *I. longicephalus* (Fig. 2) were collected. Two specimens (BUB1587 and BUB1617) (Fig. 2A) were collected between 10.00–11.00 hrs on 21st July, 2018, from the Regional Agricultural Research Station (RARS), Ambalavayal (11°36'45.84"N 76°12'35.64"E), Wayanad District, Kerala, in a heap of soil, about 974 m a.s.l., lying about 30 m from a stream (Fig. 3).

Four specimens of *I. beddomei*, two *Uraeotyphlus narayani* Seshachar, 1939 and a few uropeltid snakes (*Rhinophis* Hemprich, 1820 and *Uropeltis* Cuvier, 1829) were also found during our field work. RARS was established in 1983 by the Kerala government to provide research support for agriculture in the high range zone that includes Wayanad, Idukki and Nelliyampathy area of Palakkad district. The station is spread over 87.3 ha, has a mild tropical climate and grows a wide variety of crops including coffee, pepper, rice, ginger, turmeric, clove and cinnamon.

Two specimens (BUB1175 and BUB1442) (Fig. 2B) were collected on 28th August, 2004; between 15.00–16.00 hrs in soil adjoining a small stream in Kuchikunnel tea plantations (11°30'10.78"N 76°29'30.21"E) situated about 1,072 m a.s.l., and 12 km north of Gudalur, a municipality and a taluk of Nilgiris, Tamil Nadu.

A single specimen (BUB1379) (Fig. 2C) of *I. longicephalus* was collected from Himakshama estate, Jodupala-Made village (12°25'1.33"N 75°40'57.25"E),

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located about 1143 m a.s.l., and 10 km west of the District headquarters, Madikeri (=Mercara), Kodagu (=Coorg) District of Karnataka. Himakshama estate, spread over 20 ha is owned by Lingeshkumar and has a mixed plantation of coffee, pepper, coconut and bananas. The specimen was collected between 13.00–15.00 hrs on 17th July, 2017, in moist and humus rich soil beneath a decaying stump of *Lagerstroemia microcarpa*, a shade tree commonly seen in the coffee plantation landscapes of the Western Ghats.

Two specimens of *I. beddomei* were collected from the estate and the site of collection was about 100 m away from the site of *I. longicephalus*.

Figure 2: Adult specimens of *Ichthyophis longicephalus* collected from Regional Agricultural Research Station, Ambalavayal, BUB1617 (A), Kuchikunnel tea plantations, Gudalur, BUB1442 (B) and Himakshama estate, Jodupala-Made village, BUB1379 (C).

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Figure 3: Paddy fields in the midst of coffee, arecanut, coconut plantations (Regional Agricultural Research Station, Ambalavayal), a habitat of collection of *I. longicephalus*.

Results and Discussion

Meristic and metric data for the newly collected specimens (Table 1) are in good agreement with the descriptions of Pillai (1986) and Kotharambath et al. (2012) for *I. longicephalus.* The new specimens include the longest and the widest specimens known to date. At 331 mm of total length, BUB 1587, is 48 mm (<15%) longer than any previously reported specimen, and BUB 1617, another notably long (310 mm total length) specimen, has a greater mid-body width of 13.78 mm, about 20% greater than for any previously reported specimen.

Based on these new data, *I. longicephalus* has the second greatest known maximum total length of any striped *Ichthyophis* of peninsular India, exceeded only by *I. davidi*, which reaches a total length of 370 mm (Bhatta et al., 2011). Annular grooves, counted dorsally for the newly collected specimens, range between 305–361, the least and the highest for *I. longicephalus* specimens known to date. In all other features the new specimens fall within the ranges reported by Kotharambath et al. (2012).

The Silent Valley National Park, the type locality for *I. longicephalus*, is situated in Palakkad, a central district of Kerala (Pillai, 1986). *Ichthyophis longicephalus* has also been reported from the north of Kerala at Kozhikode (Kalarikkal), 73 km from the type locality and to the northwest at Wayanad (Thirunelli), 110 km from the type locality, and at Kannur (Aralam Wildlife Sanctuary) 125 km from the type locality (Kotharambath et al., 2012).

Our recent surveys recorded Ambalavayal as the second locality for *I. longicephalus*, from the district of Wayanad. Ambalavayal is located about 70 km southeast of Silent Valley National Park. The nearest locality to Ambalavayal where *I. longicephalus* was previously recorded is at Thirunelli, about 40 km to the northwest (Kotharambath et al., 2012) (Fig. 1).

Himakshama estate of Jodupala-Made village is the first location for *I. longicephalus* from the state of Karnataka and is about 176 km southeast from Silent Valley National Park. The locality reported from Coorg of Karnataka is the furthest from its type locality and thus further extends the range of *I. longicephalus* by about 40 km compared to the earlier reports. Gudalur, the first recorded locality for *I. longicephalus* from the state of Tamil Nadu, is about 49 km south of its type locality (Fig. 1).

Conclusions

The discovery of five more specimens of *I. longicephalus* collected from three new localities (Fig. 1) adds to the emerging picture that this species is not particularly narrowly distributed or rare. Thus we agree with Kotharambath et al. (2012) that *I. longicephalus* might be more reasonably considered as of Least Concern in the IUCN Red List (IUCN 2020) rather than its current Data Deficient status formulated before the discovery of the additional specimens and localities reported here and by Kotharambath et al. (2012). Coffee estates situated in the district of Coorg are home to at least three species of striped ichthyophiids (*I. beddomei* (Fig.

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4A and 4B), *I. kodaguensis* (Fig. 4C and 4D) and *I. longicephalus*) (Venu, 2008 and present report), one indotyphlid (*Gegeneophis carnosus* (Beddome, 1870)) (Malathesh et al., 2002; Venu and Venkatachalaiah, 2006) and one *Uraeotyphlus* (Venu pers. observ.).

Figure 4: Congeneric species of *Ichthyophis* co-inhabiting along with *Ichthyophis longicephalus* in peninsular India: *Ichthyophis beddomei*, dorsal (A) and ventral (B) views; dorsum (C) and ventrum (D) of *Ichthyophis kodaguensis*.

Table 1: Metric (in millimeters) and meristic characteristics of the newly recorded *Ichthyophis longicephalus* specimens from the states of Karnataka (BUB1379), Kerala (BUB1587, BUB1617) and Tamil Nadu (BUB1175, BUB1442), India. BUB-Bangalore University, Bengaluru.

Voucher details	BUB1175	BUB 1379	BUB1442	BUB1587	BUB1617
Total length (mm)	243	222	233	331	310
Distance between naris and tentacles (TN) (mm)	2.71	2.72	2.62	2.96	2.73
Distance between eye and tentacle (TE) (mm)	1.56	1.48	1.46	1.53	1.54
TN/TE (mm)	1.73	1.83	1.79	1.8	1.77
Head length (mm)	10.38	10.77	9.98	13.12	13.24
Width at midbody (mm)	6.72	8.84	8.45	13.52	13.78
Distance between eye and naris (mm)	4.08	3.95	4.09	4.81	4.55
Distance between eye and tip of snout (mm)	4.76	4.86	4.68	6.36	5.81
Distance between eye and jaw angle (mm)	2.29	1.91	1.73	3.82	3.53
Distance between nares (mm)	1.6	1.79	1.44	2.38	2.1
Distance between tip of snout and first nuchal groove (mm)	10.14	10.96	11.56	13.95	13.45
Distance between snout tip and 2nd nuchal groove (mm)	12.28	13.32	14.28	17.46	16.54
Distance between snout and 3rd nuchal groove (mm)	14.7	15.51	15.84	20.08	19.28
Width of lateral stripe at midbody (mm)	1.51	1.64	1.44	2.81	3.3
Length of tail from anterior end of vent (mm)	3.62	3.47	4.98	6.56	4.52
Total annuli (counted ventrally)	326	366	302	334	343
Total annuli (counted dorsally)	323	362	306	351	347
Annular grooves behind disc	4	4	3	5	3
Premaxillary-maxillary teeth	38	40	42	38	40
Vomeropalatine teeth	46	52	44	48	50
Dentary teeth	41	40	44	42	42
Splenial teeth	22	20	20	24	22

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To the best of our knowledge, Kodagu is the only district of Karnataka state with three out of the four caecilian genera found in the Western Ghats. In this regard, coffee estates in the remote areas of Kodagu district seem to provide an important sanctuary for caecilians and afford good locations for further exploration of the diversity and natural history, including the impact of anthropogenic influences, of these neglected, but fascinating, groups of vertebrates (Wilkinson, 2012; Mailho-Fontana et al., 2020).

Acknowledgments

We thank P. Rajendran and Ajithkumar RARS, Mr. Jose (Kuchikunnel tea plantations) and Mr. Lingesh Kumar (Himakshama estate) for permitting us to carry out field sampling and logistic support. Our thanks to Manikantan for the hospitality, Seetharam (CCRI, Balehonnur) and Vijayalakshmi (RCRS, Chundale) for arranging field work at RARS. Field assistance by Manju (Himakshama estate), Mahendran, Deepa, Chandran, Vasu, Pushkaran, Vinod, Naushad (RARS) and Ramaswamy, Raju, Narayan, Ravi (KuchiKunnel tea plantations) is acknowledged. Our thanks to two anonymous reviewers whose inputs enabled us to improve the manuscript.

Conflict of interest

All the authors declare that there are no conflicting issues related to this research article.

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