



***Rhyacoschistura larreci*, a new genus and species of loach from Laos and redescription of *R. suber* (Teleostei: Nemacheilidae)**

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Abstract

Rhyacoschistura, new genus, belongs to a group of genera (*Physoschistura*, *Mustura*, *Pteronemacheilus*, *Petruichthys*) characterised by the modified branched pectoral-fin rays of males, with a very thick first ray, usually without membranes between some of the branches and/or rays, and anterior rays and/or membranes covered by small tubercles at maturity. *Rhyacoschistura* is distinguished from them by the combination of: presence of a suborbital flap; emarginate caudal fin; lower lip with a wide median interruption and connected to isthmus by a frenum; body depth about equal from behind head to caudal-fin base. *Rhyacoschistura larreci*, new species, is described from the Mekong drainage in Xayaburi Province, Laos. It is distinguished by details of the morphology of the pelvic fin, and its colour pattern (flank with numerous narrow slanted bars, very irregularly organised and shaped, more or less connected, or sometimes covering the whole flank). *Schistura suber*, from Nam Ngum watershed, is redescribed on the basis of adults and placed in *Rhyacoschistura*.

Key words: *Schistura*, *Mustura*, *Physoschistura*

Introduction

Nemacheilid loaches typically occur in fast flowing water of small streams and less often in other habitats such as large rivers and caves. The family has its greatest diversity in Southeast Asia, from where about 260 species have been described (Kottelat 2012a, 2013); most are described and figured in Kottelat (1984, 1990, 1998, 2000, 2001) and Freyhof & Serov (2001). Besides, new species and genera are still regularly described (e.g. Bohlen & Šlechtová 2010, 2013a–b; Ou *et al.* 2011, Plongsesthee *et al.* 2013, Bohlen *et al.* 2014, 2016; Kottelat 2012b, 2017a–h, 2018).

While information has been published on the fishes of various drainages in Laos, some areas remain poorly known and virtually unsampled. One of them is Xayaburi Province, where a very brief visit in December 2018 led to the discovery of several new species, one of which represents a new genus.

In 2000, I published the diagnosis of *Schistura suber*. This was one of 64 newly discovered species (39 of them in the genus *Schistura*) that had to be included in my 2001 book on *Fishes of Laos*. Unfortunately the deadline set by the contract for the completion of the book could not be modified and I was to be away for months with another project. It would have made no sense to include all these species without names (about 15 % of the species in the book), or to omit them, and it was decided to publish only diagnoses in order to make the names available, with complete descriptions to be published later. Only the species easiest to identify have been described; in several of the recognised species (e.g. *S. kongphengi*, *S. clatrata*, *S. nicholsi*, *S. pervagata*) there was a suspicion that more species were present but time was not available for more detailed work. Of course, a stretch of undisturbed time to write these descriptions never came in the next 20 years. Somehow, this shows it was the right decision in 2000 to make names available for these species, otherwise they would still be without names and would have escaped attention, for example their status could not have been assessed in the IUCN Red List. But identification problems remain. *Schistura suber* was described on the basis of 3 specimens, suspected to be juveniles but with very distinctive characters. Surveys conducted in the Nam Ngum drainage in 2012 and 2013 allowed the discovery of adults, which are very different from the juveniles and belong to the new genus described herein.

The present article describes the new species obtained in Xayaburi Province, discusses its generic affinities, and redescribes *R. suber*.

Material and methods

Measurements and counts follow Kottelat (1990) and Kottelat & Freyhof (2007). The last 2 branched dorsal and anal-fin rays articulating on a single pterygiophore are noted as “1½”. Frequency of meristic values are indicated in parentheses, if more than one value is observed; asterisks indicate the condition for the holotype. Toponymy is as obtained in the field and uses the spellings on the 1:100'000 topographic map (Service Géographique d'État, 1985, sheets E 47-23, 24); alternative spellings or names are noted in square brackets. Abbreviations used: CMK, collection of the author; MHNG, Muséum d'Histoire Naturelle, Genève; and ZRC, Zoological Reference Collection, Lee Kong Chian Natural History Museum, Singapore. Comparative data of species of the genus *Mustura* are from Kottelat (2018). Data on the other species are based on examined material and on Kottelat (1990).

Rhyacoschistura, new genus

Type species. *Rhyacoschistura larreci*, new species.

Etymology. *Rhyacoschistura* is derived from the Greek word *ρύαξ*, -κος (rhyax, meaning a rushing stream, a torrent) and the genus name *Schistura* (itself based on *σχιστός* [schistos; divided] and *οὐρά* [oura; tail]). In reference to the torrent and hill stream habitat of the species placed in the genus. Gender feminine.

Diagnosis. *Rhyacoschistura* is distinguished from the other genera of Nemacheilidae by the combination of: the modified male pectoral fin (especially the first branched ray wider than the following rays, without a membrane between the branches except near the tip, covered by small pointed tubercles at maturity; more details below); the capsule of the anterior chamber of the air bladder in two halves, connected by a manubrium; the lower lip with a wide median interruption, the two halves forming an acute angle, not in contact medially, wide and fleshy medially, partly free from the jaw and connected to the isthmus by a frenum; the suborbital flap is present or absent; the body depth is about equal from behind head to caudal-fin base; depth of caudal peduncle 1.1–1.3 times in its length; caudal fin emarginate; and scales very distinct, covering whole body, including predorsal and prepectoral areas.

Pectoral fin of males slanted upwards and expanded laterally; first branched ray rigid, about 4 times wider than following rays; anterior branch not further branched, posterior branch branched again, without membrane between them, except near tip (Fig. 1). Branched ray 2: anterior branch unbranched, posterior branch branched again. Following rays branched once or twice; space between branches of branched ray 2 very narrow (or lacking a membrane) and space increasingly wider in posterior rays. Dorsal surface of first branched ray and part of membrane just along posterior branch covered by small pointed tubercles. Unculiferous pads (sensu Conway *et al.* 2012) present in *R. suber*, along posterior margin of all branched rays; along anterior and posterior margins of first branched ray, posterior one covered by small tubercles, smaller than those on ray.

Air bladder capsule in two halves, separated and connected by a manubrium; no posterior chamber of air bladder visible in abdominal cavity.

Mouth arched, about 2–2.5 times wider than long (Fig. 2). Upper lip thin, with median notch, and thin and shallow wrinkles. Lower lip with wide median interruption, sometimes leaving tip of jaw exposed; two halves forming an acute angle (when mouth closed and in properly fixed specimens), not in contact medially. Along median interruption, anterior edge of lower lip extending backwards until about medial extremity of postlabial groove; space between median interruption and postlabial groove narrow. Each half of lower lip fleshy medially, about 1.5–2 times thicker than at corner of mouth, not forming a ‘cushion’ (see Kottelat 2018). Medial portion with 0–3 narrow sulci, lateral portion with thin shallow wrinkles.

Colour pattern very variable, also intraspecifically. Smallest known individuals (up to about 25–30 mm SL) plain grey to yellowish, then a dusky midlateral stripe appears, which develops into a series of faint short bars, then into a pattern of irregular bars. Pattern at caudal-fin base: a black bar, arched, extending on base of rays, almost complete, except along upper and lower extremities.

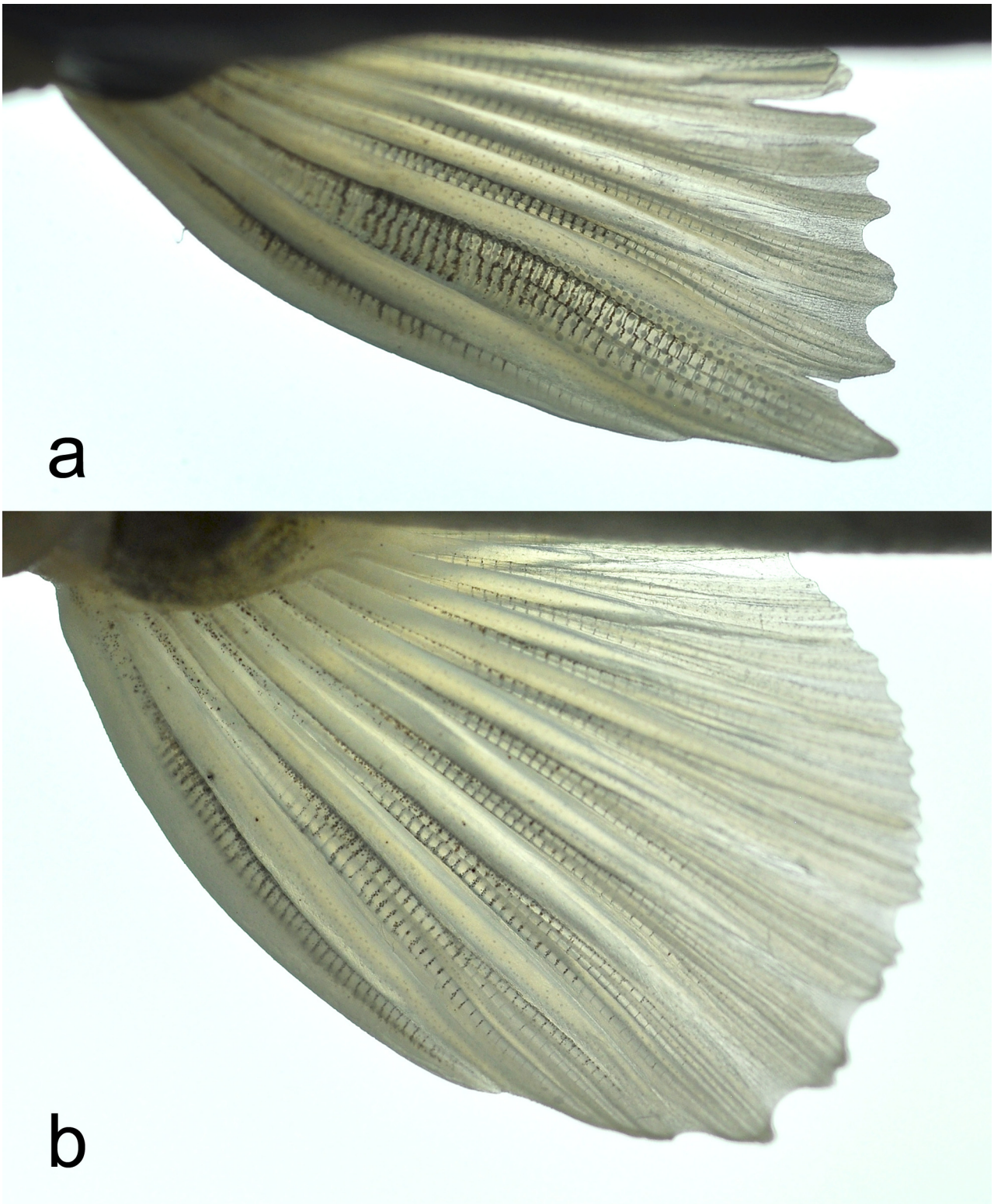


FIGURE 1. *Rhyacoschistura larreci*, left pectoral fin, dorsal view, of: **a**, male, MHNG 2727.011, holotype, 57.1 mm SL; and **b**, female, CMK 28034, 68.8 mm SL.



FIGURE 2. *Rhyacoschistura larreci*, CMK 28034, 68.8 mm SL; mouth.

Caudal fin emarginate, with 8+8 or 8+7 or 7+8 branched rays. Dorsal fin with $7\frac{1}{2}$ branched rays; margin slightly convex; origin above or slightly in front of pelvic-fin origin.

Male of *R. larreci* with suborbital flap (modified lateral ethmoid), extremity of free part usually globulous, with a swollen cap of unculiferous tissue representing about half of flap, and with small tubercles along posterior edge (Fig. 3a). Suborbital flap missing in *R. suber*.

Included species. *Rhyacoschistura larreci* and *R. suber* (Kottelat, 2000).

Remarks. Among nemacheilid genera from northeast India and continental Southeast Asia, *Rhyacoschistura* shares the sexually dimorphic male rigid, thickened, curled, first branched pectoral-fin ray with only a narrow or no space between the branches with *Mustura*, *Pteronemacheilus*, *Malihkaia*, *Physoschistura*, *Petruichthys* and (based on photographs) apparently *Protonemacheilus*. Although in many other genera of Nemacheilidae the first branched pectoral-fin ray of males is also significantly thicker than the other rays and than in females, the type of modification is different (see below).

Rhyacoschistura is distinguished from these genera in having larger and distinctly conical and pointed tubercles on the first branched pectoral-fin ray and smaller, less sharp tubercles along the posterior margin, or on unculiferous pad behind the ray (vs. numerous small, granulose or conical tubercles on ray and fins, in several species very densely set).

In males of *Mustura*, the posterior branch of branched rays 1 and 2 is not further branched (vs. branched in *Rhyacoschistura*); the dorsal fin margin is straight to concave (vs. slightly convex); the caudal fin is forked (vs. emarginate); the pelvic-fin origin is under the base of branched dorsal-fin rays 1–3 (vs. below or slightly in front of dorsal-fin origin); the colour pattern is variable, usually including a midlateral row of very irregular, vertically elongated blackish blotches, more or less connected to a middorsal row of irregularly shaped saddles; the black pattern at the caudal-fin base is made of two spots: a black spot over upper procurrent rays and upper two principal rays; and a vertically elongated patch of densely-set dark brown pigments along the base of the principal rays of the lower lobe (vs. a black bar, arched, extending on to the base of rays, almost complete, except along upper and lower extremities).

In males of *Pteronemacheilus*, the membrane is present between the two branches of the first branched ray (although narrow) (vs. branches are adjacent, without membrane between them in *Rhyacoschistura*). Branched ray 2 has an elevated flange of skin on its dorsal side, on the proximal $\frac{1}{3}$ – $\frac{1}{2}$. Branched rays 3 and 4 are connected by thick tissues forming a hard elongate swelling (rod) between them on their dorsal surface; the rays have a slight curve downwards at about the distal extent of the rod, creating a shallow concavity in the ventral surface of the fin (vs. rays 3–4 and adjacent membranes not modified). Males have neither a suborbital flap nor a suborbital groove (vs. present in one species). The caudal fin is deeply emarginate (vs. emarginate).

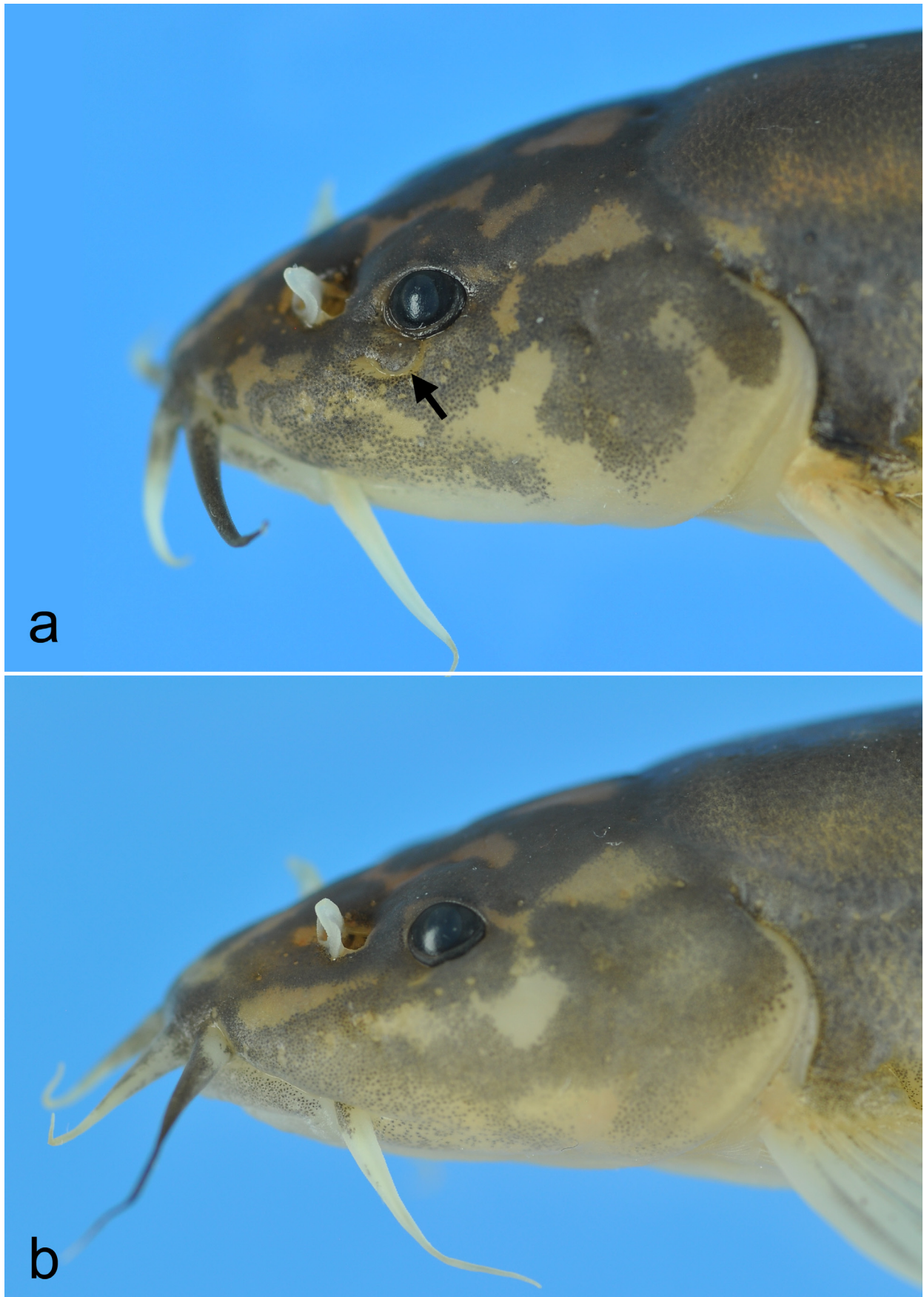


FIGURE 3. *Rhyacoschistura larreci*, head of: **a**, male, with suborbital flap (arrow), MHNG 2727.011, holotype, 57.1 mm SL; and **b**, female, CMK 28034, 68.8 mm SL.



FIGURE 4. *Rhyacoschistura larreci*, MHNG 2727.011, holotype, 57.1 mm SL; Laos: Xayaburi: Nam Houng watershed.



FIGURE 5. *Rhyacoschistura larreci*, CMK 28037, paratype, 57.8 mm SL; Laos: Xayaburi: Nam Houng watershed; immediately after fixation.

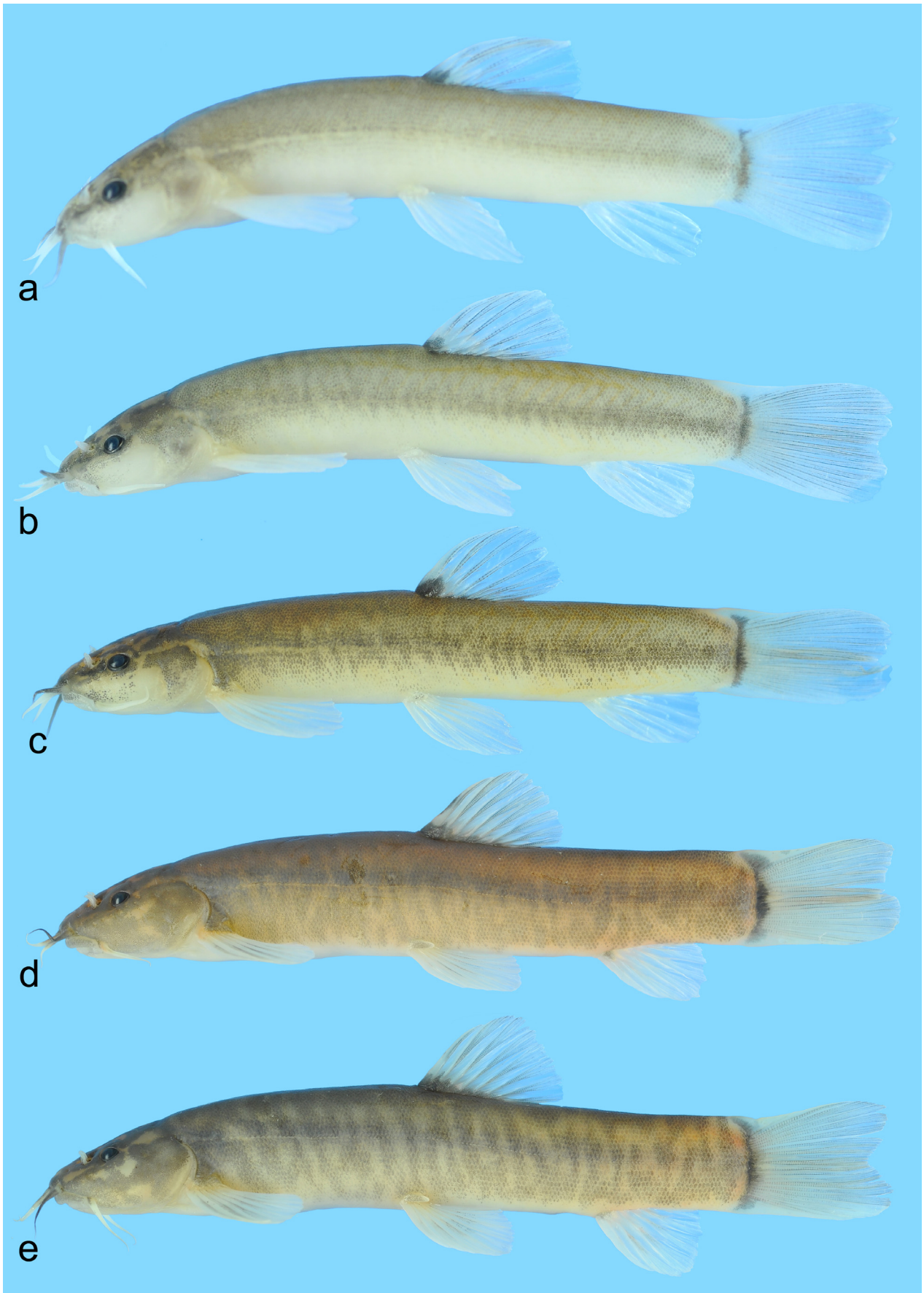


FIGURE 6. *Rhyacoschistura larreci*, CMK 28037, paratypes; Laos: Xayaburi: Nam Houng watershed; **a**, 23.9 mm SL; **b**, 26.5 mm SL; **c**, 29.2 mm SL; **d**, 63.6 mm SL; **e**, 68.8 mm SL.

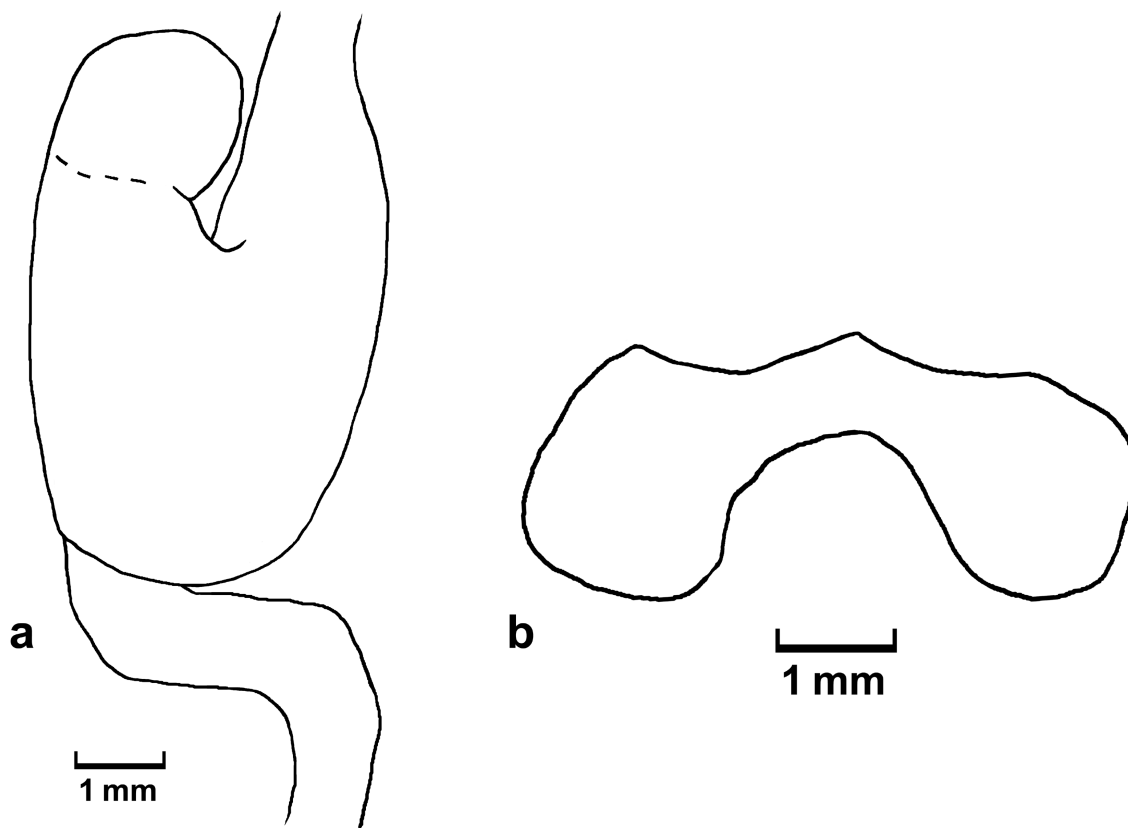


FIGURE 7. *Rhyacoschistura larreci*, CMK 28034; **a**, 49.8 mm SL; digestive tract; **b**, 50.2 mm SL; air bladder capsule.

In males of *Physoschistura* the two branches of the first branched ray are close together, without a membrane between them, except near the very tip. Branched ray 2 is thinner and the branches are close but with a narrow membrane between them. The unculiferous pads along branched rays are very narrow and the small conical tubercles are present only on a narrow band along the posterior edge of branched ray 1. Besides, the two halves of the air bladder capsule are joined medially (vs. connected by a manubrium) and the posterior chamber is free, well developed and in direct contact with the capsule (vs. absent).

In males of *Petruichthys* the first branched pectoral-fin ray is not significantly thickened but the space between the branches is very narrow; there are patches of small conical tubercles on the dorsal surface of branched ray 1 and its anterior and posterior flanges, and on the posterior flange of ray 2. Males have a suborbital flap. Besides, in *Petruichthys* the nares are separated from each other, the anterior one at the extremity of a short tube (vs. nostrils adjacent, anterior naris on anterior face of a valve-like flap); the supratemporal canal of the cephalic lateral line system has two pores on each side of the head (vs. a median pore and one on each side); the postlabial groove extends along the whole posterior edge of the lower lip, and the frenum is in the groove, under the lip (vs. postlabial groove not complete and frenum visible).

In males of *Malihkaia*, the pectoral fin is strongly falcate, the unbranched and first branched rays are rigid, arched and curved upwards; the first branched ray is about 5 times wider than the other branched rays, flattened dorso-ventrally, reaching beyond pelvic-fin base; there are no membranes between the branches and the sub-branches (Kottelat 2017a). The second branched ray is slender, branched only at tip and the membrane between the branches is very narrow. Besides, *Malihkaia* has a deeply furrowed lower lip (vs. smooth, with thin, shallow furrows or wrinkles in *Rhyacoschistura*) and the suborbital flap is not globulous and does not have small tubercles along its posterior margin (vs. globulous and with small tubercles along its posterior margin).

The morphology of the male suborbital flap (globulous, with tubercles at the extremity) is shared by *Rhyacos-*

chistura, *Mustura*, *Physoschistura* and *Petruichthys*, and has not yet been reported in other nemacheilid genera in South and Southeast Asia.

See Kottelat (2018) for a more detailed discussion of the modified pectoral-fin rays and for diagnoses of the remaining genera of Nemacheilidae present in northeastern India and mainland Southeast Asia.

***Rhyacoschistura larreci*, new species**

(Figs. 4–6)

Holotype. MHNG 2727.011, 57.1 mm SL; Laos: Xayaburi Province: Houay Plong at bridge 4 km South of Ban Houy Chouang, itself 33 km from Hongsa on road to Xayaburi; 528 masl; 19°32'20.1"N 101°29'49.5"E; M. Kottelat & T. Phommavong, 12 December 2018.

Paratypes. CMK 28037, 48; ZRC 60828, 8; 26.5–68.8 mm SL; same data.

Diagnosis. *Rhyacoschistura larreci* is distinguished from *R. suber* by its colour pattern (flank with numerous narrow slanted bars, very irregularly organised and shaped, more or less connected, or sometimes covering whole flank); suborbital flap present in males (vs. absent); on dorsal surface of pectoral fin, small tubercles along branched rays 1–3 and on membrane behind branched ray 1 (vs. tubercles on unculiferous pad behind branched ray 1).

Description. See Figures 4–6 for general appearance and Table 1 for morphometric data of holotype and 6 largest paratypes. A moderately elongate nemacheilid with body depth slowly increasing up to slightly in front of dorsal-fin origin. Behind dorsal fin, body depth almost uniform until caudal-fin base. Dorsal profile with a very slight concavity between head and body. Head from about circular anteriorly to compressed posteriorly. Interorbital area slightly convex. In lateral view, eye flush with dorsal profile of head. Cheeks not swollen. Snout rounded in dorsal and lateral view. Depth of caudal peduncle 1.1–1.3 times in its length, depth uniform. Dorsal ridge on posterior fourth of post-dorsal area. Ventral ridge on posterior half of caudal peduncle. Largest recorded size 68.8 mm SL.

Dorsal fin with 4 unbranched and 7½ branched rays; distal margin convex. Second branched ray longest. Pectoral fin with 1 unbranched and 10* (6) or 11 (1) branched rays, rounded and reaching half of distance to pelvic-fin base in females, slightly falcate and reaching about ⅔ of distance to pelvic-fin base in males. No axillary pectoral lobe. Pelvic fin with 1 unbranched and 7 branched rays; reaching about halfway of distance to anal-fin origin; falcate, posterior margin straight; origin at vertical through dorsal-fin origin; axillary lobe present, entirely free. Anus situated about 1.5–2 eye diameters in front of anal fin, behind posterior extremity of pelvic fin. Anal fin with 3 unbranched and 5½ branched rays; distal margin straight. Caudal fin with 8+8* branched rays (one specimen with 7+8 rays is probably anomalous); dorsal and ventral procurrent rays cannot be counted; emarginate, lobes rounded, upper lobe slightly longer than lower one.

Body entirely covered by scales, including predorsal area and belly between pectoral-fin bases. All scales very distinct. Lateral line complete in large specimens, interrupted in some smaller ones, with 103–122 pores (difficult to count with accuracy). Cephalic lateral line system with 6 supraorbital, 4 + 10–11 infraorbital, 9 preoperculo-mandibular and 3 supratemporal pores.

Anterior naris pierced on front side of a pointed flap-like tube. Posterior naris adjacent to anterior one. Mouth arched, gape about twice as wide as long (Fig. 2). Lips thick, fleshy. Upper lip with a median notch and short, fine wrinkles. Processus dentiformis present. Lower lip with median interruption; median part with 1–2 shallow sulci, lateral part with fine, shallow wrinkles. Frenum of lower lip wide, median part of lower lip not attached to jaw. Tip of lower jaw not exposed. No median notch on lower jaw. Inner rostral barbel reaching beyond corner of mouth; outer one reaching beyond posterior margin of eye. Maxillary barbel reaching middle of postorbital area.

Intestine with a loop behind stomach (Fig. 7a). Air bladder without posterior chamber visible in abdominal cavity. Two halves of bony capsule of anterior chamber of air bladder connected by a manubrium (Fig. 7b).

Sexual dimorphism. Males with globulous suborbital flap, with small tubercles along posterior edge; females with neither suborbital flap nor suborbital groove. In males, pectoral fin rigid, slightly curled upwards (Fig. 1a). Membrane between unbranched and first branched rays narrower distally than at midlength. First branched ray about 4 times wider than adjacent rays. After branching point, anterior branch wider than posterior one, becoming narrower again at level of branching point of posterior branch. Anterior branch unbranched. Posterior branch branched again. No membrane between branches. On dorsal surface of first branched rays, on distal half of rays and adjacent part of membrane behind posterior branch, small tubercles organised in about 6–7 irregular longitudinal rows.

Branched ray 2: posterior branch branched again; no membrane between branches. Branched rays 3–8 branched twice; membrane narrow or absent between branching points 1 and 2. A few small tubercles along posterior edge of branched ray 2 and sometimes behind ray 3.

In female, first branched ray only slightly wider than adjacent rays; branching of rays as in males, but all rays and branches connected by membranes (Fig. 1b). No tubercles on rays and membranes.

TABLE 1. Morphometric data of type material of *Rhycoshistura larreci* (n=7). Range and mean include holotype data.

	holotype	range	mean
Standard length (mm)	57.1	52.3–68.8	
Total length (mm)	69.8	64.1–82.7	
In percent of standard length			
Total length	122.3	120.3–123.7	122.2
Head length (dorsal)	20.7	19.3–21.5	20.3
Head length (lateral)	23.9	22.6–24.1	23.4
Predorsal length	56.2	54.3–56.8	55.5
Prepelvic length	53.0	50.6–53.0	51.6
Pre-anus length	73.3	72.6–73.9	73.3
Pre-anal length	78.0	77.8–80.1	78.5
Head depth	13.4	12.6–13.4	13.0
Body depth at dorsal-fin origin	17.1	17.1–18.2	17.8
Depth of caudal peduncle	13.3	13.0–13.8	13.5
Length of caudal peduncle	16.6	15.1–16.9	15.8
Head width	17.5	15.8–17.5	16.5
Body width at dorsal-fin origin	13.9	13.8–14.3	14.0
Snout length	10.2	9.6–10.3	10.1
Eye diameter	3.7	3.1–3.7	3.4
Interorbital width	8.4	7.5–8.6	8.2
Length of dorsal fin	19.1	17.0–20.6	18.3
Length of upper caudal-fin lobe	22.0	20.3–23.8	22.0
Length of median caudal-fin rays	18.5	17.3–19.5	18.1
Length of lower caudal-fin lobe	23.0	21.3–24.5	22.7
Length of anal fin	18.8	16.3–19.3	18.0
Length of pelvic fin	18.8	15.7–19.4	18.3
Length of pectoral fin	22.0	17.7–22.0	20.7
In percent of dorsal head length			
Snout length	49	47–52	50
Eye diameter	18	16–18	17
Interorbital width	41	38–43	41
In percent of lateral head length			
Snout length	43	42–44	43
Eye diameter	15	14–15	15
Interorbital width	35	33–37	35

Coloration. After 2 weeks in formalin (Figs. 4, 6). Body background colour beige to pale brown, darker posteriorly, paler on belly; except otherwise stated, all markings darker grey to dark brown. Head dark brown to blackish on top and side, with a variable pattern of pale to whitish patches, typically organised in: a large blotch on nape, and one on each side of it anteriorly; a v-shaped mark between eyes and another one between nostrils; a median longitudinal line on snout and one between eye and base of outer rostral barbel; and a white patch behind and posterior to eye. Rostral barbels dark brown; inner ones whitish distally. Maxillary barbels whitish with a narrow black area at base.

In large specimens (Figs. 4, 6e), flank with numerous narrow slanted bars, extending downwards to level of in-

sersion of pectoral fin, very irregularly organised and shaped, more or less connected, or sometimes covering whole flank. In smallest specimens, flank covered by dark pigments, denser on dorsal half (Fig. 6a); with increasing size, pigments become denser at midheight of flank, forming a midlateral band from head to caudal-fin base (Fig. 6b–c), later dissociated into irregular bars (Fig. 6d). Back crossed by narrow bars, which are often distinct and merging into a dark background colour.

Black bar at caudal base arched, extending on base of rays, almost complete, except along upper and lower extremities. A narrow pale band in front of black bar.

Dorsal fin hyaline; in smaller specimens with a black spot at base of unbranched ray and first branched ray; in larger specimens black band extending along entire base. A black mark at midlength of membrane covering unbranched rays. A few black pigments along rays and between segments at level of first branching point, forming a faint row of spots.

Caudal, anal and pelvic fins hyaline.

Pectoral fin hyaline; black pigments along middle posterior edge of unbranched and branched rays 1–2, and their branches, forming faint longitudinal marks, more intense in males than in females.

In life (Fig. 5): background colour pale grey, marks dark brown, bar at caudal-fin base and markings on dorsal fin black. Fins yellowish, pectoral fin more intense. (Sampling happened in late afternoon and in rain, therefore vague information).

Notes on biology. Two dissected females (CMK 28037, 50.2, 62.9 mm SL) did not have ripe ovaries.

Distribution. *Rhyacoschistura larreci* is presently known only from the type locality, Houay Plong, a small mountain creek tributary of Nam Met, itself a tributary of Nam Houng, itself a tributary of Mekong. It was obtained in a very small stream, about 1 m wide and 20 cm deep, among stones and boulders. It is probably present in the uppermost parts of many other tributaries of the Nam Met, and possibly adjacent streams, but time was not available to reach and sample more sites with similar morphology.

Etymology. Named for LARReC, Living Aquatic Resources Research Center, Vientiane, for its 20th anniversary, and appreciation to several of its staff for 20 years of collaboration in the field. Treated as a masculine noun in genitive, indeclinable.

***Rhyacoschistura suber* (Kottelat, 2000)**

(Figs. 8–10)

Schistura suber Kottelat, 2000: 72, fig. 60 (type locality: Laos: Vientiane Province: unnamed small forest stream along road from Thad Leuk to Nam Leuk dam site; 18°27'05"N 103°04'06"E, Mekong drainage; holotype: ZRC 45383; noun in apposition, indeclinable)

Examined material. All from Laos: Nam Ngum drainage. CMK 22434, 17, 33.9–54.1 mm SL; small unnamed creek entering Nam Ngum from the east immediately downstream of bridge on road to site of Nam Ngum 3 powerhouse; 405 masl; 18°59'27"N 102°50'20"E; M. Kottelat et al., 11 February 2012. — CMK 22522, 9, 36.3–57.3 mm SL; unnamed stream, km 20 on road from Nam Phay bridge to Na Xai Sawang; 600 masl; 19°02'51"N 102°44'36"E; M. Kottelat et al., 18 February 2012. — CMK 22643, 16, 27.7–50.0 mm SL; Nam Ngum upstream of confluence with Nam Ting; 890 masl; 19°24'58"N 102°58'05"E; M. Kottelat et al., 22 February 2012. — CMK 23557, 4, 32.1–58.2 mm SL; small stream entering Nam Ngum (now in Nam Ngum 2 reservoir) from the west; about 390 masl; 18°57'35"N 102°47'19"E; M. Kottelat et al., 22 March 2013. — CMK 23567, 143, 24.2–67.8 mm SL; forest creek at about 1.5 km on road from bridge on Nam Ngum (near planned site of Nam Ngum 3 power house) to Na Xai Sawang; 495 masl; 19°00'03"N 102°49'27"E; M. Kottelat et al., 23 March 2013.

On divide between Nam Ngum and Nam Mang drainages: CMK 13308, 2 paratypes, 26.5–28.2 mm SL; small forest stream along road from Ban Pak Leuk to Ban Longxan; 18°27'05"N 103°04'06"E; M. Kottelat et al., 25 February 1997.

Diagnosis. *Rhyacoschistura suber* is distinguished from *R. larreci* by its colour pattern (0–16 bars on flank, of variable width, usually narrower than interspaces, very irregularly shaped and set, sometimes restricted to lower half of body; sometimes bars missing, especially in juveniles); no suborbital flap (vs. present); on dorsal surface of pectoral fin, small sharply pointed tubercles on branched rays 1–3 and on unculiferous pad behind branched ray 1 (vs. tubercles on membrane behind branched ray 1, no unculiferous pad).

Description. Based mainly on CMK 23567. See Figures 8–10 for general appearance and Table 2 for morphometric data of 7 specimens. A moderately elongate nemacheilid with body depth almost uniform from behind head to caudal-fin base. Dorsal profile with a small concavity between head and body. Head slightly depressed; body from about circular anteriorly to compressed posteriorly. Interorbital area arched, with small groove and ledge along upper margin of eye. In lateral view, eye below dorsal profile of head. Cheeks not swollen. Snout rounded. Depth of caudal peduncle 1.0–1.2 times in its length, depth uniform. Low dorsal keel on posterior fourth of post-dorsal area. Low ventral keel immediately in front of caudal-fin base. Dorsal keel separated by a marked concavity from upper margin of caudal fin. Largest recorded size 68.0 mm SL.

TABLE 2. Morphometric data of *Rhyacoschistura suber* (CMK 23567, n=7).

	range	mean
Standard length (mm)	55.3–60.4	
Total length (mm)	65.9–74.3	
In percent of standard length		
Total length	119.1–123.0	120.8
Head length (dorsal)	19.3–20.6	19.9
Head length (lateral)	22.6–24.8	23.5
Predorsal length	55.6–57.9	56.5
Prepelvic length	52.3–54.6	53.9
Pre-anus length	74.5–77.2	76.3
Pre-anal length	78.9–81.5	80.4
Head depth	11.4–12.6	12.0
Body depth at dorsal-fin origin	17.0–18.0	17.6
Depth of caudal peduncle	12.4–13.6	13.1
Length of caudal peduncle	13.3–15.5	14.4
Head width	15.8–17.5	16.5
Body width at dorsal-fin origin	12.9–15.5	14.4
Snout length	9.2–10.5	9.8
Eye diameter	2.6–3.4	3.0
Interorbital width	7.5–8.8	8.3
Length of dorsal fin	16.5–18.7	17.3
Length of upper caudal-fin lobe	19.2–22.8	20.9
Length of median caudal-fin rays	16.8–19.4	18.1
Length of lower caudal-fin lobe	19.1–23.0	21.0
Length of anal fin	16.0–18.9	17.8
Length of pelvic fin	17.2–19.6	18.8
Length of pectoral fin	18.5–21.1	19.9
In percent of dorsal head length		
Snout length	45–51	49
Eye diameter	13–17	15
Interorbital width	38–46	42
In percent of lateral head length		
Snout length	38–44	42
Eye diameter	11–14	13
Interorbital width	32–38	35

Dorsal fin with 4 unbranched and 7½ branched rays; distal margin convex; branched ray 2 longest; origin above pelvic-fin origin or slightly behind. Pectoral fin with 1 unbranched and 11 branched rays, rounded, posterior margin straight in males, reaching about halfway to pelvic-fin base. Pelvic fin with 1 unbranched and 8 branched rays, reaching about ¾ of distance to anus; rounded to falcate; origin slightly in front of dorsal-fin origin; axillary lobe

present, small, entirely free. Anus situated about 1–1½ eye diameter in front of anal fin. Anal fin with 3 unbranched and 5½ branched rays; distal margin straight to slightly concave. Caudal fin with 8+8 (5) or 7+8 (or 8+7, difficult to count) branched rays; procurent rays cannot be counted; emarginate, lobes rounded, subequal.

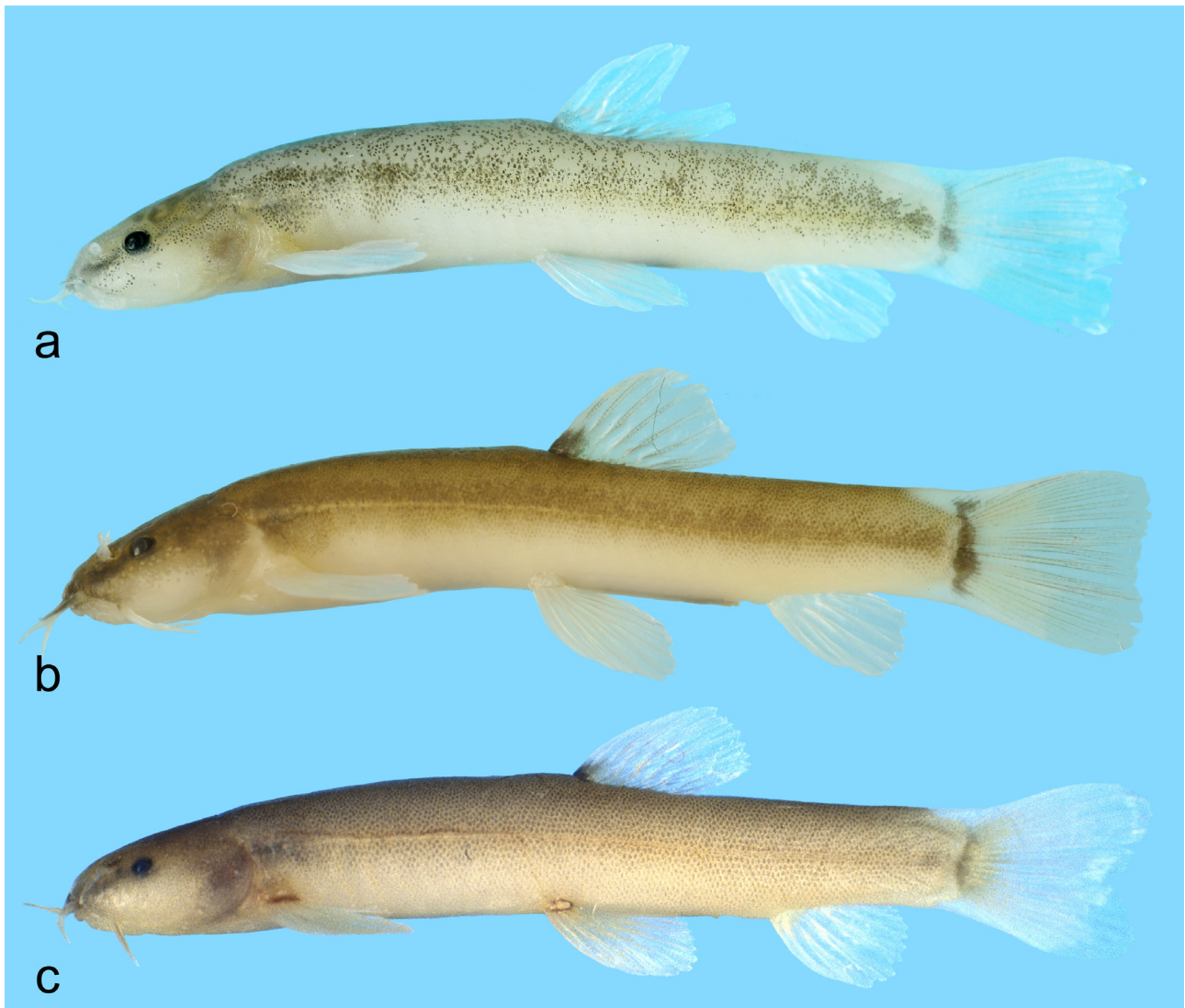


FIGURE 8. *Rhyacoschistura suber*, juveniles; **a**, CMK 23567, 19.3 mm SL; Laos: Nam Ngum watershed; **b**, CMK 22643, 28.7 mm SL; Laos: Nam Ngum watershed; and **c**, ZRC 45383, holotype, 29.7 mm SL; Laos: Nam Ngum–Nam Mang divide.

Body entirely covered by scales, including predorsal area and belly between pectoral-fin bases. All scales very distinct. Lateral line complete, with 115–130 pores. Cephalic lateral line system with 6 supraorbital, 4 + 10–11 infraorbital, 9–10 preoperculo-mandibular and 3 supratemporal pores.

Anterior nare pierced in front side of a pointed flap-like tube, tip reaching at least anterior margin of eye. Posterior nare adjacent to anterior one. Mouth arched, gape about 2–2.5 times wider than long (Fig. 11). Lips fleshy. Upper lip with median notch, with a few shallow wrinkles. Processus dentiformis present. Lower lip with wide median interruption; median part smooth, with 1–3 sulci, lateral part smooth or with small wrinkles. Tip of lower jaw not exposed. A median concavity in lower jaw. Inner rostral barbel reaching corner of mouth; outer one reaching vertical of middle of eye. Maxillary barbel reaching beyond middle of postorbital area.

Intestine with a loop behind stomach (Fig. 12a). Air bladder without posterior chamber in abdominal cavity. Two halves of bony capsule of anterior chamber of air bladder connected by a manubrium (Fig. 12b).

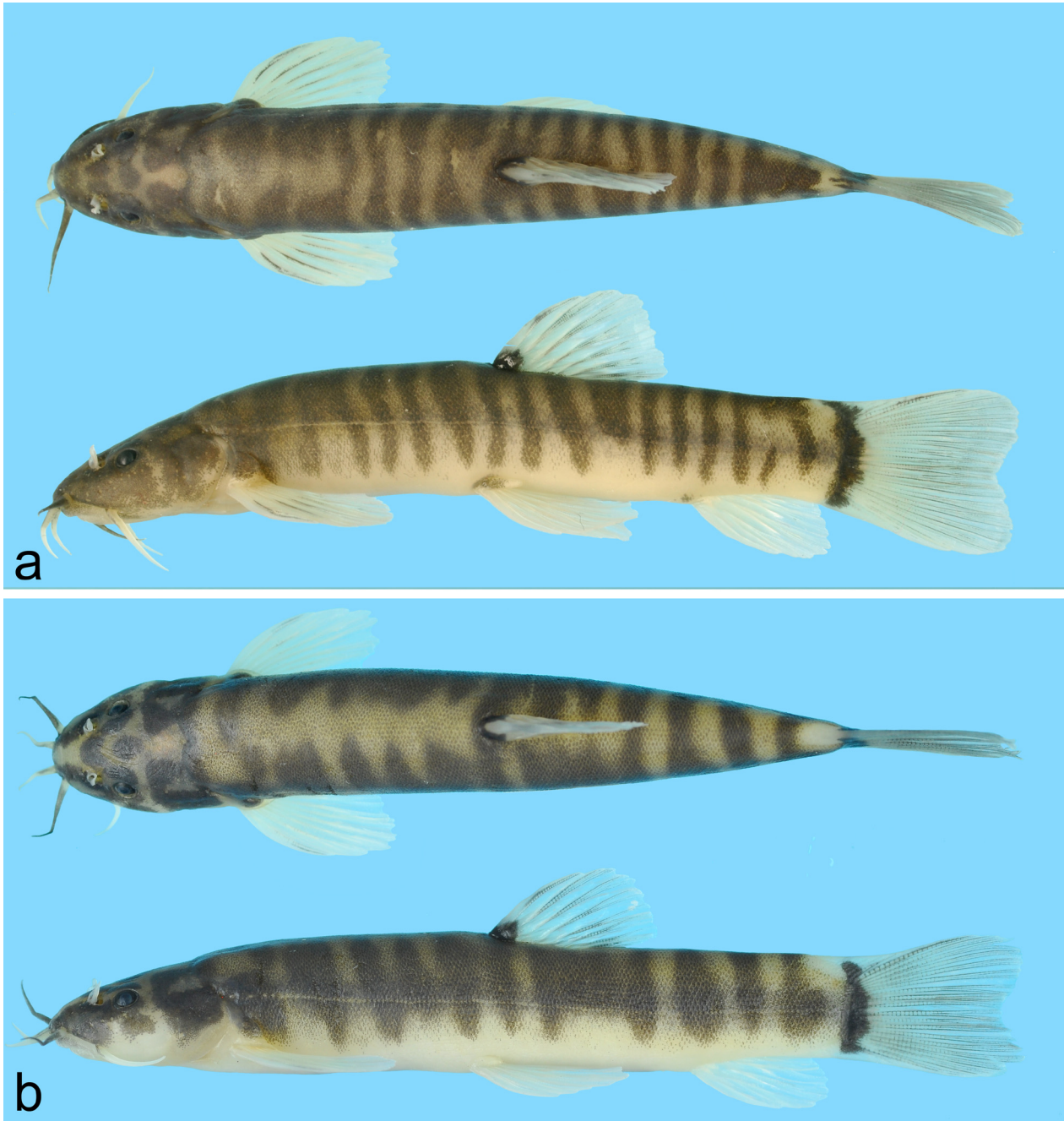


FIGURE 9. *Rhyacoschistura suber*, Laos: Nam Ngum watershed; **a**, CMK 22434, 51.5 mm SL; **b**, CMK 23567, 40.4 mm SL.

Sexual dimorphism. Males without suborbital flap, groove or slit. In males, pectoral fin rigid, slightly curled upwards (Fig. 13). Membrane between unbranched and first branched rays somewhat narrower distally than at mid-length. First branched ray about 4 times wider than adjacent rays. After branching point, anterior branch somewhat wider than posterior one, becoming narrower again at level of branching point of posterior branch. Anterior branch unbranched. Posterior branch branched again near tip. No membrane between branches. On dorsal surface of first branched ray, on whole length, small sharply pointed tubercles organised in irregular longitudinal rows, where ray is widest. Unculiferous pad along posterior margin of all rays and also along anterior margin of first branched ray. On posterior pad of first branched rays, numerous small tubercles, smaller than on rays.

Second branched ray: anterior branch unbranched, posterior branch branched again near tip. No membrane between branches. Unculiferous pad posterior to branched rays 2–3 with small tubercles, in largest specimens. Branched rays 3–8 branched twice; membrane narrow or absent between branching points 1 and 2.

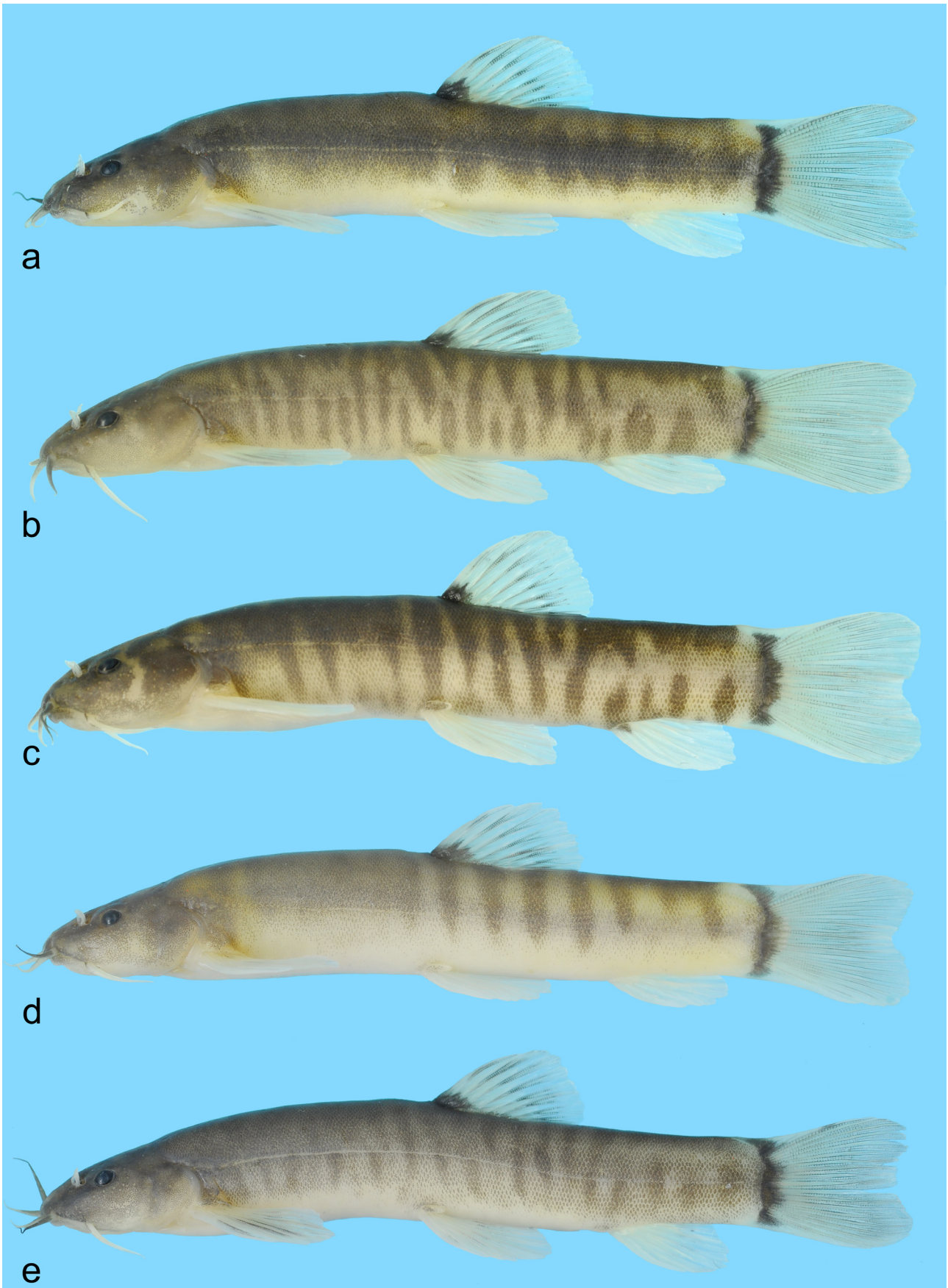


FIGURE 10. *Rhyacoschistura suber*, Laos: Nam Ngum watershed; **a**, CMK 23567, 41.6 mm SL; **b**, CMK 22522, 44.8 mm SL; **c**, CMK 22522, 49.2 mm SL; **d**, CMK 23567, 56.7 mm SL; **e**, CMK 23557, 59.0 mm SL.



FIGURE 11. *Rhyacoschistura suber*, CMK 23567, 62.8 mm SL; mouth.

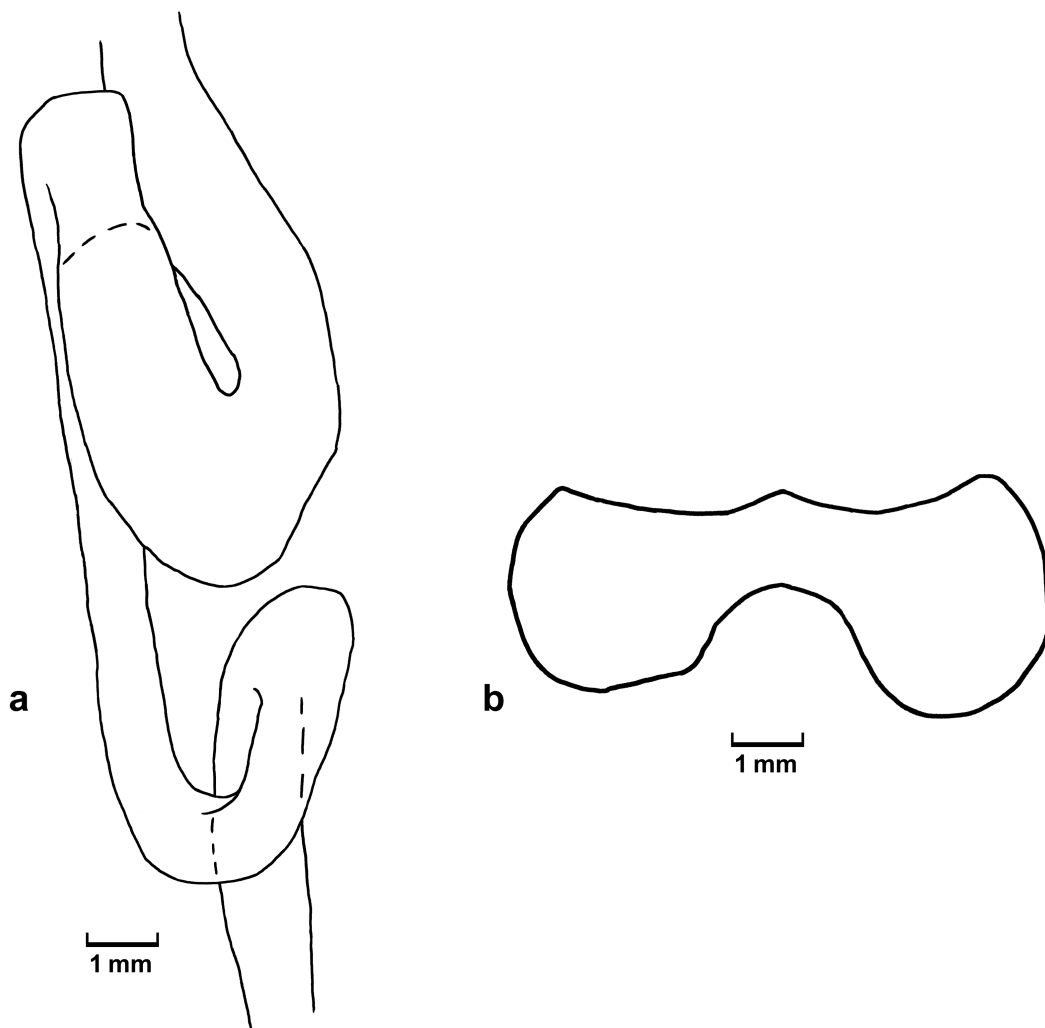


FIGURE 12. *Rhyacoschistura suber*, CMK 23567, 58.7 mm SL; **a**, digestive tract; **b**, air bladder capsule.

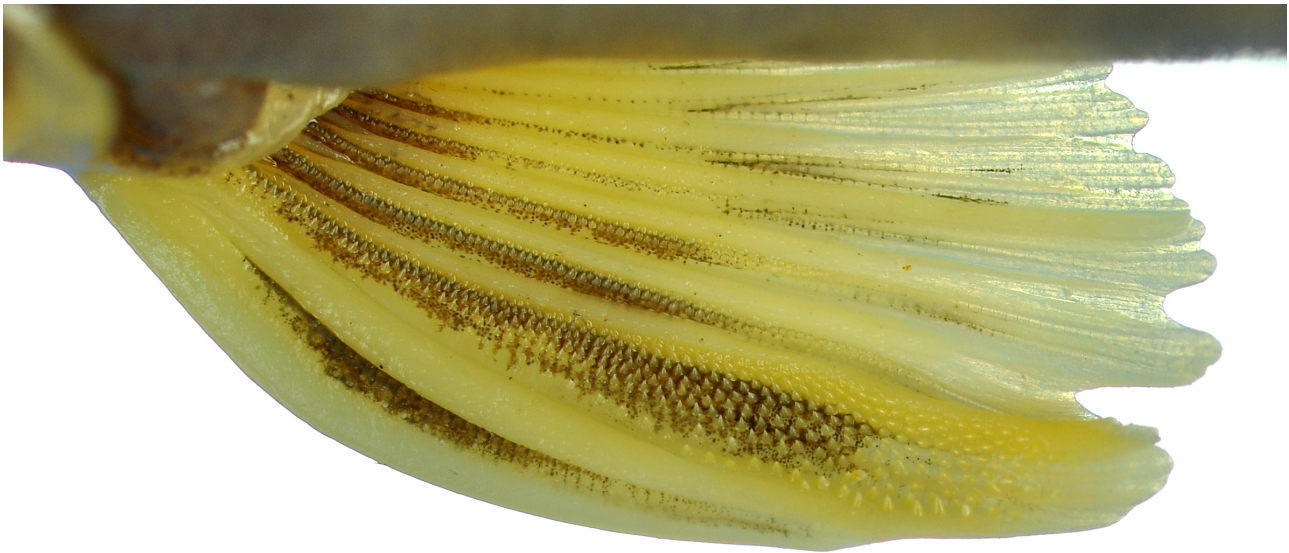


FIGURE 13. *Rhyacoschistura suber*, CMK 23567, 62.8 mm SL; left pectoral fin.

Tubercles observed only in specimens collected in late March, absent in specimens collected in February.

In female, first branched ray only slightly wider than adjacent rays; branching of rays as in males, but all rays and branches connected by membranes. No tubercles on rays and membranes.

Coloration. After 5 weeks in formalin (Figs. 8–10). Body background colour dark yellowish brown, throat, belly, lower part of caudal peduncle whitish; except otherwise stated, markings dark brown to blackish brown. In adults, dorsal surface of head mottled, very variable but leaving typically some of the following elements: a pale band between eyes, one behind and a longitudinal one on nape, enclosing a rounded dark blotch; a pale line in front of and between nostrils; and a median pale spot near tip of snout. Body with a very irregular bar pattern, with up to 16 slanted bars (usually 9–14), very irregularly set, sometimes partly fused (Fig. 10a), reaching dorsal midline or leaving a pale middorsal area (Fig. 9b), sometimes reaching to midventral area, sometimes extending upwards from midventral area, especially on caudal peduncle (Figs. 10b–c).

Pattern at caudal-fin base: broad, black, arched bar, reaching or almost reaching dorsal and ventral midlines. Posterior margin irregular; bar wider on base of simple rays and of median branched rays, leaving notches in between and at midheight.

Dorsal fin hyaline, with a black spot at base of unbranched rays and branched rays 1–2, and a rows of spots on rays, made of pigments near first branching point, and at midlength of last unbranched ray. Pectoral fin hyaline in female; males with dark pigments along posterior edge of unbranched and branched rays 1–2, forming elongate marks. Other fins hyaline.

Smallest specimens (about 25 mm SL; Fig. 8) plain beige to grey, with black basi-caudal bar and spot at base of anterior rays of dorsal fin. A dusky midlateral stripe appearing around 32–35 mm SL. Faint bars start developing, first along midlateral stripe, then extending to whole body depth.

In life: background pale brown on back, whitish on belly, with very contrasting bars.

Notes on biology. *Rhyacoschistura suber* inhabits the uppermost stretches of forest creeks, head waters and torrents, with fast and cool water, over stone to rock bottom (Fig. 14). It has occasionally been observed in larger rivers, near rapids.

Among dissected females, one (CMK 23567, 56.1 mm SL) obtained in late March had ripe ovaries with eggs 0.8 mm diameter. Females collected in February had no ripe ovaries. Stomach of dissected specimens contained larvae of aquatic insects about 1–2 mm long. Males collected in February had the modified pectoral-fin rays, but no tubercles were present. Tubercles are present only in specimens collected in late March. No samples have been obtained during other months.

Distribution. *Rhyacoschistura suber* has been observed in the Nam Ngum watershed, upstream of Nam Ngum

2 reservoir; it was not observed in other parts of the watershed, or on the Plain of Jars. The type series was obtained in 1997 in a tiny rivulet on the divide between the Nam Ngum and Nam Mang watersheds, apparently flowing to the Nam Mang watershed.



FIGURE 14. Unnamed creek entering Nam Ngum near planned Nam Ngum 3 powerhouse, Xaisomboun Province, Laos (site of CMK 22434); habitat of *Rhyacoschistura suber*; 11 February 2012.

Discussion

Schistura maejotigrina Suvarnaraksha, 2012, described from headwaters of the Chao Phraya west of Chiangmai (Thailand) apparently also belongs to *Rhyacoschistura*. The description is not very detailed, and there is no information on the pectoral fin rays in males and the air bladder, and information on the suborbital flap and lips is limited. Nevertheless, the general body shape, the emarginate caudal fin, the dorsal fin with a convex distal margin, the bar at caudal-fin base, the midlateral row of numerous short, narrow, very irregular bars, agree with the above diagnosis. It is distinguished by reportedly having 6–7½ branched dorsal-fin rays, and a pale yellowish brown body, with a midlateral row of irregular bars with a wavy stripe along their upper extremity in the anterior part of the flank. The very variable number of branched caudal-fin rays is unusual and suggests a possible problem in the way of counting them.

At least four species from north-eastern India are possibly related or belong to *Rhyacoschistura*: *S. manipurensis* (Hora, 1921), from the upper Chindwin, *S. maculosa* Lalronunga *et al.*, 2013 and *S. ferruginea* Lokeshwor & Vishwanath, 2013b, both from the Brahmaputra drainage, and *S. porocephala* Lokeshwor & Vishwanath, 2013a, from Koladyne drainage. They share the general body shape, the globulous suborbital flap, the emarginate caudal fin, the dorsal fin with a convex distal margin, the lower lip with a narrow medial frenum on each side, the bar at the caudal-fin base, and the lateral row of numerous narrow, irregular bars. These four species share a dorsal and caudal fin with rows of spots (vs. hyaline in *Rhyacoschistura*). Of them, I could examine only *S. manipurensis*. In the pectoral fin of males, the first branched ray is not wider than the other rays; branched ray 1 is branched only once

and there is no membrane between the branches; there are no tubercles on the dorsal surface of the rays; there are thick unculiferous pads on the membranes between rays 1–9; and the proximal part of branched rays 6–8 (of 11) is covered by thick muscular tissues on both sides, keeping the rays together. The unbranched ray of the pelvic fin is more rigid in males than in females (this is observed in many species of the family in South Asia). The specimens were not dissected to examine the air bladder chambers. The original descriptions of *S. maculosa*, *S. ferruginea* and *S. porocephala* do not provide information on the pectoral-fin rays, except that there are small tubercles on rays 1–6 in *P. maculosa*.

Considering the shared characters, *S. manipurensis*, *S. maculosa*, *S. ferruginea* and *S. porocephala* are tentatively placed in *Rhyacoschistura*, but their position should be re-evaluated when material becomes available for more detailed study; the genus name should be mentioned in quotation marks ('*Rhyacoschistura*'). With the present knowledge they clearly do not belong to *Schistura* or *Mustura*; besides *Schistura* presently includes a great variety of species and the real composition of the genus can be clarified only after good quality material of the type species (*S. rupecula*) becomes available from the type locality.

Comparison material. *Schistura manipurensis*: CMK 26616, 10; India: Manipur: Chakpi watershed.

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