



## *Monopterus ichthyophoides*, a new species of scaled swamp eel (Teleostei: Synbranchiformes: Synbranchidae) from Mizoram, India

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### Abstract

*Monopterus ichthyophoides* is described from specimens collected from the Sawleng River and a public well at Luangmual, both in the Barak River drainage in Mizoram, India. The new species differs from all other synbranchids in having only two, instead of five or six branchiostegal rays. It belongs to the *Amphipnous* species group characterized by possession of scales on the body and can be readily distinguished from all other species of this group by the lower number of vertebrae (114–117 vs 126–188).

**Key words:** taxonomy, freshwater fishes, Indo-Burma biodiversity hotspot

### Introduction

The family Synbranchidae or swamp eels, comprise around 22 species of elongate eel-like fishes lacking pectoral, pelvic, dorsal, and anal fins as adults. They are distributed in Central and South America, West Africa, over large parts of southern and Southeast Asia and in northern Australia (Berra 2001). The last revision of the family performed 35 years ago (Rosen & Greenwood 1976), has not lead to a fully satisfactory resolution of either synbranchid species-level taxonomy or phylogeny (see Bailey & Gans 1998). Since Rosen & Greenwood (1976), seven new synbranchid species have been described, one of which belongs to a putatively monophyletic group referred to as “the ‘Amphipnous’ group” by Bailey & Gans (1998:2) within the Asian synbranchid genus *Monopterus* Lacepède. The species of the *Amphipnous* group, *Monopterus desilvai* Bailey & Gans, along with *M. cuchia* (Hamilton), *M. fossorius* (Nayar), and *M. indicus* (Silas & Dawson) are distinguished from all other synbranchids by the presence of scales and a pair of supratharyngeal pouches (uncertain in *M. desilvai*) that act as an accessory air breathing organ (Rosen & Greenwood 1976, Bailey & Gans 1998).

During recent herpetological fieldwork in Mizoram, four specimens were collected of what seemed at first glance to be caecilian larvae, but upon closer inspection turned out to be a scaled species of synbranchid, belonging to the *Amphipnous* group. A comparison with the other four species of this group showed that it is a new species, which is described in the present paper.

### Material and methods

Measurements were taken with digital callipers to the nearest 0.1 mm, or with an ocular micrometer fitted to a stereomicroscope. Obtaining accurate measurements in synbranchids is often difficult because specimens are frequently preserved in a bent and twisted state. Standard length is not applicable to most synbranchids because the caudal fin and its supporting skeleton is generally absent except in the most basal species, *Macrotrema caligans* Cantor (see Rosen & Greenwood, 1976); therefore total length (TL) was used. Head length was measured from the tip of the snout to a vertical through the posterior end of the ventrally located gill slit. The gill arches of one of the

paratypes were removed and cleared and stained following the procedure of Taylor & Van Dyke (1985). Vertebral numbers of *M. ichthyophoides* and one paratype of *M. indicus* (BMNH 1985.7.16.52) were counted from radiographs and supplemented by the comparative vertebral counts of synbranchids published by Rosen & Greenwood (1976: 10, Table 2). Branchiostegal numbers for species of the *Amphipnous* group were taken from Talwar & Jhingran (1991) and BMNH 1985.7.16.52. We follow Steyskal (1980) for determination of the stem of Greek words. Abbreviations used: BMNH, The Natural History Museum, London; PUCMF for the Pachhunga University College Museum of Fishes, Mizoram, India.

### *Monopterus ichthyophoides* new species

Figures 1–4.

**Holotype.** PUCMF 3005, 186.6 mm TL; India: Mizoram, Barak River drainage, Sawleng River, a tributary of Tuirial River in the vicinity of Sawleng, 23°58'52" N 92°55'14" E; HT Lalremsanga, 14 August 2008.

**Paratypes.** PUCMF 3006, 2, 127.8–180.8 mm TL; India: Mizoram, Barak River drainage, public well at Luangmual, Aizawl, 23°44'26" N 92°42'00" E; Lalrotluanga, 26 July 2008. BMNH 2011.5.3.1, 184.2 mm TL; same data as holotype.

**Diagnosis.** *Monopterus ichthyophoides* differs from all other species of synbranchids in having only 2 branchiostegal rays (vs 5–6). It differs further from all other synbranchids, except *M. cuchia*, *M. fossorius*, *M. indicus*, and *M. desilvai* by the presence of scales. It differs from the latter four species also by the number of vertebrae (79–82 + 34–37 = 114–117 vs *M. cuchia* 99–112 + 55–70 = 166–188, *M. fossorius* 73 + 53–56 = 126–129, *M. indicus* 93–99 + 42–45 = 137–144, *M. desilvai* 75 + 69 = 144). It differs further from *M. cuchia* in having the scales restricted to the posterior part of its body (vs extending anteriorly up to the head) and from *M. desilvai* and *M. indicus* in having scales extending anteriorly far beyond the vent (vs. ending posterior to vent in *M. desilvai* and *M. indicus*, but with a small separate scale patch in *M. indicus*).

**Description.** For general appearance see Figures 1 and 2. Morphometric data and vertebral counts are presented in Table 1.

**TABLE 1.** Selected morphometric and meristic data for *Monopterus ichthyophoides* holotype and 3 paratypes.

	Holotype	Paratype BMNH 2011.5.3.1	Paratype PUCMF 3006	Paratype PUCMF 3006
Total length (TL) in mm	186.6	184.2	180.8	127.8
In percent of total length				
Head length (HL)	6.3	6.5	6.1	7.3
Preal length	79.2	79.5	79.2	80.1
Body depth at vent	3.2	3.6	3.0	2.8
Body width at vent	2.4	2.8	2.2	2.0
In percent of head length				
Snout length	25.6	29.2	27.3	23.7
Distance anterior-posterior naris	29.1	29.2	30.9	25.8
Ratios				
Depth/Width of body	1.3	1.3	1.4	1.4
Total length/Head length	15.9	15.4	16.4	13.7
Total length/Body depth	31.1	27.5	33.5	35.4
Abdominal vertebrae	80	82	79	82
Caudal vertebrae	34	26 +, damaged	37	35
Total vertebrae	114	108 +, damaged	116	117



**FIGURE 1.** Holotype of *Monopterus ichthyophoides*, PUCMF 3005, 186.6 mm TL, Sawleng River, Mizoram, India, in lateral view.

Body very elongate, eel-like, round to oval in cross section, but laterally compressed in its caudal portion. Depth 27.5–35.4 times in TL; body width 1.3–1.4 times in its depth. Head prominent, 6.1–7.3 times in TL, with bulging adductor muscles behind eye; snout anteriorly rounded in dorsal view. Eye small, covered by thick skin. Posterior naris an oblique slit above, medial to, and slightly in front of eye (Fig. 2a, b); anterior naris developed as small circular orifice at ventral side of upper lip (Fig. 2a, c). Lower lip overhung by upper lip, not visible in dorsal view. Lateral-line pores on head not developed. Skin covering branchial chamber smooth, not produced into longitudinal furrows. Gill membrane completely fused to isthmus medially, therefore gill openings reduced to a pair of small slits ventrolaterally on either side of head. Gill filaments absent on all gill arches. Only a single functional (open) gill slit, situated between gill arches three and four, guarded by a fleshy valve originating from ceratobranchial 3; other gill slits closed. No suprapharyngeal pouch evident. Hyoid with only two branchiostegal rays on posterior ceratohyal. Basibranchial 3, epibranchial 1, interarcual bone (and cartilage) and pharyngobranchial 2 absent (Fig. 3); hypobranchial 2 far removed from hypobranchial 1 and basibranchial 2; ceratobranchial 1 shifted posteriorly and medially, closely associated with hypobranchial and ceratobranchial 2; ceratobranchial 5 with a row of pointed, posteriorly curved teeth on its posterior aspect; a number of pointed, curved teeth also present on pharyngobranchial 3 and on pharyngobranchial 4 toothplate.

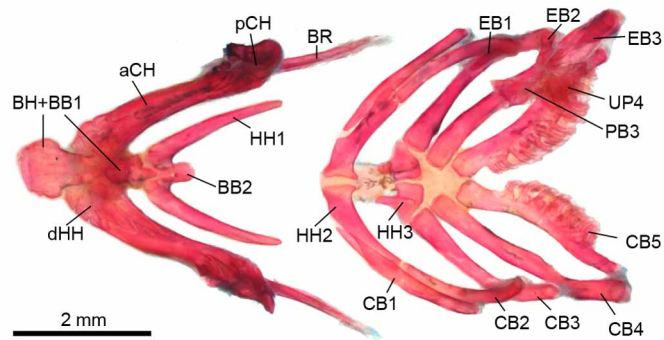
Posterior part of body covered by numerous small, circular (cycloid) scales extending further anteriorly on dorsum (starting at 50–60% TL) than on venter (starting in front of vent at 67–71 % of TL). Vent located at around 80% of TL in a completely scaled area of the venter. All fins and their supporting skeleton absent.

Vertebral counts as in Table 1.



**FIGURE 2.** Holotype of *Monopterus ichthyophoides*, PUCMF 3005, 186.6 mm TL. Head in lateral (a), dorsal (b) and ventral (c) view (arrows mark position of posterior naris in a and b and anterior naris in c) and preanal area of body in lateral view (d) to show scales (arrow marks position of vent).





**FIGURE 3.** Cleared and stained gill arches of *Monopterus ichthyophoides*, PUCMF 3006, 180.8 mm, paratype, dorsal view. aCH, anterior ceratohyal; BB, basibranchial; BH, basihyal; BR, branchiostegal rays; CB, ceratobranchial; dHH, dorsal hypohyal; EB, epibranchial; PB, pharyngobranchial; pCH, posterior ceratohyal; UP4, upper pharyngeal toothplate 4.



**FIGURE 4.** Live specimen of *Monopterus ichthyophoides*, PUCMF 3006, one of the paratypes, 30 July 2008, public well at Luangmual, Aizawl, Mizoram, India.

**Coloration.** In alcohol (Figs. 1, 2). Olive brown on the dorsum and upper half of sides, lighter brown on lower half of sides and venter. Myosepta visible as darker segmentally arranged lines.

In life (Fig. 4). Olive-brown, lighter on sides and on venter, similar to preserved specimens.

**Distribution.** Known only from two localities in the Barak River drainage in Mizoram, India (Fig. 5): Sawleng River, a small stream with muddy bank and bottom (elevation 904 m above sea level) in the vicinity of Sawleng, and a public well (elevation 1006 m above sea level) with a muddy bottom at Luangmual, Aizawl.

**Etymology.** The name *ichthyophoides* is derived from the Greek ἰχθύς (ichthys), fish, and ὄφις (ophis), snake, and the Latin ending *-oides*, meaning “similar to”. It alludes to the striking superficial similarity of this species to large larvae of the caecilian genus *Ichthyophis*.



**FIGURE 5.** Map of collecting localities of *Monopterus ichthyophoides*; \*PUCMF 3005 holotype and BMNH 2011.5.3.1 paratype, + PUCMF 3006 paratypes.

## Discussion

In their revision of synbranchids Rosen & Greenwood (1976) defined the genera of the family based on a number of apomorphic characters and character states. The new species can be assigned to the genus *Monopterus*, because it possesses at least five of its six synapomorphies (Rosen & Greenwood, 1976: 61, Fig. 66): “20, upper lip jowl-like, not swollen and separated from the snout by a groove; 21, gills when present reduced to a single row of filaments or to a thin ridge of tissue on first to third arches; [...] 23, second and third basibranchials greatly reduced or absent; 24, first ceratobranchial not articulating with first hypobranchial; 25, tissue of gill opening internally attached to isthmus.”

*Monopterus ichthyophoides* further shares with *M. boueti* Pellegrin, *M. cuchia*, *M. fossorius* and *M. indicus* at least two of the three synapomorphies of this group: “(26) second basibranchial present but reduced, posteriorly acuminate, and interlocked with first basibranchial+basihyal” and “(27) first ceratobranchial more closely associated with second than with first arch.” In addition, the new species possesses at least one of the two synapomorphies of the monophyletic group comprising *M. cuchia*, *M. fossorius*, and *M. indicus*: “29, first epibranchial, interarcual cartilage, and second pharyngobranchial absent.” Previously, a fourth species, *M. desilvai*, had been added to this assemblage by Bailey & Gans (1998). This, however, was predominantly based on the shared presence of scales on the body, a character that they interpreted as a plesiomorphic retention. The presence of suprapharyngeal pouches (Rosen & Greenwood’s character 30), or the gill arch character (Rosen & Greenwood’s character 29) were not verified by Bailey & Gans (1998) in *M. desilvai*. Bailey & Gans (1998) referred to this assemblage of four species of *Monopterus* as the “Amphipnous group” and pointed out that Talwar & Jhingran (1992) had used *Amphipnous* Müller as a subgeneric name for the species *cuchia*, *fossorius*, and *indicus* but had applied *Monopterus* to the species *albus* Zuiew. While Bailey & Gans (1998: 2) acknowledged that “Amphipnous is clearly a monophyletic group” they argued that based on Rosen & Greenwood (1976) this group would be rendered paraphyletic because *M. boueti*, an African species, was more closely related “to the ‘Amphipnous’ group than to the other species [...] of *Monopterus*.” This, however, is erroneous, because the close relationship of *M. boueti* to the species of the *Amphipnous* group would render *Monopterus* paraphyletic, not the *Amphipnous* species group. While *M. ichthyophoides* can thus be readily assigned to the *Amphipnous* species group based on one of the two synapomorphies of this assemblage, the inclusion of *M. desilvai* is still tentative and based on a shared plesiomorphy, the presence of scales. Once additional material of this species is available for a detailed study, the osteological characters for its inclusion in *Monopterus* and the *Amphipnous* species group need to be checked.

The three derived gill arch characters, 26, 27, and 29, listed by Rosen & Greenwood (1976) refer to a major transformation of the skeleton in *Monopterus* and the *Amphipnous* species group, in which the anterior gill arches are spatially removed from the posterior ones, so that a substantial gap exists between them. This separation happened within—not between—arches leading to a significant gap between basibranchial 2 and hypobranchial 2 and between hypobranchial 1 and ceratobranchial 1. In *M. ichthyophoides* the latter is located in a recess of an otherwise broadened ceratobranchial 2 and is far removed from its corresponding hypobranchial. The dorsal gill arches in species of the *Amphipnous* group also show conspicuous modifications from the condition in the basal members of the Synbranchidae, in that the interarcual bone, which extends between the uncinat process of epibranchial 1 and pharyngobranchial 2 in other synbranchids, has been lost completely. This is probably correlated with the loss of pharyngobranchial 2 and the reduction in size of epibranchials 1 and 2 in species of the *Amphipnous* group.

With the exception of *Monopterus cuchia*, the distribution of the species in the *Amphipnous* group is quite localized and restricted to peninsular India and Sri Lanka. *Monopterus fossorius* was collected from marshy areas near Trivandrum, Kerala state (Nayar 1951). *Monopterus indicus* has been found in the northern part of the Western Ghats around Mumbai, Maharashtra state (Silas & Dawson 1961), and the single known specimen of *M. desilvai* was collected from a paddy field in a coastal area of west-central Sri Lanka (Bailey & Gans 1998). *Monopterus cuchia*, as currently understood, is widespread and has been recorded from Pakistan, Nepal, northern and northeastern India and Myanmar (Talwar & Jhingran 1992). Like the peninsular Indian and Sri Lankan species of the *Amphipnous* group, *Monopterus ichthyophoides* too, has a localized distribution and is known only from two localities in the Barack River drainage in Mizoram, northeastern Myanmar. With its reduced scalation *M. ichthyophoides* most closely resembles *M. indicus* and *M. desilvai*, which may indicate a biogeographic link between two important Asian biodiversity hotspots—the Western Ghats hotspot and the Indo-Burma hotspot (Abbell et al. 2008). Such a biogeographic link, however, is speculative at this point and further studies into the phylogenetic relationships of the five species included in the *Amphipnous* group are warranted. The discovery of a new species of the family Synbranchidae also highlights the fact that the species-level diversity is still only incompletely known. A thorough revision of the family Synbranchidae is clearly needed and will have to include a detailed description of their internal anatomy due to their great external similarity, as already demonstrated by Rosen & Greenwood (1976).

**Comparative material.** *Monopterus indicus*, BMNH 1985.7.16.52, paratype, 422 mm.

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