

A diminutive new species of *Silurus* (Teleostei: Siluridae) from Guangxi, southern China

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Silurus longibarbatus, new species, is described from the Pearl River drainage in Guangxi Zhuang Autonomous Region, China. The new species is distinguished from all congeners by having three pairs of relatively long barbels, by the number of vertebrae, dorsal- and anal-fin rays, head length, pectoral-fin spine with smooth anterior and serrated posterior margins, vomerine teeth patches in continuous band, and a lateral line visible as a series of short whitish horizontal lines.

Introduction

Catfishes of the genus *Silurus* are widely distributed in Eurasia. Kobayakawa (1989) conducted the first major revision of the genus *Silurus* and recognized 17 species as valid based on external morphology and anatomy: *S. afghana*, *S. aristotelis*, *S. asotus*, *S. biwaensis*, *S. cochinchinensis*, *S. duanensis*, *S. glanis*, *S. grahami*, *S. lanzhouensis*, *S. lithophilus*, *S. mento*, *S. meridionalis*, *S. microdorsalis*, *S. soldatovi*, *S. torrentis*, *S. triostegus*, and *S. wynaadensis*. Bornbusch (1991) then provisionally placed four *Silurus* species (*S. afghana*, *S. cochinchinensis*, *S. torrentis*, and *S. wynaadensis*) in the genus *Pterocryptis*. Ferraris (2007), in his checklist of recent and fossil catfishes, considered 13 species of *Silurus* to be valid; subsequently, Britz & Win (2010) allocated *S. burmanensis* to *Silurus* from *Pterocryptis*. Among the 14 valid species, eight, namely *S. asotus*,

S. duanensis, *S. grahami*, *S. lanzhouensis*, *S. mento*, *S. meridionalis*, *S. microdorsalis*, and *S. soldatovi* are recorded in China (Chen, 1977; Kottelat, 1998; Ng & Kottelat, 1998; Chu et al., 1999; Ng & Freyhof, 2001; Hu et al., 2004; Ng & Chan, 2005).

On June 2 2014, several diminutive specimens were collected from a stream in Shanglin County, Guangxi, southern China. Through comparison with congeners, these specimens were recognized as representing an undescribed species. We herein describe this new species and name it *Silurus longibarbatus*.

Materials and methods

Length measurements were made with digital calipers and recorded to the nearest 0.1 mm. Counts and measurements were made on the left

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Fig. 1. *Silurus longibarbatus*, PRFRI 20140602002, holotype, 119 mm SL; China: Guangxi: Pearl River basin.



Fig. 2. Dorsal and ventral views of the head of *Silurus longibarbatus*, PRFRI 201406 02003, paratype, 92 mm SL; China: Guangxi: Pearl River basin.

side of specimens (whenever possible), following the method by Chu et al. (1999). Institutional acronyms follow Eschmeyer (1998) with the exception of the Pearl River Fisheries Research Institute, Chinese Academy of Fishery Science (PRFRI). Osteological features were observed using a conventional x-ray system (Longsafe LXDI-2431K-V). Vertebral counts given here do not include those of the Weberian complex. Data for the *Silurus* species used for comparison were taken from Kobayakawa (1989), Chu et al. (1999), and Hu et al. (2004).

Results

Silurus longibarbatus, new species

(Figs. 1–3)

Holotype. PRFRI 20140602002, 119 mm SL; China: Guangxi: Shanglin County: Xiyan Town: Yunhuang Village: Qingshuihe Stream, 23°29'25" N 108°30'46" E; Jie Li, 2 June 2014.

Paratypes. PRFRI 20140602001, 03-04, 74–123 mm SL; same data as holotype.



Fig. 3. Live coloration of *Silurus longibarbatu*, uncatalogued, 123 mm SL; China: Guangxi: Pearl River basin.

Diagnosis. *Silurus longibarbatu* is distinguished from all congeners by the following combination of characters: three pairs of relatively long barbels; 2 or 3 dorsal-fin rays; 50–58 anal-fin rays; 42–44 vertebrae; head length 16.6–19.3 % SL; pectoral-fin spine with smooth anterior and serrated posterior margins; vomerine teeth patches in continuous band; and lateral line visible as a series of short whitish horizontal lines.

Description. Morphometric data listed in Table 1. Figure 1 shows lateral view of body of holotype and Figure 2 shows dorsal and ventral views of head. Body laterally compressed. Head depressed. Dorsal profile almost straight, its peak above anus. Snout rounded in dorsal view; anterior pair of nostrils tubular, situated anteromedially to maxillary barbel; posterior pair of nostrils bordered by fleshy dorsal and ventral membranes, and posteromedial to base of maxillary barbel; eye

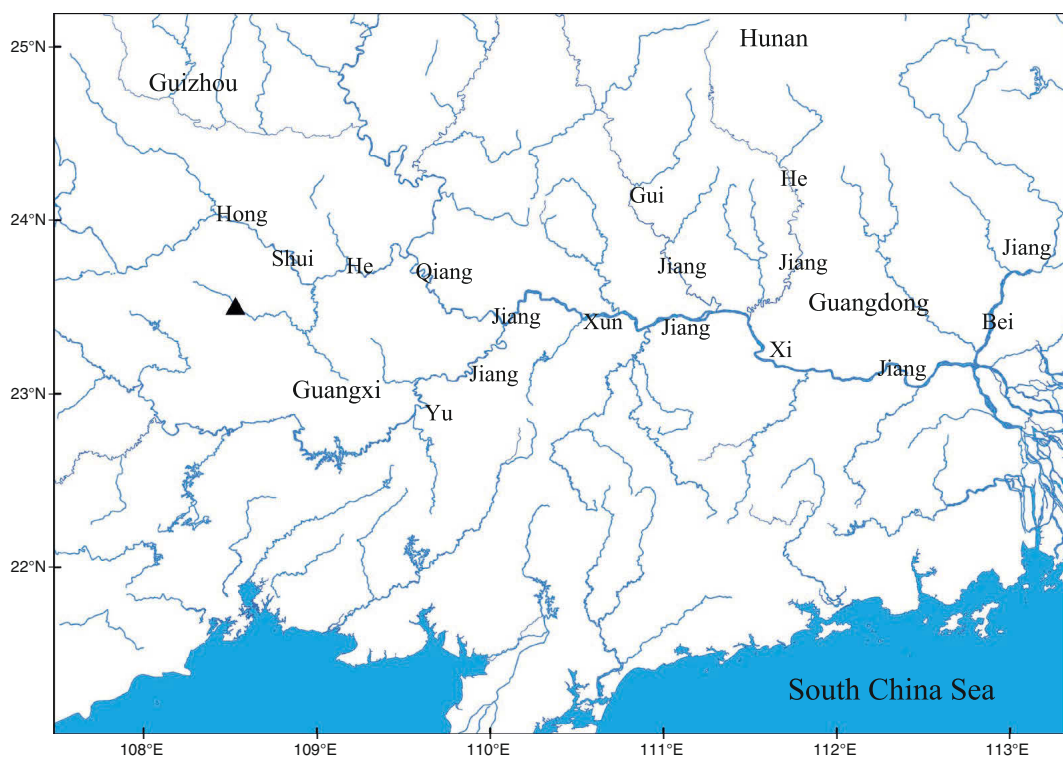


Fig. 4. *Silurus longibarbatu*, type locality (▲).

small but diameter greater than length of dorsal-fin base, positioned on anterior half of head, and visible dorsally but not ventrally.

Mouth superior; horizontal gape ending in front of vertical at anterior margin of eye; lower jaw prominently longer than upper jaw; upper rictal fold posteriorly truncated at corner of mouth and forming supramaxillary groove; teeth villiform; teeth on dentary in slightly curved pattern extending from symphysis to corner of mouth and visible dorsally when mouth closed; teeth on vomer in continuous band; barbels long; with maxillary barbel reaching or extending beyond pelvic-fin base; and two pairs of mandibular barbel each reaching pectoral-fin base; medial mandibular barbel longer than outer barbel; gill membranes separated, free from isthmus, overlapping; crescent-shaped posteromedial mandibular groove posterior to and spanning outer mandibular barbel.

Dorsal-fin small, with 2 or 3 rays; pectoral-fin with 10 or 11 branched rays; distal margin convex; two-thirds of first pectoral-fin element co-ossified into spine; anterior edge of pectoral-fin spine smooth and posterior edge with 3–5 serrations;

distal margin of pelvic-fin convex, with 8 or 9 rays; anal-fin long, with 50–58 rays; anal and caudal fins completely confluent; caudal-fin rounded, with 14 or 15 rays; vertebrae 42–44; 8 gill rakers on first arch.

Coloration. In life, body generally pale grey. Flanks, dorsal surface of body, sides of head and anal fin covered by irregular dark gray patches; abdomen whitish. Dorsal, pectoral, pelvic, and caudal fins hyaline. Lateral line visible as series of short whitish horizontal lines (Figs. 1, 3).

Etymology. The specific name *longibarbatus*, from the Latin *longus* (meaning long) and *barbatus* (meaning beard), refers to the relatively long barbels of this species.

Distribution and habitat. The new species is presently known only from the type locality at Qingshui Stream in Yunhuang Village (23°29'25"N 108°30'46"E; altitude 164 m), Xiyian Town, Shanglin County, Guangxi, southern China (Fig. 4). The stream flows into the Qingshui River, a tributary of the Hongshui River, an upper

Table 1. Morphometric data for *Silurus longibarbatus* (n=4).

	Holotype	Paratypes			Mean
	201406 02002	201406 02001	201406 02003	201406 02004	
Total length (mm)	133	136	102	83.2	113
Standard length (mm)	119	123	92.0	74.0	102
In percent of standard length					
Pre-dorsal length	26.1	26.1	26.9	27.7	26.7
Pre-anal length	37.6	37.9	41.7	35.5	38.2
Pre-pectoral length	16.2	16.0	19.3	16.0	16.9
Body depth at anus	16.3	17.7	19.8	15.9	17.4
Caudal peduncle depth	6.0	6.9	8.3	7.4	7.2
Pectoral-fin length	11.4	11.1	12.9	11.8	11.8
Pelvic-fin length	6.8	8.6	8.4	7.7	7.9
Length of dorsal-fin base	0.9	0.8	1.1	1.2	1.0
Dorsal-fin length	5.4	5.4	7.5	7.0	6.3
Head length	18.6	16.6	19.3	18.5	18.3
In percent of head length					
Snout length	35.5	32.0	33.3	39.5	35.1
Eye diameter	8.1	13.6	10.9	15.0	11.9
Interorbital distance	45.6	53.2	51.7	56.0	51.6
Head width	75.1	93.8	78.7	85.7	83.3
Mouth width	54.9	61.2	54.9	60.5	57.9
Maxillary-barbel length	163.2	185.7	201.6	199.8	187.6
Outer mandibular-barbel length	79.3	95.9	93.9	98.8	92.0
Inner mandibular-barbel length	97.3	109.5	100.4	104.2	103.9

stream Xijiang in the Pearl River basin. At the type locality, the stream is clear, slow-flowing, and approximately 0.5–1 m deep; the substrate consisted of sand, cobbles, and boulders (Fig. 5). Other fishes found in the stream included *Aphyocypris arcus*, *Channa asiatica*, *C. maculata*, *Clarias fuscus*, *Macropodus opercularis*, *Misgurnus anguillicaudatus*, *Monopterus albus*, *Neodontobutis hainanensis*, *Oreonectes platycephalus*, *Oryzias latipes*, *Parazacco spilurus*, and *Sineleotris chalmersi*.

Discussion

Silurus and *Parasilurus* were widely recognized as separate genera (Bleeker, 1862; Nichols, 1943; Berg, 1949; Tomoda, 1961), until studies by Haig (1950) and Chen (1977) recognized *Parasilurus* as a probable synonym of *Silurus*. Kobayakawa (1989) subsequently recognized 17 valid species of *Silurus*. The species of *Pterocryptis* were usually classified in *Silurus*, until Bornbusch (1991, 1995) recognized *Pterocryptis* as a valid genus and most closely related to *Silurichthys*. *Pterocryptis* was inferred to be monophyletic within the Siluridae based on the derived condition of a posteriorly shifted dorsal fin. The first proximal radial is adjacent to the neural spine and attached to the ninth, tenth, or eleventh vertebra, whereas in other silurid species, the first proximal radial is adjacent to the neural spine and attached to the seventh or eighth vertebra (Bornbusch, 1991). Bornbusch (1991) also found several additional characters to distinguish *Pterocryptis* from all other silurids: lower jaw included within the upper jaw; length of mental barbel 1–2 times in head length; dorsal-fin present; anal and caudal fins joined but separated by a shallow notch in the fin membranes; and caudal-fin slightly emarginated lobes subequal.

*Silurus longibarbatu*s has the first dorsal-fin pterygiophore inserted between the seventh and eighth vertebrae and a superior mouth, indicating that it does not represent a species of *Pterocryptis*. The new species also has a small dorsal fin, anal fin confluent with caudal fin with a distinct notch between them, lower jaw longer than upper jaw, and maxillary barbel well developed and extending beyond gill opening. Based on this combination, we assigned the new species to *Silurus*. Silurid catfishes of the genus *Silurus* currently include 14 valid species (Ferraris, 2007; Britz & Win, 2010). *Silurus longibarbatu*s has fewer anal-fin rays (50–58) than all other species of *Silurus*

except *S. duanensis* (61–87). *Silurus longibarbatu*s, *S. glanis*, *S. burmanensis*, and *S. soldatovi* have three pairs of barbels, whereas other *Silurus* species have two pairs of barbels. The new species can be distinguished from *S. glanis*, *S. burmanensis*, and *S. soldatovi* by having 50–58 anal-fin rays (vs. 83–87, 69, and 83–89 anal-fin rays in those species, respectively). *Silurus longibarbatu*s can be distinguished from *S. aristotelis*, *S. lanzhouensis*, *S. lithophilus* and *S. soldatovi* by the lack of minute papillae clustered on the tip of the maxillary barbel. *Silurus longibarbatu*s can be distinguished from *S. glanis* by having 10 or 11 (vs. 15 or 16) pectoral-fin rays and 8 or 9 (vs. 11 or 12) pelvic-fin rays. *Silurus longibarbatu*s has vomerine teeth in a single continuous band, whereas *S. burmanensis* has vomerine teeth in two separated elongate patches. *Silurus longibarbatu*s can be distinguished from *S. aristotelis*, *S. lanzhouensis*, and *S. lithophilus* by having a smooth anterior edge of the pectoral-fin spine, two pairs of mandibular barbels, and vomerine teeth in a single continuous band, whereas the other three species have a strongly serrated anterior edge of the pectoral-fin spine, one pair of mandibular barbels, and vomerine teeth in two discrete patches. *Silurus longibarbatu*s can be distinguished from *S. meridionalis* by having two pairs (vs. one pair) of mandibular barbels, 2 or 3 (vs. 5 or 6) dorsal-fin rays, the angle of the gape at a vertical with the anterior edge of the eye (vs. angle of gape at a vertical with the middle of the eye), and 50–58 (vs. 77–88) anal-fin rays.

The new species can also be distinguished from *Silurus asotus* and *S. biwaensis* by having two pairs of mandibular barbels, 2 or 3 dorsal-fin rays and 50–58 anal-fin rays, whereas the other two species have one pair of mandibular barbels, 4–6 dorsal-fin rays, and 71–88 anal-fin rays. *Silurus longibarbatu*s can be distinguished from *S. triostegus* by having two pairs (vs. one pair) of mandibular barbels, vomerine teeth in a single continuous band (vs. vomerine teeth in two discrete patches), 2 or 3 (vs. 4) dorsal-fin rays, and 50–58 (vs. 78–87) anal-fin rays. *Silurus longibarbatu*s is distinguished from *S. grahami* and *S. mento* by having two pairs of mandibular barbels, vomerine teeth in a single continuous band, and maxillary barbel reaching the pelvic-fin origin, whereas the other two species have one pair of mandibular barbels, vomerine teeth in two discrete patches, and maxillary barbel not reaching the pectoral-fin origin. *Silurus longibarbatu*s can be distinguished from *S. microdorsalis*



Fig. 5. Habitat of *Silurus longibarbatus*. Qingshuihe Stream in Yunhuang Village, Xiyan Town, Shanglin County, Guangxi, China.

as having two pairs (vs. one pair) of mandibular barbels, mandibular barbel reaching the pectoral-fin origin (vs. mandibular barbel not reaching the pectoral-fin origin), 50–58 (vs. 71–85) anal-fin rays, and 42–44 (vs. 50–52) vertebrae. The new species can be distinguished from *S. aristotelis* by having 50–58 (vs. 75) anal fin-rays, a shorter head that is 16.6–19.3 % SL (vs. a longer head, 24.4 % SL), maxillary barbel extending far beyond the

pectoral-fin base (vs. maxillary barbel not reaching the pectoral-fin base), and a smooth anterior margin of the pectoral-fin spine (vs. strongly serrated anterior margin of the pectoral-fin spine). *Silurus longibarbatus* can be distinguished from *S. lithophilus* by having 2 or 3 (vs. 4 or 5) dorsal-fin rays, 8 or 9 (vs. 9–11) pelvic-fin rays, 50–58 (vs. 77–82) anal-fin rays, and a smooth (vs. strongly serrated) anterior margin of the pectoral-fin spine.



Fig. 6. *Silurus duanensis*, PRFRI 01050247, 86.0 mm SL; China: Guangxi: Pearl River drainage.



Fig. 7. Dorsal views of the head of *Silurus duanensis*, PRFRI 01050247, 86.0 mm SL; and *S. longibarbatus*, PRFRI 20140602002, holotype, 119 mm SL; both from China: Guangxi: Pearl River basin. White arrows indicate the posterior nostril.



Fig. 8. *Silurus longibarbatus*, uncatalogued, 90 mm SL, mature female with stage IV eggs.

The new species is most similar to *Silurus duanensis* (Fig. 6) in body shape. These two species are also distributed in close geographic proximity to one another. However, the new species can be distinguished from the latter as having a shorter head (16.6–19.3 % SL vs. 21.3–23.3), vomerine teeth in a single continuous band (vs. vomerine teeth in two discrete patches), caudal fin rounded (vs. emarginate or truncate), posterior nostrils with elongated triangular flap (vs. tubular nostrils) (Fig. 7), completely confluent anal and caudal fins (vs. notch between the otherwise confluent anal and caudal fins), 8 (vs. 10–12) gill rakers and 42–44 (vs. 56 or 57) vertebrae.

Some characters of silurids have been demonstrated to show ontogenetic changes, such

as the number of anal-fin rays [see Ng & Ng's (1998) revision of *Silurichthys*] and length of the mandibular barbels (Chen, 1977; Xie, 1989; Bornbusch, 1995; Ng & Freyhof, 2001). These two characters can be used as diagnostic characters for adult specimens (Xie, 1989; Ng & Freyhof, 2001). *Silurus longibarbatus* appears to be a diminutive species; among the 40 collected specimens, size range was 72–123 mm SL. Among them, eight females were mature. The smallest female was 90 mm SL and had stage IV eggs that were almost 1 mm in diameter (Fig. 8). Thus, we suggest that the number of anal-fin rays and length of the mandibular barbels reported here for *Silurus longibarbatus* characterize the condition in adult fishes.

Comparative material. *Silurus asotus*: ASIZB 65513, 1, 435 mm SL; China: Guangdong: Pearl River drainage.

S. duanensis: ASIZB 73716, holotype, 341 mm SL; and PRFRI 01050247, 1, 86.0 mm SL; China: Guangxi: Pearl River drainage.

S. gilberti: ASIZB 609912, 440 mm SL; China: Guangxi: Pearl River drainage.

S. grahmi: ASIZB 63816, 428 mm SL; China: Yunnan: Fuxian Lake.

S. mento: ASIZB 167177, 253 mm SL; KIZ 00084, SL 256 mm; China: Yunnan: Dianchi Lake.

S. meridionalis: ASIZB 181697, 267 mm SL; China: Yunnan: Yangtze drainage.

S. microdorsalis: ASIZB 57668, 235 mm SL; China: Liaoning: Yalujiang River drainage.

S. soldatovi: ASIZB 65748, 158 mm SL; China: Liaoning: Liaohe River drainage.

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