

***Schistura hypsiura*, a new species of loach (Cobitoidea: Nemacheilidae) from South-West Myanmar**

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Abstract. *Schistura hypsiura*, a new species, is described from the western slope of the Rakhine Yoma, Myanmar. It is distinguished from all congeners by having a very deep caudal peduncle without dorsal and ventral skin crests, a deeply forked caudal fin, a suborbital flap in adult males, and a well-developed suborbital groove in adult females.

Key words. Rakhine State, Burma, caudal peduncle, sexual dimorphism

INTRODUCTION

The family Nemacheilidae (river loaches) is a characteristic element of the Eurasian freshwater fish fauna, where its members occur in virtually every river system. Most of the presently described 704 species and 46 genera are found in South and Southeast Asia (Kottelat, 2012). The genus *Schistura* is the largest genus within the Nemacheilidae, which according to Kottelat (1990) is diagnosed by the combination of the following characters: a moderately arched mouth; lower lip with a median interruption, but not forming two lateral triangular pads; colour pattern usually with more or less regular bars and a black bar at base of caudal fin; dorsal fin with one or two black marks along its base; no acuminate scales on caudal peduncle; median notch in lower jaw present or not; caudal fin usually emarginated; and sexual dimorphism present or not.

New species of *Schistura* continue to be described on a regular basis from lesser-studied parts of South and Southeast Asia (e.g., Chen et al., 2005; Zhou & Kottelat, 2005; Bohlen & Šlechtová, 2009, 2011; Ou et al., 2011; Plongsesthee et al., 2011; Lalramliana, 2012; Lokeshwor & Vishwanath, 2012; Zheng et al., 2012). In this paper we describe a new species of *Schistura* from Myanmar.

MATERIAL AND METHODS

Specimens were either fixed in 10% formalin and later transferred into 70% ethanol for storage or fixed and stored in 96% ethanol. Two specimens were cleared and stained following Taylor & van Dyke (1985). Measurements

and counts follow Kottelat (1990). Measurements were made point-to-point with dial callipers to the nearest 0.1 mm. Observations were made using an Olympus SZX7 stereomicroscope equipped with an IDS u-Eye camera. Whole specimens were photographed using a Canon EOS450D camera. Collection abbreviations: CMK – Collection of Maurice Kottelat, Cornol, Switzerland; IAPG – Institute of Animal Physiology and Genetics, Laboratory of Fish Genetics, Liběchov, Czech Republic; ZRC – Zoological Reference Collection, Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore, Singapore.

***Schistura hypsiura*, new species** (Figs. 1, 2)

Holotype. ZRC 53186, male, 69.1 mm SL; Myanmar: Rakhine State: Kyeinthali Chaung at Ka La Byin, about 17°56'N, 94°30'E; local collector, 8 February 2010.

Paratypes. Same data as holotype, ZRC 53187, 25, 29.3–72.8 mm SL, 2 specimens cleared and stained. – CMK 21983, 4, 34.5–72.6 mm SL. – IAPG A4154–4158, 5, 26.5–33.0 mm SL.

Diagnosis. A member of *Schistura* distinguished from all congeners by: features of its caudal region, including a deep caudal peduncle (as deep or deeper than the deepest part of the body anterior to the caudal peduncle); the absence of dorsal and ventral skin crests along the caudal peduncle; and a deeply forked caudal fin, with the outermost principal rays in the upper and lower lobes more than twice the length of the innermost principal rays. It can be further distinguished by: the presence of a suborbital flap in males; a well-developed suborbital groove in females; and by having 6–8 very regular bars along the body side.

Description. See Fig. 1 for general appearance and Table 1 for morphometric data of holotype and 15 paratypes. Largest specimen examined 72.8 mm SL. Body moderately

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elongated, only slightly compressed anteriorly, strongly compressed and remarkably high posteriorly (body width at origin of anal fin 5.5–7.2% SL; depth of caudal peduncle 0.8–1.0 times in its length and 0.9–1.1 times in body depth). Maximum body depth either between dorsal-fin base and anal-fin origin or at caudal peduncle. Head width increasing posteriorly between mouth and posterior tip of opercle. Anterior nostril pierced in front side of a flap-like tube, with a low anterior rim. Mouth width about 1.8–1.9 times its length (Fig. 2). Processus dentiformis present, broad, flat. Lips thick. Upper lip with a well-marked median incision; lower lip with a median interruption; both with furrows along entire length. Inner rostral barbel reaching corner of mouth. Outer rostral barbel reaching to base of maxillary barbel. Maxillary barbel reaching vertical through posterior rim of eye. Axillary pelvic lobe present and free. No adipose crest on dorsal or ventral midline of caudal peduncle.

Dorsal fin with three or four simple and $8\frac{1}{2}$ branched rays. Anal fin with three simple and $5\frac{1}{2}$ branched rays, not reaching caudal-fin base. Caudal fin with 9+8 branched rays, deeply forked, length of innermost caudal-fin rays 1.9–2.4 times in length of lower lobe, lobes rounded. Pelvic fins with 7 branched rays; origin opposite branched dorsal-fin ray 1–2; reaching beyond half of distance to anal-fin origin and just behind anus, which is located one eye diameter before origin of anal fin. Pectoral fin with 10–11 branched rays, reaching slightly behind midpoint between bases of pectoral and pelvic fins.

Body completely scaled, including ventral surface; head naked. Lateral line nearly complete, with 82–93 pores, reaching behind vertical through anal-fin origin. Cephalic lateral line system with 6 supraorbital, 4+10 infraorbital, 9 preoperculo-mandibular and 3 supratemporal pores. Both

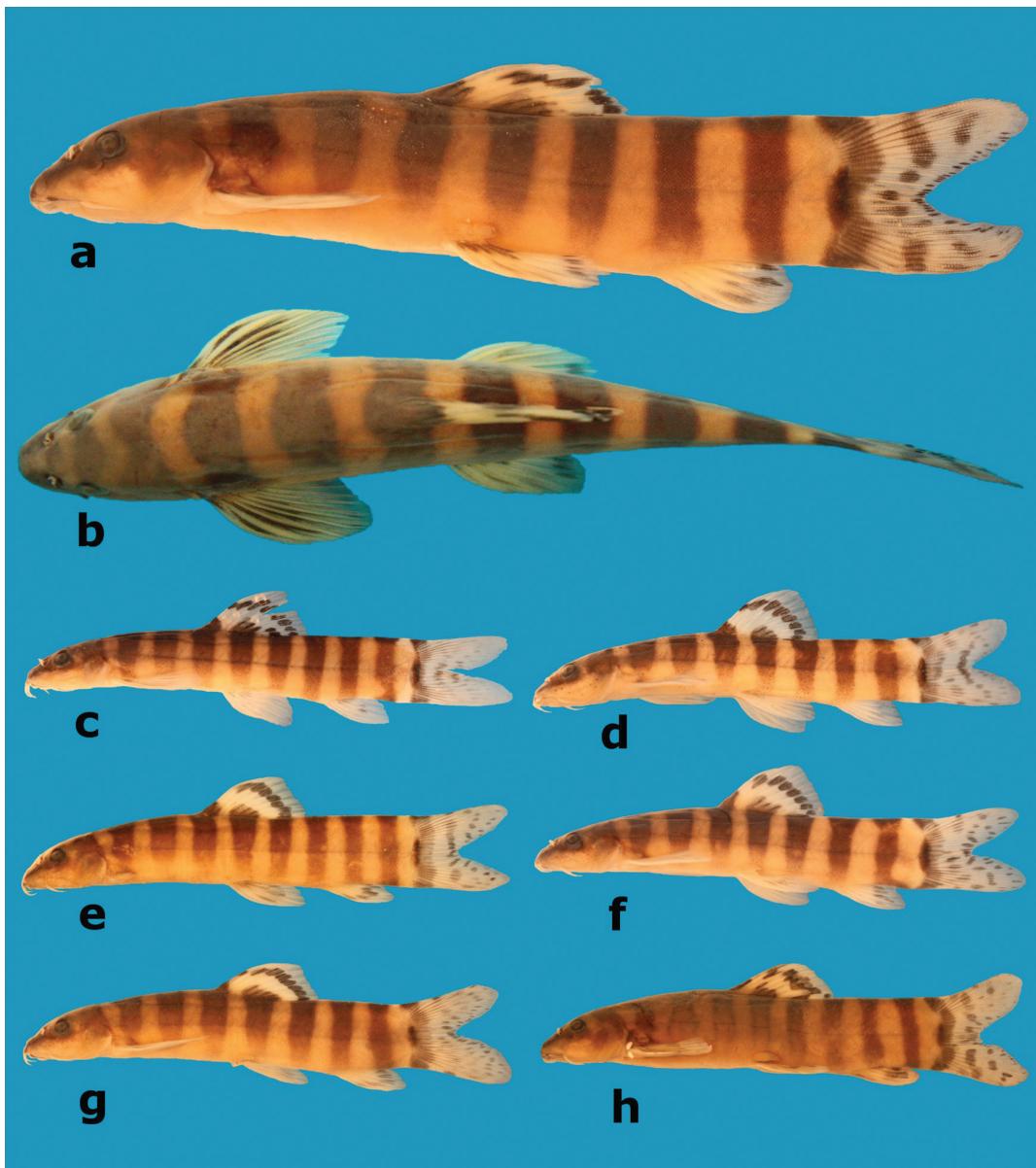


Fig. 1. *Schistura hypsiura*, Myanmar, Rakhine state: Kyeinthali Chaung, a, b, ZRC 53186, holotype, male 69.1 mm SL; c–g, ZRC 53187; c, male 48.4 mm SL; d, male 48.7 mm SL; e, male 58.2 mm SL; f, female 48.2 mm SL; g, female 51.1 mm SL; h, female 72.8 mm SL.

cleared and stained specimens with 35 vertebrae, including 4 vertebrae of Weberian apparatus and ural centrum. Skeleton of caudal peduncle similar to those of other species of Nemacheilidae, but with very broad epural, supporting 3 dorsal procurent rays dorsally and almost completely filling interneural space between pleurostyle and neural spine of preural centrum 2 (Fig. 3).

Sexual dimorphism. Males exhibit a triangular suborbital flap with a rounded posteroventral tip (Fig. 4). In the largest males (50.3–69.1 mm SL), the suborbital flap exhibits a large lateral extension (Fig. 4b). The smallest male specimen examined with this lateral extension is 29.3 mm SL. Females exhibit a suborbital groove (Fig. 4c). The smallest female specimen examined with a suborbital groove is 45.2 mm SL. Suborbital flap and groove absent in juveniles. The largest specimen without a suborbital flap or groove is 36.2 mm SL.

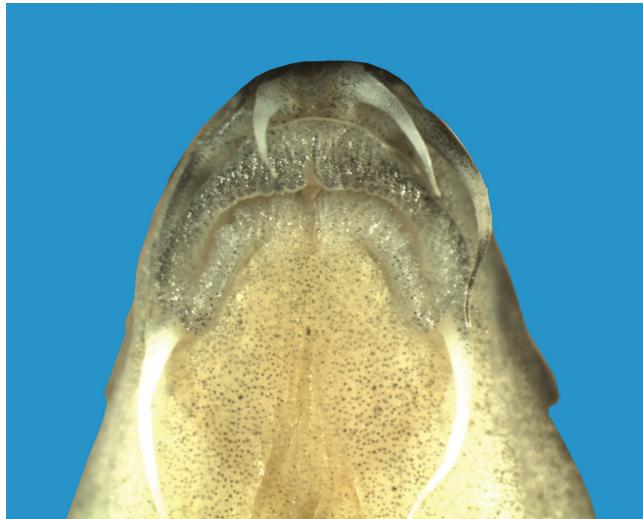


Fig. 2. *Schistura hypsiura*, Myanmar, Rakhine state: Kyeinthali Chaung, ZRC 53186, holotype, male, 69.1 mm SL. Mouth in ventral view.

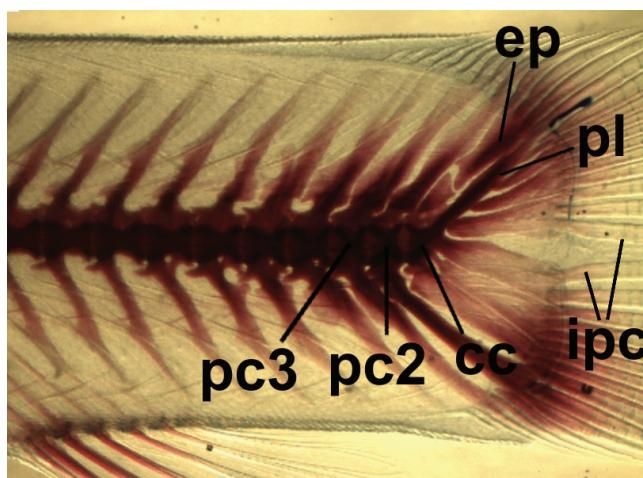


Fig. 3. *Schistura hypsiura*, ZRC 53187, 49.1 mm SL: caudal skeleton. cc = compound centrum; ep = epural; ipc = innermost principle caudal-fin rays; pc2 = preural centrum 2; pc3 = preural centrum 3; pl = pleurostyle.

Colouration. Ground colour in freshly preserved specimens white to yellowish. Body with 6–8, most commonly 7, dark brown bars reaching ventrally at least to level of pectoral-fin base, and dorsally to dorsal midline, where they join with their antimere. Another bar reaching from middle of opercle to dorsal midline, joining its antimere at nape. Dark brown blotch between eyes on dorsal surface of head. Dark brown

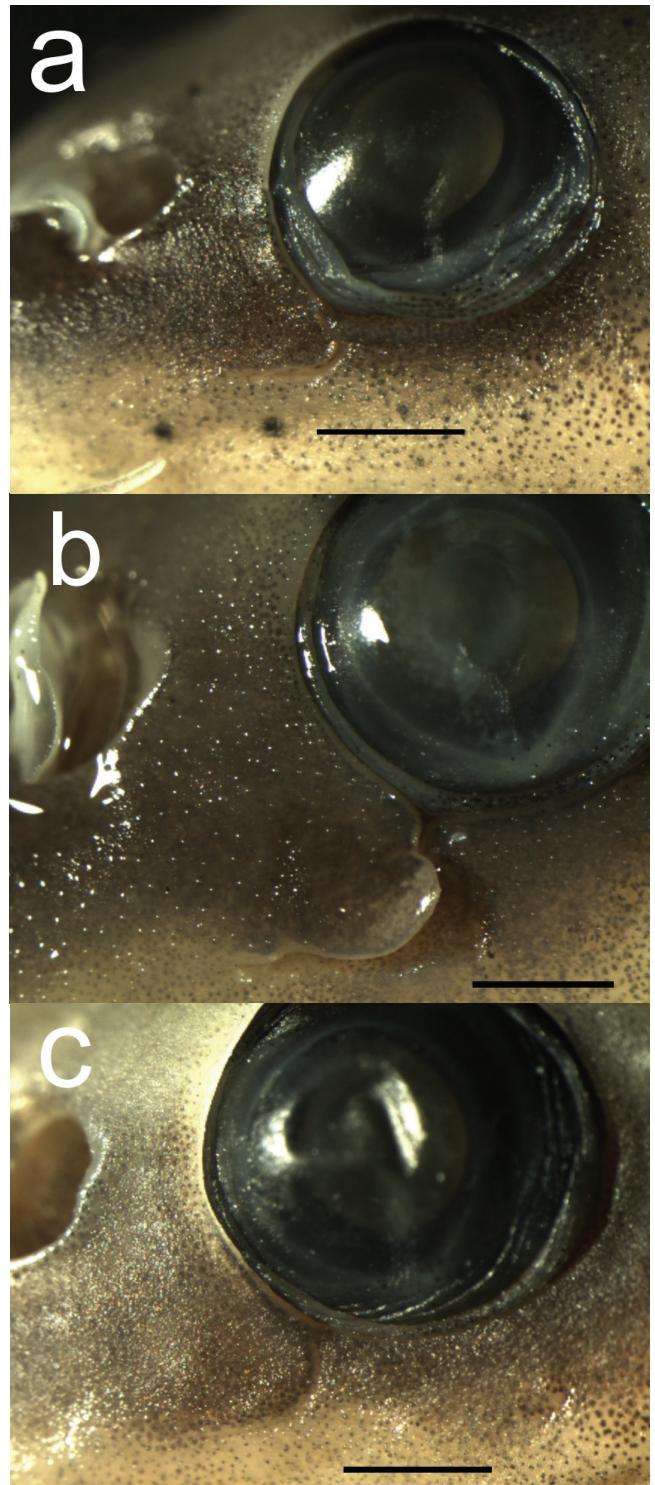


Fig. 4. Sexual dimorphism in *Schistura hypsiura*: a, ZRC 53487, paratype, 50.2 mm SL; suborbital flap of a small male; b, ZRC 53186, holotype, 69.1 mm SL, suborbital flap of a large male; c, ZRC 53187, paratype, 72.8 mm SL, suborbital groove of a female. Scale bar = 1 mm.

Table 1. Morphometric data of *Schistura hypsiura* holotype and 15 paratypes.

	Holotype	range	mean	S.D.
SL (mm)	69.1	42.9–73.4		
in percentage SL				
total length	121.9	122.5–126.8	124.6	1.3
dorsal head length	19.7	17.9–22.8	20.0	1.3
lateral head length	22.3	21.2–24.0	22.5	0.8
predorsal length	49.2	47.2–50.2	49.0	0.8
pre-pelvic length	50.9	50.5–52.8	51.9	0.6
pre-anus length	69.8	67.5–70.8	69.6	1.0
preanal length	77.6	75.5–79.5	77.5	1.0
head depth at eye	11.6	9.9–11.3	10.5	0.5
head depth at nape	13.9	12.6–14.2	13.2	0.6
body depth	19.4	15.0–20.5	17.5	1.4
depth of caudal peduncle	18.1	15.4–18.9	16.9	0.9
length of caudal peduncle	15.1	13.7–16.3	15.1	0.7
snout length	9.7	8.2–10.2	9.3	0.5
head width at nares	8.8	7.5–8.8	8.2	0.4
maximum head width	14.8	13.7–15.7	14.4	0.5
body width at dorsal origin	13.3	10.4–14.7	12.4	1.0
body width at anal origin	6.8	5.5–7.2	6.4	0.5
eye diameter	3.6	3.4–4.2	3.8	0.2
interorbital width	6.4	5.9–7.2	6.4	0.3
height of dorsal fin	17.2	14.8–19.0	16.8	1.3
length of upper caudal lobe	24.0	21.3–25.7	23.6	1.0
length of lower caudal lobe	23.3	22.3–26.5	24.4	1.0
length of median caudal rays	10.1	9.7–13.1	11.0	0.8
depth of anal fin	16.6	15.5–18.6	17.4	0.9
length of pelvic fin	18.4	19.0–20.7	19.9	0.5
length of pectoral fin	21.1	21.4–24.6	22.7	1.0

stripe extending from tip of snout to eye, meeting its antimere at snout. Dark bars broader than interspaces in anterior part of body, decreasing in width posteriorly to become as broad or narrower than interspaces in posterior part of body. Bars generally regular or narrowing ventrally. In some specimens a few bars are y-shaped, irregular or incomplete. In a large specimen (72.8 mm SL), bars in the anterior half of the body exhibit dark brown margins and paler central zones (Fig. 1h). Black bar at base of caudal fin interrupted twice; resulting in a black triangle at base of anteriormost dorsal and ventral procurrent fin rays and an elongated black blotch at center of caudal-fin base. Blotch at center of caudal-fin base much thinner than body bars; its depth 5.8–8.4% SL and width 2.3–3.8 times in its depth. All three parts of this black bar are clearly visible in juveniles. In adults a deeper dark brown bar is present across entire caudal-fin base, making components of the black bar less visible.

Dorsal fin with one to three dark brown elongated blotches at base and a prominent row of round or elongated dark brown dots at 2/3 of fin height in association with fin rays. In small specimens, dark brown dots are located at the first branching point of the branched dorsal-fin rays or slightly distal of the first branching point. In larger specimens, dark brown dots are located more distal to the first branching point of the branched dorsal-fin rays or at the level of the second branching point in the largest specimens. Caudal fin

either pale, with small scattered dots or with one to four dark brown bars. Anal fin either hyaline or with one or two indistinct dark brown stripes. Pelvic and pectoral fins either hyaline or with irregular dark brown pigmentation along rays.

Distribution. Presently known only from the type locality (Fig. 5).

Etymology. From the Greek *hypsos*, meaning high, and *oura* meaning tail; referring to the high caudal peduncle. An adjective.

DISCUSSION

Schistura hypsiura differs from all other species of the genus *Schistura* by a combination of the following three characters: 1) caudal peduncle as deep or deeper than trunk, without dorsal or ventral skin crests; 2) caudal fin deeply forked (length of outermost rays more than twice the length of innermost rays); and 3) the presence of a suborbital structure in both sexes (either a flap in males or groove in females).

Within the genus *Schistura*, relatively few species (viz. *Schistura alticrista*, *S. callidora*, and *S. dorsizona*) are reported to possess a deep caudal peduncle that is as deep or deeper than the trunk. In all of these cases, pronounced

dorsal and potentially ventral skin crests are responsible for a considerable portion of caudal peduncle depth (Kottelat, 1990; Zhou & Kottelat, 2005; Bohlen & Šlechtová, 2011a). On the contrary, dorsal and ventral skin crests are absent in *S. hypsiura* (Fig. 3) and the depth of the caudal peduncle can be attributed to only the body. Outside the genus *Schistura*, a caudal peduncle nearly as deep or as deep as the body occurs in some species of *Aborichthys* (e.g., *A. elongatus* and *A. kempfi*) and *Homatula* (e.g., *H. laxiclathra*, *H. variegata*, *H. berezowskii*, and *H. longidorsalis*), but only in combination with a very elongated and rather low body. Despite the different external appearance of the caudal region of *S. hypsiura*, the general osteology of the caudal skeleton is similar to that reported for other species of nemacheilid (e.g., see Sawada, 1982; Conway, 2011). Noteworthy, osteological features include: the expanded distal tips of the haemal and neural spines of preural centra 2 and 3 (which

support the bases of procurent rays); the enlarged flange-like rudimentary neural arch of the compound centrum; and the expanded epural, which nearly fills the interneural space between the neural spine of preural centrum 2 and the pleurostyle. The innermost principal caudal-fin rays of *S. hypsiura* also appear well developed and generally thicker than the innermost principal caudal-fin rays of other nemacheilid taxa (based on a survey of the limited osteological material available to us).

Sexual dimorphism is common in loaches and the corresponding characters are often used to diagnose species or genera (Kottelat, 1990, 2000; Bănărescu & Nalbant, 1995; Šlechtová et al., 2008). In nemacheilid loaches, sexual dimorphisms may include: different pigmentation patterns in males and females (e.g., *Yunnanilus brevis*, *Lefua costata*, and *Pteronemacheilus meridionalis*); the presence of tubercles on head and/or pectoral fins in males (e.g., *Barbatula barbatula*, *Acanthocobitis zonalternans*, *Nemacheilus binotatus*); thickened pectoral-fin rays (e.g., *Neonoemacheilus labeosus*, *Nemacheilus ornatus*); a plate-like extension of the genital papilla (*Oreonectes platycephalus* and *O. polystigma*); or elongated skinfolds on the dorsal side of the pectoral fin (*Pteronemacheilus*) (Kottelat, 1990, 2001; Bănărescu & Nalbant, 1995; Du et al., 2008; Bohlen & Šlechtová, 2011a). In members of at least 8 genera (viz. *Acanthocobitis*, *Mesonoemacheilus*, *Nemacheilus*, *Neonoemacheilus*, *Oxynoemacheilus*, *Physoschistura*, *Schistura* and *Yunnanilus*), males of some species were reported to develop a suborbital flap (Kottelat, 1990; Bănărescu & Nalbant, 1995). In *Acanthocobitis botia* and *Oxynoemacheilus persus* the males have a suborbital groove instead of a suborbital flap, which is hypothesised to correspond to the groove under the suborbital flap in other species (Kottelat, 1990). Adult males of *Acanthocobitis pictilis* show a deep slit on the cheek (Kottelat, 2012b).

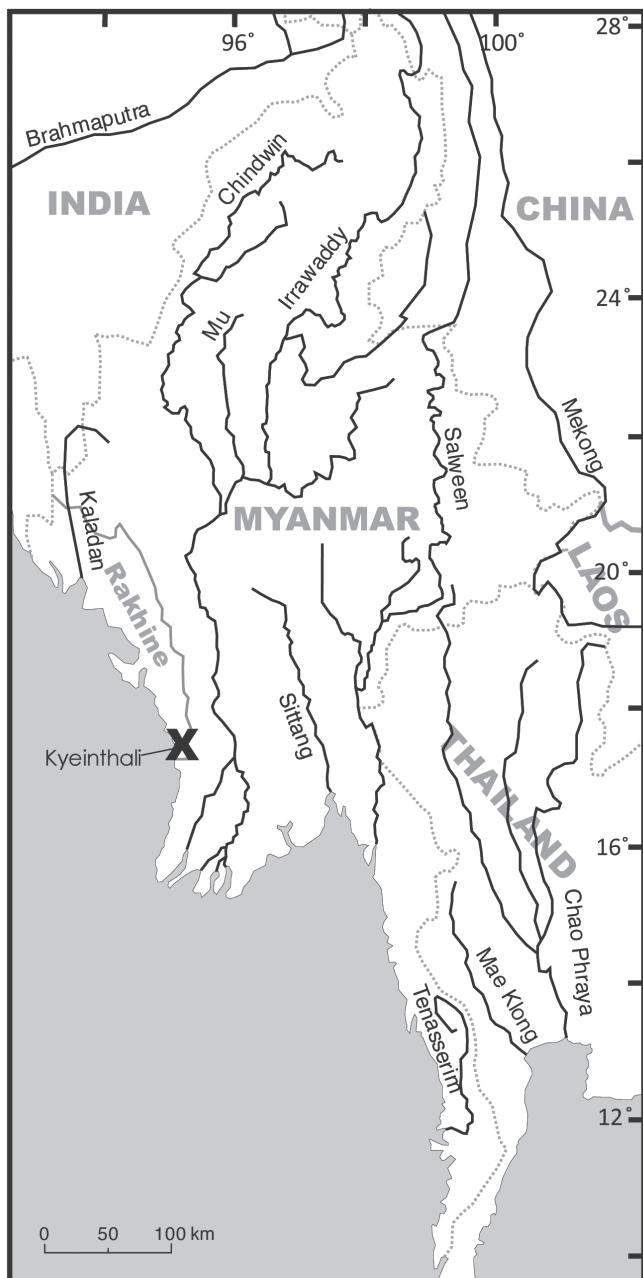


Fig. 5. Map of Myanmar and surrounding areas. Type locality of *Schistura hypsiura* in southern Rakhine State is indicated by an X.

Until now, *Acanthocobitis pictilis* and three species of the genus *Neonoemacheilus* (*N. labeosus*, *N. mendingensis*, and *N. peguensis*) were the only members of Nemacheilidae in which a suborbital structure, in the same position as the suborbital structure of the male, had been reported for adult females (Kottelat, 2012). The sexual dimorphism of *S. hypsiura* differs from that of *A. pictilis* by the presence of a broad suborbital flap in males (vs. a deep slit) and by the suborbital fold in females starting less than half of an eye diameter before the anterior margin of the eye (vs. more than one eye diameter). In *N. labeosus* and *N. peguensis*, the suborbital groove of the female is in a similar position to the ventral margin of the suborbital flap of the males and its posterior end is slightly bend upwards and forwards, making it similar in appearance to a poorly developed suborbital flap of the male. However, the suborbital groove in females of this species is much shorter than the suborbital flap of males (20–25% of eye diameter vs. 40–60% in males) and starts at level of vertical through anterior margin of eye (vs. starting clearly anterior of this level in males). In *S. hypsiura*, the suborbital groove of the female is in the same position and is equal in length to the suborbital flap of the male. Unlike the situation in *Neonoemacheilus*, in *S. hypsiura* the

suborbital groove of the female is only slightly shorter in length than the flap of the male (30.4–38.55% of eye diameter in females vs. 42.8–52.1% in males), and is bent upwards posteriorly, where it is confluent with the anteroventral margin of the orbit. Therefore it resembles the suborbital flap of the male even more than in *Neonoemacheilus*. We therefore assume that the groove and the flap are homologous and their weaker expression in females rather the result of sex-specific hormonal differences. It has been shown in the cobitid loach *Cobitis bilineata* that the development of the male-specific ossified structures on the pectoral fin can be induced in females by injections of the male hormone methyltestosterone (Lodi, 1976).

Observations on aquarium kept specimens revealed that the suborbital groove is present in live females all around the year, therefore it is not an artefact of fixation and not restricted to certain seasons.

The new species is known presently only from Kyeinthali River, a short coastal river in the south of Rakhine State in Myanmar. Rakhine State stretches along the coast of the Bay of Bengal from the border with Bangladesh about 500 km south to Gna. This state is separated from the rest of Myanmar to the east by the dry and steep Arakan (or Rakhine Yoma) Mountains, while no significant biogeographic barrier exists to the north-west. Consequently, the aquatic fauna of Rakhine differs remarkably from the fauna in Central Myanmar and several endemic species are found here (e.g., Kullander & Fang, 2004, 2009; Britz, 2007; Ng, 2008; Conway & Kottelat, 2010). *Schistura hypsiura* seems to be another Rakhine endemic, and several shared similarities with the recently described *S. koladynensis* (e.g., a deeply forked caudal fin and deep caudal peduncle, regular dark bands on the body, a dissociated black bar at base of caudal peduncle and details of the pigmentation of head and fins; Lokeshwor & Vishwanath, 2012) from Mizoram suggest that these two species may be closely related and underline the faunistic connection between Rakhine and the Indian fauna.

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