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

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Abstract

A new species of striped ichthyophiid caecilian, *Ichthyophis multicolor* **sp. nov.**, is described on the basis of morphological and molecular data from a sample of 14 specimens from Ayeyarwady Region, Myanmar. The new species resembles superficially the Indian *I. tricolor* Annandale, 1909 in having both a pale lateral stripe and an adjacent dark ventrolateral stripe contrasting with a paler venter. It differs from *I. tricolor* in having many more annuli, and in many details of cranial osteology, and molecular data indicate that it is more closely related to other Southeast Asian *Ichthyophis* than to those of South Asia. The caecilian fauna of Myanmar is exceptionally poorly known but is likely to include chikilids as well as multiple species of *Ichthyophis*.

Key words: Burma, caecilians, conservation, ichthyophiids, out-of-India, systematics, taxonomy

Introduction

With forty-seven (almost one in four of the approximately two hundred) currently recognised species, *Ichthyophis* Fitzinger, 1826 is the most speciose genus of caecilian amphibians. *Ichthyophis* also has one of the largest geographical distributions of any caecilian genus, occurring in Sri Lanka and India through mainland Indochina, Sundaland and islands (including the Philippines) west of Wallace's Line (Taylor 1968; Gower *et al.* 2002), and with recent addition of *Caudacaecilia* Taylor, 1968 to its synonymy (Nishikawa *et al.* 2012) it is the only caecilian genus known from Southeast Asia. Although multiple species and specimens of *Ichthyophis* have been documented from Thailand and from Northeast India, including some recently described species (e.g., Kamei *et al.* 2009; Mathew & Sen 2009), there are only a few old literature records of any caecilians from Myanmar (Boulenger 1882; 1887; Smith 1940) and the caecilian fauna of that country must be considered essentially unexplored and unknown. A California Academy of Sciences (CAS) expedition in 2000 obtained a good sample (14 specimens) of a striped caecilian from a single locality in Ayeyarwady Region. The specimens can be referred to *Ichthyophis* on the basis of their having a combination of a tertiary annular system and tentacular apertures distant from the eye (e.g. Wilkinson & Nussbaum 2006). The species is unusual among *Ichthyophis* in having a dark ventrolateral stripe (adjacent to and below the lateral pale stripes that are typical of many *Ichthyophis*) bordering a much paler ventral colouration, a feature found elsewhere only in *I. tricolor* from peninsular India. Numerous other features distinguish the Myanmar population from *I. tricolor,* indicating the former to be a new species that we describe below.

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References

AmphibiaWeb (2013) Information on amphibian biology and conservation. [web application]. Berkeley, California. Available from: http://amphibiaweb.org/ (accessed 1 December, 2013)

Annandale, N. (1909) Notes on Indian batrachia. *Records of the Indian Museum*, 3, 282–286.

Bhatta, G., Dinesh, K.P., Prashanth, P., Kulkarni, N. & Radhakrishnan, C. (2011) A new caecilian *Ichthyophis davidi* sp. nov. (Gymnophiona: Ichthyophiidae): the largest striped caecilian from the Western Ghats. *Current Science*, 101, 1015–1019.

Boulenger, G.A. (1882) *Catalogue of the batrachia gradientia s. caudata and batrachia apoda in the collection of the British Museum.* 2nd. ed. London, 88–104. Pls.104–109.

Boulenger, G.A. (1887) An account of the batrachians obtained in Burma by M. L. Fea, of the Genoa Civic Museum. *Annali del Museo civico di storia naturale di Genova*, *Series 2*, 5 (25), 418–424, Pl 414.

Castresana, J. (2000) Selection of conserved blocks from multiple alignments for their use in phylogenetic analysis. *Molecular Biology and Evolution,* 17, 540–552.
http://dx.doi.org/10.1093/oxfordjournals.molbev.a026334

Fitzinger, L.J. (1826) *Neue Classification der Reptilien nach ihren natürlichen Verwand-tschaften nebst einer Verwandschaftstafel und einem Verzeichnisse der Reptiliensammlungen des K. K. zoologischen Museums zu Wien.* J. G. Heubner, Wien.

Gower, D.J., Kupfer, A., Oommen, O.V., Himstedt, W., Nussbaum, R.A., Loader, S.P., Presswell, B., Müller, H., Krishna, S.B., Boistel, R. & Wilkinson, M. (2002) A molecular phylogeny of ichthyophiid caecilians (Amphibia: Gymnophiona: Ichthyophiidae): Out of India or out of southeast Asia? *Proceedings of the Royal Society B*, 269, 1563–1569.
http://dx.doi.org/10.1098/rspb.2002.2050

Gower, D.J. & Wilkinson, M. (2005) Conservation biology of caecilian amphibians. *Conservation Biology*, 19, 45–55.
http://dx.doi.org/10.1111/j.1523-1739.2005.00589.x

Gower, D.J., Wilkinson, M., Sherratt, E. & Kok, P.J.R. (2010) A new species of *Rhinatrema* Duméril & Bibron (Amphibia: Gymnophiona: Rhinatrematidae) from Guyana. *Zootaxa,* 2391, 47–60.

IUCN (2013) IUCN Red List of Threatened Species. Version 2013.2. Available from: http://www.iucnredlist.org (accessed 1 December, 2013)

Kamei, R.G., Wilkinson, M., Gower, D.J. & Biju, S.D. (2009) Three new species of striped *Ichthyophis* (Amphibia: Gymnophiona: Ichthyophiidae) from the northeast Indian states of Manipur and Nagaland. *Zootaxa,* 2267, 26–42.

Kamei, R.G., Gower, D.J., Wilkinson, M. & Biju, S.D. (2013) Systematics of the caecilian family Chikilidae (Amphibia: Gymnophiona) with the description of three new species of *Chikila* from northeast India. *Zootaxa*, 3666 (4), 401–435.
http://dx.doi.org/10.11646/zootaxa.3666.4.1

Kotharambath, R., Wilkinson, M., Oommen, O.V., George, S., Nussbaum, R.A. & Gower, D.J. (2012a) On the systematics, distribution and conservation status of *Ichthyophis longicephalus* Pillai, 1986 (Amphibia: Gymnophiona: Ichthyophiidae). *Journal of Natural History*, 46 (47–48), 2935–2959.
http://dx.doi.org/10.1080/00222933.2012.717972

Kotharambath, R., Gower, D.J., Oommen, O.V. & Wilkinson, M. (2012b) A third species of *Gegeneophis* Peters (Amphibia: Gymnophiona: Indotyphlidae) lacking secondary annular grooves. *Zootaxa,* 3272, 26–34.

Larkin, M.A., Blackshields, G., Brown, N.P., Chenna, R., McGettigan, P.A., McWilliam, H., Valentin, F., Wallace, I.M., Wilm, A., Lopez, R., Thompson, J.D., Gibson, T.J. & Higgins, D.G. (2007) Clustal W and Clustal X version 2.0. *Bioinformatics*, 23, 2947–2948.
http://dx.doi.org/10.1093/bioinformatics/btm404

Maddin, H.C., Russell, A.P. & Anderson, J.S. (2012) Phylogenetic implications of the morphology of the braincase of caecilian amphibians (Gymnophiona). *Zoological Journal of the Linnean Society*, 166 (1), 160–201.
http://dx.doi.org/10.1111/j.1096-3642.2012.00838.x

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 & Ravichandran, 1999. *Records of the Zoological Survey of India, Occasional Papers*, 309, 1–56.

Nishikawa, K., Matsui, M. & Orlov, N.L. (2012) A new striped *Ichthyophis* (Amphibia: Gymnophiona: Ichthyophiidae) from Kon Tum Plateau, Vietnam. *Current Herpetology*, 31, 28–37.

Nishikawa, K., Matsui, M., Sudin, A. & Wong, A. (2013) A new striped *Ichthyophis* (Amphibia: Gymnophiona) from Mt. Kinabalu, Sabah, Malaysia. *Current Herpetology*, 32, 159–169.

Nishikawa, K., Matsui, M., Yong, H.S., Ahmad, N., Yambun, P., Belabut, D.M., Sudin, A., Orlov, N.L., Ota, H., Yoshikawa, N., Tominaga, A., Shimada, T. & Shimada, T. (2012) Molecular phylogeny and biogeography of caecilians from Southeast Asia (Amphibia, Gymnophiona, Ichthyophiidae), with special reference to high cryptic species diversity in Sundaland. *Molecular Phylogenetics and Evolution*, 63 (3), 714–723.
http://dx.doi.org/10.1016/j.ympev.2012.02.017

Nussbaum, R.A. (1979) The taxonomic status of the caecilian genus *Uraeotyphlus* Peters. Oc*casional Papers of the Museum of Zoology University of Michigan*, 687, 1–20.

Nussbaum, R.A. & Gans, C. (1980) On the *Ichthyophis* (Amphibia: Gymnophiona) of Sri Lanka. *Spolia Zeylanica*, 35 (1&2), 137–154.

Peters, W. (1879) Über die Eintheilung der Caecilien und insbesondere über die Gattungen *Rhinatrema* und *Gymnopis. Monatsbericht der Deutschen Akademie der Wissenschaften zu Berlin,* 1879, 924–943.
Posada, D. (2008) jModelTest: Phylogenetic model averaging. *Molecular Biology and Evolution,* 25, 1253–1256. http://dx.doi.org/10.1093/molbev/msn083
Ronquist, F. & Huelsenbeck, J.P. (2003) MrBayes 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics,* 19, 1572–1574. http://dx.doi.org/10.1093/bioinformatics/btg180
San Mauro, D., Gower, D.J., Oommen, O.V., Wilkinson, M. & Zardoya, R. (2004) Phylogeny of caecilian amphibians (Gymnophiona) based on complete mitochondrial genomes and nuclear RAG1. *Molecular Phylogenetics and Evolution,* 33, 413–427. http://dx.doi.org/10.1016/j.ympev.2004.05.014
Smith, R.A. (1940) The amphibians and reptiles obtained by Mr. Ronald Kaulback in Upper Burma. *Records of the Indian Museum,* 42 (3), 465–486.
Stamatakis, A. (2006) RAxML-VI-HPC: Maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. *Bioinformatics,* 22, 2688–2690. http://dx.doi.org/10.1093/bioinformatics/btl446
Swofford, D.L. (2002) PAUP*: Phylogenetic analysis using parsimony. Version 4.0b. Sunderland, Sinauer Associates, MA.
Tamura, K., Dudley, J., Nei, M. & Kumar, S. (2007) MEGA4: Molecular Evolutionary Genetics Analysis (MEGA) software version 4.0. *Molecular Biology and Evolution*, 24, 1596–1599. http://dx.doi.org/10.1093/molbev/msm092
Taylor, E.H. (1960) On the caecilian species *Ichthyophis monochrous* and *Ichthyophis glutinosus* and related species. *University of Kansas Science Bulletin*, 40, 37–120.
Taylor, E.H. (1968) *Caecilians of the world: a taxonomic review*. University of Kansas Press, Lawrence, USA, i–xiv + 848 pp.
Taylor, E.H. (1973) A caecilian miscellany. *University of Kansas Science Bulletin*, 50, 187–231.
Wilkinson, M. & Kok, P.J. (2010) A new species of *Microcaecilia* (Amphibia: Gymnophiona: Caeciliidae) from Guyana. *Zootaxa*, 2719, 35–40.
Wilkinson, M. & Nussbaum, R.A. (1998) Caecilian viviparity and amniote origins. *Journal of Natural History,* 32, 1403–1409. http://dx.doi.org/10.1080/00222939800770701
Wilkinson, M. & Nussbaum, R.A. (1999) Evolutionary relationships of the lungless caecilian *Atretochoana eiselti* (Amphibia: Gymnophiona: Typhlonectidae). *Zoological Journal of the Linnean Society*, 126 (2), 191–223. http://dx.doi.org/10.1111/j.1096-3642.1999.tb00153.x
Wilkinson, M. & Nussbaum, R.A. (2006) Caecilian phylogeny and classification. *In*: Exbrayat, J.-M. (Ed.), *Reproductive Biology and Phylogeny of Gymnophiona (caecilians)*. Science Publishers, Inc., Enfield, New Hampshire, U.S.A., pp. 39–78
Wilkinson, M., San Mauro, D., Sherratt, E. & Gower, D.J. (2011) A nine-family classification of caecilians (Amphibia: Gymnophiona). *Zootaxa*, 2874, 41–64.
Wilkinson, M., Sheps, J., Oommen, O.V. & Cohen, B.L. (2002) Phylogenetic relationships of Indian caecilians (Amphibia: Gymnophiona) inferred from mitochondrial rRNA gene sequences. *Molecular Phylogenetics and Evolution*, 23 (3), 401–407. http://dx.doi.org/10.1016/s1055-7903(02)00031-3
Wilkinson, M., Sherratt, E., Starace, F. & Gower, D.J. (2013) A new species of skin-feeding caecilian and the first report of reproductive mode in *Microcaecilia* (Amphibia: Gymnophiona: Siphonopidae). *PloS One*, 8 (3), e57756. http://dx.doi.org/10.1371/journal.pone.0057756

APPENDIX 1

Voucher and GenBank accession numbers for specimens of *Ichthyophis multicolor* **sp. nov.** for which DNA sequence data were generated. * denotes holotype. GenBank accession numbers given in order: *12s, 16s, cytb*.

CAS 212254: FR715999, FR716007, FR716015
CAS 212255: FR716000, FR716008, FR716016
CAS 212262: FR716001, FR716009, FR716017
CAS 212263: FR716002, FR716010, FR716018
CAS 212264*: FR716003, FR716011, FR716019
CAS 212265: FR716004, FR716012, FR716020
CAS 212266: FR716005, FR716013, FR716021
CAS 212267: FR716006, FR716014, FR716022