

Three new species of loaches of the genus *Schistura* from the Nam Ngiep drainage, central Laos (Teleostei: Nemacheilidae)

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Abstract. Three new species of *Schistura* are described from the middle Nam Ngiep drainage, central Laos. *Schistura albisella*, new species, occurs in small tributaries, in very fast stretches; it is distinguished by its unique colour pattern of 10–14 irregular blackish bars over a greyish background, more or less completely covered by a broad dark-brown to black midlateral stripe and, above it, a thinner stripe between the head and below the dorsal-fin base; the bars and stripes leave a pattern of whitish saddles and spots along the back. *Schistura musa*, new species, was observed in the Nam Ngiep and the lower part of its tributaries on pebble to stone bottom along the shores, with moderate to fast current; it is distinguished by a very elongated body with a marked hump behind the head, a colour pattern usually made of 13–18 poorly contrasted and irregularly shaped vertically elongated marks, on lower part of flank, from below dorsal to caudal base, more contrasted posteriorly; some specimens are plain brown or have a clearer pattern of 17–19 bars; the marks may leave a pale stripe between their upper extremity and the darker dorsal midline; 8+7 branched caudal-fin rays; 7½ branched dorsal fin rays; and an incomplete lateral line. *Schistura crassa*, new species, was observed in the Nam Ngiep and its tributaries, among stones, in stretches with fast current; it is distinguished by a stout body and caudal peduncle, an incomplete lateral line, a dull brown body with 8–11 poorly contrasted bars, mainly as a midlateral row of irregular blotches overlaid on an inner axial stripe; largest specimens with a plain body. All three new species have a small size, less than 57 mm SL. All three are endangered by the construction of several dams on the Nam Ngiep.

Key words. Cobitoidei, *Schistura*, Mekong basin, stone loach

INTRODUCTION

Loaches of the genus *Schistura* typically occur in fast flowing waters of small streams as well as in other habitats such as large rivers and caves. The genus presently includes about 210 valid species (pers. obs., updated from Kottelat, 2012, 2013). The genus has its greatest diversity in Southeast Asia (Irrawaddy, Salween, Mae Klong, Chao Phraya, Mekong, and Red River drainages, and drainages in between) from where about 160 species have been described; most are described and figured in Kottelat (1990, 1998, 2000, 2001) and Freyhof & Serov (2001). Besides, new species are still regularly described (e.g., Bohlen & Šlechtová, 2010, 2013a, 2013b; Ou et al., 2011; Plongsesthee et al., 2013; Bohlen et al., 2014, 2016; Kottelat, 2017a–f). The interrelationships within *Schistura* have not been studied but accumulating morphological, molecular and distribution data unsurprisingly show that the genus is paraphyletic (pers. obs.; see also, e.g., Freyhof et al., 2016).

The Nam Ngiep is a river of central Laos flowing North–South from the hills fringing the east of the Plain of Jars at about 1,600 masl to the Mekong, which it enters near Pakxan. It flows about parallel to the Nam Xan to the East, which also enters the Mekong near Pakxan, about 7 km downriver of the mouth of the Nam Ngiep. To the west, the Nam Ngiep is adjacent to the Nam Ngum, which also flows from the Plain of Jars to the Mekong. The Nam Ngiep originates on the hills east of the Plain of Jars (where maps mention its headwaters as Nam Ngiou and Nam Ko). It first flows for about 20 km with a low gradient then descends through a very fast stretch for about 50 km (where it is also named Nam Chiap on maps). It then reaches an area of smoother landscape for about 20 km around Ban Naxong and Ban Thaviang and then enters 70 km of gorges and rapids before entering the plain, about 50 km before its confluence with the Mekong. The stretches in the gorges and most waterfalls have been or will be flooded by dams.

Very little has been published on the fishes of the Nam Ngiep, except en-passant mention of some species of the Plain of Jars and the description of *S. crabro* from an unspecified locality (Kottelat, 2000, 2001). There is possibly information in some environmental assessments, but these have not been made available. A survey of the fishes of the middle Nam Ngiep was conducted in 2013 in connection with the construction of the Nam Ngiep 1 hydropower scheme (which will flood the whole of the lower gorges and rapids). Fifty-six species

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were observed in a stretch corresponding to the upper 50 km of the high gradient stretch that will be flooded. Eight species were new or probably new to science at the time of the survey. Three new species of *Schistura* are described in the present article.

MATERIAL AND METHODS

Measurements and counts follow Kottelat (1990) and Kottelat & Freyhof (2007). 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 on the 1:100'000 topographic map (Service Géographique d'État, 1985, sheets E 48–15, 27, 28, 39, 40, 51, 52); names or spellings differing from the map are noted in square brackets, except for Nam Ngiep (Nam Gniap on map).

Abbreviations used: CMK, collection of the author; MHNG, Muséum d'Histoire naturelle, Genève; and ZRC, Lee Kong Chian Natural History Museum, National University of Singapore, Singapore.

Schistura albisella, new species (Figs. 1–4)

Holotype. MHNG 2768.031, 37.2 mm SL; Laos: Saysomboune Province: Khon District: Nam Ngiep drainage: Houay Hok, a small creek entering Nam Ngiep, about 3.5 km south of Ban Soppouan on road to Ban Sopyouak, 18°44'57"N 103°25'28"E, 261 masl; M. Kottelat et al., 31 Jan 2014.

Paratypes. CMK 24358, 32, 22.7–42.9 mm SL (+6 ethanol-fixed); ZRC 56445, 5, 30.2–35.9 mm SL; same data as holotype. — CMK 24454, 27, 24.9–43.7 mm SL (+ 3 ethanol-fixed); Laos: Saysomboune Province: Khon District: Nam Ngiep drainage: Houay Kolong, first creek crossing road from Ban Houaysey to Ban Nam Youak, 18°43'32"N 103°21'20"E, 415 masl; M. Kottelat et al., 14 Feb 2014. — CMK 24729, 1 (ethanol-fixed); Laos: Saysomboune Province: Khon District: Nam Ngiep drainage: Nam Youak [Nam Gnok] between Ban Nam Youak and Ban Houaysey, 18°43'27"N 103°22'39"E, 304 masl; M. Kottelat et al., 14 Feb 2014.

Diagnosis. *Schistura albisella* is distinguished from the other species of the genus by its unique colour pattern: a broad dark-brown to black midlateral stripe; above it, a thinner stripe from head to below dorsal-fin base; 10–14 very irregular bars, reaching dorsal midline; bars and stripes leaving a pattern of whitish saddles and spots along back; stripes become broader in larger specimens and may cover most saddles. The following additional characters, not unique, may be useful for identification: a vertically elongated black blotch at caudal-fin base; pelvic-fin origin in front of anal-fin origin; no visible sexual dimorphism; caudal fin forked, with 9+8 branched rays; 7½ branched dorsal-fin rays; 9–10 pectoral-fin rays; lateral line complete, usually interrupted several times where scales are deeply



Fig. 1. *Schistura albisella*, MHNG 2768.031, holotype, 37.2 mm SL; Laos: Saysomboune Province: Nam Ngiep drainage.



Fig. 2. *Schistura albisella*; Laos: Saysomboune Province: Nam Ngiep drainage; a, CMK 24358, 29.2 mm SL, right side, reversed; b, CMK 24454, 42.3 mm SL.

embedded; body entirely scaled, except between pectoral-fin bases; axillary pelvic lobe present; both lips fleshy; upper lip with a shallow or without median notch and with fine, shallow furrows; lower lip with narrow median interruption; median part with a few shallow sulci, lateral part smooth.

Description. See Figs. 1–4 for general appearance and Table 1 for morphometric data of holotype and 11 paratypes. A moderately elongate nemacheilid with body depth slowly increasing up to slightly in front of dorsal-fin origin. Behind dorsal fin, body depth decreasing slowly until anal-fin origin, then depth about constant to caudal-fin base. Dorsal profile continuous between head and body. Head depressed; body slightly compressed anteriorly to compressed posteriorly. Interorbital area slightly convex. In lateral view, eye flush with dorsal profile of head. Cheeks not swollen. Snout rounded. Caudal peduncle 1.2–1.6 times longer than deep, of uniform depth. Low dorsal ridge on posterior 1/5 of post-

Table 1. Morphometric data of holotype and 11 paratypes of *Schistura albisella*. Range and mean include holotype data.

	Holotype	Range	Mean
Standard length (mm)	37.2	35.8–43.7	
Total length (mm)	45.0	44.3–52.6	
In percent of standard length			
Total length	120.9	118.6–123.7	120.9
Head length (dorsal)	22.1	20.9–23.1	21.9
Head length (lateral)	24.2	22.8–25.8	24.2
Predorsal length	56.5	54.4–57.2	56.0
Prepelvic length	51.8	49.5–51.8	50.7
Pre-anus length	73.0	71.1–73.8	72.4
Pre-anal length	77.1	76.3–79.2	77.6
Head depth	12.3	10.6–12.5	11.6
Body depth at dorsal-fin origin	16.9	15.2–19.0	16.6
Depth of caudal peduncle	12.1	11.3–12.9	12.1
Length of caudal peduncle	14.9	14.6–16.3	15.6
Head width	16.2	14.6–16.4	15.5
Body width at dorsal-fin origin	13.3	10.8–14.9	13.0
Snout length	8.9	8.8–10.1	9.5
Eye diameter	4.1	3.9–4.7	4.3
Interorbital width	6.7	6.6–8.0	7.1
Length of dorsal fin	18.5	16.7–19.1	18.0
Length of upper caudal-fin lobe	21.8	20.0–22.9	21.2
Length of median caudal-fin rays	16.9	14.9–18.3	16.7
Length of lower caudal-fin lobe	21.6	19.4–22.7	20.7
Length of anal fin	18.3	16.1–19.4	17.5
Length of pelvic fin	18.2	16.5–18.8	17.9
Length of pectoral fin	19.8	17.0–21.3	19.9
In percent of dorsal head length			
Snout length	40	40–46	43
Eye diameter	18	18–22	19
Interorbital width	30	29–35	33
In percent of lateral head length			
Snout length	37	37–43	39
Eye diameter	17	16–19	18
Interorbital width	28	26–35	30

dorsal area. Low ventral ridge on posterior half of caudal peduncle. Dorsal ridge continuous with upper margin of caudal fin. Largest recorded size 43.7 mm SL.

Dorsal fin with 4 unbranched and 7½ (12*) branched rays; distal margin strongly convex; second branched ray longest; origin above base of 1st to 3rd branched pelvic-fin rays. Pectoral fin with 1 unbranched and 9 (2) or 10 (10*) branched rays (including small last ray, usually unbranched), rounded, reaching about two thirds of distance to pelvic-fin base. Pelvic fin with 1 unbranched and 7 (12*) branched rays (including small last ray, usually unbranched); reaching up to 2/3 of distance to anus; triangular, posterior margin convex; origin in front of dorsal-fin origin. Axillary lobe present, free. Anus situated about 1–1½ eye diameter in front of anal fin. Anal fin with 3 unbranched and 5½ (12*) branched rays; distal margin straight. Caudal fin with 9+8 (11) or 8+8 (1*); but 1 dorsal procurrent ray at upper extremity



Fig. 3. *Schistura albisella*, CMK 24358, 42.9 mm SL; Laos: Saysomboune Province: Nam Ngiep drainage.

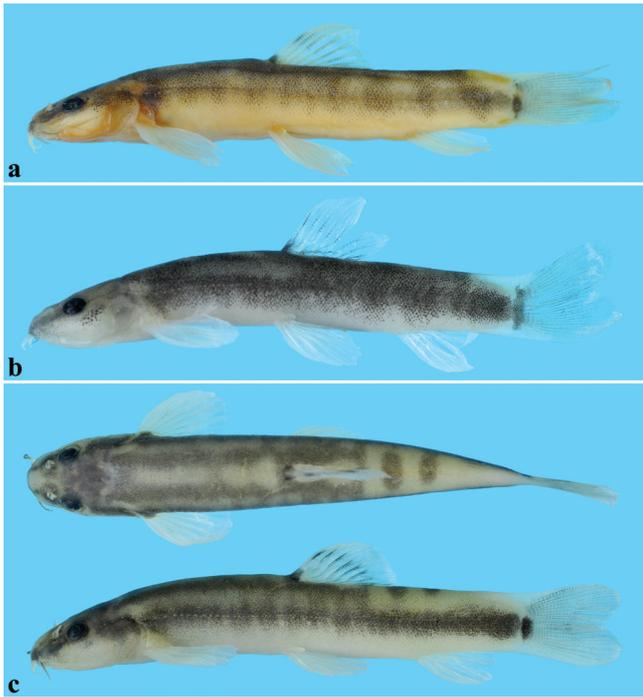


Fig. 4. *Schistura albisella*, juvenile colour pattern; Laos: Saysomboune Province: Nam Ngiep drainage; a, CMK 24454, 24.9 mm SL; b, CMK 22358, 22.5 mm SL; c, CMK 24454, 32.8 mm SL.

analogous to ‘missing’ branched ray); 7–9 dorsal and 5–6 ventral procurrent rays (approximate numbers, counted with transmitted light); forked, lobes rounded, subequal, lower one slightly longer.

On pectoral fin, thick unculiferous pad (sensu Conway et al., 2012) along anterior edge of unbranched ray; on dorsal side an unculiferous pad on each membranes between unbranched ray and branched ray 3, including between branches; on ventral side, an unculiferous pad below each ray. On pelvic fin, an unculiferous pad along anterior edge of unbranched ray; no pad on dorsal side; on ventral side, an unculiferous pad below simple ray and branched rays 1–2. On anal fin, an unculiferous pad along anterior edge of last unbranched ray.

Body entirely covered by scales, except on belly between pectoral-fin bases. Scales deeply embedded, especially anteriorly. In largest specimens, deeply embedded on whole body. Lateral line complete in most specimens, ending a few scales before caudal-fin base, but usually not visible externally in areas where scales most deeply embedded, especially between tip of pectoral fin and above base of anal-fin; sometimes incomplete; with 40–98 pores. Cephalic lateral line system with 6 supraorbital, 4 + 10–12 infraorbital, 9–10 preoperculo-mandibular and 3 supratemporal pores.

Anterior nostril pierced in front side of a pointed flap-like tube (not reaching eye). Posterior nostril adjacent to anterior one. Mouth arched, gape about 2–3 times wider than long (Fig. 5). Lips thick, smooth. Upper lip with a shallow or without median notch and with fine, shallow furrows, edge straight. Processus dentiformis present. Lower lip with narrow median interruption; median part with a few shallow sulci, lateral part smooth. Tip of lower jaw not exposed. No



Fig. 5. *Schistura albisella*, CMK 24358, 42.9 mm SL; mouth.

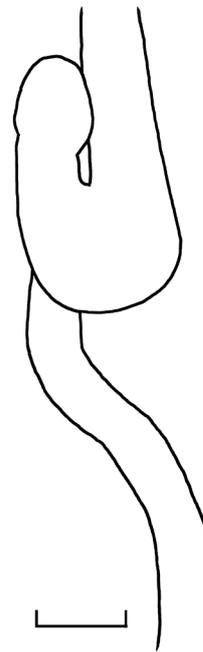


Fig. 6. *Schistura albisella*, CMK 24358, 35.1 mm SL; digestive tract. Scale bar = 1 mm.

median notch in lower jaw. Inner rostral barbel not reaching corner of mouth; outer one reaching at most to base of maxillary barbel. Maxillary barbel reaching at most vertical of posterior margin of eye. Stomach relatively small, narrow (not much wider than intestine); intestine almost straight behind stomach (Fig. 6). Air bladder without posterior chamber in abdominal cavity.

Sexual dimorphism. None observed. Ripe females deeper bodied.

Coloration. After one month in formalin. Head and body background colour pale yellowish to grey; throat, belly, lower part of caudal peduncle whitish; except otherwise stated, markings dark brown to black. Sides of head brown with pale areas behind and below eye, on opercle and above posterior branch of infraorbital canal. Top of head and snout pale, with irregular transverse band between nostrils, between eyes and on nape, extending on side behind eye (but leaving tip of occiput pale). Body with about 10–14



Fig. 7. Houay Kolong, tributary of Nam Ngiep, Saysomboune Province, Laos; habitat of *Schistura albisella*; 14 February 2014. Arrows indicate typical position of the fish.

very irregular bars, superimposed and poorly contrasted with a broad midlateral stripe; bars extending to middorsal area and meeting contralaterals. Broad midlateral stripe (width about equal to 2 eye diameters, from gill opening to end of caudal peduncle, not extending on caudal fin. Median area of stripe deep black, upper and lower edges made of less densely-set, dark brown pigments. A second stripe from head until below dorsal-fin base between midlateral stripe and dorsal midline. Stripes and bars leaving a row of 3–5 more or less round pale saddles in predorsal area, sometimes flanked by a row of pale spots on each side (Figs. 1, 2b), and 3–4 transverse pale saddles on back (predorsal saddles less contrasted than postdorsal ones, last saddle about white). With increasing size, stripes becoming wider and covering most of flank, pale patches in predorsal area becoming indistinct, saddle in postdorsal area becoming indistinct except for last 1 or 2. In most extreme cases, only 1 pale triangular patch remaining at upper and lower extremity of end of caudal peduncle (Fig. 3).

Pattern at caudal-fin base: a small vertically-elongated deep black spot corresponding to width and intensity with black part of midlateral stripe, separated from it by a narrow line without pigments. Overimposed, a vertically elongated blotch of less densely set dark brown pigments, between bases of last upper and last lower caudal procurrent rays. Black pigments on basal part of uppermost and lowermost 4–5 principal rays. Pale triangles at upper and lower extremities of caudal-fin base very contrasted between blotch and midlateral stripe.

Dorsal fin hyaline, with a small black spot at base of simple rays and first branched ray, a low elongated blotch at base of branched rays 3–7 (not in all specimens) and a small orange spot between them; distal half of unbranched rays 3–4 black; a row of elongated spots on rays made of pigments on rays and of dusky membranes between main branches. Caudal fin hyaline; besides pattern at base (see above), black pigments along rays and between segments of all rays, denser (especially between branches). Anal fin hyaline; a small spot at base of unbranched rays (in some specimens); distal half of last unbranched ray dark grey to black; a row of elongated spots made of pigments on rays. Pectoral and pelvic fins hyaline; a row of elongated spots

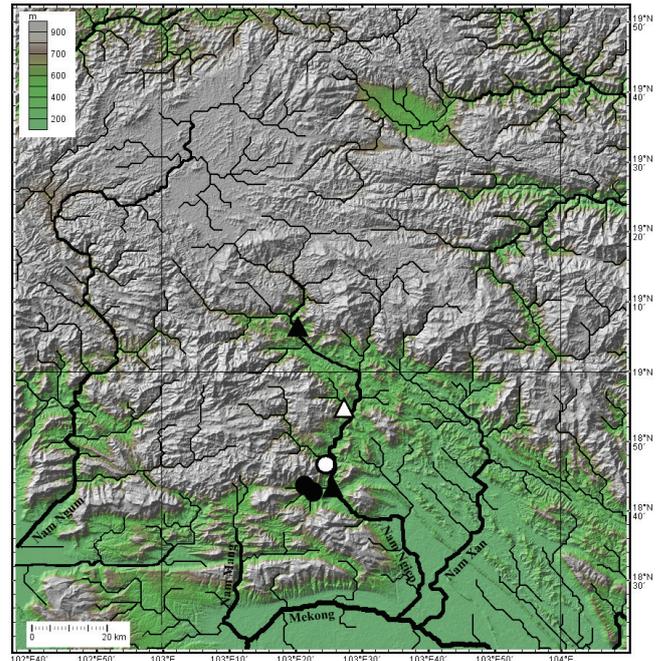


Fig. 8. Laos: Nam Ngum, Nam Ngiep and Nam Xan drainages, showing distribution of *Schistura albisella* (circles) and *S. musa* (triangles). Open symbols: type localities.

made of pigments on rays. Base of pectoral, pelvic and anal fins orange.

Juveniles (Fig. 4): In smallest specimens (22–32 mm SL), bars very irregular, faint; black dot at caudal-fin base distinct. Midlateral stripe faint, more distinct on caudal peduncle, where pale patch along dorsal midline in front of caudal fin already distinct. In larger juveniles, bars becoming less distinct, merging with stripes, leaving only pale middorsal area between them.

In life (from photographs of freshly caught specimens): all marks dark brown, posterior third of midlateral stripe and blotch at caudal-fin base black. Saddles cream to yellowish brown. Pectoral and pelvic fins yellow to orange; anal and caudal fins pale orange; dorsal fin with orange spot at base of branched ray 2; tip of unbranched rays 3–4 and branched rays 1–3 and membranes inbetween orange.

Notes on biology. A female with distended belly (CMK 24358, 41.7 mm SL) had ripe ovaries with yellow eggs 2.1 mm diameter. The stomach of a dissected male 35.1 mm SL was empty but the intestine was filled with remains of unidentifiable insects. *Schistura albisella* was collected in head waters and small streams, in fast to very fast water, with small cascades (Fig. 7). It was usually found at the places with the strongest current, near the largest stones, or at the edge of cascades.

Distribution. *Schistura albisella* is presently known only from small tributaries of the Nam Ngiep near Ban Soppouan and Ban Sopyouak (Fig. 8). It is probably more widely distributed in the Nam Ngiep drainage, but this is the only area where roads and safety allowed to access headwaters with steep gradient.

Etymology. From the Latin *albus* (white) and *sella* (saddle), reference to the whitish marks along the back. A noun in apposition.

Remarks. The pattern of a stipe overimposed on bars and leaving a series of whitish saddles is unique among *Schistura* s.l. A few specimens of some populations of *S. dorsizona* may have a reminiscent pattern (Fig. 9). *Schistura dorsizona* is found in the Mekong drainage from the Xe Kong northwards to the Nam Ngum drainages, including the Nam Ngiep, but the two species are not syntopic. *Schistura dorsizona* is found in streams with slower current, over a bottom of gravel and pebble of mixed colours. Usually, adult *S. dorsizona* have a pattern made of 6–12 black saddles, which extend downwards until about midheight of the body, on a whitish to yellowish-brown background. Sometimes the saddles are divided along the dorsal midline, or may be in contact laterally, leaving a pale middorsal stripe or a row of pale blotches. A midlateral stripe is present, front the tip of the snout to the caudal-fin base, from very faint to black, sometimes very wide and covering most of the upper half of the flank (Fig. 9a). In some of the largest specimens, the saddles and the stripe are wider and occupy most of the upper 2/3 of the flank, except for a narrow middorsal pale stripe or a row of small pale blotches (Fig. 9b). Further studies may show that *S. dorsizona* in fact includes several species.

Schistura albisella differs from *S. dorsizona* in having, among others, the black spot at caudal-fin base narrow and vertically elongated (vs. broad, triangular or diamond shaped), no conspicuous black marks on caudal fin (vs. usually one or two vertical rows of black spots), bars narrow, often indistinct and very irregular (vs. saddles broad, conspicuous and regularly shaped), lower third of body dark grey, becoming increasingly paler downwards, almost totally black in large adults (vs. unmarked, pale yellowish white, sharply contrasted with background colour above midlateral stripe), $7\frac{1}{2}$ branched dorsal-fin rays (vs. $8\frac{1}{2}$), a stouter caudal peduncle (its depth 1.2–1.6 times in SL vs. 1.9–2.1) and a somewhat stouter body (depth 15.2–19.0% SL vs. 12.7–16.9).

Conservation status. *Schistura albisella* was observed in 2014 at three localities in two tributaries of the Nam Ngiep, in stretches with swift current, including far upstream in a headwater. Two of these sites will be flooded by the Nam Ngiep 1 reservoir and one is far above the reservoir level (320 masl). It is expected to be present further up in other tributaries, as well as in unsurveyed parts of the Nam Ngiep drainage. Because of access difficulties and serious security reasons it was not possible to sample other streams with similar fast stretches. Because of its apparent preference for swift headwaters, *S. albisella* is expected to be present in other headwaters in adjacent areas of the drainage with same topography, but its presence remains to be demonstrated. Awaiting more information on its distribution, *S. albisella* probably qualifies to the Data Deficient category under IUCN criteria (IUCN, 2001). Further studies will probably assess it as Near Threatened or Least Concern, especially if part of its habitat is kept intact in a conservation area.



Fig. 9. *Schistura dorsizona*, CMK 24525, Laos: Nam Ngiep drainage; a, 32.6 mm SL; b, 42.2 mm SL.

***Schistura musa*, new species**
(Figs. 10–11)

Holotype. MHNG 2768.032, 42.3 mm SL; Laos: Saysomboune Prov.: Nam Ngiep drainage: Nam Khai [Nam Mang], immediately upstream of confluence with Nam Ngiep, about 22 km downstream of Ban Pou, 19 km upstream of Ban Soppouan; 286 masl, 18°53'49"N 103°28'22"E; M. Kottelat et al., 30 Jan 2014.

Paratypes. CMK 24319, 12, 25.8–38.5 mm SL (+ 3 ethanol-fixed); ZRC 56446, 5, 26.7–32.5 mm SL; same data as holotype. — CMK 24365, 1, 41.3 mm SL; Laos: Saysomboune Prov.: Nam Ngiep drainage: Khon District: Nam Pouan [Nam Phouan], upstream of Ban Soppouan, about 300 m upstream of confluence with Nam Ngiep, 244 masl, 18°46'57"N 103°25'58"E; M. Kottelat et al., 31 Jan 2014. — CMK 24496, 2, 27.3–29.2 mm SL (+ 1 ethanol-fixed); Laos: Xiangkhouang Prov.: Thathom District: Nam Ngiep north of Ban Naxong, 337 masl, 19°03'24"N 103°22'06"E; M. Kottelat et al., 17 Feb 2014.

Additional material (non type). CMK 26647, 1, 43.2 mm SL; Laos: Bolikhamsai Prov.: Nam Ngiep drainage, mixed localities; K. Vatthanatham, March 1999.

Diagnosis. *Schistura musa* seems related to *S. thavonei* with which it shares characters that distinguish them from all other species of the genus in Southeast Asia, like the very elongated body, with a marked hump behind the head (depth at dorsal-fin origin 6.2–8.1 times in its length) and the colour pattern including a pale stripe from the upper extremity of the gill opening to the upper half of the base of the caudal fin (not distinct in all specimens). The black pattern at the base of the caudal fin is made of two asymmetrical slanted marks, one on the base of each lobe, and in front of them a contrasted patch without any pigment extending from dorsal to ventral midlines. Other shared characters useful to



Fig. 10. *Schistura musa*, MHNG 2768.032, holotype, 42.3 mm SL; Laos: Saysomboune Prov.: Nam Ngiep drainage: Nam Khai; right side, reversed.

distinguish them from other species of *Schistura* are: male without suborbital flap; 8+7 branched caudal-fin rays; 7½ branched dorsal fin rays; 9–10 pectoral-fin rays; lateral line incomplete, reaching at most to above anal-fin base.

Schistura musa is distinguished from *S. thavonei* by its colour pattern. In *S. musa*, the body is usually dull brown; most specimens do not have a clear pattern. Those with a pattern have 13–18 poorly contrasted and very irregularly shaped vertically elongated marks, on lower ½ to 2/3 of flank, from below dorsal fin to caudal-fin base; they become more contrasted posteriorly. In some specimens, a clear barred pattern is present, with 8–9 predorsal bars and 8–10 below and behind dorsal fin. In some specimens, the bars leave a pale stripe between their upper extremity and the darker dorsal midline. In *S. thavonei*, the colour pattern is made of two broad dark brown stripes (one middorsal, one midlateral) and between them a pale yellowish-brown stripe from the upper extremity of the gill opening to the upper half of the base of the caudal fin; overimposed to the midlateral stripe, a row of 12–24 short black bars, located increasingly lower on the flank from head to tail, posteriormost ones restricted to the lower half of the body or forming blotches along the ventral midline of the caudal peduncle.

Description. See Figs. 10–11 for general appearance and Table 2 for morphometric data of holotype and 6 paratypes. An elongate nemacheilid with body depth increasing up to about midway between occiput and dorsal-fin origin, then decreasing until end of dorsal-fin base, then slightly increasing immediately behind dorsal fin, then tapering to caudal-fin base. Dorsal profile with a concavity between head and body and immediately behind dorsal-fin base. Head slightly depressed; body slightly compressed anteriorly to compressed posteriorly. Interorbital area arched, with a shallow groove above eye. In lateral view, eye flush with dorsal profile of head. Cheeks slightly swollen in holotype. Head and snout pointed in lateral view. Caudal peduncle, slightly tapering posteriorly, depth 1.6–1.8 times in its length. Low dorsal keel on posterior ¼ of post-dorsal area. Low ventral keel on entire length of caudal peduncle. Dorsal keel separated from



Fig. 11. *Schistura musa*, CMK 24319, paratypes; Laos: Saysomboune Prov.: Nam Ngiep drainage: Nam Khai; a, 31.3 mm SL; b, 38.5 mm SL.

caudal-fin base by a marked concavity. Largest recorded size 42.3 mm SL.

Dorsal fin with 4 unbranched and 7½ (7*) branched rays; distal margin straight to slightly convex; first or second branched ray longest. Pectoral fin with 1 unbranched and 8 (7*) branched rays (including small last ray, usually unbranched), rounded, reaching about one third of distance to pelvic-fin base. Axillary pectoral lobe present. Pelvic fin with 1 unbranched and 5 (1) or 6 (6*) branched rays (including small last ray, usually unbranched); reaching about ½ to 2/3 of distance to anus; rounded; origin slightly in front of dorsal-fin origin. Axillary pelvic lobe present, free. Anus situated about 1.5–3 eye diameter in front of anal fin. Anal fin with 3 unbranched and 5½ (7*) branched rays; distal margin straight to slightly convex. Caudal fin with 8+7 (6) or 8+6 (1*, lowermost ray damaged, was probably two branched rays); about 3–5 dorsal and 3–4 ventral procurvent rays (cannot be counted with accuracy); forked, lobes rounded, subequal, lower lobe slightly longer than upper one.

On pectoral fin, thick unculiferous pad (sensu Conway et al., 2012) along anterior edge of unbranched ray; on dorsal side a pad on each membrane along posterior edge of unbranched ray and branched rays 1–4; on ventral side, a pad on membranes along anterior edge of branched rays 1–4. On pelvic fin, a pad along anterior edge of unbranched ray; on dorsal side a pad on membranes along posterior edge of branched rays 1–3; on ventral side, a pad on membranes along anterior edge of branched rays 1–3. On anal fin, a pad along anterior edge of last unbranched ray.

Body covered by scales except on belly in front of anus or pelvic-fin base. In largest specimens scales in predorsal area sparsely distributed, missing in smaller specimens. Scales deeply embedded. Lateral line incomplete, often interrupted, reaching between pelvic-fin base and middle of caudal peduncle (posterior extent increasing with size), with 40–91 pores (difficult to count with accuracy because of gaps). Cephalic lateral line system with 5–6 supraorbital, 4 + 9–10 infraorbital, 9 preoperculo-mandibular and 3 supratemporal pores.

Table 2. Morphometric data of type material of *Schistura musa* (n=7). Range and mean include holotype data.

	Holotype	Range	Mean
Standard length (mm)	42.3	30.4–42.3	
Total length (mm)	49.7	35.5–49.7	
In percent of standard length			
Total length	117.6	113.3–119.9	117.0
Head length (dorsal)	17.8	17.8–19.6	18.8
Head length (lateral)	20.8	20.4–22.3	21.3
Predorsal length	52.8	50.6–55.5	52.6
Prepelvic length	49.8	48.2–51.9	50.0
Pre-anus length	67.2	67.2–71.7	69.2
Pre-anal length	74.2	73.5–77.1	75.6
Head depth	9.6	8.5–9.6	9.0
Body depth at dorsal-fin origin	13.5	12.3–14.5	13.1
Depth of caudal peduncle	10.2	9.0–10.5	9.9
Length of caudal peduncle	16.6	15.3–16.6	16.0
Head width	11.8	11.0–12.5	11.7
Body width at dorsal-fin origin	10.9	9.8–12.2	10.7
Snout length	8.2	7.5–8.4	8.1
Eye diameter	2.4	2.4–3.5	3.0
Interorbital width	4.9	4.9–6.0	5.6
Length of dorsal fin	14.9	13.5–15.8	14.8
Length of upper caudal-fin lobe	16.9	16.8–18.1	17.4
Length of median caudal-fin rays	12.2	12.2–15.8	13.7
Length of lower caudal-fin lobe	17.0	16.9–20.0	17.7
Length of anal fin	13.2	13.0–15.9	14.0
Length of pelvic fin	13.3	12.8–14.4	13.6
Length of pectoral fin	15.0	13.8–15.9	14.9
In percent of dorsal head length			
Snout length	46	40–46	43
Eye diameter	14	14–18	16
Interorbital width	28	28–31	29
In percent of lateral head length			
Snout length	39	35–4y	38
Eye diameter	12	12–17	14
Interorbital width	24	24–27	26

Anterior naris pierced in front side of a flap-like tube. Posterior naris adjacent to anterior one. Mouth arched, gape about 2–3 times wider than long (Fig. 12). Lips thin. Upper lip with median notch (small to conspicuous), without furrows, edge not crenulated. Processus dentiformis present. Lower lip with median interruption; median part with 1–3 sulci, lateral part smooth. Tip of lower jaw not exposed. No median notch or concavity at tip of lower jaw. Inner rostral barbel not reaching base of maxillary barbel; outer one reaching vertical of posterior nare. Maxillary barbel reaching at most vertical of anterior half of eye. Intestine almost straight behind stomach (Fig. 13). Air bladder without posterior chamber in abdominal cavity.

Sexual dimorphism. None observed, but in holotype (largest specimen), the first branched ray of the pectoral fin is clearly thicker (especially the branches) than the other rays and than in other specimens. Thickened pectoral-fin rays are observed



Fig. 12. *Schistura musa*, MHNG 2768.032, holotype, 42.3 mm SL; mouth.

in males of many nemacheilids and are potentially sexually dimorphic in *S. musa* too. No specimen with suborbital flap, groove or slit.

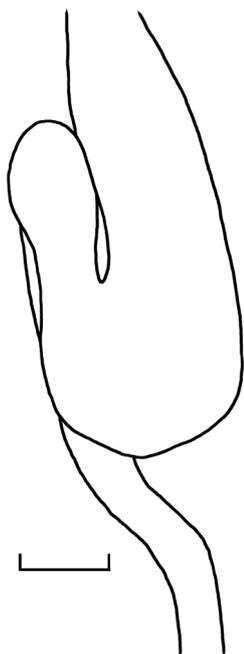


Fig. 13. *Schistura musa*, CMK 24319, 29.0 mm SL; digestive tract. Scale bar = 1 mm.

Coloration. After 6 weeks in formalin. Head and body background colour pale brown, throat, belly, lower part of caudal peduncle pale yellowish brown; except otherwise stated, markings darker brown. Head without pattern. In most specimens body without clear pattern. A row of 13–18 poorly contrasted and very irregularly shaped vertically elongated marks, on lower $\frac{1}{2}$ to $\frac{2}{3}$ of flank, from below dorsal fin to caudal-fin base; becoming more contrasted posteriorly (Fig. 11). In four largest specimens, a clear barred pattern, with 8–9 predorsal bars and 8–10 below and behind dorsal-fin, wider than interspaces (Fig. 10). Postdorsal bars wider than predorsal ones, and appearing as resulting from merging of several of the irregular marks of smaller individuals. Predorsal bars increasingly less distinct anteriorly. Postdorsal bars not reaching dorsal and ventral midlines. Anterior bars merged into colour of back. In some specimens, bars leaving a pale stripe between their upper extremity and darker dorsal midline (Fig. 11). A wide inner axial stripe present on posterior half of body in some specimens.

Black pattern at caudal-fin base: last bar on caudal peduncle separated from caudal-fin base by a narrow yellowish space, leaving a vertical band devoid of any pigment. On upper half of base: a patch of black deep pigments on basal part of upper 4–5 principal rays and on last 2 procurrent rays (on rays only, not on fleshy base of fin). Anterior edge usually more posterior than that of patch on lower half of fin. On lower half: a patch of black deep pigments on basal part of lower 3–4 principal rays. A roundish spot of small black pigments at middle of base of fin, about $\frac{1}{4}$ of its depth, in two largest specimens merged with or overimposed on last bar of caudal peduncle (Fig. 10). Posterior part of dorsal keel dark brown, leaving a vertical unpigmented patch running from concavity between keel and caudal fin, in front and/or behind dark spot and to ventral mid-line.



Fig. 14. Nam Khai, Nam Ngiep drainage, Saysomboune Province, Laos; type locality of *Schistura musa*; 30 January 2014.



Fig. 15. Nam Pouan, tributary of Nam Ngiep, Saysomboune Province, Laos; habitat of *Schistura crassa* (type locality) and *S. musa*; 31 January 2014.

Dorsal fin hyaline, with a small black spot at base of simple rays and first branched ray, continued as a low dark grey band along whole base of fin. Black pigment on each branched ray around branching point and on distal half of last unbranched ray. In holotype, a patch of black pigments on membranes between last unbranched rays and branched ray 3, on one or the other side. Caudal fin hyaline, with pigments along edges of all rays. Anal, pelvic and pectoral fins hyaline, with a few pigments near branching points of branched rays.

Notes on biology. A dissected female (CMK 24319, 37.4 mm SL) had ovaries with white oocytes (estimated less than 50) and a few yellow ova about 0.7 mm diameter. A male (CMK 24319, 29.0 mm SL) had ripe testes; its stomach was filled with numerous small insect larvae. The largest sample was obtained at the mouth of a small tributary, 3–5 m wide, 20–50 cm deep, with moderate to fast current, over a pebble to stone bottom in an uninhabited area (Fig. 14). In the same area, a single specimen was obtained in the Nam Ngiep itself, among stones along the shore. Two specimens were collected in a stretch where the river is wider, shallower and with a weaker current; the bottom was made of pebbles and stones, but was heavily silted with mud and sand, apparently originating from work in the river at construction sites or hydropower dam(s) upriver (Google Earth images dated 23 January 2014 [3 weeks before sampling] show clear-water tributaries entering a very turbid Nam Ngiep).

Distribution. *Schistura musa* has been observed only in the middle Nam Ngiep (Fig. 8); the sections upstream and downstream could not be sampled. It has not been observed in the reasonably well surveyed Nam Ngum drainage to the west and in the insufficiently sampled Nam Xan to the east.

Etymology. *Musa* is the genus name of the bananas (*Musa* spp.). A reference to the shape of the preserved specimens. A noun in apposition.

Conservation status. *Schistura musa* was observed at three localities in 2014. It was observed in two tributaries of the Nam Ngiep in the area that will be flooded by the Nam Ngiep 1 reservoir; it is expected to be present further up in these tributaries, in stretches with low gradient, as well as in unsurveyed parts of the Nam Ngiep drainage. These streams could not be sampled further upstream because of access difficulties and serious security issues. Because of its apparent preference for stretches with relatively moderate current, *S. musa* is not expected to reach very far upstream along these tributaries. It was also collected in the Nam Ngiep itself, above the maximum level of the reservoir (320 masl), but there the bottom of the river is covered by sediments apparently originating from construction work at the sites of Nam Ngiep 2 hydropower scheme and road construction. As a result, all known sites are or will be inundated or covered by sediments at least part of the year and the survival of the species at these sites is unlikely. It may still be able to survive in some still unsampled tributaries of the drainage but its presence first has to be demonstrated. However, these are small water bodies with limited flow and they are not expected to be able to support large populations of large adults. The sharp decrease in range, habitat quality and population size probably qualifies *S. musa* to the Endangered or Critically Endangered categories under IUCN criteria (IUCN, 2001).

***Schistura crassa*, new species**
(Figs. 16–18)

Holotype. MHNG 2768.033, male (?), 48.5 mm SL; Laos: Saysomboune Province: Khon District: Nam Pouan [Nam Phouan], upstream of Ban Soppouan, about 300 m upstream of confluence with Nam Ngiep; 244 masl, 18°46'57"N 103°25'58"E; M. Kottelat et al., 31 Jan 2014.

Paratypes. CMK 24329, 4, 38.2–45.4 mm SL; ZRC 56447, 1, 41.1 mm SL; Laos: Saysomboune Province: Nam Ngiep drainage: Houay San [Xao], immediately upstream of confluence with Nam Ngiep, about 23 km downstream of Ban Pou, 18 km upstream of Ban Soppouan; 286 masl, 18°53'11"N 103°28'07"E; M. Kottelat et al., 30 Jan 2014. — CMK 24357, 2, 40.0–40.2 mm SL; Laos: Saysomboune Province: Khon District: Nam Ngiep drainage: Houay Hok, a small creek entering Nam Ngiep, about 3.5 km south of Ban Soppouan on road to Ban Sopyouak; 261 masl, 18°44'57"N 103°25'28"E; M. Kottelat et al., 31 Jan 2014. — CMK 24403, 1, 45.4 mm SL; Laos: Saysomboune Province: Khon District: Nam Ngiep drainage: Nam Youak [Nam Gnok] at Ban Sopyouak, about 200 m upstream of confluence with Nam Ngiep; 236 masl, 18°42'57"N 103°25'55"E; M. Kottelat



Fig. 16. *Schistura crassa*, MHNG 2768.033, holotype, male (?), 48.5 mm SL; Laos: Saysomboune Province: Nam Ngiep drainage: Nam Pouan.

et al., 2 Feb 2014. — CMK 24410, 1, 46.4 mm SL; Laos: Xiangkhouang Province: Thathom District: Nam Ngiep, rapids about 8.2 km downstream of Ban Pou; 305 masl, 18°59'21"N 103°29'42"E; M. Kottelat et al., 29 Jan 2014. — CMK 24442, 2, 46.5–56.5 mm SL; Laos: Saysomboune Province: Khon District: Nam Ngiep drainage: Nam Youak [Nam Gnok] between Ban Nam Youak and Ban Houaysey; 304 masl, 18°43'27"N 103°22'39"E; M. Kottelat et al., 14 Feb 2014.

Diagnosis. *Schistura crassa* is distinguished from the other species of the genus in Southeast Asia by the following combination of characters: body dull brown with 8–11 poorly contrasted bars, appearing mainly as a midlateral row of irregular blotches overimposed on inner axial streak; largest specimens with a plain dark brown body; pattern at caudal base: a narrow line of deep grey pigments along base of all principal rays and a narrow vertically elongated blotch of black pigments along median ¼ of caudal-fin base; lateral line incomplete, reaching from above pelvic-fin origin to above anal-fin base, with 25–56 pores; lower jaw with a median incision; pelvic-fin origin under branched dorsal-fin rays 1–2; stout body, depth 16.7–22.9% SL (in individuals above about 40 mm SL); depth of caudal peduncle 1.1–1.4 times in its length, 1.1–1.6 times in body depth; small size (mature around 45 mm SL).

Description. See Figs. 16–18 for general appearance and Table 3 for morphometric data of holotype and 11 paratypes. A deep-bodied nemacheilid with body depth increasing up to slightly in front of dorsal-fin origin, then regularly decreasing until caudal-fin base. Dorsal profile continuous between head and body. Head slightly depressed; body slightly compressed anteriorly to compressed posteriorly. Interorbital area flat. In lateral view, eye flush with dorsal profile of head. Cheeks slightly swollen in some of the largest specimens (above 45 mm SL). Snout blunt. Caudal peduncle 1.1–1.4 times longer

Table 3. Morphometric data of type material of *Schistura crassa* (n=12). Range and mean include holotype data.

	Holotype	Range	Mean
Standard length (mm)	48.5	38.2–56.5	
Total length (mm)	58.9	46.4–69.3	
In percent of standard length			
Total length	121.3	119.6–122.6	121.3
Head length (dorsal)	23.5	21.4–24.8	23.3
Head length (lateral)	25.5	23.7–27.6	25.4
Predorsal length	52.3	50.9–53.6	52.5
Prepelvic length	52.6	50.3–52.6	51.4
Pre-anus length	68.4	66.1–70.7	68.1
Pre-anal length	75.9	75.5–79.2	77.1
Head depth	14.9	13.1–15.5	14.3
Body depth at dorsal-fin origin	19.2	16.7–22.9	19.4
Depth of caudal peduncle	14.5	12.4–14.5	13.4
Length of caudal peduncle	16.3	15.5–17.2	16.3
Head width	17.6	14.3–19.0	16.4
Body width at dorsal-fin origin	13.7	12.2–17.8	14.6
Snout length	11.1	10.2–12.8	11.0
Eye diameter	5.0	4.3–5.6	5.1
Interorbital width	8.1	6.6–8.8	7.6
Length of dorsal fin	18.1	18.1–21.8	20.1
Length of upper caudal-fin lobe	22.1	18.7–24.0	22.1
Length of median caudal-fin rays	15.4	15.4–18.8	17.1
Length of lower caudal-fin lobe	22.5	18.6–24.1	22.0
Length of anal fin	18.4	17.2–19.7	18.3
Length of pelvic fin	18.0	16.2–19.2	18.1
Length of pectoral fin	20.5	17.9–23.1	21.1
In percent of dorsal head length			
Snout length	47	45–53	47
Eye diameter	21	20–24	22
Interorbital width	35	29–38	32
In percent of lateral head length			
Snout length	43	40–46	43
Eye diameter	19	18–22	20
Interorbital width	32	27–34	30

than deep, of uniform depth. Low dorsal keel on posterior 1/3 of post-dorsal area. Low ventral keel crest on posterior half of caudal peduncle. Dorsal crest continuous with upper margin of caudal fin. Largest recorded size 56.5 mm SL.

Dorsal fin with 4 unbranched and 8½ (12*) branched rays; distal margin slightly convex to straight. Second branched ray longest. Pectoral fin with 1 unbranched and 9 (2), 10 (7*), 11 (3) branched rays (including small last ray, usually unbranched), rounded, reaching about two thirds of distance to pelvic-fin base. Pelvic fin with 1 unbranched and 7 (12*) branched rays (including small last ray, usually unbranched); reaching to anus; rounded; posterior margin convex; origin below base of branched dorsal-fin rays 1–2; axillary lobe present, free. Anus situated about 1.5–2.3 eye diameters in front of anal fin, about at extremity of pelvic fin. Anal fin with 3 unbranched and 5½ (12*) branched rays; distal margin convex. Caudal fin with 9+8 (11*), 10+8 (1) branched rays; about 7–10 dorsal and 5–7 ventral procurrent rays,

forked, lobes rounded, of equal length. On pectoral fin, thick unculiferous pads (sensu Conway et al., 2012) on membranes between rays and between branches of rays 1–3.

Body entirely covered by scales, but scarce or occasionally absent on anterior part of predorsal area; absent on belly in front of extremity of pectoral fin, sometimes until pelvic-fin base. Scales embedded, deeply embedded in anterior part of body. Lateral line incomplete, reaching between above pelvic-fin origin and anal-fin base, with 25–56 pores (number increasing with increasing size). Cephalic lateral line system with 6 supraorbital, 4 + 10–11 infraorbital, 9–10 preoperculo-mandibular and 3 supratemporal pores.

Anterior naris pierced on front side of a short flap-like tube. Posterior naris adjacent to anterior one. Mouth arched, gape about 2–3 times wider than long (Fig. 19). Lips thick. Upper lip with median notch, with a few shallow furrows, edge not crenulated. Processus dentiformis present. Lower lip with



Fig. 17. *Schistura crassa*, CMK 24442, females, paratypes; Laos: Saysomboune Province: Nam Ngiep drainage: Nam Youak; a, 46.5 mm SL; b, 56.5 mm SL.

median interruption; median part with 2–4 sulci, lateral part smooth. Tip of lower jaw not exposed. A median notch at tip of lower jaw. Inner rostral barbel reaching at most corner of mouth; outer one reaching at most below posterior half of eye. Maxillary barbel reaching at most anterior third of postorbital area. Intestine with a bend behind stomach (Fig. 20). Air bladder without posterior chamber in abdominal cavity.

Sexual dimorphism. None observed. No specimen with suborbital flap, groove or slit. No modified pectoral rays, no tubercles, no patches of unculi. Ripe females deeper bodied.

Coloration. After one month in formalin. Head and body background colour brown; ventral surface of head, belly, lower part of caudal peduncle yellowish brown; except otherwise stated, markings darker brown. Head without pattern. Pattern on body poorly contrasted, more so with increasing size, head and body plain dark brown in largest specimen (Fig. 17b). A broad diffuse inner axial stripe, not contrasted. Body with 8–11 bars (2–3 predorsal, 2–4 subdorsal, 3–5 postdorsal), poorly contrasted, discernible mainly as a midlateral row of blotches overimposed on inner axial stripe (Figs. 16, 17a). In some specimens, a few



Fig. 18. *Schistura crassa*, CMK 24357, 40.2 mm SL; Laos: Saysomboune Province: Nam Ngiep drainage: Houay Hok.



Fig. 19. *Schistura crassa*, CMK 24442, 56.5 mm SL; mouth.

poorly contrasted saddles, more distinct on caudal peduncle. In a single specimen (CMK 24357, 40.2 mm SL; Fig. 18), body paler and saddles continuous with midlateral blotches.

Pattern at caudal-fin base: a narrow line of deep, grey pigments along posterior edge of hypural plate along base of all principal rays. A narrow vertically elongated blotch of black pigments along median $\frac{1}{4}$ of fin base.

Dorsal fin hyaline, pale yellow, with a small black spot at base of simple rays and first branched ray and a narrow band along base of branched rays 2–8, leaving a reddish orange spot between them; a row of spots made of black pigments along edge of rays and between segments near first branching point and on membranes between branches. Caudal fin with a pink triangular patch on extremity of posterior upper procurrent rays expanded as a distal margin on upper two principal rays; a similar mark, much paler, on lower edge; rest of fin pale yellowish. Caudal, anal, pectoral and pelvic fins hyaline pale yellowish; a line of dark grey pigments along edges of rays and between segments. In largest specimen (female) pectoral-fin rays with black pigments on dorsal surface of each ray, as a patch near base and one near branching, denser on posterior branch. No information on juveniles or on live coloration.

Notes on biology. Two dissected females (CMK 24442, 46.5–56.5 mm SL) had ripe ovaries with yellow eggs 2.1 mm diameter. *Schistura crassa* was observed in the Nam Ngiep and in small tributaries, among stones, in stretches with fast current (Figs. 15, 21). Each sample included only very few individuals.

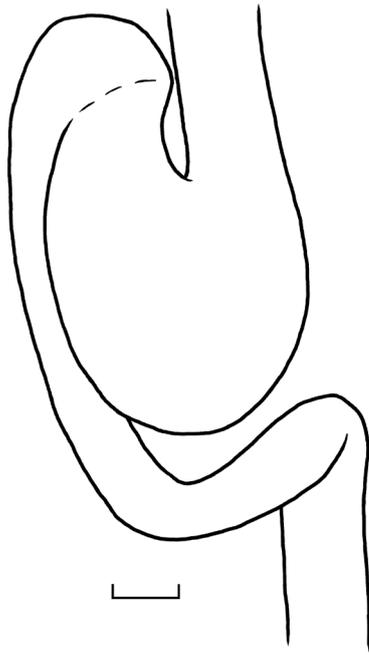


Fig. 20. *Schistura crassa*, CMK 24329, 42.5 mm SL; digestive tract. Scale bar 1 mm.

Distribution. *Schistura crassa* has been observed only in the middle Nam Ngiep (Fig. 22); the sections upstream and downstream could not be sampled. It has not been observed in the reasonably well surveyed Nam Ngum drainage to the west and in the superficially sampled Nam Xan to the east.

Etymology. The Latin adjective *crassus*, *-a*, *-um*, means thick, stout, corpulent.

Remarks. Because of their habitat in the hilly area in most drainages, most species of *Schistura* have small distribution ranges (Kottelat, 2017b) and, for identification, it would make little or no sense to compare a new species with species in very distant drainages. *Schistura crassa* is here compared with its congeners in the Nam Ngiep as well as those from Nam Kading and Nam Xan drainages to the East and South and Nam Ngum and Nam Mang to the North and West. This concerns 8 named species in the Nam Kading (*S. atra*, *S. cataracta*, *S. dorsizona*, *S. kongphengi*, *S. nudidorsum*, *S. obeini*, *S. sombooni*, *S. tubularis*; Kottelat, 1998, 2016), 7 in the Nam Xan and Nam Ngiep (*S. coruscans*, *S. crabro*, *S. defectiva*, *S. dorsizona*, *S. nicholsi*, *S. sigillata*, *S. sombooni*; pers. obs., unpubl.) and 12 in the Nam Ngum and Nam Mang (*S. coruscans*, *S. defectiva*, *S. dorsizona*, *S. ephelis*, *S. isostigma*, *S. leukensis*, *S. personata*, *S. quaesita*, *S. quasimodo*, *S. sigillata*, *S. suber*, *S. tenura*; Kottelat, 2000, 2001, pers. obs.).

Schistura crassa has a colour pattern made of 8–11 poorly contrasted bars, discernible mainly as a midlateral row of blotches where overimposed with inner axial stripe, with most specimens almost plain brown. The barred pattern distinguishes *S. crassa* immediately from several other species of *Schistura*, a number of which actually belong to distinct and still unnamed genera: *S. dorsizona* (with a whitish to pale yellowish body; a conspicuous large black



Fig. 21. Nam Ngiep, downstream of Ban Pou, Xiangkhouang Province, Laos; habitat of *Schistura crassa*; 29 January 2014.

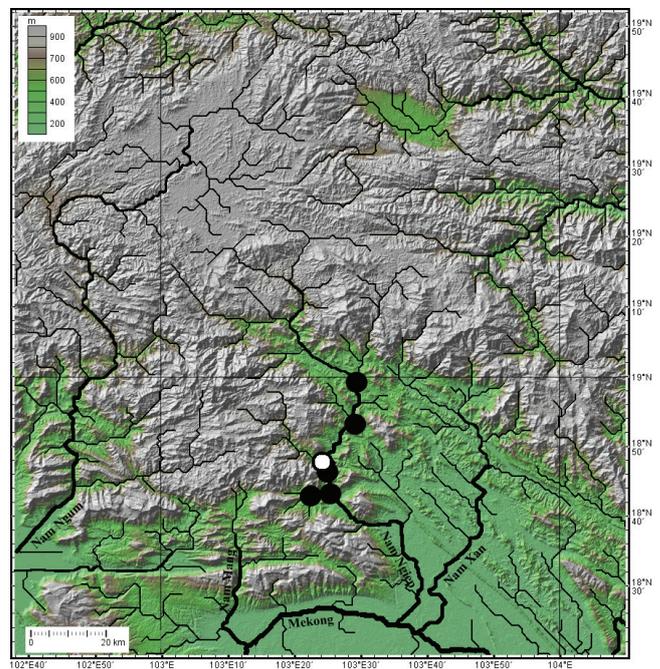


Fig. 22. Laos: Nam Ngum, Nam Ngiep and Nam Xan drainages, showing distribution of *Schistura crassa* (circles). Open symbol: type locality.

blotch occupying most of caudal-fin base, usually diamond-shaped or triangular; colour pattern made of a combination of saddles and a midlateral stripe, rarely of bars; Fig. 9), *S. isostigma* (with a pale yellowish white body; a midlateral row of 5–7 longitudinally elongated blotches; 5–8 irregular saddles on dorsal midline; suborbital flap present), and *S. atra* (with a plain dark brown to black body; nostril flap elongated, reaching eye).

Among *Schistura* species with a barred pattern, several have a very distinctive organisation of the bars: *S. crabro* (with orangish body; 4–8 broad black bars; tip of snout yellow; 7+7 branched caudal-fin rays; lateral line reaching to middle of dorsal-fin base), *S. sigillata* (with 13–15 narrow bars, some of them broader and darker on middle of side, often alternating with narrower and shorter bars, giving the impression of an axial row of blotches; lateral line incomplete, reaching about

pelvic-fin origin), *S. quasimodo* (head flat with pointed profile and depressed snout; 6–8 broad bars; body sometimes plain dark brown, independently of size; high hump behind head; anterior naris flap pointed, reaching anterior margin of eye; anus situated at equal distance from pelvic base and anal origin), and *S. suber* (0–16 bars, very irregularly shaped and set, sometimes restricted to lower half of body or missing; anterior naris flap reaching to posterior margin of eye; 8+8 branched caudal rays; lateral line complete).

Some of the species of *Schistura* with a barred colour pattern have characters infrequently seen in the genus that distinguish them from *S. crassa* as follow: *S. coruscans* and *S. leukensis* have a broad, short and poorly marked processus dentiformis (vs. slender, narrow, pointed in *S. crassa*); *S. defectiva* has, in lateral view, a pointed snout and head, whose profile is straight from the tip of the snout until about halfway to dorsal-fin origin (vs. rounded in *S. crassa*); and *S. tubularis* has the anterior naris at the tip of a tube (vs. on the front side of a flap in *S. crassa*).

From the remaining species of *Schistura* with a barred colour pattern, *S. crassa* is distinguished by having the bars poorly contrasted, discernible mainly as a midlateral row of irregular blotches and overimposed on inner axial stripe; some specimens have a plain body. In all the other barred species the bars are distinct and contrasted against the background. Besides, *S. crassa* is distinguished:

- from *S. nicholsi* in having a median notch in the upper lip (vs. no notch); a more slender caudal peduncle (its depth 1.1–1.4 times in its length vs. 0.8–1.2);
- from *S. sombooni* in having a median notch in the upper lip (vs. no notch), a more forward dorsal-fin origin (predorsal length 50.9–53.6% SL vs. 53.0–55.3), a deeper body (18.1–22.9% SL in most specimens vs. 16.7–18.3), a larger eye (eye diameter 20–24% of dorsal head length vs. 16–17);
- from *S. kongphengi* in having an incomplete lateral line (vs. complete); scales present in predorsal area (vs. no scales in predorsal area);
- from *S. cataracta* in having an incomplete lateral line (vs. complete); the posterior margin of the last bar on body (if distinct) more or less straight, not touching the black bar at the base of the caudal fin (vs. posterior margin of last bar on body distinctly convex, at midheight almost in contact with the black bar at caudal-fin base);
- from *S. nudidorsum* in having an incomplete lateral line (vs. complete); scales present in predorsal area (vs. no scales in predorsal area); a deeper body (depth 16.7–22.9% SL vs. 14.3–16.9);
- from *S. obeini* in having 8–11 very poorly contrasted bars (vs. 10–17 blackish brown bars, sharply contrasted against bright yellowish brown background); a small size (up to 57 mm SL vs. up to 105);
- from *S. ephelis* in having an incomplete lateral line (vs. complete); the top of the head and the cheeks plain brown (vs. top of head vermiculated, cheeks dotted); low dorsal and ventral keels on caudal

peduncle (keels high); a median notch in the upper lip (vs. no notch);

- from *S. personata* in having 8–11 very poorly contrasted bars (vs. 12–16 distinct bars); an incomplete lateral line (vs. complete); a median notch in the upper lip (vs. no notch); the top of the head plain brown (vs. vermiculated);
- from *S. quaesita* in having an incomplete lateral line (vs. complete); dorsal and caudal fins pale yellow, other fins hyaline or pale yellow (vs. in adults dorsal, anal, pectoral and pelvic fins bright yellow, caudal fin bright yellow to red); no spots overimposed on bars (vs. 13–16 irregular black dots along lateral line, sometimes fused to form an irregular stripe); a stouter caudal peduncle (its depth 1.1–1.4 times in its length vs. 1.4–1.6; 12.4–14.5% SL vs. 9.4–11.4; 1.1–1.6 times in body depth vs. 1.4–1.9); a more forward pelvic fin (its origin under base of branched dorsal-fin rays 1–2 vs. under rays 2–3); a small size (up to 57 mm SL vs. up to 96);
- from *S. tenura* in having an incomplete lateral line (vs. complete), 8–11 poorly contrasted bars (vs. 7–10 very distinct and contrasted bars); a deeper body (depth 16.7–22.9% SL vs. 11.0–14.3); a stouter caudal peduncle (its depth 1.1–1.4 times in its length vs. 1.7–1.9; 12.4–14.5% SL vs. 7.7–10.1).

Conservation status. *Schistura crassa* was observed in 2014 at several localities in the Nam Ngiep itself and small tributaries. All these sites will be flooded by the Nam Ngiep 1 reservoir (320 masl) or are in the drawdown zone. It is expected to be present further up in these tributaries, as well as in unsurveyed parts of the Nam Ngiep drainage. These streams could not be sampled further upstream because of access difficulties and serious security issues. Because of its apparent preference for stretches with fast current, *S. crassa* is expected to reach some distance upstream along these tributaries. With current data, all known sites will be inundated, at least part of the year, or covered by sediments and the survival of the species at these sites is unlikely. It may be able to survive in some still unsampled areas of the drainage but its presence first has to be demonstrated. However, these are small water bodies with limited flow and they are not expected to be able to support large populations of large adults. The sharp decrease in range, habitat quality and population size probably qualifies *S. crassa* to the Endangered or Critically Endangered categories under IUCN criteria (IUCN, 2001).

Material used for comparison. Most morphometric data are from Kottelat (1990, 1998, 2000). Besides, the following material was available for comparison of non-morphometric characters: all from Mekong drainage in Laos, except where noted: *Schistura atra*: CMK 12629, 1 paratype; Nam Kading drainage: Nam Theun; *S. cataracta*: CMK 12244, 58 paratypes; CMK 19126, 72; Nam Kading drainage: Nam Theun; *S. coruscans*: CMK 24291, 21; Nam Ngiep drainage: Ban Pou; CMK 24523, 97; Nam Ngiep drainage: Nam Xong; *S. crabro*: CMK 24534, 2; Nam Xan drainage: Nam Mang; CMK 24559, 2; Nam Xan: Ban Pakhuang; *S. defectiva*: CMK

24327, 251; Nam Ngiep drainage: Houay San; *S. dorsizona*: CMK 21522, 8; Xe Kong drainage: Xe Namnoy; CMK 24616, 94; Nam Xan: Ban Pakhuang; *S. isostigma*: CMK 13275, 6 paratypes; Nam Mang drainage: Nam Leuk; CMK 15651, 1; Xe Kong drainage: Xe Kaman; *S. kongphengi*: CMK 12771, 31 paratypes; Nam Kading drainage: Nam Theun; CMK 16034, 102; Xe Banghiang drainage: Xe Lanong; CMK 19107, 12; Nam Kading drainage: Nam Xot; *S. leukensis*: CMK 13315, 90 paratypes; Nam Mang drainage: Nam Leuk; *S. nicholsi*: CMK 5029, 15; CMK 15039, 41; Thailand: Nam Huang drainage; CMK 24680, 124; Nam Xan: Nam Xao; *S. nudidorsum*: CMK 12677, 14; Nam Kading drainage: Nam Phao; *S. obeini*: CMK 12672, 18 paratypes; Nam Kading drainage: Nam Phao; CMK 12501, 35; Nam Kading drainage: Nam Gnouang; CMK 22875, 14; Nam Kading drainage: Nam Theun; *S. personata*: CMK 13354, 12 paratypes; Nam Ngum drainage: Nam San; CMK 22705, 30; Nam Ngum drainage: Nam Chat; *S. punctifasciata*: CMK 12393, 72 paratypes; Xe Bangfai drainage: Nam Phit; CMK 12485, 24 paratypes; Xe Bangfai drainage: Nam Kathang; *S. quaesita*: CMK 22699, 42; CMK 22706, 14; CMK 22749, 40; Nam Ngum drainage: Nam Chat; *S. quasimodo*: CMK 13352, 37 paratypes; CMK 23805, 2; Nam Ngum drainage: Nam San; CMK 23578, 1; Nam Ngum; *S. sigillata*: CMK 13353, 23 paratypes; CMK 23806, 3; CMK 23822, 1; Nam Ngum drainage: Nam San; *S. sombooni*: CMK 12684, 72 paratypes; Nam Kading drainage: Nam Theun; CMK 15241, 27; Nam Ngiep drainage: Nam Sen; *S. suber*: CMK 13308, 2 paratypes; Nam Mang drainage: Nam Leuk; CMK 22434, 17; Nam Ngum; CMK 22522, 9; Nam Ngum drainage: Nam Phay; *S. tenura*: CMK 13324, 25 paratypes; CMK 13329, 22; Nam Mang drainage: Nam Leuk; *S. tubularis*: CMK 14354, 5 paratypes; CMK 22936, 8; Nam Kading drainage: Nam Theun.

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