



A new rainbow gudgeon of *Sarcocheilichthys* (Teleostei: Cyprinidae) from Fujian Province, China with redescriptions of *S. hainanensis*

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Abstract

The teleostean family Cyprinidae is a megadiverse fish taxon that occupies most of the freshwater biomes of the world. The cyprinid genus *Sarcocheilichthys* of the subfamily Gobioninae is represented by a total of 14 nominal species, most of which are distributed in the vast continent of China. Our recent field collections and surveys in river systems of Fujian Province, southern China, had discovered a cyprinid fish that was recognized herein as a *Sarcocheilichthys* species new to science. The undescribed species, temporarily known as the Hanjiang rainbow gudgeon, is most similar to *S. nigripinnis* but can be well distinguished by differences in meristic counts, dorsal fin blotch patterns, and the morphology of oromandibular structures and genital organs. A detailed redescription of the valid Hainan rainbow gudgeon, *S. hainanensis*, is also provided herein.

Key words: *Sarcocheilichthys*, Gobioninae, new species, Fujian Province, China

Introduction

The teleostean family Cyprinidae is a megadiverse taxon with over 367 genera and 300 species described, making it the largest family of freshwater fishes (Nelson 2016). The cyprinid subfamily Gobioninae, whose members are commonly known as gudgeons, is a relatively stable and well-established subfamily within Cyprinidae, and its monophyly has also been proven and confirmed by numerous phylogenetic studies (Yang *et al.* 2006; Tang *et al.* 2011; Yang *et al.* 2015). Gudgeon fishes have diverse morphologies, reproductive plans, and ecological traits. Most members have specialized morphologies for a benthic lifestyle, such as inferior barbed-mouths, bodies with flattened ventral sides, or wide, modified pectoral fins. However, other members possess slender and elongated body shapes or general minnow-like deep bodies (Bănărescu & Nalbant 1973; Bănărescu & Coad 1991).

The gobionine genus *Sarcocheilichthys* was established by Bleeker (1859), with the type species being *Leuciscus variegatus* Temminck & Schlegel, 1846. Species of *Sarcocheilichthys*, commonly known as rainbow gudgeons, are widely distributed in East Asia, from the frigid rivers of Russia to the subtropical, muggy regions of northern Vietnam (Hosoya 1982; Luo *et al.* 1977; Yue 1998; Zhang *et al.* 2008; Liu *et al.* 2013). Rainbow gudgeons share similar reproductive strategies with Acheilognathine bittlerling fishes, which involve the female individuals treating freshwater clams as nurseries by depositing eggs into their mantle cavities. This is a rather unique trait among Gobionine species, who usually lay eggs on aquatic substrates or have dispersible, pelagic eggs (Kitamura 2011).

The taxonomy of *Sarcocheilichthys* has been reviewed by numerous authors (Mori 1927; Bănărescu & Nalbant 1967; Hosoya 1982; Luo *et al.* 1977; Yue 1998). There are currently 11 nominal species recognized, with 10 of these species being distributed in China. These include *S. sinensis* Bleeker, 1871; *S. lacustris* (Dybowski, 1872); *S. nigripinnis* (Günther, 1873); *S. davidi* (Sauvage, 1878); *S. sciistius* Abbott, 1901; *S. hainanensis* Nichols & Pope, 1927; *S. kiangsiensis* Nichols, 1930; *S. parvus* Nichols, 1930; *S. caobangensis* Nguyễn & Ngô, 2001; and *S. vittatus* An, Zhang & Shen, 2020. (Mori 1927; Bănărescu & Nalbant 1967; Luo *et al.* 1977; Yue 1998; An *et al.* 2020; Li *et al.* 2022).

As aforementioned, *Sarcocheilichthys* species are widely distributed in East Asia, and their rather localized reproductive plans have made them models for multiple studies targeting freshwater fish biogeography, speciation, and phylogenetics (Yonezawa 1958; Zhang *et al.* 2008; Fujita *et al.* 2008). The phylogenetics and phylogeography of *Sarcocheilichthys* were studied extensively by Zhang *et al.* (2008) and Liu *et al.* (2013); the former focused on the phylogeny and speciation of seven species/subspecies within the genus distributed in China, while the latter concentrated on the phylogeography of *S. nigripinnis*, a species with an exceeded distribution from the northeastern Yellow River to the Pearl River in southern China. Both studies employed the mitochondrial DNA fragment of the cytochrome b gene as a molecular marker. The results of Zhang *et al.* (2008) showed that the overall species of *Sarcocheilichthys* in China can be classified into two major clades, while the populations of *S. nigripinnis* can be further separated into Southern and Northern clades. The results of Liu *et al.* (2013) concord with this. These results indicate divergence between populations, suggesting the potential for breeding of cryptic undescribed species.

In order to gain a deeper understanding of the diverse Chinese freshwater ichthyofauna, we embarked on numerous collection trips across China, yielding significant results. Our field crew collected *Sarcocheilichthys hainanensis* from Hainan Island, a species that was formerly treated as a junior synonym of *S. nigripinnis* (Luo *et al.* 1977; Mai 1978) but was tentatively classified as a distinctive species by Kottelat (2001) based on differences in body shapes and pharyngeal teeth rows. Here, we provide a comprehensive description of the species and compare it with *S. nigripinnis*, fully supporting the validity of this species as distinct.

Moreover, during our extensive surveys in the Hanjiang River, which flows through both Fujian and Guangdong Provinces, a new species was discovered. The aim of this paper is to document the newly discovered species. Comparisons of the new species with its congeneric members will also be discussed.

Materials and Methods

The specimens of *Sarcocheilichthys* examined in this study were obtained from direct capture by hand nets or casting nets, which were then fixed in 10% formalin for a few days before being transferred to 70% EtOH for long-term preservation. The methods for morphometry and meristic counts follow Hosoya (1982), Chen and Chang (2007), and Chen *et al.* (2009). Unless otherwise specified, all lengths are shown in standard length (SL). All specimens were given an NTOUP accession number and deposited in the Pisces collection of NTOU. Abbreviations for meristic characters are as follows: D, dorsal fin rays; A, anal fin rays; P₁, pectoral fin rays; P₂, pelvic fin rays; LL, lateral line scales; TR, transverse scale rows; PreD, predorsal scales; and Vert, vertebral counts.

Systematics

Redescription of *Sarcocheilichthys hainanensis* Nichols & Pope, 1927

Sarcocheilichthys Bleeker, 1860

Sarcocheilichthys Bleeker, 1860: 435.

Barbodon Dybowski, 1872: 216.

Chilogobio Berg, 1914: 488.

Georgichthys Nichols, 1918: 17.

Exoglossops Fowler & Bean, 1920: 311.

Sarcocheilichthys hainanensis Nichols & Pope, 1927

(Figs 1, 4–7)

Sarcocheilichthys hainanensis Nichols & Pope, 1927: 352, Fig. 21, Pl. 26 (fig. 3) (holotype: AMNH 8370, Nodoo, Hainan Island, China); Chevey & Lemasson, 1937: 44; Kottelat 2001: 39; Kottelat 2001: 79; Kottelat 2013: 158; An *et al.* 2020: 217

Sarcocheilichthys nigripinnis hainanensis: Bănărescu & Nalbant 1967; Yu 1986.



FIGURE 1. Specimens of *Sarcocheilichthys hainanensis* and *S. nigripinnis* examined. A. *S. hainanensis*, NTOUP2013-05-026, 85.14 mm SL, male; B. *S. nigripinnis*, NTOUP2014-10-014, 92.11 mm SL, male. Scale bar = 1 mm.

Materials Examined. NTOUP-2013-05-026, 3 specimens, 50.80–85.14 mm SL; Baisha County, Hainan Island, PRC; coll. I-S. Chen *et al.*, 26 May 2013.

Diagnosis. The Hainan rainbow gudgeon *Sarcocheilichthys hainanensis* can be distinguished from its congeners by the following unique combination of characters: (1) fin rays: D 3+7; A 3+6; P₁ 1+14; P₂ 1+7; (2) scales: LL 39–40; TR 8; PreD 11; (3) vertebral count 4+33; (4) body features: body overall slender; pharyngeal teeth in 1 row; lip lobes bulb-like; barbules absent; male individuals with a finger-like protrusion posterior to anus; and (5) coloration: body with a lateral streak posterior from gill slits to caudal fin base; dorsal fin with a single black streak and black blotch; upper and lower caudal fin edges with single black streaks.

Redescription. Body proportions as shown in Table 1, frequencies of meristic counts in Table 2. Body spindle-shaped, depth greatest at dorsal fin base. Body profile slightly convex anterior to dorsal fin base and slightly concave posterior towards caudal peduncle base. Snout bluntly, large male individual with a slight concave. Mouth inferiorly positioned; upper jaw prominent, posterior end of gape doesn't reach beyond middle-vertical position of orbit; both jaws retractable, outstretching downward. Upper lip thick; tip of lower lip with thin horny sheath. Pharyngeal teeth in one row. Lower lip with two lateral lobes (Fig. 4B), short and bulb-like, situated along lower jaw, anterior end pointing towards tip of lower jaw, connecting to upper lip posteriorly. Barbules absent. Male individuals with a short, finger-like extension just posterior to anus (Fig. 7C). Vertebrae 4+33.

Fins. Dorsal fin with 3 unbranched rays and 7 branched rays (3); anal fin with 3 unbranched rays and 6 branched rays (3); pectoral fins with 1 unbranched ray and 14 branched rays (3); pelvic fins with 1 unbranched ray and 7 branched rays (3). All fins flexible. Dorsal fin origin anterior to pelvic fin insertions. Pectoral fins horizontal, slightly longer in length than head, posterior tips not extending beyond pelvic fin insertions. Posterior tip of pelvic fins extending beyond anus when compressed. Caudal fin forked, upper and lower lobes equal in length and shape. All fins without elongated rays.

Squamation. Lateral line pored scales 39 (3); transverse scale rows 8 (3); predorsal scales 11 (2) or 12 (1). All scales cycloid, moderately big, no exceptionally enlarged scales. Head completely naked, predorsal regions scaled until vertical position of upper edge of gill slit. Thoracic region and abdomen scaled; anus almost covered by scales. Lateral line complete.

TABLE 1. Morphometric percentages of three *Sarcocheilichthys* species examined herein.

	<i>Sarcocheilichthys hanjiangensis</i> sp. nov.			<i>Sarcocheilichthys hainanensis</i>	<i>Sarcocheilichthys nigripinnis</i>	
	Holotype	♂	♀	♂	♂	♀
n	1	7	5	3	1	1
SL (mm)	53.02	49.58–57.94	44.85–53.95	50.80–85.04	92.11	90.18
Percent in standard length (%)						
Head length	20.09	19.74–20.95 (20.26)	19.84–21.07 (20.30)	17.80–18.62 (18.26)	20.08	20.25
Body depth	26.22	25.74–27.83 (26.42)	25.94–28.12 (26.76)	22.09–26.32 (24.25)	26.77	27.18
Body width	14.94	14.40–15.37 (14.98)	14.71–15.33 (15.07)	11.06–13.10 (11.91)	16.68	14.91
Caudal peduncle length	20.07	19.32–22.06 (20.75)	19.43–23.05 (20.47)	20.47–23.68 (21.26)	20.24	19.67
Caudal peduncle depth	12.56	12.63–13.28 (13.03)	11.99–13.35 (12.90)	11.74–11.96 (11.83)	13.36	13.25
Predorsal length	45.51	43.91–47.01 (45.12)	44.87–48.94 (46.55)	44.94–48.68 (46.49)	45.93	46.44
Dorsal fin base	13.94	12.48–14.05 (13.69)	13.26–13.98 (13.63)	10.68–11.79 (11.36)	13.36	13.25
Anal fin base	8.60	8.05–8.98 (8.48)	8.26–10.79 (8.86)	8.76–10.19 (9.31)	8.15	8.03
Snout to ventral fin	47.76	47.04–49.12 (47.84)	47.54–50.26 (49.33)	47.95–48.58 (48.35)	48.55	49.53
Snout to anal fin	70.31	69.55–72.46 (70.56)	55.58–73.91 (68.40)	70.80–71.23 (71.01)	70.50	71.80
Dorsal origin to caudal base	52.81	52.99–58.73 (54.42)	52.61–53.99 (53.34)	53.19–53.88 (53.48)	52.99	48.27
Pectoral origin to pelvic insertion	25.39	23.96–25.96 (24.92)	24.56–25.70 (25.71)	24.29–25.80 (24.89)	26.23	25.80
Length of longest dorsal soft ray	22.73	22.35–24.01 (23.18)	22.54–24.86 (23.72)	21.79–22.42 (22.04)	20.29	20.39
Length of longest pectoral soft ray	20.07	19.72–21.00 (20.33)	19.98–21.22 (20.54)	18.23–19.14 (18.82)	19.55	19.51
Length of longest ventral soft ray	17.80	17.82–18.67 (18.21)	17.57–18.71 (18.13)	16.48–17.54 (16.84)	16.45	16.42
Length of longest anal soft ray	17.24	17.04–18.03 (17.31)	15.85–17.57 (17.04)	17.19–17.48 (17.32)	17.28	15.65
Percent in head length (%)						
Snout length	6.43	6.35–6.69 (6.49)	6.32–6.88 (6.64)	5.93–7.09 (6.67)	7.43	7.33
Interorbital width	8.03	7.79–8.36 (7.94)	7.90–8.41 (8.11)	6.5–7.5 (7.00)	7.87	7.50
Eye diameter	6.24	6.19–6.51 (6.29)	6.23–7.34 (6.60)	5.68–6.48 (6.12)	5.69	5.69
Head width	12.81	12.73–13.30 (13.05)	12.64–13.71 (13.17)	11.08–11.76 (11.30)	12.26	12.08
Head depth at orbit midline	14.65	14.48–14.85 (14.69)	14.21–15.50 (14.75)	12.52–13.70 (12.92)	13.48	13.99

Coloration in preservatives. Body yellow (caused by long-term preservation), dorsal side of body dark above lateral line (dark regions restricted in dorsal side of body in juveniles), and blotchless below lateral line. Body with a thick lateral streak from gill slits to caudal fin base, width about three rows of scales. Head yellowish with dorsal side black until lower rim of orbit, ventral side and thoracic region weakly pigmented. A black, slight oval-shaped spot just posterior to opercle with upper end below lateral line (Fig. 6B). Dorsal fin with a broad stripe along unbranched rays and a single blotch located at median-posterior part (Fig. 5B). Pectoral fins, pelvic fins and anal fin with black shade or vague blotches between branched rays. Both lobes of caudal fin with a broad black smear located at upper and lower edges.

Remarks. The Hainan rainbow gudgeon *Sarcocheilichthys hainanensis* can be differentiated from its Chinese congeneric species, *S. sinensis* and *S. lacustris*, by its broad mid-lateral stripe (vs. having broad transverse bands), and from *S. sciistius*, *S. parvus*, and *S. caobangensis* by its mid-lateral stripe not extending anteriorly to snout tip

across orbit (vs. stripe extending to snout tip). *S. hainanensis* can also be differentiated from *S. nigripinnis* and *S. davidi* in having only one row of pharyngeal teeth (vs. both having two rows), and further separated from the former in having a finger-like protrusion posterior to the anus in male individuals (vs. no such character), dorsal fin markings (single stripe and a posterior blotch vs. weakly pigmented), smaller head (18.26% in SL vs. 20.17% in SL), and smaller caudal peduncle depth (11.83% in SL vs. 13.31% in SL) (see Table 1).

Distribution. *Sarcocheilichthys hainanensis* has been known so far only from Hainan Island, PRC.

Sarcocheilichthys hanjiangensis Chen & Li, new species

(Figs 2–6)

Materials Examined

Holotype: NTOUP-2008-12-004, 53.02 mm SL; Ting Jiang, tributary of Hanjiang, Changtin County, Longyan City, Fujian Province, PRC; coll. I-S. Chen *et al.*, 4 December 2008.

Paratypes: All paratypes were collected with the holotype. NTOUP-2008-12-005, 12 (44.85–57.94 mm SL).

Diagnosis. The Hanjiang rainbow gudgeon, *Sarcocheilichthys hanjiangensis*, can be distinguished from its congeners by the following unique combination of characters (counts for holotype marked with an asterisk): (1) fin rays: D 3+7*; A 3+6*; P₁ 1+14*; P₂ 1+7*; (2) scales: LL 37*–39; TR 8*–9; PreD 10*; (3) vertebral count 4+33*; (4) body features: body relatively robust. Pharyngeal teeth in 2 rows. Lip lobes elongated, spindle-like with blunt anterior end; barbules absent. Male individuals with a finger-like protrusion posterior to anus; female ovipositor short, with a simple tube-like opening; and (5) coloration: body scattered with patches of black blotch; fins whitish-orange; dorsal fin with a tadpole-like blotch.

Description. Body proportions as shown in Table 1, frequencies of meristic counts in Table 2. Counts for holotype marked with an asterisk. Body spindle-shaped, depth greatest at dorsal fin base, and slightly compressed laterally. Body profile slightly convex anterior to dorsal fin base and straight posterior towards posterior end of caudal peduncle dorsally and ventrally. Snout blunt. Mouth slightly oblique, inferiorly positioned; upper jaw prominent, posterior end of gape touches the anterior edge of orbit but not succeeding; both jaws retractable, outstretching downward. Upper lip thin; tip of lower lip with well-developed horny sheath. Pharyngeal teeth in two rows (Fig. 3), longer teeth hook-like. Lower lip with two lateral lobes (Fig. 4A), elongated and narrow, situated along lower jaw, anterior end pointing towards tip of lower jaw, connecting to upper lip posteriorly. Barbules absent. Anus located in middle between pelvic fin insertion and anal fin origin. Male individuals with a short, finger-like extension just posterior to anus (Fig. 7A). Female individuals with ovipositor, length not extending to anal fin origin, ovipositor tube gradually reduced posteriorly until shaping like a bottleneck at posterior tip with a simple pore opening (Fig. 7B). Vertebrae 4+33.

TABLE 2. Meristic count frequencies of three *Sarcocheilichthys* species examined herein. Note that the counts for the holotype of *S. hanjiangensis* is marked with an asterisk.

Species	D		A		P ₁		P ₂	
	3+7	Av.	3+6	Av.	1+14	Av.	1+7	Av.
<i>S. hanjiangensis</i> sp. nov.	13*	7	13*	6	13*	14	13*	7
<i>S. hainanensis</i>	3	7	3	6	3	14	3	7
<i>S. nigripinnis</i>	2	7	2	6	2	14	2	7

Species	LL				TR			Pred				
	37	38	39	Av.	8	9	Av.	9	10	11	12	Av.
<i>S. hanjiangensis</i> sp. nov.	4*	7	2	38	9*	4	8	3	10*	-	-	10
<i>S. hainanensis</i>	-	-	3	39	3	-	8	-	-	2	1	11
<i>S. nigripinnis</i>	-	-	2	39	2	-	8	-	1	1	-	11



FIGURE 2. Fresh and preserved (lower) holotype of *Sarcocheilichthys hanjiangensis*, NTOUP2008-12-004, 53.02 mm SL, male. Scale bar = 1 mm.

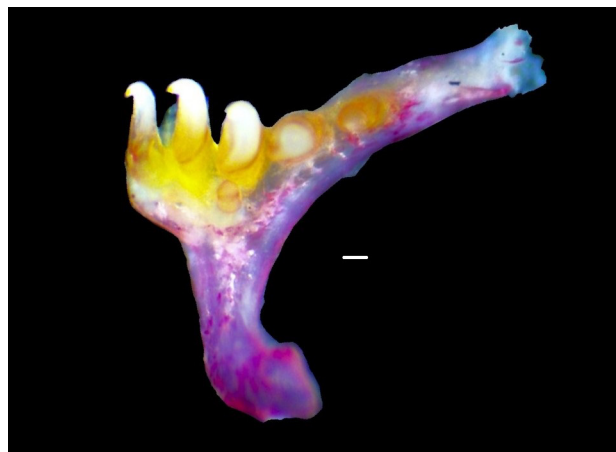


FIGURE 3. Left pharyngeal teeth of *S. hanjiangensis*, holotype, NTOUP2008-12-005, 50.69 mm SL, male. Scale bar = 0.01 mm. Photo taken by WC Chen.

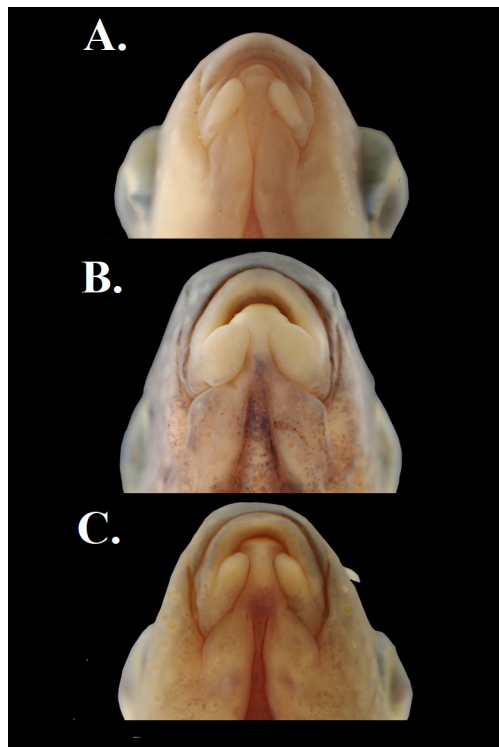


FIGURE 4. Lower lip of three *Sarcocheilichthys* species examined herein. A. *S. hanjiangensis*, holotype, NTOUP2008-12-004, 53.02 mm SL, male; B. *S. hainanensis*, NTOUP2013-05-026, 85.14 mm SL, male; C. *S. nigripinnis*, NTOUP2014-10-014, 92.11 mm SL, male.

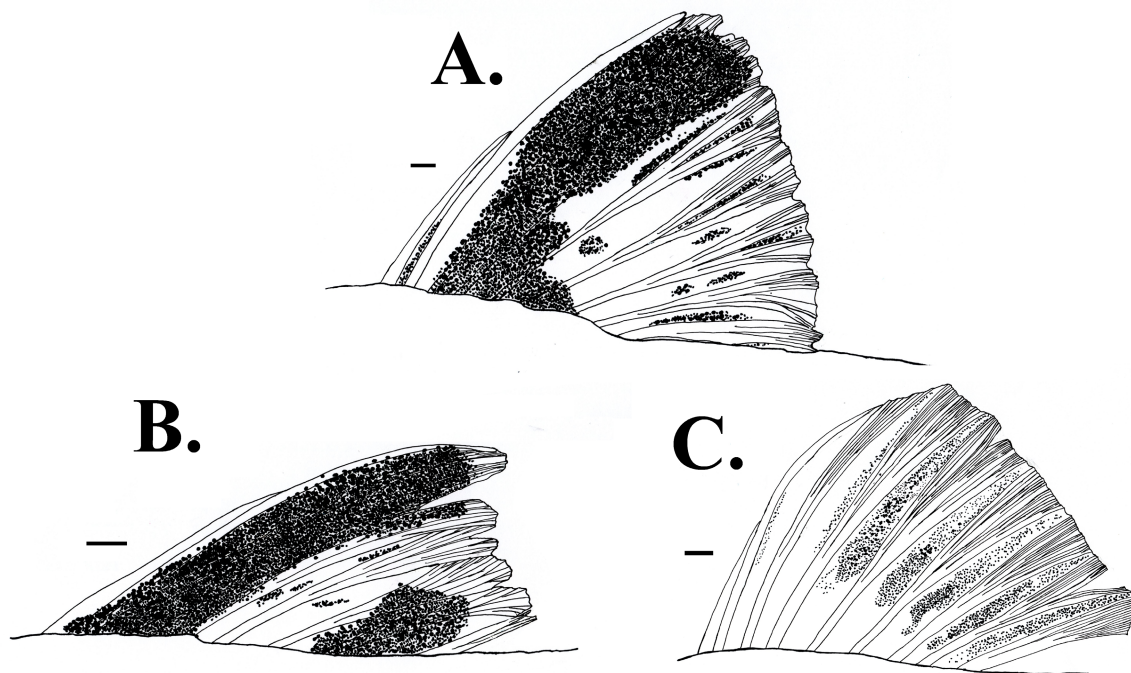


FIGURE 5. Dorsal fin markings of three *Sarcocheilichthys* species examined herein. A. *S. hanjiangensis*, holotype, NTOUP2008-12-004, 53.02 mm SL, male; B. *S. hainanensis*, NTOUP2013-05-026, 85.14 mm SL, male; C. *S. nigripinnis*, NTOUP2014-10-014, 92.11 mm SL, male. Scale bar = 0.1 mm.

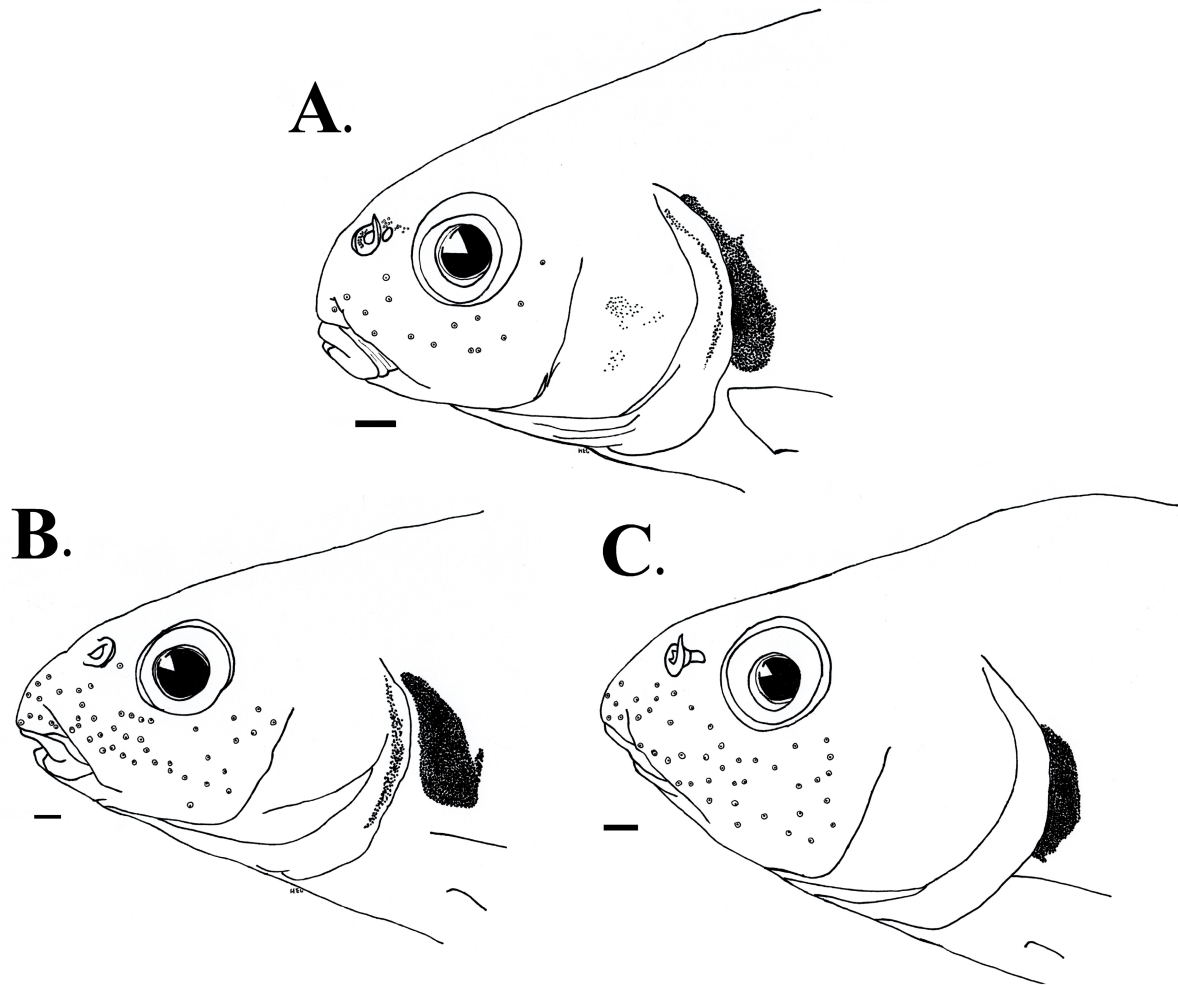


FIGURE 6. Head of three *Sarcocheilichthys* species examined herein, showing tubercle and post-opercle marking patterns. A. *S. hanjiangensis*, paratype, NTOUP-2008-12-005, 57.94 mm SL, male; B. *S. hainanensis*, NTOUP-2013-05-026, 85.14 mm SL, male; C. *S. nigripinnis*, NTOUP-2014-10-014, 92.11 mm SL, male. Scale bar = 0.1 mm.

Fins. Dorsal fin with 3 unbranched rays and 7 branched rays (13); anal fin with 3 unbranched rays and 6 branched rays (13); pectoral fins with 1 unbranched ray and 14 branched rays (13); pelvic fins with 1 unbranched ray and 7 branched rays (13). All fins flexible. Both dorsal fin and anal fin with exceptionally short first unbranched ray. Dorsal fin origin anterior to pelvic fin insertions, posterior end of fin base about vertical position of anus. Pectoral fins almost horizontal, almost same length as head, posterior tips not surpassing pelvic fin insertions. Posterior tip of pelvic fins extending beyond anus when compressed. Caudal fin forked, upper and lower lobes equal in length and shape, posterior tips rounded. All fins without elongated rays in both sexes.

Squamation. Lateral line pored scales 37* (4), 38 (7), or 39 (2); transverse scale rows 8* (9) or 9 (4); predorsal scales 9 (3) or 10* (10). All scales cycloid and in moderate size; no exceptionally enlarged scales. Head completely naked, predorsal regions scaled until vertical position of the upper edge of gill slit. Thoracic region and abdomen scaled; anus almost covered by scales. Lateral line complete, almost straight with anterior end slightly curved upwards.

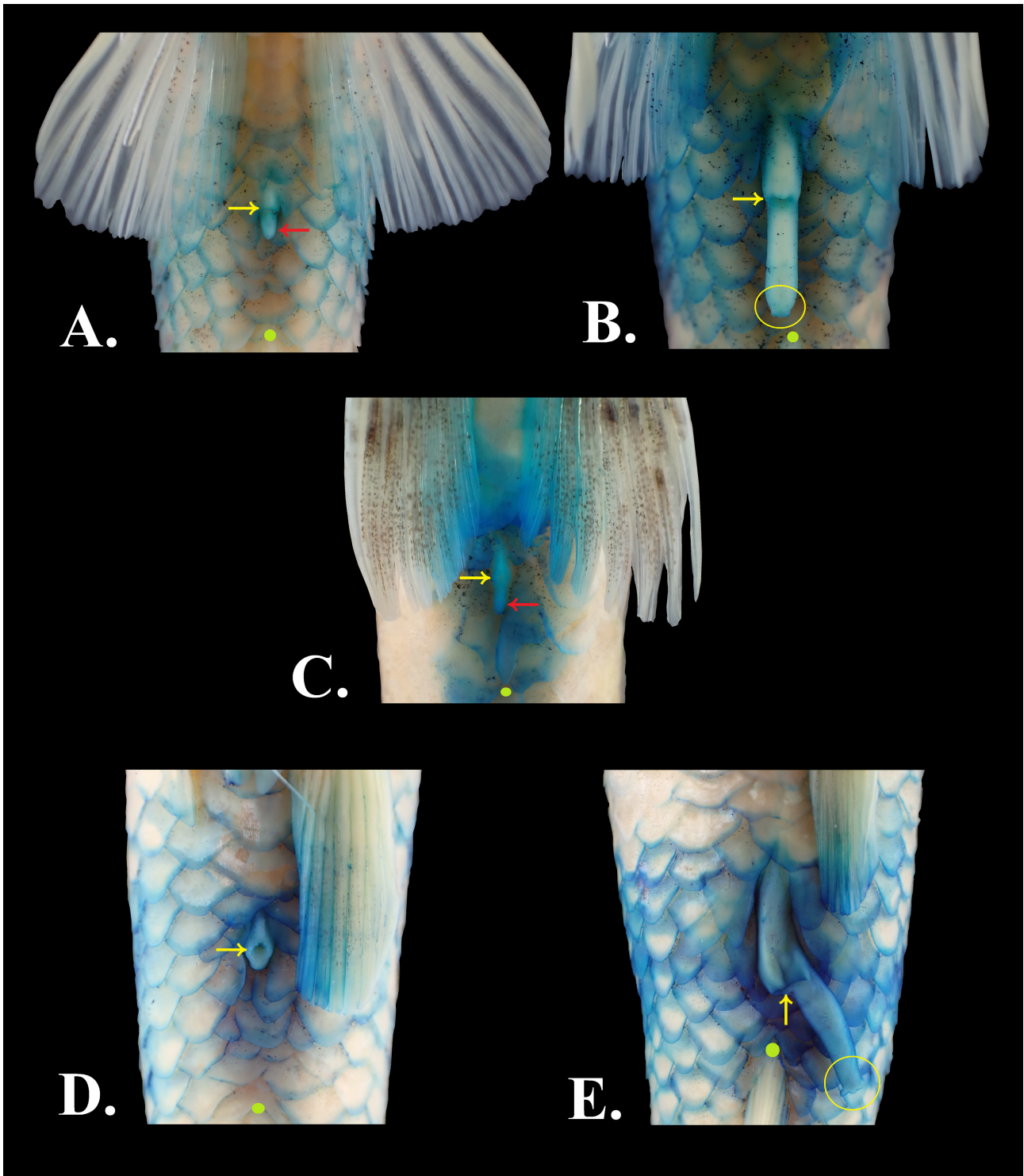


FIGURE 7. Anus and female ovipositor of three *Sarcocheilichthys* species examined herein, yellow arrow marks the position of anus, red arrow marks the finger-like protusions, green dot indicates anal fin origin, and yellow circle highlighting the opening of female ovipositor tube. A. *S. hanjiangensis*, holotype, NTOUP2008-12-004, 53.02 mm SL, male; B. *S. hanjiangensis*, paratype, NTOUP2008-12-005, 53.95 mm SL, female; C. *S. hainanensis*, NTOUP2013-05-026, 85.14 mm SL, male; D. *S. nigripinnis*, NTOUP2014-10-014, 92.11 mm SL, male; E. *S. nigripinnis*, NTOUP2014-10-014, 90.18 mm SL, female.

TABLE 3. Character comparison of *Sarcocheilichthys* with a vague, not-reached-to-snout lateral stripe from China. “-“ marks the inaccessible data for that species. Note that data of *S. davidi* and *S. kiangsiensis* were from their original descriptions and data of *S. scistiuis* from An *et al.* (2022).

Species	Cornified Lower lip sheath	Pharyngeal teeth	Female ovipositor	Dorsal fin Markings	Body markings	Type locality
<i>S. hanjiangensis</i> <i>n. sp.</i>	Well developed	2	Not Extending beyond anal fin origin	Tadpole-like blotch	Dorsal side dark, with vague lateral streak and scattered black patches	Hanjiang, Changfin county, Fujian
<i>S. nigripinnis</i> Günther, 1873	thin	2	Extends beyond anal fin origin	Lightly pigmented, without specific blotches	Vague lateral streak with irregularly scattered blotches, becomes dense posteriorly	Shanghai
<i>S. davidi</i> Sauvage, 1878	Well developed	2	-	Dusky black, without specific blotches	Lateral streak present and scattered black patches	Western Szechwan, China
<i>S. scistiuis</i> Abbott, 1910	No	2	Extends beyond anal fin origin	Translucent or orange-red with two rows of black spots,	Irregularly scattered brown blotches, becomes dense posteriorly	Pei-Ho River (Haihe River), Tien-Tsin (Tianjin)
<i>S. hainanensis</i> Nichols & Pope, 1927	thin	1	-	Stripe along soft ray and a single blotch	Dorsal side dark, with lateral streak posterior from gill slits to caudal fin base	Nodoa, Hainan Island
<i>S. kiangsiensis</i> Nichols, 1930	Well developed	1	-	Dusky without specific blotches	Dorsal side greyish black, with lateral streak present and scattered black patches	Hokou, lower Yangtze River, eastern Kiangsi Province, China

Coloration and markings when fresh. See Fig. 2. Body creamy yellow, dorsal side black, not reaching downward beyond lateral line. Scales with black spots posteriorly, forming irregular blotch patches. Rows of relatively regularly lined black spots aside lateral line, forming a vague lateral stripe. Head yellowish with dorsal side black until lower rim of orbit, ventral side until thoracic region white. Ventral side of body whitish yellow. A narrow, black marking just posterior to opercle, upper side narrow and round on lower side, width no more than one scale, shaping like an elongated teardrop, and upper end not extending upwards beyond lateral line (Fig. 6A). Dorsal fin yellowish orange with a large, tadpole-shaped blotch from base of second and third branched ray until covering tips of third unbranched ray to third branched ray (Fig. 5A). Pectoral fins, pelvic fins, and anal fin white with an orangish yellow shade medially, scattered with bits of pigmentation between branched rays. Caudal fin milky yellow with two stripes along unbranched rays on both lobes, scattered with bits of black spots between these stripes.

Colouration in preservatives. Body overall yellowish (caused by long-term preservations), all shades of color faded. All blotches remain intact, body with a lateral stripe extending from gill slits to caudal fin base. All fins whitish.

Remarks. The characters of having a vague lateral stripe and body mottled with black blotch patches can be employed to initially differentiate the new species *Sarcocheilichthys hanjiangensis* from its Chinese congeneric species, *S. sinensis* and *S. lacustris* (both having three to four large patches of transverse bands), and *S. sciistius*, *S. parvus*, and *S. caobangensis* (all three having clear lateral stripe extending from snout tip to caudal fin base). *S. hanjiangensis* can also be differentiated from *S. kiangsiensis* by its absence of barbels (vs. barbels present), fewer lateral line scales (37–39 vs. 42–44), higher pharyngeal teeth row counts (2 vs. 1), and a relatively robust head (20.26% in SL vs 25% in SL), and from *S. hainanensis* by having higher pharyngeal teeth row counts (2 vs. 1), lower predorsal scale counts (9–10 vs. 11–12), a shorter caudal peduncle length (20.59% in SL vs. 21.26% in SL), a greater caudal peduncle depth (12.94% in SL vs. 11.83% in SL), a lower lip lobe morphology (long and narrow vs. short, bulb-like) (Fig. 4A; 4B), dorsal fin markings (tadpole-like blotch vs. single stripe along unbranched ray) (Fig. 5A; 5B), and a post-opercle blotch pattern (narrow, elongated teardrop shape vs. slight oval shaped blotch below lateral line) (Fig. 6A; 6B) (Table 1; 2).

S. hanjiangensis is most similar to *S. nigripinnis* and *S. davidi* in overall fin ray and scale counts, body proportions, and pharyngeal teeth row counts. However, *S. hanjiangensis* can be distinguished from *S. nigripinnis* by its male anus morphology (having a finger-like protrusion vs. no such character), female ovipositor length (not reaching anal fin origin vs. extending beyond anal fin origin) and ovipositor opening morphology (single pore vs. pedal shaped) (Fig. 7B; 7E), dorsal fin markings (tadpole-like blotch vs. dusky, slightly pigmented) (Fig. 5A; 5C), body markings (vague lateral streak with patches of spots vs. large, connected patches of pigmentation) (Fig. 1B; 2), and post-opercle blotch pattern (narrow, elongated teardrop shape vs. thin, single blotch below lateral line) (Fig. 6A; 6C). *S. hanjiangensis* can be further distinguished from *S. davidi* by its lower lip lobe morphology (narrow and long, situated along lower jaw vs. slightly bulbish, anterior end pointing towards midline of lower jaw), dorsal fin markings (tadpole-like blotch vs. dusky, slightly pigmented), body markings (vague lateral streak with patches of spots vs. large, connected patches of pigmentation), and post-opercle blotch pattern (narrow, elongated teardrop shape vs. single thin blotch below lateral line).

Etymology. The specific name, *hanjiangensis*, refers to Hanjiang, a river system of Fujian Province that runs through Changtin County, where the types of the new species were collected.

Distribution. *Sarcocheilichthys hanjiangensis* **sp. nov.** has been known so far only from its type locality.

Comparative materials

Sarcocheilichthys hainanensis: NTOUP2013-05-026, 3 specimens (50.80–85.14 mm SL); Baisha County, Hainan Island. PRC; coll. I-S. Chen *et al.*, 26 May 2013.

Sarcocheilichthys nigripinnis: NTOUP2014-10-014, 2 specimens (90.18–92.11 mm SL); Hanjiang, tributary of Yangtze River, Annan City, Shanxi Province, PRC.

Discussion

Allopatric speciation has always been an important driver for the speciation of freshwater fishes (Near & Benard 2004; Seehausen & Wagner 2014). As for *Sarcocheilichthys*, its special reproductive plans, compared to its gobionine relatives, and its relatively wide distribution have led to its high diversity in East Asia. Zhang *et al.* 2008; Fujita *et al.* 2008).

Studies conducted by Zhang *et al.* (2008) showed that the *Sarcocheilichthys* of East Asia can be separated into two clades; one of them is a paraphyly group including *S. nigripinnis* and *S. czerskii*. However, according to Li *et al.* (2022), *S. sciistius*, formerly considered a junior synonym of *S. nigripinnis*, is actually valid and also the senior synonym of *S. czerskii*. Furthermore, the “northern clade” and “southern clade” of Clade II in Zhang *et al.* (2008) actually represent two individual species: *S. sciistius* (distributed northwards of Yangtze River) and *S. nigripinnis* (distributed southwards of Yangtze River), respectively, and the results of Liu *et al.* (2013) agree with this.

The analysis results of Liu *et al.* (2013) further indicate that the population of *S. nigripinnis* can be separated into seven well-bootstrap-value-supported lineages, and one of them represents the population of Hanjiang (lineage V). Our examinations of the “*S. nigripinnis*” collected in Hanjiang supported this lineage being an individual species with great morphological differences in coloration and female ovipositor morphologies (Figs. 1–2; 4–7). Liu *et al.* (2013) further speculate that the Hanjiang “*S. nigripinnis*” population, now recognized as a new species, *S. hanjiangensis*, might have undergone genetic drift events with other populations from Oujiang, Jiulongjiang, and Mulan River, all of which are from the Minnan region, as they share a late time of the most recent common ancestor (0.12~0.95 Ma). Therefore, we speculate the existence of a “*S. nigripinnis* species complex” with various valid but unrecognized species due to a lack of definitive character examination or overall coloration and genetic similarities. We anticipate that these new species will be unearthed from the Minnan region of southern China.

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