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A new striped species of *Ichthyophis* Fitzinger, 1826 (Amphibia: Gymnophiona: Ichthyophiidae) from Mizoram, northeast India

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***Abstract.*—A new species of striped *Ichthyophis* is described from Mizoram State of northeast India. For its distinguishing features, *Ichthyophis benjii* sp. nov. has narrow (W/S >5) irregular faint lateral yellow stripes extending immediately from corner of the mouth to the level of the posterior vent, not contacting the disc, barely or not visible on the collars ventrally, patchy in the trunk region; known to attain lengths greater than 400 mm, 26 < L/W < 30; head V-shaped, short (L/H > 24); TAs (tentacular apertures) more than twice as far from nares as from eyes (TN/TE > 2); C2 (second collar) noticeably longer than C1 (first collar). It differs from all other striped congeners, except for *I. tricolor* and *I. multicolor*, in having an indistinct pale yellowish lateral stripe that is bordered by a darker ventrolateral longitudinal stripe immediately above the pale venter on each side. It differs from *I. tricolor* and *I. multicolor* in having more AGs (annular grooves) 388–422 counted dorsally; and in having 118–124 vertebrae vs. < 120 (*I. tricolor*) or > 125 (*I. multicolor*). An analysis of mitochondrial 16s rRNA shows *Ichthyophis benjii* sp. nov. to be a sister taxon to *I. multicolor* with an uncorrected *p*-distance of 0.055. At present, due to the lack of data on the population status and range of distribution, we propose the species be considered as Data Deficient (DD) under the IUCN Red List criteria.**

Keywords. 16s rRNA, caecilian, conservation, Data Deficient, *Ichthyophis benjii* **sp. nov**., Indo-Burma

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Introduction

The caecilian genus *Ichthyophis* Fitzinger, 1826 is represented globally by 49 currently recognized species, of which India is home to 15 species (Dinesh 2020; Lalremsanga et al. 2021) and the eight states of northeast India are home to nine species. These nine species of *Ichthyophis* can be divided into eight striped forms (*I. alfredi* Mathew and Sen, 2009; *I. daribokensis* Mathew and Sen, 2009; *I. garoensis* Pillai and Ravichandran, 1999; *I. khumhzi* Kamei, Wilkinson, Gower, and Biju, 2009; *I. moustakius* Kamei, Wilkinson, Gower, and Biju, 2009; *I. nokrekensis* Mathew and Sen, 2009; *I. sendenyu* Kamei, Wilkinson, Gower, and Biju, 2009; and *I. multicolor* Wilkinson, Presswell, Sherratt, Papadopoulou, and Gower, 2014) and a single unstriped form (*I. sikkimensis* Taylor, 1960). Of these nine, six were described in a single year in 2009 (Mathew and Sen 2009; Kamei et al. 2009). Pillai and Ravichandran (1999) described *I. husaini*, an unstriped form, based on a single specimen from Thebronggiri Coffee Garden, Rongram, Garo Hills, Meghalaya, which was later synonymized with the striped form, *I. garoensis* (Kamei and Biju, 2016).

Taylor (1962, 1968) divided the genus *Ichthyophis* into two groups based on the presence or absence of a dorsolateral stripe. While subsequent molecular genetic studies have shown that these groups are non-monophyletic (Gower et al. 2002), the presence or absence of a stripe remains an important taxonomic character in the identification of *Ichthyophis* species. The taxonomy of *Ichthyophis* is challenging, as there are many species but few characters that serve to distinguish them. The

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discovery of additional new *Ichthyophis* species from South and Southeast Asia is likely because one-fourth of the currently recognized species of the group have been described in the last 15 years (Wilkinson et al. 2014). To date, except for *I. moustakius* and *I. multicolor* (Lalremsanga et al. 2021), no published information is available on the molecular genetic data of northeast Indian *Ichthyophis*. Based on morphology and genetic data, here we describe a new species of striped *Ichthyophis* from Mizoram, India.

Materials and Methods

Morphology. Measurements were taken with a Mitutoyo dial vernier caliper (505–671) to the nearest 0.1 mm, except for total length and circumference, which were measured to the nearest 1 mm using thread and a ruler. Annular grooves were counted using ImageJ2 software (Rueden et al. 2017), then cross-checked manually, and vertebrae were counted using digital radiography at 56 kVp and 24 mAs (Allengers MARS 30 X-Ray Machine). Sex was determined by examination of the gonads.

The abbreviations used here follow Kamei et al. (2009, 2013) for several features of the external morphological characters and ratios of measurements: AGs, number of annular grooves, counted both dorsally and ventrally; TGs, transverse grooves on collars; L, total length; W, maximum width at midbody; S, maximum width of stripe; T, tail length (distance behind posterior of vent to tail tip); C1, first collar; C2, second collar; CM, corner of the mouth; E, eye; N, naris; TA, tentacular aperture; L/H, total length divided by head length (the latter, ST–NG1 measured directly behind CM); PM, premaxillary-maxillary teeth; VP, vomero-palatine teeth; OM, outer mandibular teeth; IM, inner mandibular teeth; L/T, total length divided by tail length (the latter, distance behind vent); TP, tentacular papillus; ST, snout tip; NG, nuchal groove; L/W, total length divided by midbody width; and W/S, width at midbody divided by maximum width of stripe at midbody. The comparison was conducted based on literature (Taylor 1960, 1968; Kamei et al. 2009; Mathew and Sen 2009; Wilkinson et al. 2014; Kamei and Biju 2016) and museum specimens of regional congeners deposited in the Departmental Museum of Zoology Mizoram University (MZMU), India, and the National Centre for Biological Sciences (NCBS), India (Appendix 1).

Molecular genetic analysis. Tissue samples were preserved in absolute alcohol. DNA isolation was carried out using the Qiagen QIAamp DNA Mini Kit, Fifth Edition, 2006. Isolated DNA was subjected to 0.8% agarose gel electrophoresis to check the yield and presence of isolated DNA. Polymerase Chain Reaction (PCR) amplification of a fragment of the mitochondrial gene 16s rRNA was carried out using the following primers: 16SF-L02510 (5'-CGCCTGTTTATCAAAAACAT-3') (Palumbi 1996) and 16SR -H03063 (5'-CTCCGGT-TTGAACTCAGATC-3') (Rassmann et al. 1997). For amplification, a total of 0.2 µM of the primer sets, 0.2 mM dNTP mix, and 1–2 µg of template DNA were used in a 30 µl PCR reaction mixture. The amplification was carried out using DyNAzyme II DNA polymerase. PCR was performed in a PCR System-Proflex 3X32 well triple block (ThermoFisher) as follows: one cycle of 95 °C for 3 min; 35 cycles of 95 °C for 30 sec, 50.5 °C for 30 sec, 72 °C for 2 min; and a final extension of 72 °C for 5 min and 4 °C for 10 min. The newly generated sequence was submitted to the NCBI GenBank database (Accession No. MZ153116), and was included in a dataset with 20 additional ichthyophiid sequences obtained from the NCBI database. These sequences (maximum of 2,655 base pairs) were aligned with MEGA 7 using the MUSCLE algorithm (Edgar 2004) with default parameter settings (Kumar et al. 2016). The GenBank sequence of *Uraeotyphlus* cf. *oxyurus* was used as the out-group. Phylogenetic relationships were estimated with Maximum Likelihood (ML) in RaxmlGUIv1.3 (Silvestro and Michalak 2012) using the selected model (GTR+gamma) based on the lowest Bayesian Information Criterion score (Nei and Kumar 2000) with 1,000 rapid bootstraps. Uncorrected pairwise sequence divergence was calculated in MEGA7. Bayesian inference phylogenetic analysis was also performed with MrBayes 3.2.5 (Ronquist and Huelsenbeck 2003) using the model (GTR+I+gamma) selected based on the Akaike Information Criterion in MrModeltest 2.4 (Nylander 2004). The MCMC (one cold and three hot chains) was run for 20,000,000 generations by sampling one tree every 1,000 generations. The average standard deviations of split frequencies became less than 0.01 when the analysis was terminated. The first 25% of trees were discarded as burn-in, and the remaining trees were used to assess Bayesian Posterior Probabilities (BPP) for nodal support.

Systematics

***Ichthyophis benjii* sp. nov.**

Figs. 1–5; Tables 1–3.

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Holotype: MZMU 1479, an adult male, collected by Lal Biakzuala on 12 August 2019, from a soil pit of ca. 1.5 m depth for a pillar at a construction site at Durtlang (23°47'6.58"N, 92°43'31.74"E; 1,233 m asl), Aizawl District, Mizoram, India (Fig. 1).

Paratypes (*n* = 4): MZMU 1462, adult male, collected by Gospel Zothanmawiia Hmar on 15 July 2019 from a water drain at Chhinga veng (23°44'4.99"N, 92°43'14.04"E; 991 m asl), Aizawl, Mizoram, India; MZMU 1481, adult male, collected by Lal Biakzuala on 28 August 2019 from the roadside at Tanhril (23°44'4.07"N, 92°40'34.90"E;

Fig. 1. Holotype (MZMU 1479) of *Ichthyophis benjii* **sp. nov.** in life from Durtlang. *Photo by H.T. Lalremsanga.*

821 m asl), Aizawl, Mizoram, India; MZMU 1513, a road-killed adult female, collected by Lal Biakzuala on 4 September 2019 from Lianchhiari road inside Mizoram University Campus (23°44'12.01"N, 92°40'3.45"E; 857 m asl), Aizawl, Mizoram, India; MZMU 2025, an adult female, collected from a soil pit of ca. 2 m depth by Lalengzuala Tochhawng on 26 October 2020 from Durtlang Gosen veng (23°47'4.55"N, 92°43'44.08"E; 1,230 m asl), Aizawl, Mizoram, India.

Diagnosis. *Ichthyophis* with narrow (W/S > 5) irregular faint lateral yellow stripes extending from immediately behind CMs to the level of the posterior of vent, not contacting the disc, barely or not visible on the collars ventrally, patchy in the trunk region; known to attain lengths greater than 400 mm, 26 < L/W < 30; head more V-shaped than U-shaped in dorsal view, short (L/H > 24); TAs more than twice as far from nares as from eyes (TN/TE > 2); without distinctive moustache-like stripes between snout tip and TAs; and C2 noticeably longer than C1. *Ichthyophis benjii* **sp. nov.** differs from all other striped congeners in having a markedly less prominent pale yellowish lateral stripe, bordered by a darker ventrolateral longitudinal stripe immediately above the pale venter on each side. It can be differentiated from *I. tricolor* and *I. multicolor* in having much higher AGs of 385–422 and 383–423 counted dorsally and ventrally, respectively.

Description of the holotype. Morphometric and meristic data are given in Table 1. Mostly good condition; longitudinal incisions mid-ventrally 50 mm anterior to the third annulus from the disc and ca. 30 mm approximately one-fourth along anterior body; small depressed scar (5.5 mm long x 2 mm wide) on the mid-dorsal surface of the head slightly posterior to eyes; small subvertical split approximately halfway along left lower lip; patches of stratum corneum scattered throughout. Total length 414 mm, girth maximal throughout midbody, increasing very gradually over first 70 mm, decreasing less gradually over last ca. 40 mm; L/W 29.2, width at mid-body slightly more than 3% of total length (W/L 0.03). Maximum width of stripe at midbody is less than 1% of total length (S/L 0.0068) and 20.9% of the width at midbody (S/W 0.20). Head and nuchal region dorsoventrally compressed; ventral surface slightly flattened in the trunk region. Head somewhat more V- than U-shaped in dorsal view. In lateral view, distance of CM from top of head is more than twice the distance from bottom of head (top of head to CM 5 mm, bottom of head to CM 2.3 mm). Eye slightly closer to the lip than to the top of the head in lateral view (top of head to eye 1.7 mm; eye to lip 1.3 mm) surrounded by a narrow whitish ring. Eye slightly elevated above adjacent skin, larger than naris (E 0.4 mm; N 0.3 mm) but smaller than TP (0.65 mm). TAs more than twice as far from nares as from eyes (TA-E/TA-N 0.47). Naris above the level of AM; equidistant from top and bottom of head in lateral view. Tongue V-shaped, strongly plicate posteriorly, margin overlying only posterior-most IMs. Teeth slender, inwardly curved with sharp and pointed tips (PMs 37; VPs 37; OMs 35; IMs 31 including empty sockets). Choanae elongated along the axis of the head, distance between them four times each of their greatest widths. Collar region broader than adjacent head. Laterally, C2 slightly longer than C1. NG1 complete dorsally. Four anteromedially flexed, evenly spaced TGs on C2 dorsally. Dorsally, AGs are mostly complete, 401 in number, and those on first one-third of the body curve anteromedially. The first three AGs widely incomplete on ventral surface. A total of 397 AGs present ventrally; AGs on first four-fifths of the body

Table 1. Morphometric (in mm) and meristic data for the type series of *Ichthyophis benjii* **sp. nov**., and for sympatric *I. khumhzi* and *I. moustakius* from Mizoram, India. See text for abbreviations not defined here. *, Holotype; #, Lower jaw broken; **, Tail anomaly; —, data not recorded.

Species	***Ichthyophis benjii* sp.nov.**					***I. moustakius***		***I. khumhzi***			
Museum Number	MZMU 2025	MZMU* 1479	MZMU 1481	MZMU 1513	MZMU 1462	MZMU 1758	MZMU 1847	MZMU 910	MZMU 912	MZMU 1005	MZMU 1460
Locality	Gosen	Durtlang	Tanhril	MZU	Chhinga Veng	Teirei	Thakthing	MZU	Tuivamit	Maubawk	Aibawk
Sex	f	m	m	f	m	f	m	f	f	m	m
Total length (L)	410	414	436	459	473	203	349	456	380	358	465
Width at midbody (W)	15.2	14.2	16.1	17.6	18.0	9.0	14.0	12.2	15.51	15.7	17.4
Circumference at midbody	52	38	45	51	53	31	50	37	51	52	55
Width of stripe at midbody (S)	2.8	2.8	3.0	3.2	3.2	2.5	4.5	2.2	2.8	3.3	3.04
Width at anterior of vent	7.8	5.8	6.2	6.9	5.6	4.9	6.1	4.6	7.6	6.2	8.4
Head length (H)	14.2	15.6	17.4	18.2	18.7	9.8	12.8	15.4	16	15	21.9
Length of C1	4.6	4.1	4.8	5.4	4.3	2.4	3.9	4.5	4.3	3.2	4.9
Length of C2	4.8	4.7	5.5	5.8	5.7	3.1	4.3	5.4	5.2	4.9	5.4
Head width at CM	9.1	9.3	11.1	10.8	10.8	6.1	8.3	8.7	10.6	9.6	12.9
Head depth behind CM	6.8	6.5	7.1	6.8	6.3	3.8	5.5	4.9	5.3	5.8	6.2
Head width at NG1	10.4	11.1	12.2	11.7	11.2	6.4	8.9	9.5	10.0	10.6	9.2
E-E	5.5	7.0	7.3	7.5	7.3	4.6	6.1	6.4	6.0	6.4	8.5
N-N	2.4	2.7	3.3	3.4	3.1	1.9	2.3	1.8	2.4	2.1	2.2
E-N	4.9	6.4	7.6	7.5	7.4	3.3	4.4	6.3	6.0	6.1	7.7
TA-TA	6.5	7.5	8.6	8.5	8.2	4.7	6.5	6.2	7.7	6.6	8.4
TA-E	1.5	2.2	2.3	2.1	2.0	1.1	1.9	1.8	2.2	2.2	1.8
TA-N	3.7	4.7	5.4	4.6	5.2	2.6	2.9	4.2	4.2	4.2	5.6
Lip-ST	1.3	1.2	1.2	1.2	1.2	1.1	1.2	1.1	1.3	1.1	1.2
N-Lip	1.4	1.1	1.2	1.2	1.1	0.7	1.1	1.3	0.8	1.2	1.2
E-Lip	1.5	1.4	1.9	1.9	1.3	1.1	1.4	1.2	1.3	1.6	1.5
TA–ST	4.8	5.7	6.9	5.8	6.5	3.2	4.7	5.5	6.7	5.0	6.9
TA-Lip	0.5	0.6	0.7	0.7	0.7	0.4	0.4	0.7	0.8	0.5	0.8
E-ST	5.3	7.0	8.3	8.1	8.2	3.9	6.2	7.2	7.6	7.1	8.7
N-ST	1.9	1.3	1.7	1.6	1.8	0.8	1.3	1.2	1	1.2	1.8
T	4.5	4.7	4.6	4.7	5.6	3.6	4.7	4.3	4.7	4.5	2.2**
DL	5.2	5	4.7	4.8	6.2	2.8	3.4	4.5	4.6	4.7	5.4
DW	3.4	4.0	3.0	3.9	4.5	2.3	2.5	2.7	3.3	2.7	4.8
AGs (counted dorsally)	388	401	422	392	406	275	286	359	362	359	362
AGs (counted ventrally)	383	397	423	391	396	265	275	355	363	353	345
TGs	2	2	0	0	1	2	1	1	1	1	3
AGs behind disc (L/R)	5/5	6/6	6/6	5/5	5/5	7/7	6/6	3/3	5/5	3/3	1
AGs interrupted by disc (L/R)	5/5	5 / 5	5 / 5	6 / 6	6 / 5	5/5	5/4	5/4	7/7	7/7	6/6
L/W	26.3	29.2	27.1	26.1	26.3	22.6	24.9	37.3	24.5	22.8	26.7
L/H	28.9	26.5	25.1	25.2	25.3	20.7	27.3	29.6	23.8	23.8	21.2
L/T	91.1	88.1	94.8	97.7	84.5	56.4	74.2	106	80.9	79.6	211.4
TN/TE	2.5	2.1	2.3	2.2	2.6	2.4	1.5	2.3	1.9	1.9	3.9
W/S	5.4	5.1	5.4	5.5	5.6	3.6	3.1	5.5	5.5	4.7	5.7
E-ST/E-E	0.9	1.0	1.1	1.1	1.2	0.9	1.0	1.1	1.3	1.1	1.0
PM teeth	38	37	38	39	38	42	35	48	46	40	54
VP teeth	37	37	31	37	35	41	34	50	48	45	50
OM teeth	35	35	34	29	37	36	33	47	45	38	45
IM teeth	32	31	29	#	35	34	28	36	37	37	38
Vertebrae	121	124	124	118	122	120	109	—	—	126	119

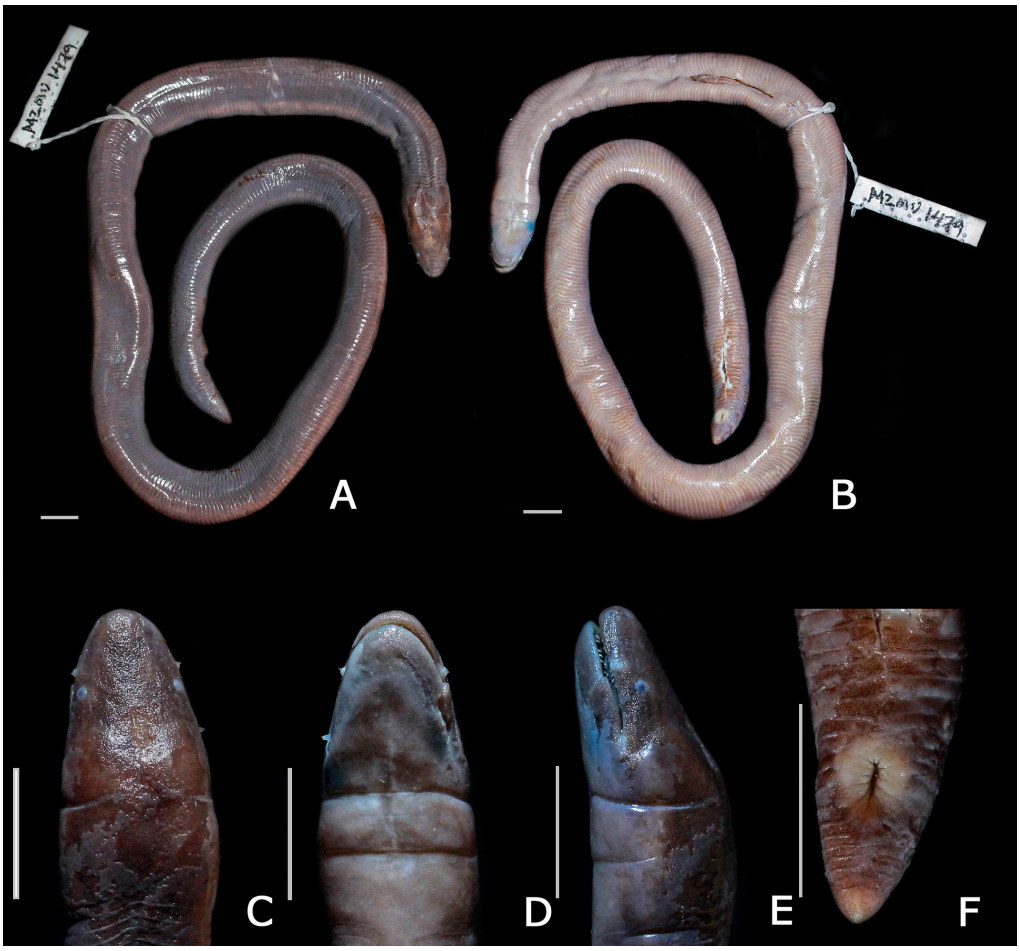

Fig. 2. Preserved holotype (MZMU 1479) of *Ichthyophis benjii* **sp. nov. (A)** Dorsal view of full body. **(B)** Ventral view of full body. **(C)** Dorsal view of head. **(D)** Ventral view of head. **(E)** Left lateral view of head. **(F)** Ventral side of tail. Each scale bar indicates 10 mm. *Photos by Ro Malsawma.*

curved posteromedially, decreasing posteriorly, more or less orthoplicate by 34th AG anterior to vent; five AGs interrupted by the disc on both left and right; six more midventrally complete AGs on tail. Tail short (4.7 mm), shorter than ST-TA (5.7 mm), tapered and downturned towards tip. The last few annuli shorter. The terminus ends in a short (1.3 mm) cap, approximately the length of the three preceding tail annuli or two body annuli. Margins of longitudinally slit vent slightly elevated, formed by ten main denticulations, five on each side, with some irregular subdivisions. No associated papillae. Vertebrae 124 in number.

In preservation, dorsum brownish grey, more chocolate brownish where stratum corneum absent. Venter much paler brownish grey. A distinct pale spot, longer than wide (5 x 4 mm), forms a disc around the vent. Narrow (W/S 5.1), irregular, faint yellowish lateral stripe on each side; unbroken from slightly above and in front of CMs to the second-to-last annulus, fading gradually on first annulus behind the vent; wider and more prominent behind CMs and C1, but almost broken on C2, not visible ventrally on collars, not connecting with or curving towards disc. Immediately below each lateral stripe, running from C2 to the level anterior to the vent, a mostly slightly indistinguishable narrower brown line, a little paler than the dorsal color, with a gradual but rapid transition to a much paler tan color that predominates on the venter, but becomes gradually darker in the posterior region. Narrow, pale lines along upper lower jaw and lower upper jaw. Tentacular papillus and ST pale. Eye covered by translucent skin, surrounded by a narrow whitish ring. In life, dorsum dark brownish grey, venter reddish grey, narrow irregular faint lateral stripes dull-yellow. A pale yellowish, thin midventral line extends from level with the anterior of the CMs across C1 to NG2. AGs appear mostly paler than adjacent skin except in the region where crossing faint lateral yellowish stripes, especially on venter. Tail tip pale.

Variation. Morphometric and meristic data for the type series are given in Table 1. The specimens generally resemble the holotype except for features highlighted here. Specimens MZMU 1462 and MZMU 1513 much larger, with total lengths of 473 mm and 459 mm, respectively. MZMU 1462, MZMU 1481, MZMU 1513, and MZMU 2025 less elongate, with lower values for L/W (26.1–26.3). MZMU 1481 has the highest dorsal AG count (422) and also is the only specimen to have

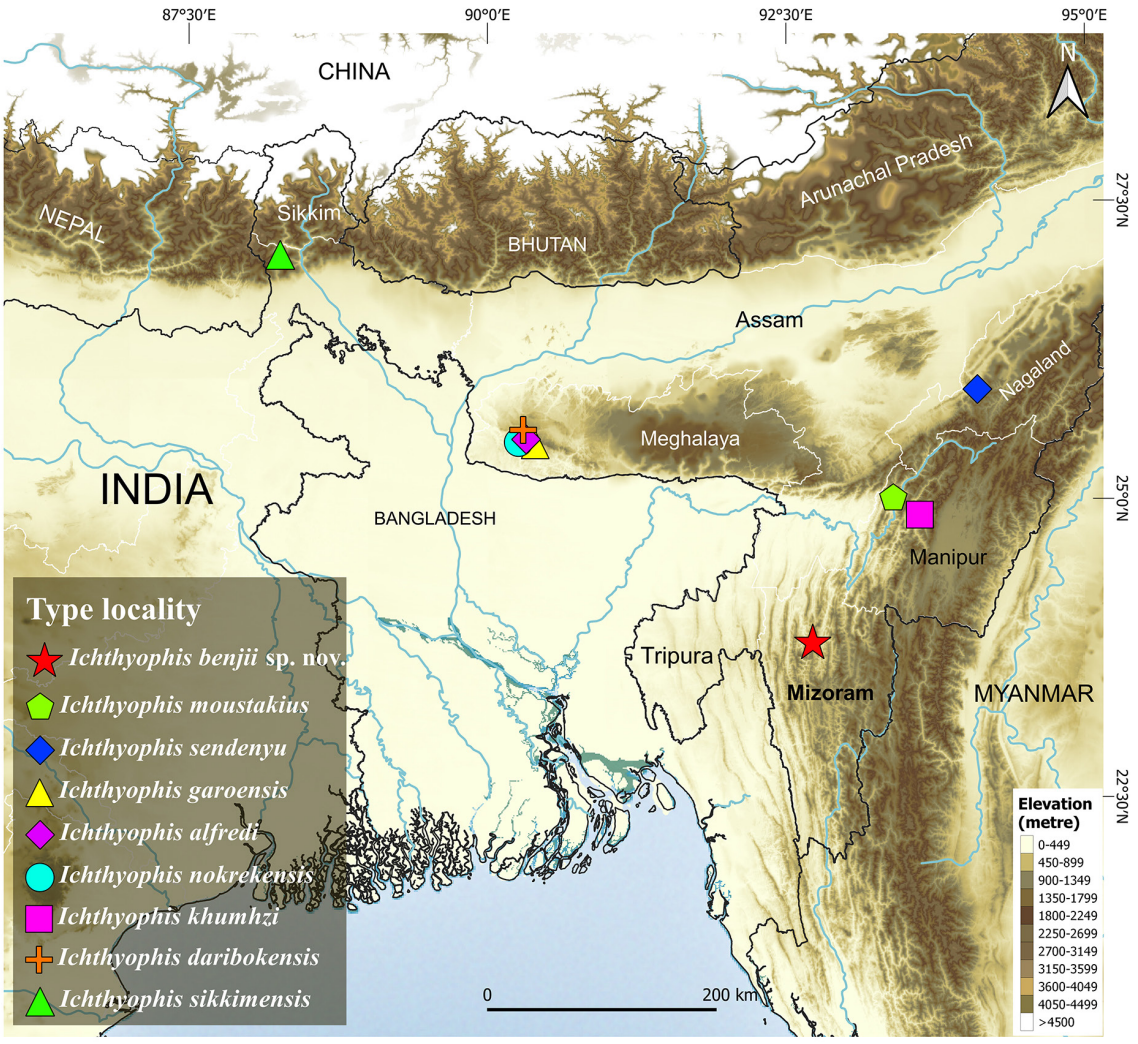

Fig. 3. Distribution of type localities of the Indo-Burman *Ichthyophis* species, including *I. benjii* **sp. nov.**

more ventral AGs (423) than dorsal AGs. MZMU 1481 and MZMU 1513 lack transverse grooves on C2. MZMU 1513 has many fewer OMs (29), possibly due to damage on the lower jaw. W/S 5.1–5.4 in specimens less than 450 mm in length; W/S 5.5–5.6 in larger specimens, indicating that the width of the stripe does not grow as fast as the width of the body. Similar allometries are apparent in the relative lengths of the head (L/H) and of the tail (L/T), and the tail appears to lengthen more slowly than the head. AGs on the tail curve anteromedially in MZMU 1462 but are orthoplicate in other specimens. Radiographs show 118 to 124 vertebrae with no correlation with total length.

Distribution and natural history. All the specimens were collected from a secondary forested area of Aizawl Municipal Council area, Aizawl District in Mizoram at ca. 821–1,233 m asl during the mid- to late monsoon season from the months of July to October. All of the specimens were found on the surface. Three of the paratypes were encountered and collected at night from the roadside, while the holotype and one paratype (MZMU 2025) were likely trapped during night time in the pit for a pillar basement in the heart of the residential area at the Durtlang locality. During this period, surface activity appears to be nocturnal. This species is more rarely encountered than other sympatric *Ichthyophis* species; a thorough day-and-night survey of the herpetofauna in this area conducted from 2015 to date has yielded only the five individuals described here. A small freshwater shrimp was recovered from inside the mouth of MZMU 1462, indicating that prey items include freshwater macroarthropods. Other amphibians found in the same macrohabitat during the collection period include the caecilians *Ichthyophis khumhzi, I. moustakius*, and the recently confirmed *I. multicolor* (Lalremsanga et al. 2021), and frogs *Duttaphrynus melanostictus, Fejervarya multistriata, Minnervarya asmati, Megophrys serchhipii, Polypedates teraiensis, Zhangixalus suffry,* and *Zhangixalus smaragdinus.*

Etymology. The species epithet "*benjii*" is dedicated in memory of Benjamin Lalremsanga (1988–2020, nephew of Hmar Tlawmte Lalremsanga) who used to actively assist the author(s) in their herpetofaunal surveys.

Suggested English common name: Benji's Caecilian

Table 2. Comparative data for the type series of striped *Ichthyophis* species of the Indo-Burma region.

Species	Number of specimens	AG D	AG V	W/S	L/W	L/H	TN/TE	AGs behind disc	AGs interrupted by disc	PM	VP	OM	IM
***I. benjii* sp. nov.**	5	388–422	383–423	5.1–5.6	26.1–29.2	25.1–28.9	2.1–2.6	5–6	5–6	37–39	31–37	29–37	29–35
I. alfredi	5	269–299	262–295	2.9–4.97	22.17–33.22	28.62–45.05	1.53–3.98	5–7	5–7	38	36	36	40
I. bannanicus	4	328–408	—	—	—	—	—	—	—	—	—	—	—
I. daribokensis	15	264–310	263–304	2.8–4.2	18.85–25.87	25.29–31.79	1.6–2.96	4–7	4–7	40	34	40	36
I. garoensis	13	264–309	263–307	2.8–5	19.6–29.7	20.7–25.3	1.8–2.3	4–8	4–6	40–52	39–48	39–43	38–51
I. khumhzi	3	341–362	347–360	6.79–9.11	24.26–26.32	25.64–28.51	2.15–2.341	2–4	4–6	50–56	47–58	42–49	40–46
I. kohtaoensis	2	362–366	—	—	—	—	—	—	—	22–23	22–23	20–21	17–18
I. moustakius	8	238–268	236–262	2.68–4	18.8–24.62	18.62–24.53	1.87–2.25	4–6	3–5	40–43	39–42	40–43	34–35
I. multicolor	14	346–386	—	4.4–7.2	24.4–27.5	25.8–39.5	1.9–2.6	3–6	5–8	38–51	35–48	30–43	22–37
I. nokrekensis	12	269–300	266–302	4.26–7.64	19.4–25.65	25.7–31.97	1.52–3.11	5–7	4–6	38	36	40	34
I. sendenyu	5	283–308	283–304	3.26–4.0	20.81–26.76	21.55–23.88	1.75–1.89	4–7	5–9	39–46	41–44	39–44	43–45

Comparison. The comparison is based on the examination of specimens, papers with original descriptions, and review articles (Taylor 1960, 1965, 1968, 1973; Pillai 1986; Pillai and Ravichandran 1999; Wilkinson et al. 2007; Kamei et al. 2009; Mathew and Sen 2009; Bhatta et al. 2011; Nishikawa et al. 2013; Wilkinson et al. 2014; Kamei and Biju 2016). *Ichthyophis benji* **sp. nov.** differs from all the other known congeners by the following criteria. *Ichthyophis benji* **sp. nov.** has a distinct dorsolateral stripe which is absent in *I. acuminatus*, *I. billitonensis*, *I. cardamomensis*, *I. catlocensis*, *I. chaloensis*, *I. dulitensis*, *I. glandulosus*, *I. javanicus*, *I. lakimi*, *I. laosensis*, *I. larutensis*, *I. monochrous*, *I. orthoplicatus*, *I. sikkimenis*, *I. singaporensis*, *I. sumatranus*, *I. weberi*, and *I. youngorum*; and by having a higher number of annular groves (385–422) vs. less than 380 annular groves in *I. asplenius* (247–270), *I. atricollaris* (275–310), *I. beddomei* (240), *I. biangularis* (330–333), *I. davidi* (321–336), *I. elongates* (274–290), *I. hypocyaneus* (314–316), *I. kodaguensis* (276–305), *I. longicephalus* (348), *I. mindanaoensis* (287–326), *I. nguyenorum* (212–218), *I. paucisulcus* (259), *I. pauliI* (335), *I. pseudangularis* (269–271), *I. supachaii* (322), and *I. tricolor* (245–284). *Ichthyophis benji* **sp. nov**. has a higher number of vertebrae (118–121) than *I. humphreyi* (112) and *I. mindanaoensis* (110–116). *Ichthyophis benji* **sp. nov.** has L/W 26–30 vs. L/W 19–21 in *I. glutinosus*. In life, *I. benji* **sp. nov.** has a dark brownish grey dorsum and a pale reddish venter vs. both dorsum and venter black in color in *I. nigroflavus*. Splenial teeth are present in *I. benji* **sp. nov.** vs. being absent in *I. paucidentulus*. In addition to these, no single character serves to distinguish *I. benjii* **sp. nov.** from all other *Ichthyophis,* but combinations of diagnostic characters serve to distinguish it from any other species. In particular, with the exception of *I. khumhzi* and *I. longicephalus*, all other south Asian striped *Ichthyophis* (*I. beddomei, I. garoensis, I. glutinosus, I. kodaguensis, I. pseudangularis,* and *I. tricolor*) differ from *I. benjii* **sp. nov.** in having TAs less than twice as far from nares as from eyes (TN/TE < 2). All southeast Asian striped *Ichthyophis* (*I. attricolaris, I. biangularis, I. bannanicus, I. bernisi, I. elongatus, I. humphreyi, I. hypocyaneus, I. kohtaoensis, I. paucisulcus,* and *I. supachaii*) differ from *I. benjii* **sp. nov.** in having markedly fewer IMs than dentary teeth. *Ichthyophis longicephalus* differs from *I. benjii* **sp. nov.** in head shape and size (L/H < 18 vs. > 25, respectively), and in having subequal collars and a stripe that extends onto the tail.

Ichthyophis benjii **sp. nov.** differs from all the species of northeast India and adjacent Myanmar by the combination of the following characteristics. *Ichthyophis benjii* **sp. nov.** has a much higher dorsal AG count (388–422) than other species in the Indo-Burma region: *I. alfredi* (269–299), *I. bannanicus* (328–381), *I. daribokensis* (264–310), *I. garoensis* (264–309), *I. khumhzi* (341–362), *I. kohtaoensis* (362–366), *I. moustakius* (238–268),

Fig. 4. Paratypes of *Ichthyophis benjii* **sp. nov.** in life: **(A)** MZMU 1462 from Chhinga Veng, **(B)** MZMU 1481 from Tanhril, **(C)** MZMU 2025 from Gosen, and **(D)** *I. multicolor* MZMU 1740 from Tuirini Bridge, Aizawl District. *Photos by H.T. Lalremsanga.*

I. multicolor (346–386), *I. nokrekensis* (269–300), *I. sendenyu* (283–308), and *I. sikkimenis* (276–292). For the W/S ratio, *Ichthyophis benjii* **sp. nov.** (5.1–5.6) differs from *I. daribokensis* (2.8–4.2), *I. moustakius* (2.68–4.0) and *I. sendenyu* (3.26–4.0). *Ichthyophis benjii* **sp. nov.** differs from *I. alfredi* in a smaller L/H ratio (28.62–45.05 vs. 25.1–28.9 in *Ichthyophis benjii* **sp. nov.**) and from *I. sikkimensis* by the presence of lateral stripes (vs. unstriped in *I. sikkimensis*). Furthermore, *I. benjii* **sp. nov.** differs from *I. khumhzi* (50–56), *I. kohtaoensis* (22–23), and *I. garoensis* (40–52) in having fewer PMs (38–39); from *I. garoensis* (39–48), *I. khumhzi* (47–58), *I. kohtaoensis* (22–23), *I. moustakius* (40–43), and *I. sikkimenis* (41–44) in number of VP (31–37); from *I. khumhzi* (42–49) and *I. kohtaoensis* (20–21) in number of OMs (29–37); from *I. alfredi* (40), *I. daribokensis* (36), *I. garoensis* (38–51), *I. khumhzi* (40–46), *I. kohtaoensis* (17–18), and *I. sikkimenis* (43–45) in number of IMs (29–35). *Ichthyophis benjii* **sp. nov.** differs from *I. multicolor* in having < 125 vertebrae (118–124) vs. > 125 (126–132); < 120 in *I. tricolor*. Among many other differences, *Ichthyophis benjii* **sp. nov.** can be easily distinguished from its sympatric species *I. garoensis, I. moustakius* and *I. sendenyu* by the absence of distinctive moustache-like stripes extending forward from the TAs, and from *I. multicolor* in having a markedly less prominent, thin, and irregular pale yellowish lateral stripe (see Fig. 4).

Molecular systematics. Both the 16s ML and BI phylogenies are congruent in the position of *Ichthyophis benjii* **sp. nov.**, which is recovered as a moderately supported (65% bootstrap; BPP=0.79) sister taxon to a strongly-supported lineage (100% bootstrap; BPP=1.0) of *I. multicolor* (Fig. 5). Genetically, *Ichthyophis benjii* **sp. nov.** is distinct from *I. multicolor* with an uncorrected *p*-distance of 0.055. Uncorrected *p*-distances to other sampled *Ichthyophis* are 0.059–0.085 (Table 3).

Discussion

The 13 nominal species of caecilians (excluding the species newly described here) of northeast India, most of which were described this century (Mathew and Sen 2009; Kamei et al. 2009; Kamei et al. 2013), are currently represented by two families (Chikilidae: 4 species and Ichthyophiidae: 9 species) (Kamei et al. 2016). None of these species is sufficiently known regarding conservation status, with six being Data Deficient (DD) and the rest yet to be evaluated on the IUCN Red List. Similar to the majority of caecilian species globally (Gower and Wilkinson 2005), we suggest that *Ichthyophis benjii* **sp. nov.** should currently be considered DD, given that we know very little about its extent of distribution and population status or its ecological preferences and

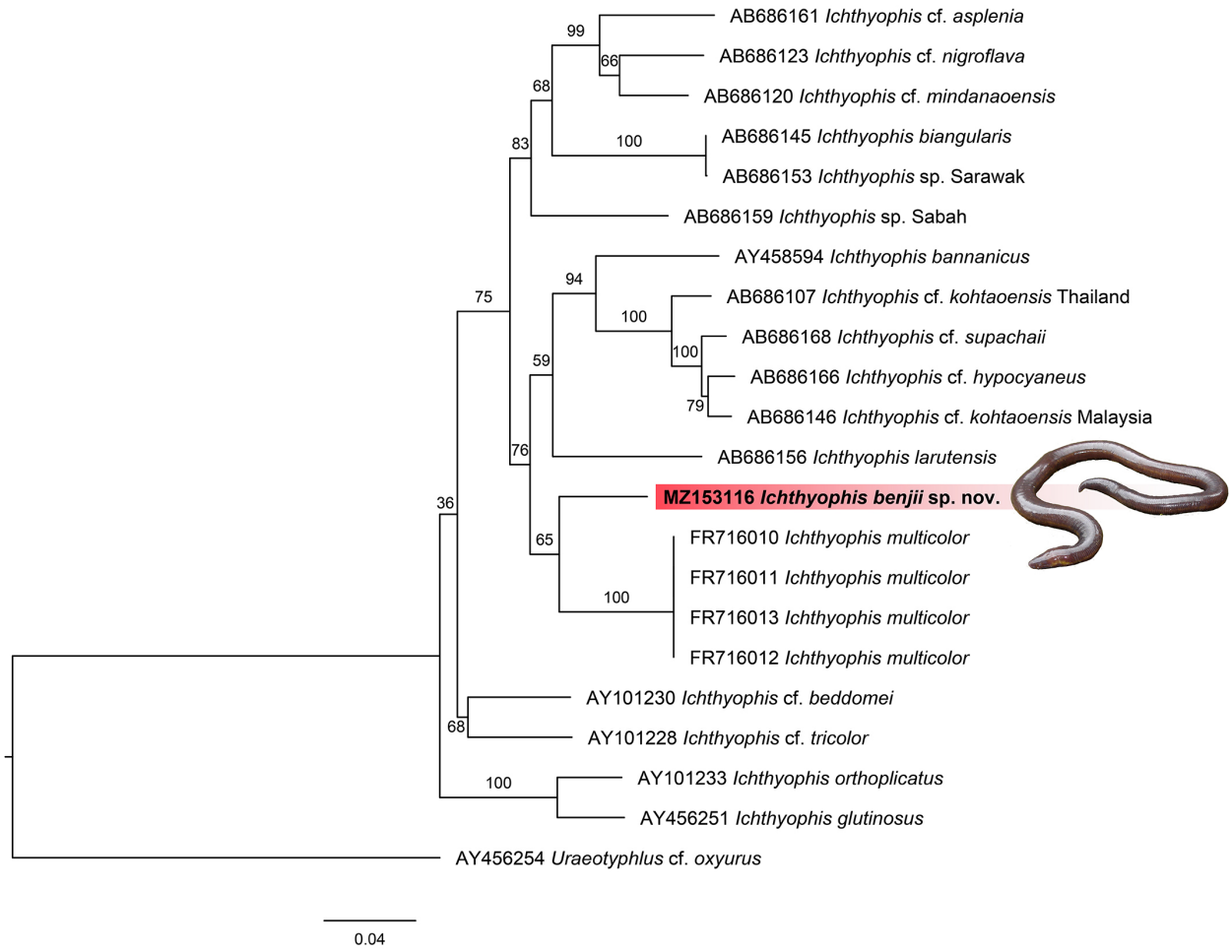

Fig. 5. Maximum Likelihood phylogram of 16s rRNA. Numbers at internal branches are bootstrap support. *Epicrionops marmoratus* and *Rhinatrema bivittatum* were used as the out-group. The taxon name in bold denotes the sample newly sequenced in this study. Numbers preceding taxon names are GenBank accession numbers.

tolerances. Due to the prolonged monsoon season (March to October) with heavy rainfall, especially in the State of Mizoram, many *Ichthyophis* are killed in paddy fields, agricultural areas, and near human settlements by farmers and local people, who think they are snakes. However, all the specimens of the new species described here were found in areas of anthropogenic disturbance within ca. 60 km^2 of the Aizawl city municipal area. Therefore, we are hopeful that *I. benjii* will not qualify as Endangered if additional populations can be found in a wider area.

The northeast Indian caecilian fauna is poorly known (Kamei 2017). Working with the group here can be difficult, given their fossorial lifestyle, the often harsh terrains, and the challenging infrastructure. The present report of a new *Ichthyophis* caecilian from northeast India is perhaps unsurprising because this region's biodiversity is poorly explored and documented despite its highly distinct and biogeographical importance (Kamei et al. 2012, 2017; Mani 1995; Bossuyt et al. 2004). Dedicated fieldwork, together with more stable systematics, will help to advance our knowledge and allow us to formulate more precise conservation assessments.

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Table 3. Uncorrected *p*-distances for mitochondrial 16s rRNA among *Ichthyophis* samples included in the phylogenetic analysis.

	GenBank accession number and species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	**MZ153116 *Ichthyophis benjii* sp. nov.**																					
2	FR716010 *Ichthyophis multicolor*	0.055																				
3	FR716011 *Ichthyophis multicolor*	0.055	0.000																			
4	FR716012 *Ichthyophis multicolor*	0.055	0.000	0.000																		
5	FR716013 *Ichthyophis multicolor*	0.055	0.000	0.000	0.000																	
6	AB686161 *Ichthyophis* cf. *asplenia*	0.059	0.069	0.069	0.069	0.069																
7	AB686107 *Ichthyophis* cf. *kohtaoensis* Thailand	0.063	0.088	0.088	0.088	0.088	0.105															
8	AB686120 *Ichthyophis* cf. *mindanaoensis*	0.063	0.067	0.067	0.067	0.067	0.060	0.093														
9	AY456251 *Ichthyophis glutinosus*	0.065	0.079	0.079	0.079	0.079	0.109	0.107	0.103													
10	AB686156 *Ichthyophis larutensis*	0.065	0.075	0.075	0.075	0.075	0.102	0.084	0.088	0.105												
11	AB686168 *Ichthyophis* cf. *supachaii*	0.067	0.080	0.080	0.080	0.080	0.100	0.034	0.093	0.105	0.085											
12	AY458594 *Ichthyophis bannanicus*	0.071	0.062	0.062	0.062	0.062	0.100	0.072	0.095	0.109	0.083	0.072										
13	AB686146 *Ichthyophis* cf. *kohtaoensis* Malaysia	0.071	0.088	0.088	0.088	0.088	0.103	0.032	0.098	0.106	0.084	0.020	0.075									
14	AY101233 *Ichthyophis orthoplicatus*	0.074	0.090	0.090	0.090	0.090	0.086	0.081	0.080	0.037	0.077	0.086	0.083	0.090								
15	AY101230 *Ichthyophis* cf. *beddomei*	0.076	0.080	0.080	0.080	0.080	0.074	0.086	0.063	0.073	0.071	0.082	0.071	0.088	0.075							
16	AB686145 *Ichthyophis biangularis*	0.076	0.076	0.076	0.076	0.076	0.090	0.102	0.078	0.113	0.098	0.101	0.100	0.106	0.103	0.084						
17	AB686153 *Ichthyophis* sp. Sarawak	0.076	0.076	0.076	0.076	0.076	0.090	0.103	0.078	0.114	0.099	0.101	0.101	0.106	0.103	0.084	0.000					
18	AB686166 *Ichthyophis* cf. *hypocyaneus*	0.080	0.086	0.086	0.086	0.086	0.106	0.036	0.099	0.111	0.089	0.021	0.074	0.019	0.095	0.091	0.105	0.105				
19	AB686123 *Ichthyophis* cf. *nigroflava*	0.080	0.082	0.082	0.082	0.082	0.062	0.096	0.049	0.104	0.099	0.096	0.096	0.099	0.086	0.078	0.081	0.081	0.102			
20	AY101228 *Ichthyophis* cf. *tricolor*	0.080	0.078	0.078	0.078	0.078	0.074	0.082	0.073	0.081	0.079	0.082	0.079	0.084	0.077	0.054	0.084	0.084	0.093	0.076		
21	AB686159 *Ichthyophis* sp. Sabah	0.085	0.082	0.082	0.082	0.082	0.088	0.091	0.078	0.102	0.089	0.091	0.088	0.091	0.099	0.088	0.081	0.082	0.092	0.079	0.095	
22	AY456254 *Uraeotyphlus* cf. *oxyurus*	0.161	0.165	0.165	0.165	0.165	0.185	0.186	0.184	0.176	0.179	0.186	0.184	0.184	0.158	0.165	0.192	0.192	0.183	0.184	0.165	0.181

Literature Cited

Bossuyt F, Gower DJ, Pethiyagoda R, Roelants K, Mannaert A, Wilkinson M, Bahir MM, Manamendra-Arachchi K, Ng PKL, et al. 2004. Local endemism within the Western Ghats-Sri Lanka biodiversity hotspot. *Science* 306: 479–481.

Dinesh KP, Radhakrishnan C, Channakeshavamurthy BH, Deepak P, Kulkarni NU. 2020. A checklist of amphibians of India with IUCN conservation status. Version 3.0, updated through April 2020. Available: http://zsi.gov.in./WriteReadData/userfiles/file/Checklist/Amphibians_2020.pdf [Accessed: 11 July 2021].

Edgar RC. 2004. MUSCLE: multiple sequence alignment with high accuracy and high throughput. *Nucleic Acids Research* 32: 1,792–1,797.

Frost DR. 2021. Amphibian Species of the World: an Online Reference. Version 6.1. Available: https://amphibiansoftheworld.amnh.org/index.php [Accessed: 9 July 2021].

Gower DJ, Wilkinson M. 2005. Conservation biology of caecilian amphibians. *Conservation Biology* 19: 45–55.

Kamei RG. 2017. An overview of caecilians (Amphibia: Gymnophiona) of North East India. Pp. 49–72 In: *Diversity and Ecology of Amphibians of India. ENVIS Bulletin: Wildlife and Protected Areas*, Volume 19. Wildlife Institute of India, Dehradun, India. 319 p.

Kamei RG, Biju SD. 2016. On the taxonomic status of *Ichthyophis husaini* Pillai and Ravichandran, 1999 (Amphibia: Gymnophiona: Ichthyophiidae). *Zootaxa* 4079(1): 140–150.

Kamei RG, Gower DJ, Wilkinson M, Biju SD. 2013. Systematics of the caecilian family Chikilidae (Amphibia: Gymnophiona), with description of three new species of *Chikila* from northeast India. *Zootaxa* 3666(4): 401–435.

Kamei RG, Mauro DS, Gower DJ, Van Bocxlaer I, Sherratt E, Thomas A, Babu S, Bossuyt F, Wilkinson M, Biju SD. 2012. Discovery of a new family of amphibians from northeast India with ancient links to Africa. *Proceedings of the Royal Society B: Biological Sciences* 279: 2,396–2,401.

Kamei RG, Wilkinson M, Gower DJ, Biju SD. 2009. Three new species of striped *Ichthyophis* (Amphibia: Gymnophiona: Ichthyophiidae) from the northeast Indian states of Manipur and Nagaland. *Zootaxa* 2267: 26–42.

Kumar S, Stecher G, Tamura K. 2016. MEGA7: Molecular Evolutionary Genetics Analysis Version 7.0 for bigger datasets. *Molecular Biology and Evolution* 33: 1,870–1,874.

Lalremsanga HT, Purkayastha J, Vabeiryureilai M, Muansanga L, Decemson H, Biakzuala L. 2021. Range extension of *Ichthyophis multicolor* Wilkinson et al., 2014 to India and first molecular identification of *Ichthyophis moustakius* Kamei et al., 2009. *Check List* 17: 1,021–1,029.

Mani MS. 1995. *Biogeography in India*. Surya Publications, Uttaranchal, India. 130 p.

Mathew R, Sen N. 2009. Studies on caecilians (Amphibia: Gymnophiona: Ichthyophiidae) of North East India with description of three new species of *Ichthyophis* from Garo Hills, Meghalaya and additional information on *Ichthyophis garoensis* Pillai and Ravichandran, 1999. *Records of the Zoological Survey of India, Occasional Papers* 309: 1–56.

Nei M, Kumar S. 2000. *Molecular Evolution and Phylogenetics*. Oxford University Press, New York, New York, USA. 333 p.

Palumbi SR. 1996. Nucleic acids II: the polymerase chain reaction. Pp. 205–247 In: *Molecular Systematics*. Editors, Hillis DM, Moritz C, Mable BK. Sinauer Associates, Sunderland, Massachusetts, USA. 636 p.

Nylander J. 2004. Mr.Modeltest v2, program distributed by the author. Evolutionary Biology Centre, Uppsala University, Uppsala, Sweden. Available: https://github.com/nylander/MrModeltest2 [Accessed: 11 July 2021].

Pillai RS. 1986. Amphibian fauna of Silent Valley, Kerala, S. India. *Records of the Zoological Survey of India* 84: 220–242.

Pillai RS, Ravichandran MS. 1999. Gymnophiona (Amphibia) of India. A taxonomic study. *Records of the Zoological Survey of India. Occasional Papers* 172: i–vi + 1–117.

Rassmann K, Tautz D, Trillmich F, Gliddon C. 1997. The microevolution of the Galápagos Marine Iguana, *Amblyrhynchus cristatus*, assessed by nuclear and mitochondrial genetic analyses. *Molecular Ecology* 6: 437–452.

Ronquist F, Huelsenbeck JP. 2003. MrBayes 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* 19: 1,572–1,574.

Rueden CT, Schindelin J, Hiner MC, DeZonia BE, Walter AE, Arena ET, Eliceiri KW. 2017. ImageJ2: ImageJ for the next generation of scientific image data. *BMC Bioinformatics* 18: 529.

Silvestro D, Michalak I. 2012. RaxmlGUI: a graphical front-end for RAxML. *Organisms, Diversity, and Evolution* 12: 335–337.

Taylor EH. 1960. On the caecilian species *Ichthyophis monochrous* and *Ichthyophis glutinosus* and related species. *University of Kansas Science Bulletin* 40: 37–120.

Taylor EH. 1965. New Asiatic and African caecilians with redescriptions of certain other species. *University of Kansas Science Bulletin* 46: 253–302.

Taylor EH. 1968. *Caecilians of the World: A Taxonomic Review*. University of Kansas Press, Lawrence, Kansas, USA. xiv + 848 p.

Taylor EH. 1973. A caecilian miscellany. *University of Kansas Science Bulletin* 50: 187–231.

Wilkinson M, Gower DJ, Govindappa V, Venkatachalaiah G. 2007. A new species of *Ichthyophis* (Amphibia: Gymnophiona: Ichthyophiidae) from Karnataka, India. *Herpetologica* 63: 511–518.

Wilkinson M, Presswell B, Sherratt E, Papadopoulou A, Gower DJ. 2014. A new species of striped *Ichthyophis* Fitzinger, 1826 (Amphibia: Gymnophiona: Ichthyophiidae) from Myanmar. *Zootaxa* 3785: 45–58.

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Appendix 1. List of comparative materials examined.

***Ichthyophis khumhzi*.** INDIA: MZMU 910 Mizoram University campus, Mizoram; MZMU 912 College Veng, Mizoram; MZMU 1005 Maubawk, Mizoram; MZMU 1460 Aibawk, Mizoram; MZMU 1564 Tuivamit, Mizoram; MZMU 1739 Melthum, Mizoram; MZMU 1740 Mission Vengthlang, Mizoram; MZMU 1796 Tanhril, Mizoram; MZMU A104, Republic veng, Mizoram; NCBS 5385 Siaha, Mizoram.

***Ichthyophis* cf. *sendenyu*.** INDIA: MZMU 899 Tanhril, Mizoram; MZMU 918 Chawlhhmun, Mizoram; MZMU 921 Ramrikawn, Mizoram; MZMU 925, Tuivamit, Mizoram.

***Ichthyophis moustakius*.** INDIA: MZMU 909 Kulikawn, Mizoram; MZMU 919 Chhangurkawn, Mizoram; MZMU 1758 Dampa Tiger Reserve, Mizoram; MZMU 1761 Mizoram University (MZU) campus, Mizoram; MZMU 1847 Thakthing, Mizoram; MZMU 1863 Sihphir, Mizoram; NCBS 5389 Chhingchhip, Mizoram; NCBS 5401 Sawleng, Mizoram.

***Ichthyophis* cf. *garoensis*.** INDIA: MZMU 1506 Mizoram.

***Ichthyophis multicolor*:** INDIA: MZMU 911 Kolasib, Mizoram; MZMU 913 Mualpui, Mizoram; MZMU 1480 College Veng, Mizoram; MZMU 1504 Tamdil National Wetland, Mizoram; MZMU 1541 Tlangnuam, Mizoram; MZMU 1956 Tuirini, Mizoram; MZMU 1965 Zemabawk, Mizoram; MZMU 2003 Mission Veng, Mizoram; MZMU 2005 Mizoram University campus, Mizoram; MZMU 2007 Tlangnuam, Mizoram; MZMU 2112 Mizoram University campus, Mizoram.