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Osteology of incomplete lateral lined schisturid loaches of Meghalaya: a comparative account

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Abstract

The present study is based on the comparative osteology among *Schistura* fishes with incomplete lateral line found in Meghalaya. Six species are studied for osteology, three already described ones and three unknown species. The clearing and staining of this species group showed variations and similarities in their neurocranium structure, ceratobranch structure, air bladder capsule structure, vertebrae number, fin insertions and caudal vertebrae complex in all cases. The study revealed that *Schistura fasciata* has a total of 37 vertebrae, *S. reticulofasciata* with 35–36, *S. syngkai* with 34–35, *S.* sp. 1 with 35, *S.* sp. 2 with 37 and *S.* sp. 3 with 32 vertebrae.

Keywords: *Schistura*, Nemacheiline fish, comparative osteology, Meghalaya

Introduction

Nemacheiline fishes of the genus *Schistura* McClelland, 1838, are highly diversified predominantly small and colourful fishes with mouth moderately arched, lower lip with a median interruption, no formation of two lateral triangular pads, and lips smooth to strongly furrowed. Some of them have feebly to well develop processus dentiformis while it is absent in some. *Schistura* have diverse colour pattern usually with bars, split in many, basicaudal black bars with complete or dissociate. Their caudal fins are slightly emarginated to fork (Vishwanath *et al.*, 2014).

Meghalaya is drained by two drainage system i.e., Brahmaputra River drainage and Barak-Surma-Meghna River drainage system. Khynriam & Sen (2014) listed 12 species of *Schistura* from Meghlaya viz., *Schistura beavani* (Gunther, 1868), *S. cinticauda* (Blyth, 1860), *S. devdevi* (Hora, 1935), *S. multifasciata* (Day, 1878), *S. papulifera* Kottelat *et al.*, 2007, *S. prashadi* (Hora, 1921), *S. reticulofasciata* (Singh & Bănărescu, 1981), *S. rupecula* McClelland, 1838, *S. scaturigina* McClelland, 1839, *S. sijuensis* (Menon, 1987), *S. sikmaensis* (Hora, 1921) and *S. vinciguerrae* (Hora, 1935). Out of these, the occurrence of five species viz., *S. cinticauda, S. rupecula, S. prashadi, S. sikmaensis* and *S. vinciguerra* are doubtful due to their original type locality and may possibly be the misidentification of the specimens. After a thorough investigation on the available *Schistura* species in Meghalaya, nine species of *Schistura* including three unknown species are with incomplete lateral lined viz., *S. devdevi, S. fasciata* Lokeshwor & Vishwanath, 2011, *S. larketensis* Choudhury *et al.*, 2017, *S. papulifera, S. reticulofasciata, S. syngkai* Choudhury *et al.*, 2019, *S.* sp. 1, *S.* sp. 2 and *S.* sp. 3.

Comparative osteology is one of the tools of taxonomy in systematic study of species within the genus or family. Proper osteological study of fish species from Meghalaya has not been carried out. Out of the six studied herein, three species are already named and three are unknown. The clearing and staining of *Schistura devdevi, S. larketensis* and *S. papulifera* were not carried out due to the unavailability of specimens in the museum and could not find them during survey. The studies have revealed the structural similarities and variations amongst the *Schistura* species group with incomplete lateral line in their neurocranium, ceratobranch,

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air bladder capsule, vertebrae counts, fin insertions and caudal vertebrae complex.

Materials and Methods

Specimens were collected from different parts of Meghalaya from both drainage systems i.e., Brahmaputra River drainage and Barak-Surma-Meghna River drainage. Collected specimens were preserved in 10% formalin buffer solution in translucent bottle. General counts and measurements follow Kottelat (1990). Point to point measurements has been done by using dial caliper nearest to 0.1 mm unit. Measurements of body parts are expressed in percentage of Standard Length (SL) and subunits of head parts are expressed as percentage of Lateral Head Length (LHL). Clearing and double staining of bones follow Taylor & Van Dyke (1985) with necessary modifications according to size of the fish. Identification of bones follows Sawada (1982) and Prokofiev (2010). Data from Kottelat *et al.,* 2007 for *Schistura papulifera* and data from Hora, 1935 for *Schistura devdevi* were used in the absence of comparative materials. The museum specimens of *Schistura larkentesis* have been observed from Guwahati University Museum of Fish (GUMF). The clearing and staining of *Schistura devdevi* (Hora, 1935), *S. larketensis* Choudhury *et al.,* 2017, and *S. papulifera* Kottelat *et al.,* 2007 was not be able to carried out due to the unavailability of specimens.

Results

The recent survey on various river systems of Meghalaya revealed nine loach species having incomplete lateral line under genus *Schistura* and family Nemacheilidae. Table 1 shows the distribution and status of *Schistura* with incomplete lateral line in the two drainage system in Meghalaya i.e. The Brahmaputra drainage system and the Barak-Surma – Meghna drainage system. The highest assemblage of this species group is found in Brahmaputra drainage system with 8 species viz., *Schistura devdevi, S. larketensis, S. papulifera, S. reticulofasciata, S. syngkai, S.* sp. 1, *S.* sp. 2 and *S.* sp. 3. Barak-Surma-Meghna drainage system is inhibited by 3 species viz., *Schistura fasciata, S. reticulofasciata* and *S. syngkai*. There are 4 species viz., *Schistura fasciata, S. reticulofasciata,* and *S. syngkai* have been reported from both the drainage systems *i.e.*, from Bahmaputra and Barak-Surma-Meghna drainage systems. Among them *S. papulifera* and *S. larketensis* are found in cave and *S. papulifera* is under critically endangered according to IUCN (2010).

Systematic Accounts

***Schistura devdevi* (Hora, 1935)**

(Figure 1 A)

Nemacheilus devdevi Hora, 1935: 54, pl. 3 (Type locality: Eastern Himalayas; small streams below Darjeeling and Sikkim, India).

Material examined: ZSI/VF/ERS 2076, 31.1 mm SL; India: Assam: Dhemanji district: Subansiri River at Padomukh (Brahmaputra River system); Coll. R. Mathew & party, 03-ii-2006. ZSI/VF/ERS 2495, 34.2 mm SL; India: Arunachal Pradesh: Subansiri district: Sippi River (Brahmaputra River system); Coll. R. Mathew & party, 05-vi-2007.

Diagnosis: Body with 4–6 dark broad saddles on dorsum, 7–8 irregular bars on flanks; basicaudal bar fragmented with a short dark brown bar on ventral portion and a short faintly mark spot on dorsal portion; 7½ branched dorsal-fin rays, pelvic fin with 6 rays, caudal fin slightly emerginate with 8+7 branched rays; lateral line incomplete with 54 pores terminating above vertical to anal-fin origin.

Distribution: India: Arunachal Pradesh, Meghalaya, Sikkim.

***Schistura fasciata* Lokeshwor & Vishwanath, 2011**

(Figure 1 B)

Schistura fasciata Lokeshwor & Vishwanath, 2011: 1514–1519 (Type locality: Barak River at the western side of Maram Hill, Senapati District, Manipur, India)

Material examined: ADBU-MF/1000/1–5, 5 exs., 55.9–66.0 mm SL; Sohra, East Khasi Hills, Meghalaya, India; Daphisha Pala, 05-x-2022.

Diagnosis: Body with 11-13 dark brown transverse bars, bars arranged regularly, often fused on mid-dorsal line, width of bar broader than interspace; moderately high adipose crest on dorsal and ventral sides of caudal peduncle; lateral line incomplete, reaching vertical to posterior end of anal-fin base; three black spots on base of dorsal-fin; dorsal-fin with 8½ branched rays; processus dentiformis large.

Distribution: Barak River, Maram Hill, Senapati District, Manipur and Sohra, East Khasi Hills, Meghalaya, India.

***Schistura larketensis* Choudhury *et al.,* 2017**

(Figure 1 C)

Schistura larketensis Choudhury *et al.,* 2017: 089–100 (Type locality: Krem Khung about 1.5 km from Larket village, East

Jaintia Hills District, Meghalaya, India).

Material examined: GUMF 0261, female, 54.5 mm SL, holotype; GUMF 0264/3, 3exs., 49.6–61.3 mm SL; Krem Khung, Larket village, East Jaintia Hills District, Meghalaya, India.

Diagnosis: Body with pale to weakly-pigmented; thick and short basicaudal bar immediately below lateral line (often appearing broken in some individuals); eyes vestigial or absent; anterior nostrils forming long and pointed triangular tube-like flaps; incomplete lateral line; small and cylindrical axillary pelvic lobe; emarginated caudal-fin.

Distribution: Krem Khung, Larket village, East Jaintia Hills, Meghalaya, India.

***Schistura papulifera* Kottelat *et al.,* 2007**

(Figure 1 D)

Schistura papulifera Kottelat *et al.,* 2007: 35-44 (Type locality: Krem Synrang Pamiang system, in the Jaintia Hills, Eastern Meghalaya, India.

Diagnosis: Pale white body, vestigial eye which is subcutaneous and eternally appearing as small diffuse blackish spot, not communicating with outside by a canal; lower half of head covered by numerous small skin projections and five pores in supratemporal canal of cephalic lateralis line system; 8½ branched dorsal-fin rays; incomplete lateral line, extending to level of pelvic fin origin and no axillary pelvic bone.

Distribution: Krem Synrang Pamiang system, in the Jaintia Hills, Eastern Meghalaya, India.

***Schistura reticulofasciata* Singh & Bănărescu, 1982**

(Figure 1 E)

Schistura reticulofaciata Singh & Bănărescu in Singh *et al.*, 1982: 206 (Type Locality: Barapani, near Shillong, Meghalaya, India)

Material examined: ADBU-MF/1001/1–7, 7 exs., 43.6–49.0 mm SL; Ano stream, Damring River, Brahmaputra drainage, West Garo Hills, Meghalaya, India (25°41′27.29"N, 90°23′15.29"E, altitude 455 m asl); Wimarithy K. Marak, 12-ii-2022.

Diagnosis: Body with network of numerous irregular bars, most of which are vertical and connected by one or two longitudinal stripes; lateral line incomplete; processus dentiformis present; black spot on dorsal-fin base; basicaudal bar incomplete; caudal fin emarginated.

Distribution: Barapani, near Shillong, East Khasi Hills and Ano Stream, Damring River, West Garo Hills, (Brahmaputra drainage) Meghalaya, India.

***Schistura syngkai* Choudhury, Mukhim, Dey, Warbah & Sarma, 2019**

(Figure 1 F)

Schistura syngkai Choudhury *et al.,* 2019: 186 (Type locality: Twahdioh stream of Wahblei River, near Seinduli village, Surma-Meghna drainage, West Khasi Hills District, Meghalaya).

Material examined: ADBU-MF/1003/1–7, 7 exs., 31.5–37.9 mm SL; Ruding stream, Dudhnoi River, Brahmaputra drainage, East Garo Hills, Meghalaya, India; Wimarithy K. Marak, 19-x-2021.

Diagnosis: Body with prominent dark brown or black mid-lateral stripe about eye diameter or wider, overlain on 12-18 vertically-elongated black blotches; lateral line incomplete; dorsal-fin with three oblique bars, dark blotch slightly above the base of the simple rays; basicaudal bar incomplete and black spot above margin of caudal-fin base, caudal-fin slightly emarginated.

Distribution: Twahdioh Stream, Wahblei River, Surma-Meghna drainage, West Khasi Hills District and Ruding stream, Dudhnoi River, Brahmaputra Drainage, East Garo Hills District, Meghalaya, India.

***Schistura* sp. 1**

(Figure 1 G)

Material examined: ADBU-MF/1004/1–6, 6 exs., 32.9–41.1 mm SL; Sarongkol stream, Didram River, Brahmaputra Drainage, North Garo Hills District, Meghalaya, India (25°53′50.28"N, 90°31′48.48"E, altitude 106 m asl); Wimarithy K. Marak, 19-x-2021.

Diagnosis: Body with 9-10 bars; two rows of black marking on dorsal-fin; lateral line incomplete; basicaudal bar complete and black spot above it, caudal fin truncated.

Distribution: Sarongkol stream, Didram River, Brahmaputra drainage, North Garo Hills District, Meghalaya, India.

***Schistura* sp. 2**

(Figure 1 H)

Material examined: ADBU-MF/1005/1–5, 5 exs., 21.9–37.0 mm SL; Wah Sohphoi River, Barak-Surma-Meghna Drainage, Eastern-West Khasi Hills District, Meghalaya, India; Ibansiewdor Marngar and Spellindar Warjri, 27-xi-2022.

Diagnosis: Body with 6-7 saddles reaching up to or beyond lateral line, blotches or black patches along the lateral line between the saddles; lateral line incomplete; basicaudal bar incomplete, caudal-fin emarginated.

Distribution: Wah Sohphoi River, Barak-Surma-Meghna drainage, Eastern West Khasi Hills, Meghalaya, India.

***Schistura* sp. 3**

(Figure 1 I)

Material Examined: ADBU-MF/1002/1–2, 2 exs., 34.9–35.9 mm SL; Chidrang stream, Damring River, Brahmaputra drainage, Meghalaya, India (25°53′57.13"N, 90°37′18.42" E, altitude 90 m asl); Wimarithy K. Marak, 22-iii-2022.

Diagnosis: Body with 9 broad bars, interspace very narrow; incomplete lateral line; basicaudal bar complete; caudal-fin deeply emargnated.

Distribution: Chidrang stream, Damring River, Brahmaputra drainage, Meghalaya, India.

Discussion

The meristic count of the *Schistura* species with incomplete lateral line in Meghalaya is shown in Table 2. The studies have revealed that there are differences in dorsal-fin rays where it is 3/7½ in *Schistura devdevi* and *S. syngkai*; 3–4/7½–8½ in *S.* sp. 1; 4/8½–9½ in *S.* sp. 3; and 4/8½ in *S. fasciata, S. larketensis, S. papulifera, S. reticulofasciata* and *S.* sp. 2. Anal fin rays shows the same counts in almost all the species except in *S. larketensis* and *S. papulifera* where it shows a range of 3/5–5½ and 3/5–6½ respectively. Pelvic-fin rays of all species are with 7–8 rays except *Schistura devdevi* with 6 rays. Caudal-fin rays also shows similarities and variations among this species group where it is 8+7 branched rays in *Schistura devdevi*; 9+8 in *S. fasciata, S. larketensis* and *S.* sp. 3; 8+9 in *S. papulifera*; 8+8 in *S. reticulofasciata, S. syngkai* and *S.* sp. 2 while it shows in range of 7–8+8 in *S.* sp. 1.

Comparative ostelogy

Comparative study of the bones of 6 species of incomplete lateral lined *Schistura*; 3 already described ones viz., *S. fasciata, S. reticulofasciata* and *S. syngkai* and 3 unknown species viz., *Schistura* sp. 1, *S.* sp. 2 and *S.* sp. 3, revealed the differences in their neurocranium structure, ceratobranch structure, air bladder capsule structure, vertebrae counts, fin insertions and caudal vertebrae complex.

Neurocranium structure: Variations in the neurocranium structure of incomplete lateral lined *Schistura* is observed in the shape of fontanelle, demarcation between two sides of frontals, supraethmoid-ethmoid complex (narrow to broad) and different shape of parietals which are shown in Figure 2 (A–F).

The shape of the anterior part of the fontanelle shows variation among different species. It is pointed in *Schistura reticulofasciata* and *S.* sp. 2 (Figure 2 B and F respectively) whereas it is blunt in the rest of the species observed. The base of the fontanelle is observed to be broadest in *Schistura reticulofasciata* (Figure 2 B) and narrowest in species like *S. fasciata* and *S. syngkai* (Figure 2 A and D respectively). The supraethmoid-ethmoid complex joins firmly with anterior part of frontals and prevomer. Its size varies from one species to another where it is narrowest in *Schistura fasciata* (Figure 2 A) and broadest in *S.* sp. 1 (Figure 2 E). Frontal bone is paired in all cases and articulated anteriorly with the posterior part of supraethmoid-ethmoid complex; posteriorly, it is joined with the fontanelle and a pair of parietal on each side of frontal. Number of gill rackers ranges from 8 in *Schistura fasciata* and *S.* sp. 1, 9 in *S. reticulofasciata* and *S.* sp. 3 to 10 in *S. syngkai* and *S.* sp. 2 (Table 3).

Ceratobranch and air bladder capsule structure: Variation in number of pharyngeal teeth in ceratobranch is observed in all the species. A prominent small posterior process is also observed on it in all cases with slight variation (Figure 3 A–F, where it is not much visible in some due to image taken from different angle).

Presence of free part of the air bladder structure is observed in *S. syngkai, S.* sp. 1 and *S.* sp. 3 (Figure 4 C, D and E respectively) while it is absent in *S. fasciata, S. reticulofasciata* and *S.* sp. 2 (Figure 4 A, B and F respectively).

Vertebrae counts and fin insertions: Variation in vertebrae counts among 6 species of incomplete lateral lined *Schistura* and all the meristic counts are given in Table 2 & 3. Study shows that *Schistura fasciata* and *S.* sp. 2 has the highest

number of vertebrae counts with 37 vertebrae where as *S.* sp. 3 has the lowest number with 32 vertebrae. Insertion of dorsal-fin in *Schistura fasciata*, *S. reticulofasciata*, *S. syngkai* and *S.* sp. 1 shows similarities of insertion between 11th and 12th vertebrae while *S.* sp. 3 between 10th and 11th vertebrae and *S.* sp. 2 between 12th and 13th vertebrae. Likewise, anal-fin insertion shows some similarities and variations which ranges from 20th -21st vertebrae in *Schistura* sp. 3 and 23rd-24th vertebrae in *S. fasciata*. Abdominal vertebrae range from 15 vertebrae in *Schistura* sp. 3 to 21 vertebrae in *S. fasciata*. Caudal vertebrae also show the range from 16 vertebrae in *S. fasciata* to 19 vertebrae in *S.* sp. 1.

Caudal vertebrae complex: Variations and similarities in caudal vertebrae complex are observed among the species of incomplete lateral lined *Schistura* from Meghalaya which are given in Figure 5 (A–F). Number of hypural ranges from 5 in *Schistura syngkai* (Figure 5 D), *S.* sp. 1 (Figure 5 E) and *S.* sp. 2 (Figure 5 F) to 6 in *S. fasciata* (Figure 5 A), *S. reticulofasciata* (Figure 5 B) and *S.* sp. 3 (Figure 5 C). Variation in epural size can be observed in all cases where it is broadest in *Schistura fasciata* (Figure 5 A) and narrowest in *S.* sp. 3 (Figure 5 C) and *S. syngkai* (Figure 5 D). In *Schistura* sp. 2, 1st hypural is not reaching to the base of parhypural of 1st preural centrum (Figure 5 F).

Conclusion: Comparative study of osteology of *Schistura* with incomplete lateral line from Meghalaya revealed that there are distinct variations and similarities in structure of bones among different species. Similarities in bone structure among the incomplete lateral lined *Schistura* may be an indication of their close relation to one another whereas the differences in bone structures also helps in grouping them as different species. Further comparative osteological studies of *Schistura* and other fishes from Meghalaya needs to be carried out to solve the various ambiguities in the field of fish taxonomy and to construct proper phylogeny.

Figures legend

Figure 1: A. *Schistura devdevi*, ZSI/VF/ERS 2495, 34.2 mm SL; **B.** *Schistura fasciata* ADBU-MF/1000/2, 63.1 mm SL; **C.** *S. larketensis,* GUMF 0264/3, 49.6 mm SL (Photo courtesy H. Choudhury); **D.** *S. papulifera,* MHNG 2680.074, holotype, 45.1 mm SL (Photo courtesy M. Kotellat); **E.** *S. reticulofasciata,* ADBU-MF/1001/1, 45.5 mm SL; **F.** *S. syngkai* ADBU-MF/1003/1, 37.9 mm SL ; **G**. *Schistura.* sp. 1, ADBU-MF/1004/1, 41.1 mm SL; **H**. *Schistura* sp. 2, ADBU-MF/1005/2, 34.5 mm SL.; **I.** *Schistura*. sp. 3, ADBU-MF/1002/1, 35.9 mm SL.

Figure 2: Neurocranium structure showing differences in shape of fontanelle which is indicated by an arrow in the figure. **A**. *Schistura fasciata* ADBU-MF/1000/1, 61.04 mm SL; **B**. *S. reticulofasciata* ADBU-MF/ 1001/3, 46.2 mm SL; **C**. *Schistura* sp. 3, ADBU-MF/1002/2, 34.9 mm SL; **D**. *S. syngkai* ADBU-MF/1003/3, 35.0 mm SL; **E**. *Schistura* sp. 1, ADBU-MF/1004/4, 40.0 mm SL; **F.** *Schistura* sp. 2, ADBU-MF/1005/1, 37.0 mm SL. Scale = 1 mm.

Figure 3: Ceratobranch structure: showing differences in pharyngeal teeth and posterior process. **A**. *Schistura fasciata*; **B**. *S. reticulofasciata*; **C**. *S.* sp. 3; **D**. *S. syngkai*; **E**. *S.* sp. 1; **F.** *S.* sp. 2. Scale = 1 mm.

Figure 4: Air bladder capsule structure showing the presence or absence of free part of air bladder which is indicated by arrow in the figure. **A**. *Schistura fasciata*; **B**. *S. reticulofasciata*; **C**. *S.* sp. 3; **D**. *S. syngkai*; **E**. *S.* sp. 1; **F.** *S.* sp. 2.

Figure 5: Caudal vertebrae complex. **A**. *Schistura fasciata*; **B**. *S. reticulofasciata*; **C**. *S.* sp. 3; **D**. *S. syngkai*; **E**. *S.* sp. 1; **F.** *S.* sp. 2. **npu**– posterior uroneural; **epu**– epural; **hp**– hypural; **ust**– urostyle; **ph**– parhypural; **hpu**– haemal spinal and arch; **pc1**– 1st preural centrum; **pc2**– 2nd preural centrum. Scale = 1 mm.

Table legend

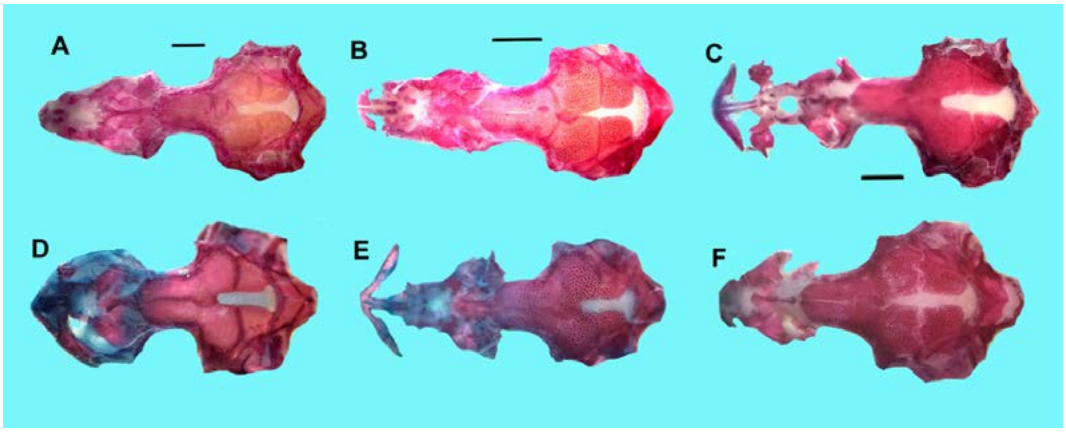
Table 1: Distribution of *Schistura* species with incomplete lateral line in two river systems in Meghalaya, northeastern India and their status.

CR – Critically Endangered, **LC** – Least Concern**, NE** – Not Evaluated, **NT** – Near Threatened, **VU** – Vulnerable, **Brah** – Brahmaputra River System, **Ba-Su-Me** – Barak-Surma-Meghna River System.

Table 2: Meristic data of *Schistura* with incomplete line from Meghalaya.

Table 3: Osteological data of *Schistura* with incomplete lateral line from Meghalaya.

Figure 1: A. Schistura devdevi, ZSI/VF/ERS 2495, 34.2 mm SL; B. Schistura fasciata ADBU-MF/1000/2, 63.1 mm SL; C. S. larketensis, GUMF 0264/3, 49.6 mm SL (Photo courtesy H. Choudhury); D. S. papulifera, MHNG 2680.074, holotype, 45.1 mm SL (Photo courtesy M. Kotellat); E. S. reticulofasciata, ADBU-MF/1001/1, 45.5 mm SL; F. S. syngkai ADBU-MF/1003/1, 37.9 mm SL ; G. Schistura. sp. 1, ADBU-MF/1004/1, 41.1 mm SL; H. Schistura sp. 2, ADBU-MF/1005/2, 34.5 mm SL.; I. Schistura. sp. 3, ADBU-MF/1002/1, 35.9 mm SL.



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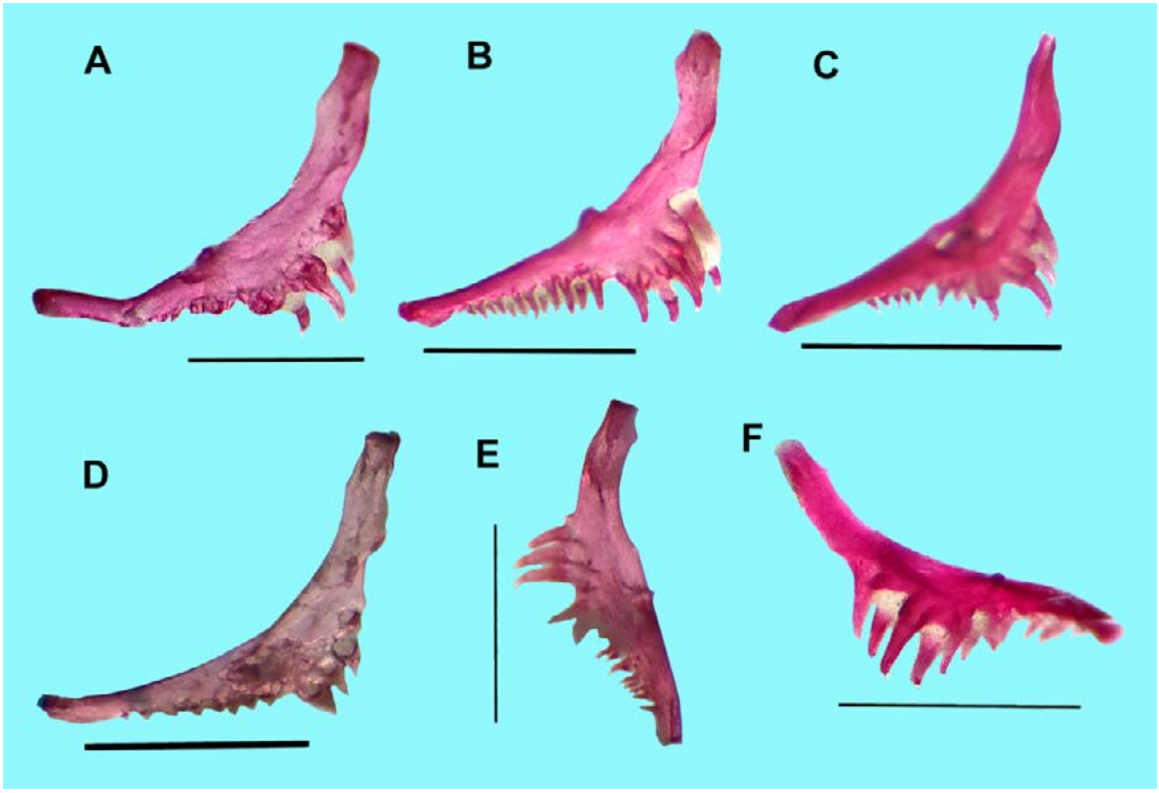

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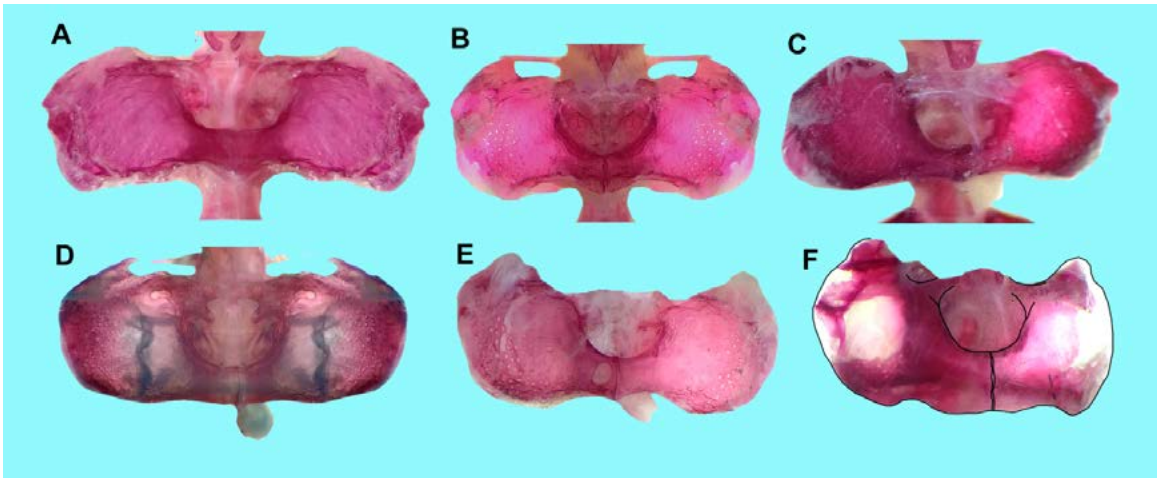

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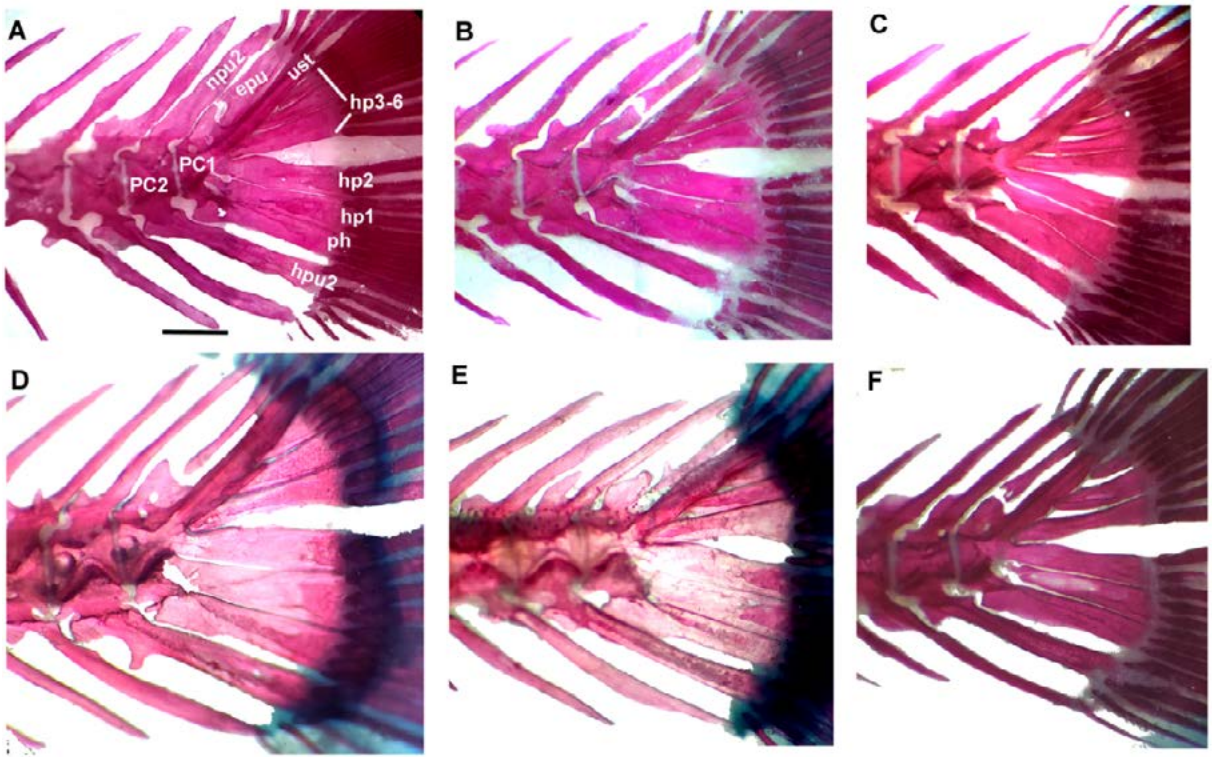

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TABLES

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CR – Critically Endangered, LC – Least Concern, NE – Not Evaluated, NT – Near Threatened, VU – Vulnerable, Brah – Brahmaputra River System, Ba-Su-Me – Barak-Surma- Meghna River System.

Sl. No.	Species	Brah	Ba-Su-Me	IUCN Status (2010)
1.	*Schistura devdevi* (Hora, 1935)	+	+	NT
2.	*Schistura fasciata* Lokeshwor & Vishwanath, 2011	–	+	NE
3.	*S. larketensis* Chouhdury *et al.*, 2017	+	–	LC
4.	*S. papulifera* Kottelat *et al.*, 2007	+	–	CR
5.	*S. reticulofasciata* (Singh & Bănărescu, 1982)	+	+	VU
6.	*S. syngkai* Choudhury *et al.*, 2019	+	+	NE
7.	*S.* sp. 1.	+	–	NE
8.	*S.* sp. 2.	+	–	NE
9.	*S.* sp. 3	+	–	NE

Table 2: Meristic data of Schistura with incomplete line from Meghalaya.

	S. devdevi ZSI/VF/ERS 2076; ZSI/VF/ ERS 2495	*S. fasciata* MUMF 1101 (holotype); ADBU-MF/1000/1–5	*S. larketensis* GUMF 0261 (holotype); GUMF 0264/3	*S. papulifera* Kottelat *et al.*, 2007	*S. reticulofasciata* ZSI/V/F/ERS 1929; MUMF 11070-11071; ADBU-MF/1002/1–8
Dorsal-fin rays	3/7½	4/8½	4/8½	4/8½	4/8½
Anal-fin rays	3/5½	3/5½	3/5-5½	3/5-6½	3/5½
Pectoral-fin rays	10	10	11-12	12-13	11
Pelvic-fin rays	6	8	7-8	8	8
Branched caudal-fin rays	8+7	9+8	9+8	8+9	8+8

	S. syngkai ADBU-MF/1003/1–7	*S.* sp. 1 ADBU-MF/1001/3,5,7	*S.* sp. 2 ADBU-MF/1005/1–5	*S.* sp. 3 ADBU-MF/1002/1–2	
Dorsal-fin rays	3/7½	3-4/7½–8½	4/8½	4/8½–9½	
Anal-fin rays	3/5½	3/5½	3/5½	3/5½	
Pectoral-fin rays	11	11	11	10	
Pelvic-fin rays	7	8	8	8	
Branched caudal-fin rays	8+8	7–8+8	8+8	9+8	

Table 3: Osteological data of Schistura with incomplete lateral line from Meghalaya.

	S. fasciata ADBU-MF/1000/1	*S. reticulofasciata* ADBU-MF/1002/1–8	*S.* sp. 3 ADBU-MF/1002/2	*S. syngkai* ADBU-MF/1003/3,4	*S.* sp. 1 ADBU-MF/1004/4, 5	*S.* sp. 2 ADBU-MF/1005/1
Total vertebrae	37	35-36	32	34-35	35	37
Dorsal-fin insertion	11-12	10-11, 11-12	10-11	11-12	11-12	12-13
Anal-fin insertion	23-24	21-22, 22-23	20-21	21-22	21-22	22-23
Abdominal vertebrae	21	18-19	15	16-17	16	20
Caudal vertebrae	16	16-17	17	18	19	17
Gill racker	8	9	9	10	8	10

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References

Blyth, E. 1860. Report on some fishes received chiefly from the Sitang River and its tributary streams, Tenasserim Provinces. 29 (2), 138–174 (Published by Journal of the Asiatic Society of Bengal).

Choudhury, H., Mukhim, D. K. B., Basumatary, S., Warbah, D. P. and Sarma, D. 2017. *Schistura larketensis*, a new cavernicolous fish (Teleostei: Nemacheilidae) from Meghalaya, Northeast India. Zootaxa, 4353 (1), 089–100.

Choudhury, H., Mukhim, D. K. B., Dey, A., Warbah, D. P. and Sarma, D. 2019. *Schistura syngkai*, a new fish species (Teleostei: Nemacheilidae) from Meghalaya, Northeast India. Zootaxa, 4701 (2), 185–191.

Day, F. 1878. Scientific Results of the Second Yarkand Mission. Ichthyology, 25 pp

Gunther, A. 1868. Catalogue of the fishes in the British Museum (vol. 7). Physostomi. xx + 512 pp (Published by British Museum, London). Hamilton, F. 1822. An account of the fishes found in the river Ganges and its branches. 405 pp (Published by Constable, Edinburg & Hurst, Robinson, and Co., London).

Hora, S. L. 1921. Fish and fisheries of Manipur with some observations on those of the Naga Hills. Records of the Indian Museum (Calcutta) v. 22 (pt 3, no. 19): 165-214, Pls. 9-12.

Hora, S. L. 1935. Notes on fishes in the Indian Museum. XXIV. Loaches of the genus *Nemachilus* from eastern Himalayas, with the description of a new species from Burma and Siam. Records of the Indian Museum (Calcutta) v. 37 (pt 1): 49-67, Pl. 3.

Khynriam, D. & Sen, N. 2014. Taxonomic study on nemacheilid loaches of North East India. Records of the Zoological Survey of India, 358:1–37.

Kottelat, M. 1990. Indochinese nemacheilines, a revision of nemacheiline loaches (Pisces: Cypriniformes) of Thailand, Burma, Laos, Cambodia and Southern Vietnam. 262 pp (Published by Verlag Dr. Friedrich Pfiel, Munchen,).

Kottelat, M., Harries, R. D. and Proudlove, S. G. 2007. *Schistura papulifera*, a new species of cave loach from Meghalaya, India (Teleostei: Balitoridae). Zootaxa, 1393: 35–44.

Lokeshwor, Y. and Vishwanath, W. 2011. *Schistura fasciata,* a new nemacheiline species (Cypriniformes: Balitoridae) from Manipur, India. Journal of Threatened Taxa, **3**(2). 1514–1519.

McClelland, J. 1838. Observations on six new species of Cyprinidae, with an outline of a new classification of the family. 7(2):217–948, Pls. 55–56 (Published by Journal of Asiatic Society Bengal).

McClelland, J. 1839. Indian Cyprinidae. 19 (2), 217–471, Pls. 37-61. (Published by Asiatic Researches, Calcutta).

Menon, A. G. K. 1987. The fauna of India and the adjacent countries. Pisces. Vol. IV. Teleostei - Cobitoidea. Part 1. Homalopteridae. i-x + 1-259, Pls. 1-16. (Published by Director Zoological Survey of India, Calcutta).

Prokofiev, A. M. 2010. Morphological classification of loaches (Nemacheilinae). Journal of Ichthyology, 50, 827–913.

Sawada, Y. 1982. Phylogeny and zoogeography of the superfamily Cobitoidea Cyprinoidei, Cyprinifromes). Memoirs of the Faculty of Fisheries, Hokaido University, 28:65–223.

Singh, A., Sen, N., Bănărescu, P. M., and Nalbant, T. T. 1982. New neomacheiline loaches from India (Pisces, Cobitidae), Trav du Mus'em d'Histoire Naturelle "Grigore Antipa", 23:201–212.

Taylor, P. K. and Van Dyke, G. C. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. Cybium, 9:107–119.

Vishwanath, W., Nebeshwor, K., Lokeshwor, Y., Shangningam, B. D. and Rameshori, Y. 2014. Freshwater fish taxonomy & a manual for identification of fishes of Northeast India. 131 pp (Published by Manipur University in National workshop on freshwater fish taxonomy).