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Schistura thavonei, a new species of loach from northwestern Laos (Teleostei: Nemacheilidae)

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Abstract. *Schistura thavonei*, new species, is described from the Nam Ma, Mekong drainage, in Louang Namtha Province, northwestern Laos. It is distinguished from all other Nemacheilidae by its unique colour pattern made of two broad dark brown stripes (one middorsal, one midlateral) and between them a pale yellowish-brown stripe (iridescent in life); a row of 12–24 short black bars are located increasingly lower on the flank from head to tail, posterior-most ones restricted to the lower half of the body or forming blotches along the ventral midline of the caudal peduncle. Besides, it has an elongate body with a hump immediately behind the head, 8+7 branched caudal-fin rays; and 9–10 total pectoral-fin rays. It was found in riffles, over gravel to stone bottom.

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

INTRODUCTION

Loaches of the genus *Schistura* typically occur in fast flowing stretches of small streams and less often in other habitats, such as large rivers and caves. The genus presently includes about 215 valid species (pers. obs., updated from Kottelat, 2012, 2013). The genus has its greatest diversity in mainland Southeast Asia (Irrawaddy, Salween, Mae Khlong, Chao Phraya, Mekong and Red River drainages, and drainages in between) from where about 165 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–b; Ou et al., 2011; Plongsesthee et al., 2011, 2013; Bohlen et al., 2014, 2016; Kottelat, 2017a–e). 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 fish fauna of northwestern Laos is relatively less well known than that of other areas of the country. Much of our knowledge of the fishes of Laos was obtained in connection with environmental impact assessments for hydropower projects. Despite the number of these projects in northwestern Laos, none is known to have paid attention to aquatic biodiversity, and results of inventories, if any, have not been made public. Effectiveness and quality of surveys depend largely on the culture and public pressure in the countries of origin of the developing companies, and of the financial institutions involved. The only recent information available was obtained by a superficial sampling conducted in 1999 in the upper Nam Tha and Nam Youan watershed to prepare for a guide to the fishes of Laos (Kottelat, 2001), which resulted in the description of 13 species new to science (Chen & Kottelat, 2000; Fang & Kottelat, 1999; Kottelat, 2000). Information on adjacent areas in the Mekong drainage is available for northern Thailand (Chiangmai and Chiangrai provinces) and China (Xishuangbanna); only little published information exists for the Mekong drainage in Myanmar, based on samples obtained in 1933 (Hora & Mukerji, 1934; Fowler, 1934). Photographs of some species from northwestern Laos with no accompanying information appeared in Rainboth et al. (2012), except for the description of *Oreoglanis setigera* by Ng & Rainboth (2001).

A short sampling in the Mam Ma and the Nam Youan in 2015 yielded a number of additional species. This confirmed earlier observation that the divide between the Nam Youan, which flows northwards to China (where it is known as Nanrun, a tributary of the Nan La), and the other Mekong tributaries in Laos is a significant zoogeographical boundary, at least at the local level. A number of species found in the Nam Youan drainage in Muang Sing district, Laos and Xishuangbanna, China are unknown in drainages to the south and vice versa (Kottelat, 2001).

The Nam Ma is a direct tributary of the Mekong, which it enters at Xiang Kok (20°53′59″N 100°38′19″E); it is located south of the Nam Youan watershed. Despite a very low divide between the Nam Ma and Nam Youan watersheds (about 100 m higher than the nearest streams of each watershed (excluding small headwaters), the species peculiar to the Nam Youan and streams northwards were not observed in the Nam Ma (*Devario apopyris*, *Discherodontus parvus*, *Mystacoleucus lepturus*, *Schistura kloetzliae*, *S.*

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Fig. 1. *Schistura thavonei*, MHNG 2667.078, holotype, 44.0 mm SL; Laos: Louang Namtha Province: Nam Ma.

macrocephalus, *Sectoria heterognathos*, *Rhinogobius maculicervix*). Instead, additional species were discovered on both sides. The present article describes a new species of *Schistura* from the Nam Ma watershed.

MATERIAL & 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". Frequencies of meristic values are indicated in parentheses, if more than one value is observed; asterisks indicate the condition for the holotype. When possible, toponymy and spelling follows the 1:100'000 topographic map (Service Géographique d'État, 1987, sheets F14-106, F14-118). Abbreviations used: CMK, collection of the author; KIZ, Kunming Institute of Zoology, Kunming; MHNG, Muséum d'Histoire Naturelle, Genève; and ZRC, Lee Kong Chian Natural History Museum, Singapore.

Schistura thavonei, new species

(Figs. 1–3, 6)

Holotype. MHNG 2667.078, 44.0 mm SL; Laos: Louang Namtha Province: Muang Long District: Nam Ma watershed: Nam Ma Yen, a branch of Nam Ma, upstream of Ban Sop Ma, 21°02′53″N 101°01′16″E, 638 masl; M. Kottelat & T. Phommavong, 25 March 2015.

Paratypes. CMK 26066, 30, 31.7–47.6 mm SL; ZRC 56174, 5, 35.1–43.0 mm SL; same data as holotype. — CMK 25944, 10, 36.2–50.7 mm SL; Laos: Louang Namtha Province: Muang Long District: Nam Ma watershed: Nam Ma Oun, a branch of Nam Ma, downstream of Ban Phang Thong, 21°04′55″N 101°03′37″E, 670 masl; M. Kottelat & T. Phommavong, 21 March 2015. — CMK 26054, 24, 33.1–43.4 mm SL; Laos: Louang Namtha Province: Muang Long District: Nam Ma watershed: confluence of Nam Ma and Nam Long at Ban Louang Pha Kham (0.5 km north of Muang Long), 20°58′03″N 100°49′08″E, 496 masl; M. Kottelat & T. Phommavong, 25 March 2015.

Diagnosis. *Schistura thavonei* is distinguished from the other species of the genus by its unique colour pattern made of two broad dark brown stripes (one middorsal, one midlateral) and between them a pale yellowish-brown stripe (iridescent copper to orange in life) from the upper extremity of the gill opening to the upper half of the base of the caudal fin; over-imposed to the midlateral stripe, a row of 12–24 short black bars, located increasingly lower on the flank from head to tail, posterior-most ones restricted to the lower half of the body or forming blotches along the ventral midline of the caudal peduncle. Additional characters useful for identification but not unique to the species are: body very elongate (depth 6.2–7.2 times in SL), with a marked hump behind the head; male without suborbital flap; 8+7 branched caudal-fin rays; 7½ branched dorsal fin rays; 9–10 pectoral-fin rays.

Description. See Figs. 1–3 for general appearance and Table 1 for morphometric data of holotype and 10 paratypes. A very elongate nemacheilid with body depth increasing up to about middle of pre-dorsal area of trunk, then decreasing slowly to caudal-fin base. Dorsal profile with hump immediately behind head. Head slightly depressed; body from slightly compressed anteriorly to compressed posteriorly. Interorbital area slightly arched, more so in smallest specimens. In lateral view, eye slightly below or flushed with dorsal profile of head. Cheeks not swollen. Snout pointed. Caudal peduncle 1.5–1.8 times longer than deep, tapering posteriorly. In some of largest specimens, a low dorsal crest on posterior $^{1}/_{10}$ of post-dorsal area, and a low ventral crest on posterior half of caudal peduncle. Dorsal crest separated from upper

Fig. 2. *Schistura thavonei*, paratypes; Laos: Louang Namtha Province: Nam Ma; a, CMK 25944, 44.0 mm SL; b, CMK 26054, 41.8 mm SL; c, CMK 26054, 39.5 mm SL; d, CMK 25944, 44.9 mm SL; e, CMK 26066, 44.7 mm SL.

Fig. 3. *Schistura thavonei*, paratypes; Laos: Louang Namtha Province: Nam Ma; a, CMK 26066, 33.7 mm SL; b, CMK 26054, 34.4 mm SL (right side, reversed); c, CMK 25944, 36.6 mm SL.

margin of caudal fin by a small concavity. Largest recorded size 50.7 mm SL.

Dorsal fin with 4 unbranched and 7½ (10*) or 8½ (1) branched rays; distal margin straight; second branched ray longest. Pectoral fin with 1 unbranched and 8 (9*) or 9 (2) branched rays (including small last ray, usually unbranched); rounded but with angled tip; reaching about halfway of distance to pelvic-fin base. Axillary pectoral lobe present. Pelvic fin with 1 unbranched and 6 (6) or 7 (5*) branched rays (including small last ray, usually unbranched); reaching to or at least ⅔ of distance to anus (or about halfway to anal-fin base); triangular; origin from slightly in front of dorsal-fin origin to below base of last unbranched dorsal-fin ray; axillary lobe present, entirely free. Anus situated about 2½–3 times eye diameter in front of anal fin. Anal fin with 3 unbranched and 5½ branched rays; distal margin straight to slightly convex. Caudal fin with 8+7 (10*) or 8+6 (1) branched rays; dorsal and ventral procurrent rays cannot be counted; forked, lobes rounded, lower lobe slightly longer than upper one.

On pectoral and pelvic fins, thick unculiferous pads (sensu Conway et al., 2012) along anterior edge of unbranched ray, and on dorsal side on whole width of membrane between unbranched and first branched rays, and along posterior margin of rays on membranes between remaining rays; on ventral side on whole width of membrane between unbranched and first branched ray, and along anterior margin of rays on membranes between remaining rays.

Body entirely covered by scales, except belly in front of pelvic fins. Scales embedded, increasingly less densely-set from level of dorsal fin towards head. Lateral line incomplete, reaching between vertical of pelvic-fin origin to vertical of end of anal-fin base, often with interruption near posterior extremity, with 44–91 pores. Cephalic lateral line system with 6 supraorbital, 4 + 10–12 infraorbital, 9 preoperculo-mandibular and 3 supratemporal pores.

Anterior nare pierced in front side of a pointed flap-like tube. Posterior nare adjacent to anterior one. Mouth arched, gape about 2.2–2.9 times wider than long (Fig. 4). Lips fleshy. Upper lip without or (rarely) with a small median notch, with many shallow weakly-marked furrows, edge almost smooth. Processus dentiformis present. Lower lip with narrow median interruption; median part with 2–3 feebly marked sulci, lateral part smooth. Tip of lower jaw not exposed. No median notch or concavity in lower jaw. Inner rostral barbel reaching base of outer one; outer one reaching vertical of posterior nare. Maxillary barbel reaching at most vertical of

Fig. 4. *Schistura thavonei*, CMK 25944, 44 mm SL; mouth.

posterior margin of eye. Intestine with a weak bend behind stomach (Fig. 5). Air bladder without posterior chamber in abdominal cavity.

Sexual dimorphism. None observed. None of the characters usually associated with sexual dimorphism in Nemacheilidae was observed (no suborbital flap, groove or slit; no tubercles; no modified pectoral fins in males). Ovigerous females deeper bodied.

Coloration. After one month in formalin. Head and body background colour pale yellowish brown; except otherwise stated, markings dark brown to black. Dorsal half of head plain dark brown. Barbels orange or black, lips sometimes orange. Body with broad middorsal stripe from occiput almost to caudal-fin base, leaving a whitish patch about equal to eye diameter between stripe and fin base. A broad midlateral stripe from head almost to caudal-fin base; stripe made of surface pigments anteriorly, and both deep and surface pigments posteriorly. Interspace between middorsal and midlateral stripe appearing as a yellowish brown stripe from upper extremity of gill opening to upper half of caudal-fin base, more contrasted and orange posteriorly. Along anal-fin base and ventral edge of caudal peduncle: a narrow band of greyish pigments, in a few specimens in contact with midlateral stripe.

Flank with 12–24 dark bars, upper tip at or slightly above upper edge of midlateral stripe, starting higher in predorsal area, sometimes even in contact with middorsal stripe; upper extremity of bars decreasingly lower towards back, last ones restricted to lower half of caudal peduncle. Lower extremity of bars about at level of pectoral-fin base anteriorly, decreasingly lower towards back, reaching ventral midline at anal-fin base and on caudal peduncle; last bars continuous with contralaterals, sometimes fused to form one or two elongated blotches along ventral midline, always leaving a whitish patch between last bar and fin base. Bars in front of dorsal fin narrow, narrower than or as wide as interspaces. Bars behind dorsal fin becoming increasingly darker and wider, narrower than interspaces.

Black pattern at caudal-fin base: all stripes and bars on caudal peduncle ending shortly before caudal-fin base, leaving a vertical band devoid of any pigment. On upper half: a patch of black pigments on basal part of upper 4–5 principal rays

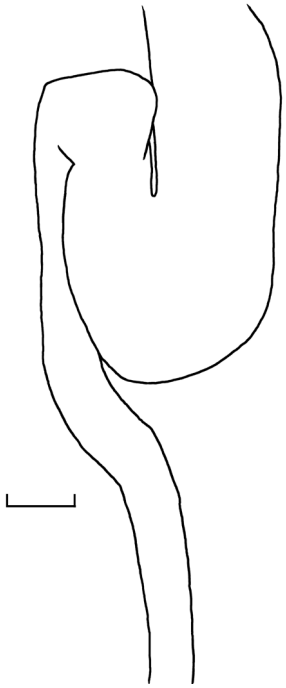

Fig. 5. *Schistura thavonei*, CMK 25944, 42.4 mm SL; digestive tract. Scale bar 1 mm.

and on last 0–2 procurrent rays (on rays only, not on fleshy base of fin). In some largest specimens, patches extending backwards up to about ¼ of length of rays. Anterior edge usually more posterior than that of upper patch on lower half of fin. On lower half: two patches of black pigments on fleshy base of fin and on proximal-most part of principal rays; first patch on upper 2–3 rays, second on remaining rays. Patches made of superficial and deep pigments, both patches may be differently dark and large. Patches usually fused or adjacent, with lower one weaker or sometimes missing, fused patches often appearing as a slanted mark, with lower patch slightly more posterior than upper. In some largest specimens, patches extending backwards up to about ¼ of length of rays.

Dorsal fin hyaline with a small black spot at base of simple rays and first branched ray and an elongated blotch at base of branched rays 2–4, both low and sometimes fused; middle part of last unbranched ray blackish, anterior edge orange; pigments on rays in area of first branching point, beyond only along edges of rays. Caudal fin hyaline; beside black pattern at base described above, an orange patch along dorsal and ventral edges, extending from black blotch backwards; black pigments along edges of rays on their entire length. Anal fin hyaline; black pigments along edges of rays in area of first branching point; tip of last unbranched rays orangish. Pectoral and pelvic fins hyaline, membranes between anterior rays pale orange; greyish pigments along edges of rays on their entire length.

In specimens less than about 40 mm SL (Fig. 3), middorsal stripe present but faint; midlateral stripe and pale area between stripes absent or poorly distinct, appearing first in postdorsal part of body. Bars less regular, especially in anterior half of flank where most reach middorsal stripe; some bars

Fig. 6. *Schistura thavonei*, CMK 25944, paratype, 50.7 mm SL; Laos: Louang Namtha Province: Nam Ma; immediately after fixation (right side, reversed).

interrupted at level of lateral line. Pattern at caudal-fin base and on fins as in adults. Smaller individuals not available.

In life, from photographs taken immediately after capture and fixation (Fig. 6): body yellowish brown, stripes darker brown, bars blackish brown. Pale stripe iridescent brown, bright yellow at extremity of caudal peduncle. Tip of snout, barbels and lips reddish orange. Dorsal, caudal and anal fins yellowish, pectoral and pelvic fins orangish.

Notes on biology. A dissected female (CMK 25066, 46.6 mm SL) had unripe ovaries with white, irregular, not mature, ova about 1.0 mm diameter. The stomach of a 42.4 mm SL specimen was filled with insect larvae about 2–5 mm long. *Schistura thavonei* was observed in clear water [as expected for a benthic fish with bright coloration and contrasted pattern]. At all sites, *S. thavonei* has been collected in stretches of streams with riffles (in the sheltered parts with somewhat quieter current), over gravel to stone bottom (Fig. 7).

Distribution. *Schistura thavonei* is presently known only from the watershed of the Nam Ma in Louang Namtha Province, a tributary of the Mekong, in northeastern Laos (not to be confused with the Nam Ma in Houa Phan Province, which flows to Vietnam and enters the Gulf of Tonkin).

Etymology. The species is named for Mr. Thavone Phommavong, in appreciation for his help and companionship during several, and sometimes difficult, fish surveys in Laos. A noun in genitive.

Fig. 7. Nam Ma Yen, Nam Ma watershed, Louang Namtha Province, Laos; type locality of *Schistura thavonei*; 25 March 2015.

Remarks. The striking colour pattern of *S. thavonei* is shared with no other Nemacheilidae. Some elements, however, are shared with *S. bella* (Fig. 8), like the yellow (iridescent in life) stripe between the upper extremity of the gill opening and the upper half of caudal-fin base, and bars more or less restricted to part of body below the pale stripe. However, in *S. bella* the bars are very variable, in some individuals regular and wider than interspaces, in others they are narrow and interconnected, forming a marmorated or variegated pattern; the middorsal stripe, when present, is very irregular,

Fig. 8. *Schistura bella*, CMK 26052, 38.4 mm SL; Laos: Louang Namtha Province: Nam Ma.

Table 1. Morphometric data of type material of *Schistura thavonei* (n=11). Range and mean include holotype data.

	Holotype	Range	Mean
Standard length (mm)	44.0	41.0–47.6	
Total length (mm)	51.7	48.5–55.9	
In percent of standard length			
Total length	117.4	115.3–119.1	117.6
Head length (dorsal)	18.0	17.8–20.4	18.5
Head length (lateral)	19.6	19.6–21.5	20.6
Predorsal length	54.3	52.2–56.0	54.4
Prepelvic length	49.5	48.8–52.0	50.6
Pre-anus length	66.7	66.2–69.1	67.8
Pre-anal length	75.9	74.7–78.7	77.2
Head depth	9.7	9.0–10.2	9.4
Body depth at dorsal-fin origin	14.9	13.9–16.2	14.9
Depth of caudal peduncle	10.7	9.3–11.3	10.0
Length of caudal peduncle	18.0	14.8–18.0	16.5
Head width	11.5	11.4–12.7	12.0
Body width at dorsal-fin origin	12.4	10.7–12.9	11.8
Snout length	7.2	7.2–8.7	8.1
Eye diameter	3.1	2.6–3.4	2.9
Interorbital width	5.2	4.8–6.1	5.4
Length of dorsal fin	16.2	14.9–16.6	15.9
Length of upper caudal-fin lobe	16.0	16.0–18.5	17.2
Length of median caudal-fin rays	11.8	11.8–15.8	13.3
Length of lower caudal-fin lobe	18.8	17.2–19.7	18.3
Length of anal fin	14.7	13.5–15.7	14.8
Length of pelvic fin	15.1	14.2–16.9	15.0
Length of pectoral fin	16.6	15.8–17.4	16.5
In percent of dorsal head length			
Snout length	40	39–48	44
Eye diameter	17	14–19	16
Interorbital width	29	26–33	29
In percent of lateral head length			
Snout length	37	35–43	39
Eye diameter	16	12–16	14
Interorbital width	27	23–29	26

Fig. 9. *Schistura* aff. *longa*, 78.0 mm SL; China: Yunnan: "Fugong" (?) (photographed at Yunnan University, Kunming, 1986).

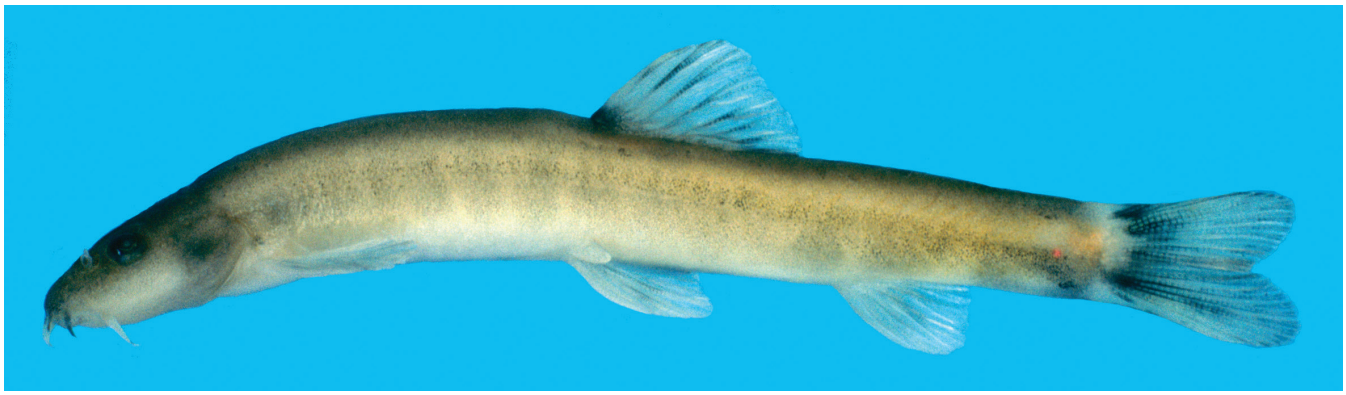

Fig. 10. *Schistura* aff. *thavonei*, KIZ uncat., 39.9 mm SL; China: Yunnan: Mekong drainage: Yangbi.

but there is usually a succession of blotches; the black mark at the base of the caudal fin differs (compare Figs. 1–3 and 8). The contrasted colour pattern at the base of the caudal-fin is species-specific in many Nemacheilidae and likely has a species-recognition or advertising function. *Schistura thavonei* has usually 7½ branched dorsal-fin rays (vs 8–9½ in *S. bella*), 8+7 branched caudal-fin rays (vs 9+8), the male does not have a suborbital flap (vs present) and there is no sexual dimorphism in the shape of the pectoral fins (vs the shape of the pectoral-fin rays is sexually dimorphic). The two species were collected together at one site (CMK 26052), in the Nam Ma proper. *Schistura bella* was in somewhat deeper and faster water than *S. thavonei*. In the field, they were first confused in the net because of the similar iridescent pale stripe. The relationships of *S. bella*, however, seems to be with a group of species commonly placed in *Physoschistura* and *Pteronemacheilus* (Kottelat, ms.).

There are no clues to the affinities of *S. thavonei*. There are a few species of *Schistura* with a similarly elongated body, of which apparently only one is named, *S. longa* from the upper-middle Salween in Yunnan (Zhu, 1982: 105, 1989: 51). Indeed, *S. thavonei* was figured and identified as *S.* sp. cf. *longa* by Rainboth et al. (2012: pl. 36). *Schistura longa* does not have stripes on the body, the bars on the posterior half of the body are fewer, broader and extend from dorsal midline almost to ventral midline. The figure of *S. longa* by Yang (in Chu & Chen, 1990: 43) shows the black pattern at the base of the caudal fin made of a vertical bar; it is possibly misidentified and might be the apparently unnamed species figured here (Fig. 9).

A number of other elongate nemacheilid species exist, unnamed, including one from the Nam Ngiep in Laos that will be described elsewhere, and a species I collected in Yangbi (Yunnan) in 1986 that has some similarities with *S. thavonei* (Fig. 10). Unfortunately, I do not have access to this material. Future research is likely to show that *S. thavonei* represent a distinct genus.

Comparison material. *Schistura bella*: CMK 26052, 7; Laos: Louang Namtha Province: Muang Long District: confluence of Nam Ma and Nam Long.

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