

***Bibarba bibarba*: A new genus and species of Cobitinae (Pisces: Cypriniformes: Cobitidae) from Guangxi Province (China)**

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Abstract

A new genus of Cobitinae, *Bibarba* gen. n., and a new species, *B. bibarba* sp. n., were discovered and are described for the Chengjiang River, a tributary of the Hongshuihe River in Guangxi Province of southern China. This river region is characterized by a Karst landscape, and the river that is inhabited by the new genus is a slowly moving stream with arenaceous and cobblestone beds. The new genus resembles *Cobitis* Linnaeus, 1758 (subfamily Cobitinae) in the shape and pigmentation pattern of their body, the absence of scales on their head, and the presence of a suborbital spine, but differs from it by a single *Lamina circularis* on the third pectoral fin ray instead of on the base of the second pectoral fin ray; two pairs of barbels (one rostral pair and one maxillo-mandibular pair) instead of three pairs of barbels (one rostral pair, one maxillary pair, and one maxillo-mandibular pair); a relatively thick and short suborbital spine with a strong medio-lateral process instead of a suborbital spine without or with a weakly formed medio-lateral process as in *Cobitis*; and the lack of a black stripe extending from the occiput through the eye to the insertion of the rostral barbel. The first two characters have not been reported in any other genus of the subfamily Cobitinae. A morphometric character analysis based on PCA reveals differences between *B. bibarba* and *C. sinensis* in body size, barbel length, interorbital width, pectoral fin length in males, and the position of the dorsal and ventral fins. Type specimens of the new species are kept in the Freshwater Fishes Museum of the Institute of Hydrobiology at the Chinese Academy of Sciences in Wuhan, Hubei Province.

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Keywords: Cypriniformes; Cobitidae; New genus; New species; Hongshuihe River; Guangxi Province; China

1. Introduction

During a study of loaches of the genus *Cobitis* in China, which was based on the specimens kept in the Freshwater Fishes Museum (FFM) of the Institute of

Hydrobiology (IHB) at the Chinese Academy of Sciences (CAS) in Wuhan (Hubei Province), we discovered several unusual specimens that had been collected from the Chengjiang River, a tributary of the Hongshuihe River, in Du'an County (23°55'–56'N, 108°06'E) in Guangxi Province (southern China) in August 1985. Although these specimens had been identified as *Cobitis sinensis* Sauvage and Dabry

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(1874), they had not been formally described (Chen 1981; Dai 1981). To establish their present status, another collection trip was organized in April 2006, during which additional specimens of the same species were collected. The specimens display characteristics that are similar to those of the genus *Cobitis* in the shape and pigmentation pattern of their body, the absence of scales on their head, and the presence of a suborbital spine. However, they share a combination of unusual characters, such as the number of barbels, the shape of the suborbital spine, the particular pigmentation pattern on the head, and the arrangement of the *Lamina circularis* (i.e., the scale of Canestrini, a secondary sexual characters, also referred to as an osseous plate or spine at the pectoral fin) in males. These characters suggest that the specimens are appropriately placed in a separate and new genus and species within the Cobitinae.

2. Materials and methods

A total of 61 adult specimens (19 males and 42 females) were collected in the Chengjiang River, a tributary of the Hongshuihe River in the upper reaches of the Pearl River in Du'an County (23°55′–56′N, 108°06′E) in Guangxi Province (southern China) in August 1985 (one male and five females) and in April 2006 (18 males and 37 females) (Fig. 1). The specimens were stored in the FFM of the IHB at the CAS in Wuhan (Hubei Province).

Twenty-one morphometric variables were measured according to the procedures reviewed by Doadrio and Perdices (1997), except for the length of the anal peduncle (Fig. 2). Scales were collected from the subdorsal region between the dorsal fins and the lateral line and photographed by using a Leica DC180 camera attached to a Leica GZ6 stereomicroscope.

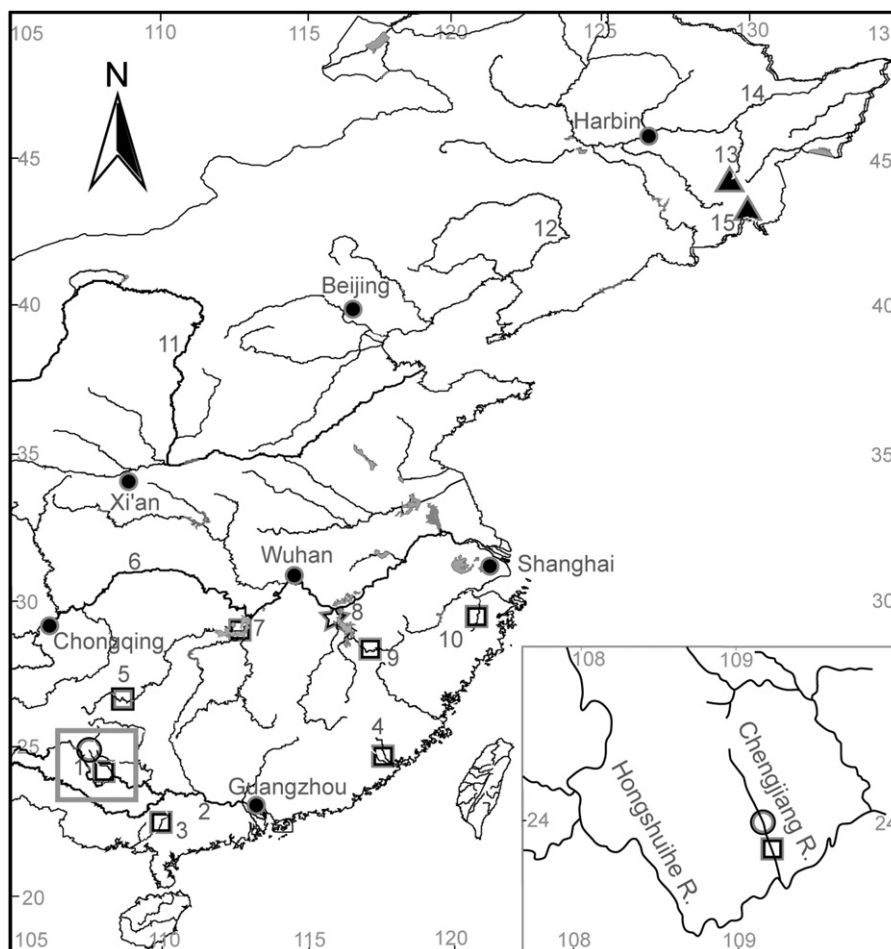


Fig. 1. Map showing the collection sites (i.e., currently known localities) of four species of loaches (Cobitidae) in China. Symbols and numerals: (○) *B. bibarba* sp. n.; (□) *C. sinensis*; (▲) *C. lutheri*; (☆) *C. macrostigma*; (●) City of China. 1. Hongshuihe River; 2. Pearl River; 3. Nanliujiang River; 4. Jiulongjiang River; 5. Yuanjiang River; 6. Yangtze River; 7. Dongting Lake; 8. Poyang Lake; 9. Xinjiang River; 10. Cao'ejiang River; 11. Huanghe River; 12. Liaohe River; 13. Mudanjiang River; 14. Songhua River; and 15. Tumen River.

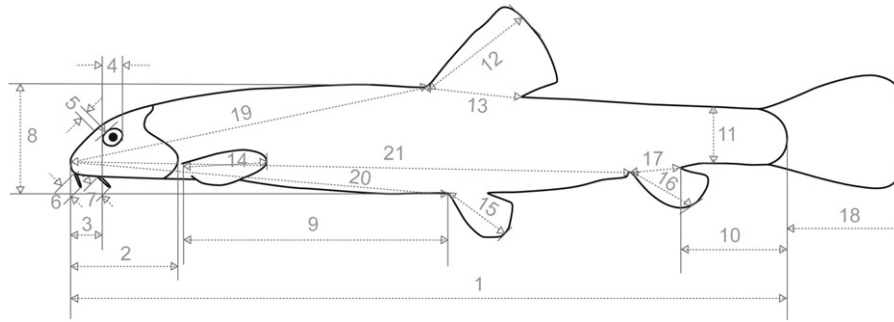


Fig. 2. Measurements taken on the specimens of loaches (Cobitidae). Numerals: 1. Standard length (rostral edge of the upper lip to the base of the caudal fin); 2. Head length (rostral edge of the upper lip to the caudalmost part of the bony opercular edge); 3. Snout length (rostral edge of the upper lip to the rostral edge of the orbit); 4. Eye diameter (horizontal diameter of the iris); 5. Interorbital width (minimum width of the skull between the eyes); 6. Rostral barbel length (base of the rostral barbel insertion to the tip of the rostral barbel); 7. Maxillo-mandibular barbel length (base of the maxillo-mandibular barbel insertion to the tip of the maxillo-mandibular barbel); 8. Body depth (maximum height between the dorsal and ventral contour of the body); 9. Pectoral-ventral length (base of the left pectoral fin to the base of the left ventral fin); 10. Caudal peduncle length (caudal insertion of the last anal ray to the base of the caudal fin); 11. Caudal peduncle depth (minimum height between the dorsal and ventral contour of the caudal peduncle); 12. Dorsal fin length (length of the longest fin ray of the dorsal fin); 13. Base of dorsal fin length (cranial insertion of the first dorsal fin ray to the caudal insertion of the last dorsal fin ray); 14. Pectoral fin length (length of the longest fin ray of the pectoral fin (in males the second ray, in females the third ray)); 15. Ventral fin length (base of the left ventral fin to the tip of its longest ray); 16. Anal fin length (length of the longest fin ray of the anal fin); 17. Base of anal fin length (cranial insertion of the first anal fin ray to the caudal insertion of the last anal fin ray); 18. Caudal fin length (base of the caudal fin to the tip of middle rays of the caudal fin); 19. Predorsal distance (rostral edge of the upper lip to the cranial insertion of the first dorsal fin ray); 20. Preventral distance (rostral edge of the upper lip to the base of the ventral fin); and 21. Preanal distance (rostral edge of the upper lip to the cranial insertion of the first anal fin ray).

Differences in body shape between *B. bibarba* and *C. sinensis* were analyzed by applying a principal component analysis (PCA). For the first analysis, raw measurements were adjusted by using their logarithmic value. For the second PCA, raw measurements were adjusted to remove size effects. The corrected variables were the proportion of raw measurements (except standard length) to standard length, and then adjusted by using their logarithmic value. Principal components were derived from the variance-covariance matrix.

3. Results

3.1. Description of *Bibarba* gen. n.

Diagnosis: Small (up to 62.8 mm total length), elongated, and laterally compressed. Head small. Mouth small, inferior, and arched. Mental lobes absent. Two pairs of barbels, of which one is rostral and the other is maxillo-mandibular. Suborbital spine bifid, relatively thick and short, with a strong medio-lateral process. Head without scales. Body scales small, oval, with a large, almost central focal area. Lateral line short, not exceeding the length of the pectoral fins. Dorsal fins on caudal half of the body. Ventral fins approximately at the same level as, or slightly caudal to, the insertion of the dorsal fins. Tip of caudal fins slightly emarginated. Anus near the anal fins. Caudal peduncle with ventral

adipose crest. Sexual dimorphism: Males smaller than females with proportionally longer pectoral, anal and ventral fins. In males, the second pectoral fin ray thickened and elongated. *Lamina circularis* present in the third pectoral fin ray and not located on the base of the fin.

Distinction from other genera: The new genus *Bibarba* is similar to *Cobitis* (Linnaeus, 1758); the morphological features that differentiate it from *Cobitis* are given in Table 1.

Type species: *Bibarba bibarba* sp. n.: By monotype.

Etymology: The generic name *Bibarba* is Latin for “two pairs of barbels” and refers to the species with two pairs of barbels, of which one pair is rostral and the other maxillo-mandibular.

Type locality: The Chengjiang River, a tributary of the Hongshuihe River in the upper reaches of the Pearl River in Du’an County, (23°55–56’N, 108°06’E) in Guangxi Province, southern China (Fig. 1).

3.2. Description of *Bibarba bibarba* sp. n. (Figs. 3A, B, 4A–C, 5B, 6A, B, 7A, B).

Holotype: IHB 87024411. Male, 48.8 mm total length, 40.7 mm standard length.

Type locality: Chengjiang River, a tributary of the Hongshuihe River in the upper reaches of the Pearl River in Du’an County, (23°55–56’N, 108°06’E) in Guangxi Province, southern China, August 1985.

Table 1. Comparison of the morphological features of the genera *Bibarba* gen. n. and *Cobitis*

Morphological feature	<i>Cobitis</i>	<i>Bibarba</i> gen. n.
Standard length (mm)	Large; usually 60–140 mm	Small; usually 46–62 mm
Barbels	Long and obvious; three pairs (rostral, maxillary and maxillo-mandibular pairs)	Short and inconspicuous; two pairs (rostral and maxillo-mandibular pairs)
Head pigmentation	Black stripe from occiput through eye to the insertion of the rostral barbel	Black stripe from operculum through eye to the insertion of the rostral barbel
<i>Lamina circularis</i>	Absent; only on the base of the second pectoral fin ray; or also on the base of the first pectoral fin ray	Only on the third pectoral fin ray, but not on the base
Suborbital spine	Short and thick; medio-lateral process absent or poorly developed	Shorter and thicker; with a strong medio-lateral process

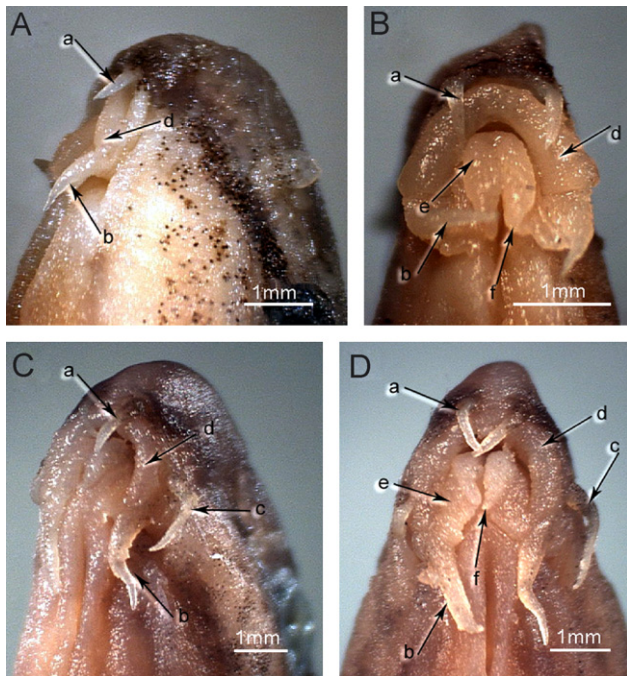


Fig. 3. Comparison of the morphology of the mouth area of *Bibarba* gen. n. and *Cobitis*. (A) and (B) *B. bibarba* sp. n., IHB 87024660, female: (A) lateral view; (B) ventral view. (C) and (D) *C. lutheri*, IHB 89ix0203, female: (C) lateral view; (D) ventral view. Abbreviations: (a) rostral barbel; (b) maxillo-mandibular barbel; (c) maxillary barbel; (d) upper lip; (e) lower lip; and (f) mental lobes.

Paratypes: IHB 0605144–156, 0605159, 14 males, 48.8–56.5 mm total length, 41.4–48.2 mm standard length; IHB 0605160–177, 87024370, 87024520, 87024659–60, 87024263, 23 females, 53.2–62.8 mm total length, 46.2–55.0 mm standard length. Specimens are from the type locality.

Diagnosis: Small-sized species (up to 62.8 mm total length); short barbels; caudal peduncle with two black spots; a black stripe from operculum through eye to the

rostral barbel insertion; dorsal fins situated on caudal half of the body; males with the second pectoral fin ray thickened and elongated, length of the second pectoral fin ray 3.3–4.6 (3.7) times of standard length; a semicircular *Lamina circularis* on the third pectoral fin ray and not located at its base in males; suborbital spine relatively thick and short with strong medio-lateral process.

Description: Fin rays formula: Dorsal rays iii, 7; anal rays iii, 5; ventral rays i, 6; pectoral rays i, 7–8; branched caudal rays, 16; upper procurent unbranched caudal ray, 7; lower procurent unbranched caudal rays, 7; vertebrae 4 + 38 + 1. Morphometric characters are given in Table 2.

Body small, elongated, and laterally compressed. Abdomen laterally rounded, dorsal surface and abdomen almost parallel. Head small, slightly laterally compressed, snout rounded. Preorbital part of the head slightly shorter than postorbital part. Mouth small, inferior, and arched, with two pairs of small barbels. Lips wrinkled. Mental lobes absent. Eyes located on upper part and middle of head. Interorbital width equal to or slightly wider than eye diameter. Suborbital spine bifid, relatively thick and short, with strong medio-lateral process, situated in front of eyes, extends caudally to underneath the middle of the eyes. The suborbital spine is formed by the lateral ethmoidal bone and may be erected or concealed under the skin through a system of muscles and ligaments. Head without scales. Body scales small, oval, with a large, almost central focal area, 27–29 radial grooves, and 2–3 supplementary grooves. Lateral line short, not exceeding the length of the pectoral fins.

Dorsal fins moderately long, located on caudal half of the body; dorsal fin length shorter than head length. In males, pectoral fins long, the second pectoral fin ray being the longest, length of the second pectoral fin ray 3.3–4.6 (3.7) times of standard length. In females,

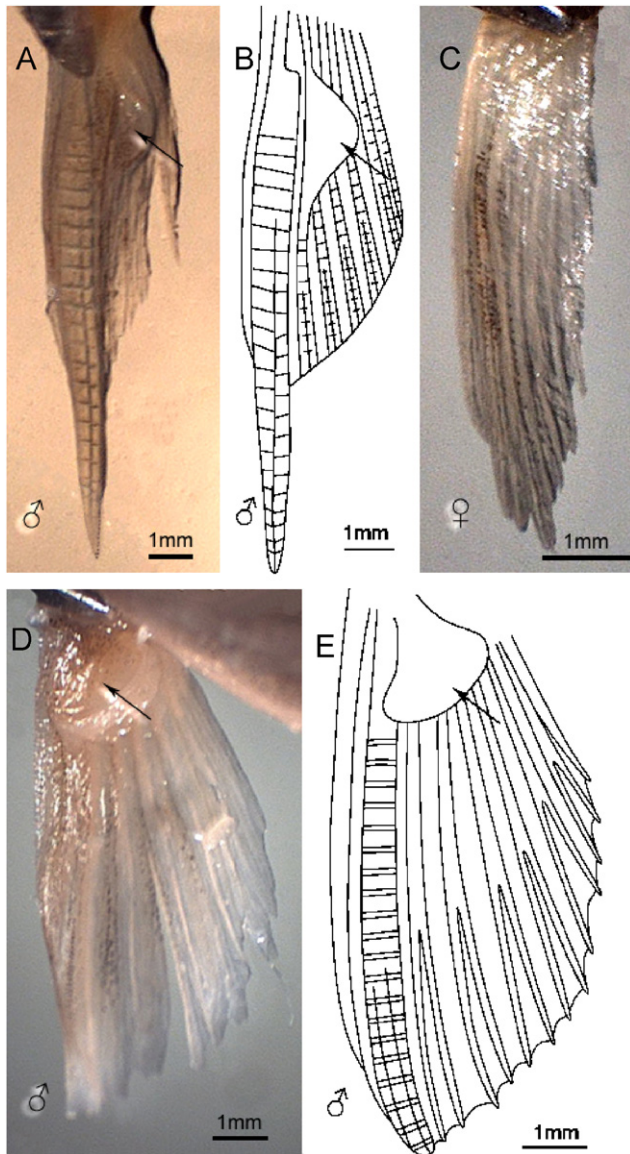


Fig. 4. Comparison of the morphology of the pectoral fins of *Bibarba* gen. n. and *Cobitis*. (A)–(C) *B. bibarba* sp. n.: (A) and (B) Pectoral fin of a male (IHB 87024411) with a semicircular *Lamina circularis* (↑); (C) Pectoral fin of a female (IHB 87024660) without a *Lamina circularis*. (D) and (E) *C. lutheri*: Pectoral fin of a male (IHB 89ix0329) with a stemlike *Lamina circularis* (↑). (B) and (E) are interpretative drawings of (A) and (D), respectively.

pectoral fins slightly shorter, the third pectoral fin ray being the longest, length of the third pectoral fin ray 6.6–8.7 (7.3) times of standard length. Ventral fins short, small, and approximately at the same level as dorsal fins, length of the third ventral fin ray 6.6–8.6 (7.5) times of standard length in males and 8.0–10.7 (9.1) times of standard length in females. Anal fins small, located on half of the space between the ventral and caudal fins, length of the third anal fin ray 6.8–8.1 (7.4) times of standard length in males and 7.5–9.3 (8.4) times of standard length in females. Anus near the anal fins. Caudal peduncle with ventral adipose crest.

Pigmentation pattern: The description of the pigmentation pattern follows Takeda and Fujie (1945), who described five longitudinal lines of dark speckles on the dorsolateral sides of the body (L_1 – L_5 from dorsal to ventral) in *Cobitis teania*. L_1 and L_2 correspond to the zone 1 described by Gambetta (1934), who distinguished only four longitudinal lines or zones. L_1 is composed of a line of 10–12 longitudinally elongated oval or rectangular blotches, and the gaps between the oval blotches are narrower than the length of the blotches. L_2 consists of a line of minute black dots, whose size diminishes towards the end of the caudal fin. L_2 does not merge with L_1 . L_3 consists of a line of 7–11 elongate blotches, which merge into a dark stripe from the level of the caudal end of the pectoral fin to the caudal end of the head. L_4 usually being absent in males, in females some specimens L_4 is present, which is characterized by a line of minute black dots like L_2 , but the line is more slender than L_2 , and usually present beyond the dorsal fin. L_5 consists of 6–8 rectangular blotches that are transversely elongated. At the level of the base of the caudal fins, two dark round or oval spots are present, the dorsal spot is smaller than or as large as the eye, the ventral spot is smaller than the dorsal spot. There are two or three striations on the dorsal fins, and five or six on the caudal fins. The head is sprinkled with many black dots, and a black stripe extends from the operculum through the eye to the insertion of the rostral barbel.

Sexual dimorphism: Males are smaller than females with proportionally longer pectoral, anal and ventral fins. In males, the second pectoral fin ray is thickened

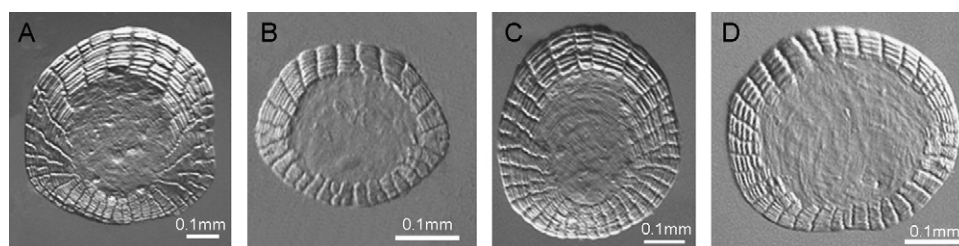


Fig. 5. Comparison of the subdorsal scales of *Bibarba* gen. n. and *Cobitis*: (A) *C. macrostigma*, IHB 63iv0356, female; (B) *B. bibarba* sp. n., IHB 87024263, female; (C) *C. sinensis*, IHB 8840712, female; and (D) *C. lutheri*, IHB 89ix0203, female.

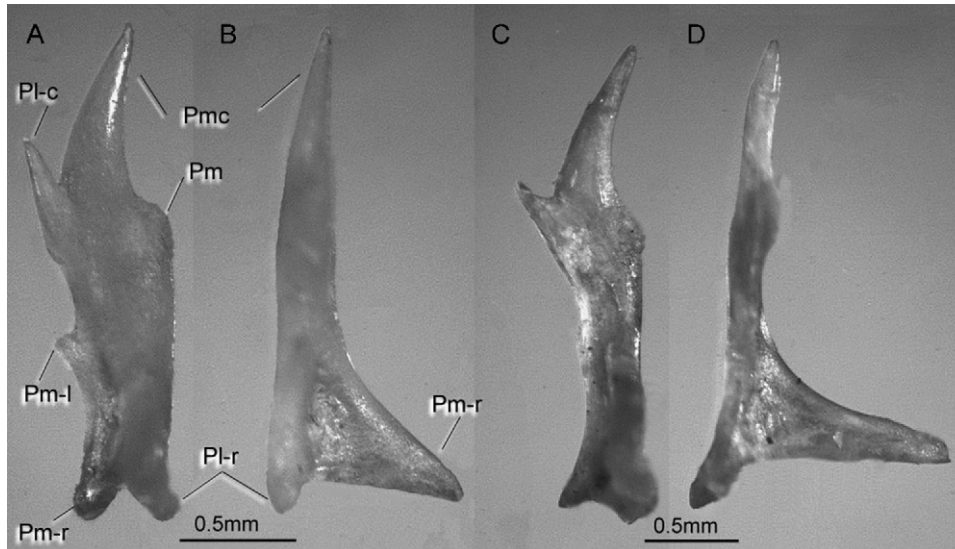


Fig. 6. Comparison of the suborbital spine of *Bibarba* gen. n. and *Cobitis*: (A) and (B) *B. bibarba* sp. n., IHB 87024660, female: (A) dorsal view; and (B) lateral view. (C) and (D) *C. lutheri*, IHB 89ix0203, female: (C) dorsal view; and (D) lateral view. Abbreviations: Pmc, *Processus mediocaudalis*; Pl-c, *Processus latero-caudalis*; Pm, *Processus medialis*; Pm-l, *Processus medio-lateralis*; Pl-r, *Processus latero-rostralis*; Pm-r, *Processus medio-rostralis*.

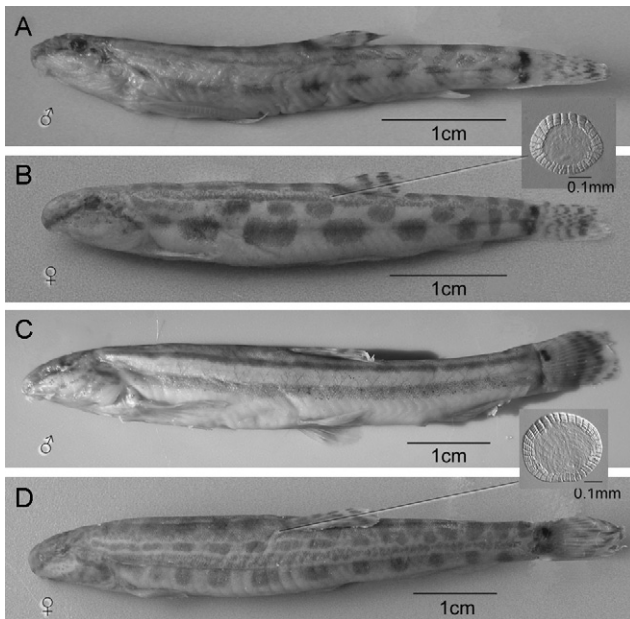


Fig. 7. Comparison of the body shape and pigmentation patterns of *Bibarba* gen. n. and *Cobitis*: (A)–(C) *B. bibarba* sp. n.: (A) Male, IHB 87024411; and (B) Female, IHB 87024660; and (C) subdorsal scale, (✓) showing the orientation of the scale on the body. (D)–(F) *C. lutheri*: (D) Male, no. 89ix0329; (E) Female, no. 89ix0203; and (F) subdorsal scale.

and elongated, whereas in females, the second fin ray is only thickened, but it is the third pectoral fin ray that is elongated. In males, a semicircular *Lamina circularis* is present on the third pectoral fin ray and is not located at the base of the fin ray.

Etymology: The species name *bibarba* is derived from the generic name.

Distribution: This new species occurs in the Chengjiang River, a tributary of the Hongshuihe River in the upper reaches of the Pearl River, in Du'an County (23°55'–56'N, 108°06'E) in Guangxi Province, southern China (Fig. 1).

3.3. Morphometry

In the PCA, the variation accounting for the first principal component (PC1) was 79.85% in males and 91.40% in females. The second principal component (PC2) accounted for 7.39% in males and 2.78% in females for the remaining variance. For both sexes, PC1 had high negative eigenvectors (almost < -0.2) for the great majority of the variations. This indicated that body size was the main factor. PC2 had high eigenvectors for the interorbital width and barbel length (Table 3). Examination of the bivariate plots of PC1 and PC2 scores displayed two groups formed by two species (Figs. 8A and B). In males, *B. bibarba* tended to score 1.04–1.90 (1.51 ± 0.22) on PC1, and -1.68 to -0.18 (-0.99 ± 0.39) on PC2. *C. sinensis* tended to score -2.37 to 1.23 (-0.35 ± 0.74) on PC1, and -1.44 to 1.66 (0.24 ± 0.95) on PC2. They were separated on PC1 by body size. In females, *B. bibarba* tended to score 1.14–1.81 (1.42 ± 0.19) on PC1, and -0.41 to 1.77 (0.62 ± 0.48) on PC2. *C. sinensis* tended to score -1.52 to 0.83 (-0.50 ± 0.59) on PC1, and -2.21 to 1.89 (-0.22 ± 1.04) on PC2. They were also separated on PC1 by body size.

Table 2. Statistical parameters for the morphometric characters of *B. bibarba* sp. n. (mm)

Variables	Males (<i>n</i> = 14)			Females (<i>n</i> = 23)		
	Range	Mean	SD	Range	Mean	SD
Standard length	41.4–48.2	43.7	1.68	44.3–54.0	49.2	2.55
Head length	8.8–10.0	9.4	0.29	11.3–9.2	10.3	0.63
Standard length/head length	4.4–4.9	4.6	0.14	4.4–5.2	4.8	0.18
Snout length	3.5–4.5	3.8	0.25	3.6–4.8	4.2	0.31
Head length/snout length	2.2–2.7	2.5	0.13	2.2–2.7	2.4	0.11
Eye diameter	1.4–1.9	1.7	0.15	1.3–2.0	1.7	0.17
Head length/eye diameter	4.8–6.3	5.6	0.48	5.1–7.1	6.1	0.59
Interorbital width	1.6–2.0	1.8	0.12	1.5–2.2	1.8	0.16
Head length/interorbital width	4.6–5.7	5.3	0.30	4.9–7.2	5.8	0.52
Maxillo-mandibular barbel length	1.0–1.5	1.3	0.13	1.1–1.8	1.4	0.16
Head length/maxillo-mandibular barbel length	6.5–9.4	7.4	0.74	6.1–9.0	7.6	0.79
Rostral barbel length	0.9–1.5	1.2	0.18	0.9–1.4	1.1	0.12
Head length/rostral barbel length	6.4–10.6	8.1	1.27	7.5–11.6	9.1	1.02
Body depth	5.8–7.8	6.6	0.56	6.2–10.4	8.7	0.94
Standard length/body depth	5.6–7.7	6.7	0.62	4.8–7.5	5.7	0.53
Pectoral–ventral length	12.9–16.4	14.2	0.99	15.7–19.3	17.8	1.03
Standard length/pectoral–ventral length	2.7–3.3	3.1	0.15	2.6–3.1	2.7	0.13
Caudal peduncle length	6.4–8.9	7.5	0.71	6.3–9.2	8.0	0.73
Standard length/caudal peduncle length	5.1–6.5	5.9	0.44	5.6–7.1	6.2	0.44
Caudal peduncle depth	3.6–4.3	3.9	0.20	3.7–5.1	4.2	0.32
Standard length/caudal peduncle depth	10.4–12.5	11.3	0.63	10.6–13.2	11.7	0.70
Caudal peduncle length/its depth	1.6–2.1	1.9	0.16	1.6–2.3	1.9	0.19
Dorsal fin length	6.7–8.5	7.7	0.49	6.0–8.8	7.6	0.66
Standard length/dorsal fin length	5.2–6.2	5.7	0.28	5.8–7.7	6.5	0.53
Base of dorsal fin length	3.5–4.4	4.0	0.30	3.5–5.3	4.3	0.40
Standard length/base of dorsal fin length	10.1–12.3	10.9	0.69	8.9–13.4	11.6	1.03
Pectoral fin length	9.7–13.0	11.8	0.95	5.8–8.0	6.7	0.48
Standard length/pectoral fin length	3.3–4.6	3.7	0.32	6.6–8.7	7.3	0.53
Ventral fin length	5.2–6.6	5.9	0.37	4.6–6.3	5.4	0.42
Standard length/ventral fin length	6.6–8.6	7.5	0.54	8.0–10.9	9.1	0.69
Anal fin length	5.2–6.5	5.9	0.38	5.0–6.8	5.9	0.43
Standard length/anal fin length	6.8–8.0	7.4	0.41	7.5–9.3	8.4	0.46
Base of anal fin length	2.2–3.2	2.7	0.31	2.5–3.5	2.9	0.25
Standard length/base of anal fin length	14.2–19.1	16.4	1.55	15.3–19.7	17.0	1.21
Caudal fin length	7.9–10.1	9.1	0.58	8.2–10.3	9.3	0.49
Standard length/caudal fin length	4.5–5.3	4.8	0.21	4.9–5.8	5.3	0.23
Predorsal distance	23.0–26.3	23.8	0.88	24.5–30.1	27.4	1.50
Standard length/predorsal distance	1.8–1.9	1.8	0.03	1.7–1.9	1.8	0.04
Preventral distance	23.9–27.2	25.2	0.89	26.3–30.8	29.1	1.38
Standard length/preventral distance	1.7–1.8	1.7	0.03	1.6–1.8	1.7	0.03
Preanal distance	31.4–36.5	33.4	1.20	34.7–41.8	38.4	1.93
Standard length/preanal distance	1.3–1.3	1.3	0.01	1.2–1.3	1.3	0.01

In a PCA, in which 20 corrected variables were carried out to remove the effect of size, PC1 accounted for 34.61% of the variation in males and for 38.14% of the variance in females. PC2 accounted for 29.10% of the remaining variation in males and for 23.89% in females. In males, the highest eigenvectors in PC1 were the barbel length, base of dorsal fin length, base of anal fin length, and length of the dorsal fin. In PC2, the highest eigenvectors were the pectoral fin length, eye diameter, and the interorbital width. In females, the

eigenvectors for PC1 were high for the barbel length, interorbital width, base of dorsal fin length, and the base of anal fin length. PC2 expressed differences in the eye diameter and the interorbital width (Table 4). The plot of PC1 against PC2 displayed two groups (Figs. 8C and D). In males, *B. bibarba* tended to score 0.68–2.16 (1.45 ± 0.41) on PC1, and 0.47–2.13 (1.21 ± 0.52) on PC2. *C. sinensis* tended to score –1.72 to 1.67 (-0.34 ± 0.76) on PC1, and –3.27 to 0.72 (0.29 ± 0.86) on PC2. They were separated on PC1 by barbel length

Table 3. Eigenvectors and eigenvalues for the first three principal components with 21 variables

Characters	Males			Females		
	PC1	PC2	PC3	FC1	FC2	FC3
Standard length	-0.2241	-0.0905	0.1247	-0.2202	0.1025	-0.1443
Head length	-0.2070	-0.0882	0.0772	-0.2122	0.0321	0.0548
Snout length	-0.2495	-0.1282	0.1594	-0.2487	0.0150	-0.0366
Eye diameter	-0.1705	0.0357	-0.5297	-0.1579	0.0452	0.5856
Interorbital width	-0.1403	-0.3696	-0.4547	-0.1206	0.3880	0.2071
Rostral barbel length	-0.2421	0.4675	0.0129	-0.2825	-0.4323	-0.1162
Maxillo-mandibular barbel length	-0.2932	0.3546	0.3497	-0.2641	-0.3342	-0.5069
Body depth	-0.2516	-0.0536	0.0601	-0.2105	0.2376	0.0652
Pectoral-ventral length	-0.2102	-0.2488	0.1686	-0.1931	0.3754	-0.2458
Caudal peduncle length	-0.1601	-0.2697	0.2672	-0.1872	0.1980	-0.0912
Caudal peduncle depth	-0.2554	-0.0887	0.0903	-0.2373	0.0359	-0.0743
Dorsal fin length	-0.1987	0.1079	-0.1509	-0.2076	-0.0621	0.1349
Base of dorsal fin length	-0.2429	0.2454	-0.2352	-0.2662	-0.2640	0.1927
Pectoral fin length	-0.1027	-0.3081	-0.1653	-0.2029	0.0506	0.1254
Ventral fin length	-0.2000	0.0590	-0.0954	-0.2153	-0.0509	0.0956
Anal fin length	-0.2167	0.0355	-0.2269	-0.2070	0.0035	0.1710
Base of anal fin length	-0.2725	0.2912	-0.1422	-0.2673	-0.3208	0.2578
Caudal fin length	-0.1978	-0.1158	-0.0714	-0.1967	0.0374	0.0285
Predorsal distance	-0.2115	-0.1901	0.0691	-0.1968	0.2331	-0.1121
Preventral distance	-0.2097	-0.1614	0.1220	-0.2007	0.2133	-0.1259
Preanal distance	-0.2336	-0.0875	0.1429	-0.2206	0.1268	-0.1858
Eigenvalue	0.1629	0.0150	0.0086	0.3041	0.0092	0.0044
Total variance (%)	79.85	7.39	4.21	91.40	2.78	1.33
Cumulative (%)	79.85	87.25	91.47	91.40	94.19	95.53

and the length of the base of the dorsal and anal fins, and on PC2 by eye diameter, interorbital width, and pectoral fin length. In females, *B. bibarba* tended to score 0.80–2.31 (1.45 ± 0.39) on PC1, and -1.74 to 1.19 (-0.46 ± 0.77) on PC2. *C. sinensis* tended to score -1.56 to 0.70 (-0.51 ± 0.53) on PC1, and -1.85 to 2.68 (-0.16 ± 1.02) on PC2. They were separated on PC1 by interorbital width, barbel length, and the length of the base of dorsal fin and anal fin.

4. Discussion

4.1. Taxonomic situation

Bibarba gen. n. is proposed here as a new genus within the subfamily Cobitinae based mainly on diagnostic characters that have not been observed in other species that are presumably closely related. The two pairs of barbels and the *Lamina circularis* on the third pectoral fin ray are, therefore, considered to be autapomorphic characters for *Bibarba* gen. n. and justify the status of *Bibarba* as a monophylum. Based on a combination of characters, such as sexual dimorphism, pigmentation pattern, appearance of the scales, structure of the suborbital spine and the barbels, the subfamily Cobiti-

nae was subdivided into 16 genera (Nalbant 1963, 1993, 1994). However, the relationships of the new genus *Bibarba* to the other genera of the Cobitinae are unclear. The sexual dimorphism, the pigmentation pattern, the ventral and dorsal fins that are placed at about the same level on the body, the absence of scales on the head, and the shape of the body suggest that *Bibarba* gen. n. may be close to *Cobitis*.

The new genus, *Bibarba*, differs from *Cobitis* in several aspects: (1) It has two pairs of barbels instead of three pairs of barbels (Fig. 3). (2) In males of *Cobitis*, the *Lamina circularis* occurs in three different states: (a) *Lamina circularis* absent; (b) one *Lamina circularis* on the base of the second ray of the pectoral fin; and (c) two *Laminae circulares*, one each on the base of the first and second rays of the pectoral fin. These three states of the *Lamina circularis* differ from the condition in *Bibarba*, which has a single *Lamina circularis* on the third pectoral fin ray near, but not at, the fin ray's base (Figs. 4A and B). (3) Although *Bibarba* is similar to *Cobitis* in the pigmentation pattern, the former has a black stripe extending from the operculum through the eye to the insertion of the rostral barbel in contrast to the latter, in which a black stripe extends from the occiput through the eye to the insertion of the rostral barbel. (4) *Bibarba* also differs from *Cobitis* in having a

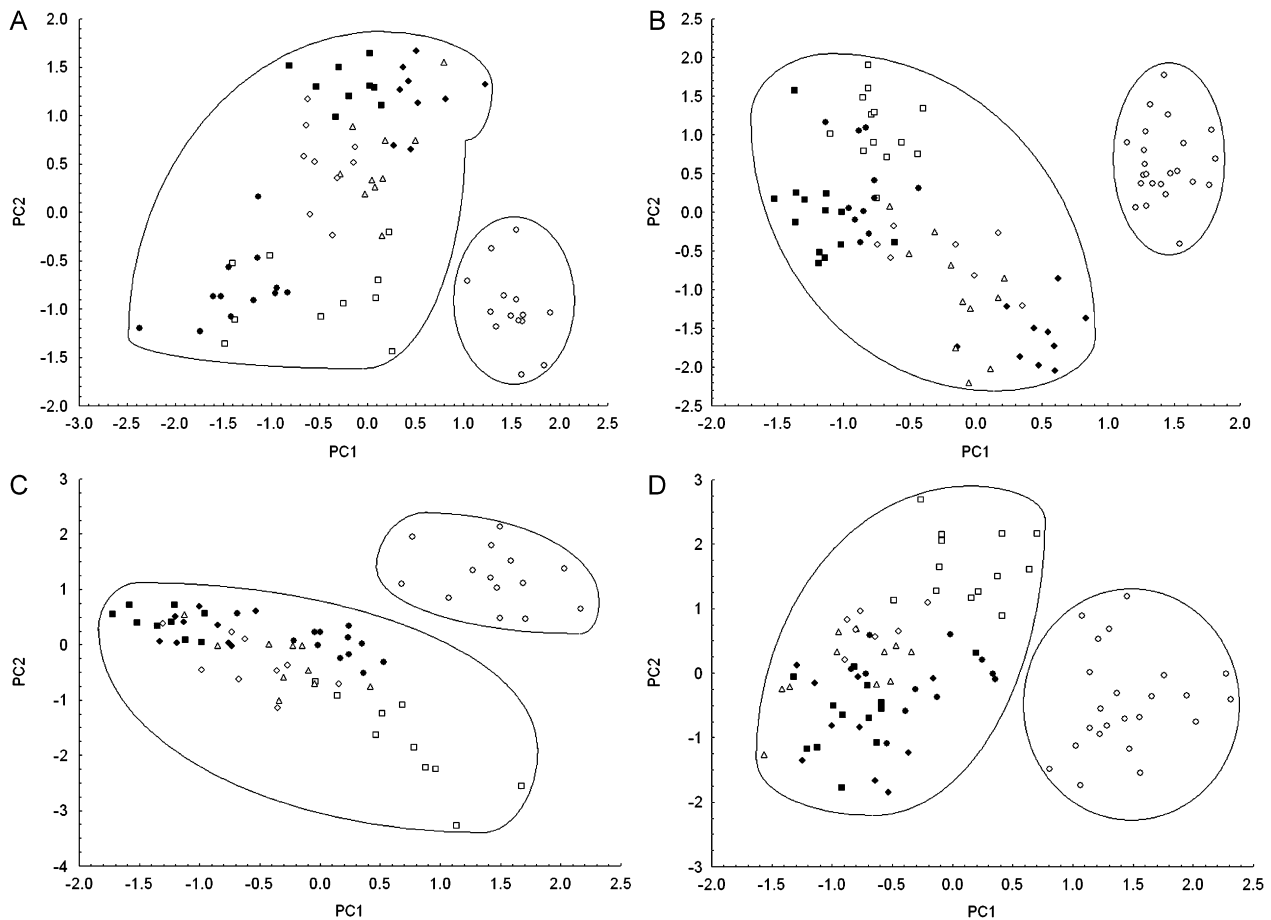


Fig. 8. Plots of principal component scores. Symbols: (○), *B. bibarba* sp. n.; (◇) *C. sinensis* (Nanliujiang River); (●) *C. sinensis* (Xinjiang River); (◆) *C. sinensis* (Cao'ejiang River); (△) *C. sinensis* (Dongting Lake); (■) *C. sinensis* (Jiulongjiang River); (□) *C. sinensis* (Chengjiang River). (A) and (B) Plot of principal components for 21 variables: (A) males and (B) females. (C) and (D) Plot of 20 variables that are size-adjusted: (C) males and (D) females.

relatively thick and stout suborbital spine with a strong medio-lateral process instead of a suborbital spine without or with a weakly formed medio-lateral process as in *Cobitis* (Figs. 6A and B). (5) The morphometric character analysis based on PCA revealed that *B. bibarba* is distinct from *C. sinensis* by its smaller body size, shorter barbel length, broader interorbital width, larger eye diameter, longer pectoral fins in males, and longer caudal peduncle.

4.2. Distribution and habitat

Presently, *Bibarba* is known only from the Chengjiang River in China. The Chengjiang River is a slowly moving stream, and *Bibarba* inhabits the areas with arenaceous and cobblestone beds. This river region is characterized by a Karst landscape, which has complex and varied land forms. Surface water usually connects with underground rivers and springs, and forms complicated water networks. The altitude is more than 152 m above sea level.

4.3. Conservation

There are many endemic species in the Hongshuihe River basin. For example, the genus *Protocobitis* Yang et al., 1994 (family Cobitidae), is endemic to a limestone cave in Du'an County (Yang et al. 1994). The genus *Heminoemacheilus* Zhu and Cao, 1987 (family Cobitidae), is endemic to a subterranean river in Du'an County (Zhu and Cao 1987). The species *Yunnanilus pulcherrimus* and *Triplophysa flacicorpus* (family Cobitidae) are also endemic to the Hongshuihe River in Du'an County (Yang et al. 2004). Obviously, the Karst environment provides a variety of habitats for these loaches. The diverse microclimates in this mountainous area may have led to the differentiation of new species, and the area became a center for speciation.

However, the biodiversity in this area has not received the attention it deserves, and few management or conservation efforts are being undertaken to protect it. At present, there is a nature reserve, Hongshuihe Nature Reserve, but it is located at the upper Hongshuihe River,

Table 4. Eigenvectors and eigenvalues for the first three principal components after 20 variables were size-adjusted

Characters	Males			Females		
	PC1	PC2	PC3	FC1	FC2	FC3
Head length	0.0083	0.0777	0.0291	-0.0054	-0.1791	-0.0296
Snout length	-0.0008	-0.0322	0.0257	-0.1328	-0.0940	-0.0133
Eye diameter	-0.0805	0.5291	-0.0640	0.2018	-0.5618	-0.1116
Interorbital width	0.2750	0.4986	0.0436	0.4808	-0.3648	0.2972
Rostral barbel length	-0.4859	0.1880	0.5738	-0.4658	-0.2304	0.4125
Maxillo-mandibular barbel length	-0.4594	-0.1029	0.4334	-0.3667	-0.0802	0.6368
Body depth	-0.0720	0.0233	-0.0147	0.1048	-0.1854	0.1243
Pectoral-ventral length	0.1402	0.0005	0.1220	0.2202	0.0787	0.1073
Caudal peduncle length	0.2320	0.0084	0.1691	0.1557	-0.0598	-0.0043
Caudal peduncle depth	-0.0490	-0.0139	-0.0784	-0.0821	-0.0386	-0.0187
Dorsal fin length	-0.1482	0.2294	-0.1220	-0.0344	-0.2751	-0.0437
Base of dorsal fin length	-0.3144	0.1934	-0.3242	-0.3206	-0.2155	-0.2949
Pectoral fin length	0.2909	0.4090	0.2872	0.0374	-0.2520	0.0006
Ventral fin length	-0.1099	0.2082	-0.0257	-0.0538	-0.2253	-0.0393
Anal fin length	-0.1203	0.2643	-0.1450	0.0155	-0.2631	-0.0644
Base of anal fin length	-0.3789	0.0915	-0.4416	-0.3515	-0.2424	-0.4390
Caudal fin length	0.0304	0.1824	-0.0108	0.0466	-0.1965	0.0372
Predorsal distance	0.0865	0.0622	0.0548	0.1412	-0.0254	0.0402
Preventral distance	0.0713	0.0259	0.0536	0.1182	-0.0267	0.0546
Preanal distance	-0.0145	-0.0237	0.0119	0.0101	0.0244	0.0411
Eigenvalue	0.0190	0.0160	0.0054	0.0164	0.0103	0.0033
Total variance (%)	34.61	29.10	9.84	38.14	23.89	7.82
Cumulative (%)	34.61	63.72	73.56	38.14	62.04	69.86

far from the Chengjiang River. The new species *B. bibarba* does not have any commercial value, it is not known as a distinct fish by local fishermen, and its population size, density, growth, and reproduction is unknown. The genus *Bibarba* seems to be restricted to its currently known location. If their habitat were destroyed, the new species would be faced with extinction. Therefore, this species should be listed under the China Red Book of Endangered Animals, and the natural habitats need to be protected. It is advisable to extend the Hongshuihe National Reserve. In protecting the new species, the entire ecosystem along the Hongshuihe River would be conserved.

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Appendix A. List of studied species and specimens

The studied specimens are cataloged and stored at the FFM of the IHB at the CAS in Wuhan (Hubei Province).

Bibarba bibarba: One male (IHB 87024411), 40.7 mm standard length, and five females (IHB 87024370, 87024520, 87024659–60, 87024263), 45.5–55.1 mm standard length, preserved in 10% formalin, August 1985; 14 males (IHB 0605144–156, 0605159), 41.4–48.2 mm standard length, and 18 females (IHB 0605160–177), 44.3–52.6 mm standard length, preserved in 10% formalin; and four males (IHB 0605133–134, 0605142–143), and 19 females (IHB 0605121–132, 0605135–141), preserved in 100% alcohol, April, 2006; Chengjiang River (Pearl River system) in Du'an County, Guangxi Province.

Cobitis lutheri: One male (IHB 89IX0329), 60.9 mm standard length, Hunchun River (Tumenjiang River system) in Hunchun County, Jilin Province; and one female (IHB 89IX0203), 62.4 mm standard length, Mudanjiang River (Songhuajiang River system) in Dunhua County, Jilin Province.

Cobitis macrostigma: One female (IHB 63iv0356), 113.0 mm standard length; Poyanghu Lake (Yangtze River system) in Hukou County, Jiangxi Province.

Cobitis sinensis: One female (IHB 8840712), 85.3 mm standard length; Yuanjiang River (Yangtze River system) in Songtao County, Hunan Province.

Cobitis sinensis: Nine males (IHB 86071979, 86074260, 87021986, 87024261, 87023804, 87024562, 87024289, 87024508, 87024514), 61.2–85.0 mm standard length, and thirteen females (IHB 86071982, 86074281–2, 86072321, 86074290, 86074231, 86074296–7, 86074288, 86074551, 86074556, 86074410, 86074213), 87.1–107.8 mm standard length; Chengjiang River (Pearl River system) in Du'an County, Guangxi Province.

Cobitis sinensis: 10 males (IHB 9606073–80, 9606082–3), 48.1–64.9 mm standard length, and 11 females (IHB 9606084, 9606086–9, 9606091–5, 9606097), 68.3–88.3 mm standard length; Dongting Lake (Yangtze River system) in Yueyang City, Hunan Province.

Cobitis sinensis: 12 males (IHB 9607001–11, 90v1866), 70.9–95.1 mm standard length, and 11 females (IHB 9607012, 9607014–23), 85.6–103.1 mm standard length; Xinjiang River (Yangtze River system) in Yujiang County, Jiangxi Province.

Cobitis sinensis: Nine males (IHB 741027–31, 741033, 741037, 741040, 741047), 45.5–54.8 mm standard length, and 10 females (IHB 741013–16, 741018–19, 741021–23, 741025), 55.1–71.1 mm standard length; Cao'ejiang River in Chengxian County, Zhejiang Province.

Cobitis sinensis: Nine males (IHB 75V3188, 75V3190, 75V3192, 75V3194–95, 75V3198, 75V3202–3, 75V3205), 60.6–68.3 mm standard length, and seven females (IHB 75V3100, 75V3186, 75V3189, 75V3193, 75V3196, 75V3197, 75V3204), 68.3–92.1 mm standard length; Nanliujiang River in Bobai County, Guangxi Province.

Cobitis sinensis: Nine males (IHB 74V0402, 74V0409, 74V0436, 74V0439–40, 74V0443–4, 74V0448, 74V0627), 55.6–66.0 mm standard length, and 13 females (IHB 74V0432, 74V0437, 74V0408, 74V0445, 74V0448, 74V0401, 74V0413–17, 74V0612–13), 83.1–107.8 mm standard length; Jiulongjiang River in Zhangzhou County, Fujian Province.

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