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# *Microphysogobio nudiventris*, a new species of gudgeon (Teleostei: Cyprinidae) from the middle Chang-Jiang (Yangtze River) basin, Hubei Province, South China

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## Abstract

*Microphysogobio nudiventris*, new species, is described from the Du-He, a tributary flowing into the Han-Jiang of the middle Chang-Jiang (Yangtze River) basin, in Zhushan County, Hubei Province, South China. It belongs in the incompletely scaled group of this genus, but differs from all other species of this group except *M. yaluensis*, *M. rapidus*, and *M. wulonghensis* in the presence of a scaleless midventral region of the body extending more than two-thirds of the distance from the pectoral-fin insertion to the pelvic-fin insertion. This new species differs from *M. yaluensis* in the slightly concave or straight distal edge of the dorsal fin, interorbital width, and snout length; from *M. rapidus* in the number of perforated scales on the lateral line and number of pectoral-fin rays, and the placement of the anus; and from *M. wulonghensis* in having the two lateral lobes of the lower lip posteromedially disconnected, the shape of the median mental pad of the lower lip, and the number of circumpeduncular scales.

**Key words:** Taxonomy, Cypriniformes, Gobioninae, Middle Chang-Jiang basin

## Introduction

Within the Cyprinidae, the Gobioninae is a monophyletic assemblage comprising 29 genera and around 200 species (Nelson 2006; Yang *et al.* 2006; Eschmeyer 2010; Liu *et al*. 2010). It is a group of small to moderate-sized benthic and rheophilic species widely known from Eurasian water bodies. This subfamily exhibits high generic-level diversity in China where it is represented by approximately 90 species from 22 genera (Yue 1998). The generic classification of some Chinese gobionin species needs further investigation. The molecular phylogenetic analysis of Tang *et al.* (2011) confirmed the monophyletic nature of the Gobioninae, but the validity of some included genera remains to be determined. For example, under their sampling scheme, the monophyletic nature of each of four genera, *Microphysogobio* Mori 1934, *Biwia* Jordan & Fowler 1903, *Rostrogobio* Taranetz 1937, and *Huigobio* Fang 1938, was not supported. Additional study is badly needed to resolve their validity.

*Microphysogobio* Mori 1934, as here defined, includes 26 currently identified species from Laos, northern Vietnam, Korea, Mongolia, and China. One species (*M. labeoides* Nichols & Pope 1927) is known from Laos (Kottelat 2001a), three [*M. kachekensis* (Oshima 1926), *M. vietnamica* Mai 1978 and *M. yunnanensis* (Yao & Yang 1977)] from northern Vietnam (Kottelat 2001b), five (*M. jeoni* Kim & Yang 1999, *M. koreensis* Mori 1935, *M. longidorsalis* Mori 1935, *M. yaluensis* Mori 1928 and *M. rapidus* Chae & Yang 1999) from Korea (Kim & Yang 1999), and one (*M. anudarini* Holcík & Pivnicka 1969) from Mongolia (Kottelat 2006). In China, eleven species were identified in *Microphysogobio* by Yue (1998); four species placed by them in *Rostrogobio* and *Huigobio* are here included in *Microphysogobio*. *Microphysogobio alticorpus* Bănărescu & Nalbant, 1968, which was not mentioned by Yue (1998), but was considered as valid by Chen & Chang (2005). *Microphysogobio hsinglungshanensis* Mori 1934, synonymized by earlier authors with *Pseudogobio chinssuensis* Nichols 1926, was

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treated as valid by Wang *et al.* (2001). Recently, two new species were added to this genus, *M. pseudoelongatus* Zhao & Zhang 2001 from Guangxi Province, South China, and *M. wulonghensis* Xing, Zhao, Tang & Zhang 2011 from Shandong Province, North China. A total of 19 Chinese species have been identified in *Microphysogobio* as here defined. Even so, the taxonomy of Chinese species of this genus is poorly understood.

A survey of fishes conducted by us in Sept. 2010 in the Du-He, a tributary flowing into the Han-Jiang of the middle Yangtze River (Chang-Jiang in Chinese) basin, in Zhushan County, Hubei Province, South China, yielded 24 specimens referable to *Microphysogobio*. These specimens were initially identified as *M. kiatingensi* (Wu 1930), which was originally described by Wu (1930) from the upper Chang-Jiang basin. Our examination showed that 16 of them are distinct from all others in the morphology of the mouth, and in scalation of the ventral region of the body, indicating that these specimens represent a new species distinct from *M. kiatingensis*. The purpose of the present paper is to provide a formal description of this unnamed species.

## Material and methods

Measurements were taken point-to-point using digital calipers connected to a data recording computer to the nearest 0.1 mm. All measurements and counts were made on the left side of specimens whenever possible following Xing *et al.* (2011). Predorsal, prepectoral, prepelvic and preanal lengths were measured from the anteriormost tip of the snout to the dorsal-, pectoral-, pelvic- and anal-fin origins. Interorbital width was taken between the upper edges of the eyes. Measurements of parts of the head are presented as percentages of head length (HL). HL and measurements of other parts of the body are given as proportions of standard length (SL). Vertebral counts, including the four Weberian vertebrae were made from radiographs. Examined specimens are deposited in the collection of the Museum of Aquatic Organisms at the Institute of Hydrobiology (IHB), Chinese Academy of Sciences, Wuhan, Hubei Province, China.

### *Microphysogobio nudiventris* sp. nov.

(Figs. 1 & 2)

**Holotype.** IHB 2011040304, 64.7 mm SL, Du-He, a tributary flowing into Han-Jiang of Chang-Jiang basin, in Zhushan County, Hubei Province, South China, E Zhang & Z.G. Jiang, April, 2011.

**Paratypes**. IHB 201104076–7, 2011040127, 2011040131, 2011040195, 2011040303, 2011040305–6, 2011040311, 2011040315–317, 15, 50.7–71.1 mm SL; other data same as holotype.

**Diagnosis.** *Microphysogobio nudiventris* belongs to the group of species with an incompletely scaled midventral region of the body. It, along with *M. yaluensis*, *M. wulonghensis*, and *M. rapidus*, differs from all other species of this group in having a scaleless midventral region of the body that extends more than two-thirds of the distance from the pectoral-fin insertion to the pelvic-fin insertion [vs. midway from the pectoral-fin insertion to the pelvic-fin insertion in *M. linghensis*, or to the pelvic-fin insertion in *M. amurensis*, *M. chenhsienensis* (Fang 1938), *M. liaohensis* (Qin 1987), *M. anudarini*, *M. chinssuensis* and *M. hsinglungshanensis*]. *Microphysogobio nudiventris* differs from *M. yaluensis* in having a slightly concave (vs. straight) distal edge of the dorsal fin, interorbital width greater (vs. less) than eye diameter, and a shorter snout with its length being less than (vs. greater than, or equal to) the postorbital head length, and from *M. rapidus* in having fewer perforated scales on the lateral line (35–37 vs. 39–41), fewer pectoral-fin rays (10–11 vs. 12–13), and a longer distance between the anus and anal-fin origin (14.1–17.7 vs. 8.2–13.1% SL). It differs from *M. wulonghensis* in having the two lateral lobes of the lower lip posteromedially disconnected (vs. connected), a heart-shaped median mental pad on the lower lip longitudinally bisected (vs. not bisected) by a groove, and more circumpeduncular scales (12 vs. 8–10).

**Description.** Morphometric data for type specimens are given in Table 1. See Figure 1 for general body appearance. Body small and slender, slightly compressed laterally. Lower surface of head and breast flat, abdomen rounded, caudal peduncle short and slightly compressed. Dorsal body profile rising sharply from tip of snout to dorsal-fin origin, greatly sloping along dorsal-fin base, then sloping gradually to caudal-fin base. Greatest body depth at dorsal-fin origin and least depth of caudal peduncle close to caudal-fin base. Anus located at anterior one-third of distance from pelvic-fin insertion to anal-fin origin.


**FIGURE 1.** *Microphysogobio nudiventris*, IHB 2011040304, holotype. (A) lateral view, and (B) ventral view.

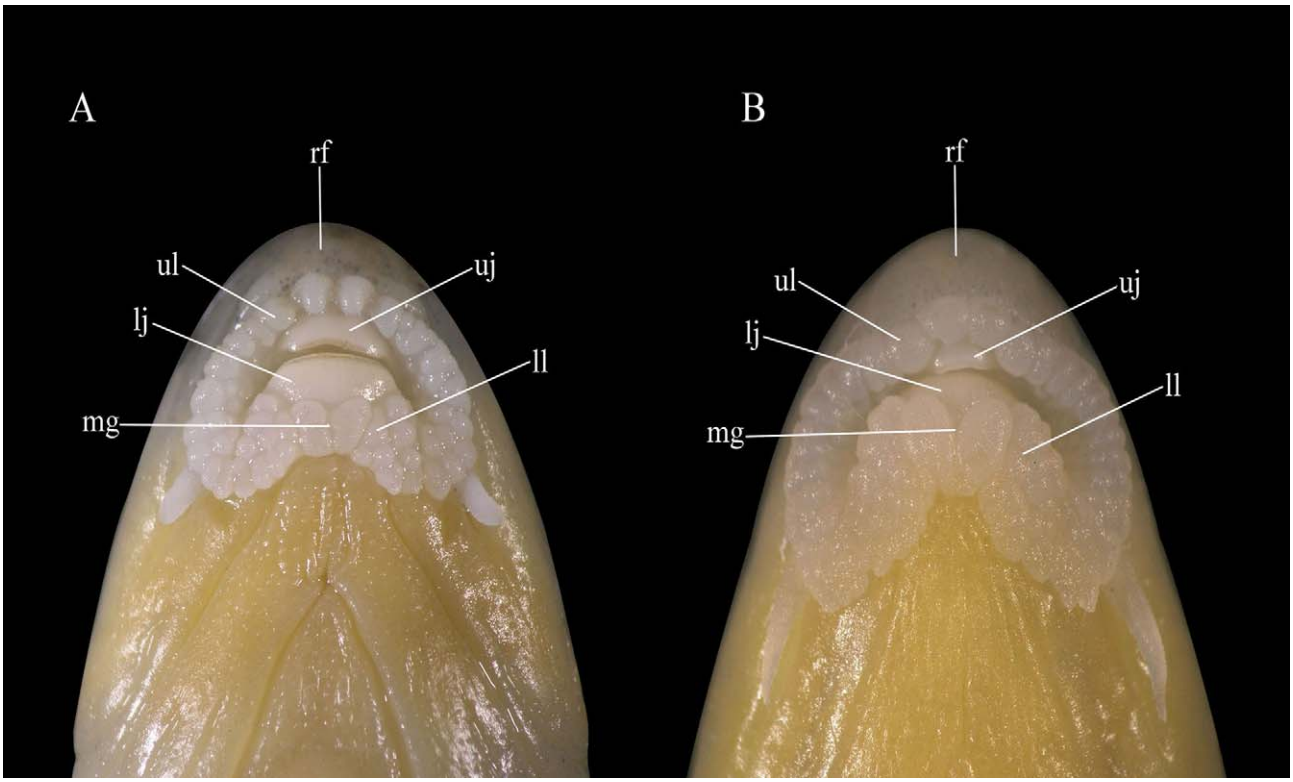


**FIGURE 2.** Ventral view of oromandibular structures in: (A) *M. nudiventris*, IHB 2011040304, holotype, and (B) *M. kiatingensis*, IHB 2011040134, 62.3 mm SL, China, Hubei Province, middle Chang-Jiang, Han-Jiang,Du-He. lj = lower jaw; ll = lower lip; uj = upper jaw; ul = upper lip; mg = mental groove; rf = rostral frenum.

Head short, length almost equal to body depth, roughly triangular in dorsal view. Snout slightly pointed, with a shallow groove across its tip in front of nostrils; snout length slightly less than postorbital part of head. Nostrils positioned closely; anterior one tubular, nearer to snout tip than to anterior margin of eye. Eye large, placed in dorsal half of head; interorbital space broad and flat, width greater than eye diameter. One pair of maxillary barbels rooted at extremity of upper lip, shorter than eye diameter, reaching beyond anterior margin of eye. Gill rakers rudimentary. Pharyngeal teeth in one row, with pointed, hooked and compressed tips.

Mouth inferior, horseshoe shaped. Lips thick, well developed, with globular papillae (Fig. 2A). Papillae on median portion of upper lip arranged in one row and larger than all others; those on lateral portions in several rows. Median mental pad of lower lip heart-shaped, and longitudinally bisected by a groove into two elements of fleshly protuberances; two lateral lobes of lower lip covered with well-developed papillae, posteriorly disconnected from each other behind median mental pad and laterally connected with upper lip around corners of mouth. Upper and lower jaws with thin horny sheaths on their cutting margins (Fig. 2A); width of cutting edge on upper jaw greater than half width of the mouth.

**TABLE 1.** Morphometric data for *Microphysogobio nudiventris* and its sympatric congener, *M. kiatingensis*.

| Characters | *M. nudiventris* | | | | *M. kiatingensis* (n = 9) | | |
|---|---|---|---|---|---|---|---|
| | Holotype | Paratypes (n = 15) | | | | | |
| | | Range | Mean | SD | Range | Mean | SD |
| SL (mm) | 64.7 | 50.7–71.1 | 57.8 | 6.08 | 54.1–88.8 | 65.5 | 12.65 |
| **In percentage of SL** | | | | | | | |
| Body depth | 20.8 | 18.0–22.5 | 20.3 | 1.35 | 14.3–18.4 | 16.4 | 1.46 |
| Predorsal length | 41.5 | 37.1–47.5 | 43.7 | 2.37 | 39.5–44.7 | 42.8 | 1.60 |
| Dorsal-fin base length | 15.2 | 14.0–15.9 | 14.8 | 0.52 | 12.9–14.2 | 13.5 | 0.45 |
| Dorsal-fin length | 21.0 | 18.6–22.1 | 20.4 | 1.08 | 19.2–23.2 | 21.2 | 1.37 |
| Preanal length | 74.8 | 73.4–79.2 | 75.8 | 1.51 | 73.1–80.5 | 75.7 | 2.53 |
| Anal-fin base length | 9.9 | 7.7–10.1 | 8.9 | 0.72 | 6.5–9.7 | 8.1 | 1.23 |
| Anal-fin length | 12.3 | 12.1–15.2 | 13.6 | 1.03 | 11.7–14.5 | 13.5 | 1.02 |
| Prepectoral length | 19.9 | 18.9–23.8 | 21.5 | 1.37 | 21.2–24.0 | 22.5 | 0.95 |
| Pectoral-fin base length | 6.7 | 5.7–7.4 | 6.4 | 0.56 | 5.2–6.5 | 5.9 | 0.46 |
| Pectoral-fin length | 23.8 | 21.1–26.4 | 23.7 | 1.48 | 17.0–25.0 | 21.2 | 2.32 |
| Prepelvic length | 47.3 | 47.3–53.1 | 50.2 | 1.73 | 46.6–50.9 | 48.5 | 1.18 |
| Pelvic-fin base length | 5.3 | 4.7–6.1 | 5.4 | 0.35 | 4.2–5.9 | 5.0 | 0.63 |
| Pelvic-fin length | 16.7 | 13.3–17.3 | 15.2 | 1.40 | 12.6–17.8 | 16.0 | 1.73 |
| Caudal-peduncle length | 19.9 | 14.4–19.9 | 17.1 | 1.51 | 16.9–19.6 | 17.8 | 0.94 |
| Caudal-peduncle depth | 8.7 | 7.9–10.0 | 9.0 | 0.56 | 6.7–8.5 | 8.0 | 0.60 |
| Head length | 22.3 | 20.2–23.3 | 21.6 | 0.83 | 19.8–23.4 | 22.2 | 1.37 |
| **In percentage of HL** | | | | | | | |
| Head depth | 71.0 | 63.9–73.2 | 68.8 | 2.54 | 56.7–62.9 | 59.0 | 2.20 |
| Head width | 76.1 | 73.9–84.5 | 76.9 | 2.73 | 58.6–70.8 | 64.2 | 3.40 |
| Snout length | 28.6 | 28.6–37.3 | 32.2 | 2.45 | 37.7–49.3 | 42.3 | 4.08 |
| Eye diameter | 27.7 | 23.3–28.8 | 26.3 | 1.39 | 22.0–32.0 | 26.7 | 3.19 |
| Interorbital width | 27.9 | 27.9–41.1 | 35.6 | 2.90 | 18.5–36.4 | 28.0 | 5.46 |
| Mouth width | 28.9 | 25.6–34.4 | 28.6 | 2.03 | 24.2–32.0 | 27.2 | 2.30 |
| Maxillary barbel length | 11.6 | 11.5–18.0 | 14.8 | 1.87 | 17.8–24.4 | 21.4 | 2.18 |

Fins flexible, without spinous rays. Dorsal fin with 3 simple and 7 (16) branched rays; distal margin slightly concave, origin far anterior to vertical through pelvic-fin insertion and nearer to snout tip than to caudal-fin base.

Pectoral fin with 1 simple and 10 (5) or 11 (11) branched rays; inserted posterior to vertical through posteriormost point of operculum; tip of adpressed fin not extending to pelvic-fin insertion. Pelvic fin with 1 simple and 7 (16) branched rays, inserted below third or fourth branched dorsal-fin ray; tip of adpressed fin reaching beyond midway to anal-fin origin. Anal fin with 3 simple and 6 (16) branched rays; origin almost equidistant from pelvic-fin insertion and caudal-fin base. Caudal fin slightly emarginated, its lobes pointed.

Lateral line complete, almost straight, slightly curving ventrally at level of dorsal fin. Lateral-line perforated scales 35 (7), 36 (5), or 37 (4). Scale rows above lateral line 3.5 (16) and below 2 (16). Predorsal scales 10 (9) or 11 (7), and circumpeduncular scales 12 (16). Midventral region of body scaleless on anterior two-thirds of distance between pectoral-fin insertion and pelvic-fin insertion or more. Vertebrae 4+33 (9) -34 (7).

**Coloration in preservative.** Head blackish dorsally and dorsolaterally above level of ventral orbital margin, shading to grayish-white below, becoming yellow on ventral surface. Ground body color white and grey dorsally, yellow-white ventrally. A longitudinal dark brown stripe extending along lateral line with 8 or 9 indistinct black blotches; dorsal body and flank above longitudinal stripe densely covered with dark-grey irregular spots, spots more sparse below longitudinal stripe. Five black crossbars on back of body; first placed posterior to head, indistinct; second and third at dorsal-fin origin and posterior end of dorsal-fin base, respectively; forth at vertical though anal-fin origin; fifth at dorsal origin of procurrent caudal-fin rays. Each scale with a crescentic mark formed by black chromatophores. All fins grey and white with irregular spots scattered along branched rays; dorsal and caudal fins with more spots.

**Distribution.** Known only from the Du-He, a tributary flowing into the Han-Jiang of the middle Chang-Jiang basin, in Zhushan County, Hubei Province, South China (Fig. 3).

**Etymology.** The specific epithet, here used as a noun, is a combination of the Latin *nudus* (naked) and *ventris* (belly), in allusion to the scalesless midventral region of the body which extends slightly more than two-thirds of the distance between the pectoral- and pelvic-fin insertions.

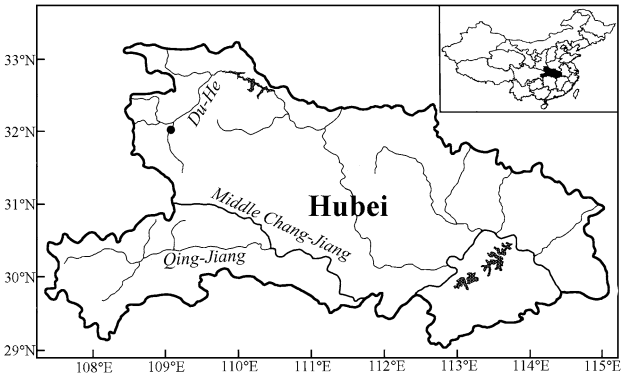


**FIGURE 3.** Map showing type locality of *M. nudiventris.*

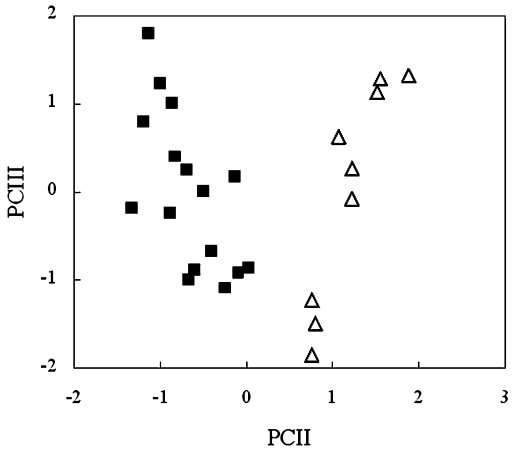


**FIGURE 4.** Scatter plot of the second and third components extracted from morphometric data for *M. nudiventris* (■), and its sympatric congener, *M. kiatingensis* (△).

## Discussion

**Type species.** The type species of *Microphysogobio* is usually listed as *M. koreensis* Mori 1934, but this is incorrect. The genus was originally proposed by Mori (1933), but without a type species designation, and *Microphysogobio* was unavailable according to the International Code of Zoological Nomenclature (no fixation of the type species after 1930). One year later, Mori (1934) provided a description of this genus, fixed *M. koreensis* as its type species, and described *M. hsinglungshanensis* from northern China. The name *M. koreensis*, however, was unavailable as its description was not published until 1935 (Mori 1935). *Microphysogobio koreensis* cannot be accepted as the type species of the genus. In fact, the type species of *Microphysogobio* was fixed by Burton (1934) as *M. hsinglungshanensis*, by monotypy.

**Generic definition.** The generic definition of *Microphysogobio* remains controversial. Bănărescu & Nalbant (1965, 1966, 1973) made significant contributions to the taxonomy of *Microphysogobio* following Mori's (1934) description. The generic diagnosis was revised, the taxonomy of some formerly described species was clarified, and new species were described. In Bănărescu's (1992) taxonomic revision of *Microphysogobio*, 23 species were identified from Vietnam, China, Korea, and Mongolia. The Chinese species were later referred to four genera by Yue (1998) in their monograph on Chinese gobionine species. One species (*M. obtusirostris*) was transferred to *Abbottina* Jordan & Fowler 1903, two (*M. chinssuensis* and *M. chenhsienensis*) to *Huigobio* Fang 1938, and three [*M. exiguus* (Lin 1932), *M. longibarbatus* (Lu, Luo & Chen 1977), and *M. nudiventris*] to *Platysmacheilus* Lu, Luo & Chen 1977. Clearly, Yue's concept of *Microphysogobio* was different from that of Bănărescu (1992).

Recently, phylogenetic relationships of the gudgeons were reconstructed using sequence data from two mitochondrial genes (COI and Cytb), and two nuclear genes (RAG1 and rhodopsin) (Yang *et al*. 2006; Tang *et al*. 201l). Results showed that some species of *Microphysogobio*, including those previously assigned to *Rostrogobio*, *Biwia*, and *Huigobio*, formed a monophyletic lineage, but sampled species within each of these three genera were not clustered in monophyletic groups. If this lineage is treated as a genus, *Biwia* Jordan & Fowler 1903 has priority over *Microphysogobio* Mori 1934, *Huigobio* Fang 1938, and *Rostrogobio* Taranetz 1937. However, Tang *et al.* (2011) stopped short of making a final decision regarding the generic status of this monophyletic lineage because the type species of *Microphysogobio* was not included in their analysis. Although molecular evidence of Tang *et al.* favored grouping species of *Biwia* and *Microphysogobio* in one genus, there are remarkable morphological differences between the two genera (Hosoya 1986). We agree with Tang *et al*. that *Biwia* should at least temporarily be retained as a genus. Also, we follow Bănărescu (1992) in transferring to *Microphysogobio* the species recognized by Yue (1998) in *Huigobio* and *Rostrogobio*. Sampled species of these three genera were not each recovered as monophyletic groups in the parsimony, likelihood or Bayesian trees of Tang *et al*., and no morphological differences can be found to diagnose them based on our examination of available species. Tang *et al.*'s molecular analysis indicated that species of *Abbottina* constituted an independent monophyletic lineage. We therefore agree with Yue (1998) about the generic classification of *Abbottina obtusirostris*.

The generic classification of *Platysmacheilus* sp. by Tang *et al.* (2011) remains doubtful. The voucher specimen of this species was from the Yuan Jiang (Red River) basin in Lang Son Province, northern Vietnam. However, *Platysmacheilus* is an endemic Chinese genus including four species currently known from the Zhu-Jiang and Chang-Jiang basins. In Tang *et al.*'s Bayesian tree, three sampled species of *Platysmacheilus* constituted a monophyletic lineage, but *Platysmacheilus* sp. was weakly united (59% posterior probability) with the other two species. *Platysmacheilus* was paraphyletic in their likelihood tree where the lineage with *Platysmacheilus* sp. as the basal group was sister to the other two species, and in their parsimony tree in which *Platysmacheilus* sp. was sister to the lineage with the other two species as the basal group. If all these facts are taken into consideration, *Platysmacheilus* sp. is better represented as an independent lineage. Likely, the voucher specimen of this species from the Yuan-Jiang basin in Lang Son Province, Vietnam was misidentified. In this context, the two Chinese species, *P. longibarbatus* and *P. exiguus*, constitute an independent monophyletic lineage in Tang *et al.*'s parsimony, likelihood and Bayesian trees. Thus, we agree with Yue (1998) that *Platysmacheilus* should be retained as a genus distinct from *Microphysogobio*.

Within the Gobioninae, *Microphysogobio* is here diagnosed by the following characters: lips thick, well developed, and papillated; upper and lower jaws with horny sheaths on their cutting margins; lower lip modified into a median mental pad and two lateral lobes; median mental pad heart-shaped or longitudinally bisected by a groove into two elements, and two lateral lobes interrupted by a median mental pad.

This generic diagnosis is similar to that of Xing *et al.* (2011) who included 23 other species in this genus without any further discussion in their description of *M. wulonghensis*. They placed in *Microphysogobio* two species (*M. chinssuensis* and *M. amurensis*) which were referred by Yue (1998) to *Huigobio* and *Rostrogobio* (each genus has two included species), but followed Yue to exclude from it four species of Bănărescu (1992), three (*M. exiguus*, *M. nudiventris*, and *M. longibarbatus*) of which were placed by them in *Platysmacheilus*, and one (*M. obtusirostris*) in *Abbottina*. The slight difference between Xing *et al.* and this study is in species composition; the other two species placed by Yue in *Huigobio* and *Rostrogobio* (*H. chenhsienensis* and *R. liaohensis*) are referred to *Microphysogobio* here.

Although *M. wulonghensis* is considered to be a member of *Microphysogobio* here, its generic classification requires further study. The original description and accompanying illustration of *M. wulonghensis* indicated that

two lateral lobes of the lower lip contact each other behind the heart-shaped medial pad (= median mental pad), and that the upper jaw is entirely enclosed by the upper lip. These two characters do not place it in *Microphysogobio*. Given that the type material of *M. wulonghensis* was not examined in this study, its generic classification remains to be resolved in the future.

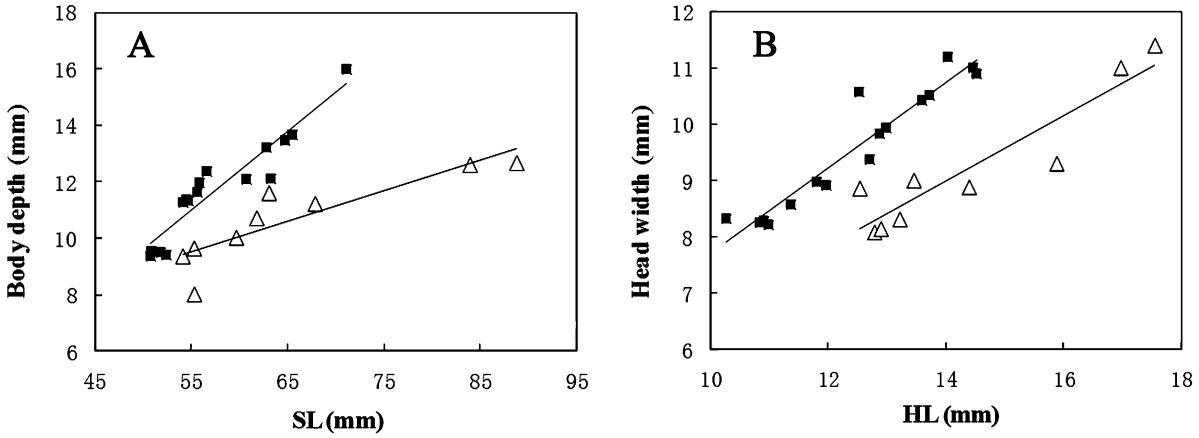


**FIGURE 5.** Relation between (A) body depth and SL, and (B) head width and HL, for *M. nudiventris* (■), and its sympatric congener, *M. kiatingensis* (?).

Three species recognized by Kawase & Hosoya (2010) in *Biwia* were not referred by Xing *et al.* (2011) to *Microphysogobio*. This means that Xing *et al.* still accepted *Biwia* as a distinct genus despite the nonmonophyletic nature of this genus shown by Tang *et al.*'s molecular phylogenetic analysis of the gudgeons. However, it is worth noting that the recognition of *Microphysogobio* as a genus in this study is an expedient taxonomic treatment, at least for facilitating the account of the new species. Its monophyly and validity require an in-depth investigation based on molecular and /or morphological data of additional species (inclusive of their type species) from these two genera.

**Comparisons with congeneric species.** *Microphysogobio nudiventris* is currently known from the Du-He, a tributary to the Han-Jiang of the middle Chang-Jiang basin. It occurs sympatrically with *M. kiatingensis*. The principal component analysis performed on the variance-covariance matrix of log-transformed measurements taken from specimens of these two species (Table 2 and Fig. 4) showed that the combination of PC2 against PC3 enabled the separation of *M. nudiventris* from *M. kiatingensis*. They were distinguishable by PC2, the main shape axis, on which the main loadings were body depth and head width. *Microphysogobio nudiventris* has a deeper body (depth 18.0–22.5 vs. 14.3–18.4% SL; Fig. 5A) and a wider head (width 73.9–84.5 vs. 80.7–86.3% HL; Fig. 5B) than *M. kiatingensis*. It is further distinguished from *M. kiatingensis* in having a scaleless (vs. scaled) midventral region of the body, and the width of the cutting edge on the upper jaw is greater than half (vs. less than half) of the width of the mouth (Fig. 2).

Besides *M. rapidus*, *M. wulonghensis* and *M. yaluensis*, there are seven other species of *Microphysogobio* with a scaleless midventral region of the body; namely *M. amurensis*, *M. liaohensis*, *M. chinssuensis*, *M. chenhsienensis*, *M. linghensis*, *M. hsinglungshanensis*, and *M. anudarini*. *Microphysogobio nudiventris* differs from *M. linghensis*, occurring in the Hai-He basin, in having the scaleless midventral region of the body reaching slightly more than two-thirds of the distance from the pectoral- to the pelvic-fin insertion (vs. not reaching midway to the pelvic-fin insertion), and a papillated (vs. nonpapillated) upper lip. Unlike *M. nudiventris*, the remaining six species possess a scaleless midventral region of the body extending to the pelvic-fin insertion. This new species further differs from *M. amurensis* (Taranetz 1937) and *M. liaohensis*, occurring in the Heilong-Jiang (Amur River) and Liao-He basins, respectively, in having a deeper body (depth 18.0–22.5 vs. 12.8–16.7% SL in *M. amurensis* and 13.0–17.9 in *M. liaohensis*), and the interorbital width greater than (vs. less than) the eye diameter. It is further distinguished from *M. chinssuensis*, hitherto known from the Yellow River basin, and *M. chenhsienensis* from river

basins in Zhejiang Province, in having a lower lip with a heart-shaped central lobe longitudinally bisected (vs. not bisected) by a groove, and the interorbital width more than (vs. less than) the eye diameter. The data for *M. amurensis* and *M. liaohensis* are from Liu & Qin (1987) and Yue (1998), and the data for *M. chinssuensis* and *M. chenhsienensis* are from Yue (1998).

Holcik and Povnicka (1969) originally described *M. anudarini* from Buinar (= Buir) Lake, in the Amur River basin, Mongolia. Baasanjav & Tsendayush (2001) regarded it as a synonym of *M. amurensis*. Subsequently, Bogutskaya & Naseka (2004) treated both names as synonyms of *M. tungtingensis*. Kottelat (2006) resurrected *M. anudarini* and *M. amurensis* from the synonymy of *M. tungtingensis* (Nichols 1926) and regarded both as distinct species; both differ in the number of simple or unbranched anal-fin rays (3 in *M. anudarini*, vs. 2 in *M. amurensis*), and *M. anudarini* also has a shorter distance between the anus and anal-fin origin (17.8–19.6 vs. 23.0–29.5% SL in *M. amurensis*). We follow Kottelat in treating *M. anudarini* as a valid species. His picture of *M. anudarini* indicates that it has a slender body, and pelvic fins inserted closer to the snout tip than to the caudal-fin base. In contrast, *M. nudiventris* has a deeper body, and pelvic fins inserted equidistant between the snout tip and caudal-fin base. Both also differ in the distance between the anus and anal-fin origin. It was given by Holcik & Povnicka (1969) as 17.8–19.6, and by Kottelat (2006) as 19.0–20.8% SL for *M. amurensis*. The values of this character range from 14.1–17.7% SL for *M. nudiventris.*

**TABLE 2.** Loadings on the first three principal components extracted from morphometric data for *M. nudiventris* and its sympatric congener, *M. kiatingensis*.

| Characters | PC 1 | PC 2 | PC 3 |
|---|---|---|---|
| Standard length | -0.234 | 0.049 | -0.132 |
| Body depth | -0.171 | -0.377 | 0.014 |
| Predorsal length | -0.224 | 0.056 | -0.212 |
| Dorsal-fin base length | -0.225 | -0.144 | 0.002 |
| Dorsal-fin length | -0.215 | 0.195 | -0.023 |
| Preanal length | -0.230 | 0.049 | -0.160 |
| Anal-fin base length | -0.165 | -0.103 | 0.593 |
| Anal-fin length | -0.213 | 0.109 | -0.044 |
| Prepectoral length | -0.222 | 0.166 | -0.083 |
| Pectoral-fin base length | -0.217 | -0.125 | 0.238 |
| Pectoral-fin length | -0.203 | -0.0123 | 0.003 |
| Prepelvic length | -0.226 | 0.008 | -0.202 |
| Pelvic-fin base length | -0.198 | -0.123 | -0.217 |
| Pelvic-fin length | -0.220 | 0.096 | 0.182 |
| Caudal-peduncle length | -0.205 | 0.126 | -0.077 |
| Caudal-peduncle depth | -0.209 | -0.187 | 0.078 |
| Head length | -0.229 | 0.130 | 0.090 |
| Head depth | -0.214 | -0.215 | 0.076 |
| Head width | -0.200 | -0.299 | 0.090 |
| Snout length | -0.168 | 0.416 | -0.138 |
| Eye diameter | -0.207 | 0.141 | 0.100 |
| Interorbital width | -0.109 | -0.340 | -0.519 |
| Mouth width | -0.202 | -0.006 | 0.191 |
| Maxillary barbel length | -0.140 | 0.418 | 0.065 |
| Variance coverage (%) | 72.25 | 11.16 | 4.53 |

Mori (1934) described *M. hsinglungshanensis* from Lwan-ho (= Luan He), Hsing-lung-shan (Xinglong County), Jehol (a former Chinese province including present Chengde Prefecture of Hebei Province, Chaoyang, Fuxin prefectures of Liaoning Province, and Chifeng City of Inner Mongolia Autonomous Region). It differed from *M. chinssuensis* (Nichols 1926) in the snout length, dorsal-fin position, and number of lateral-line scales. However, this species was recognized as a synonym of *M. chinssuensis* by most subsequent authors without further elaboration (Bănărescu & Nalbant 1966; Yue 1998). Wang *et al.* (2001) considered *M. hsinglungshanensis* to be a valid species. His taxonomic treatment of this species was followed by Xing *et al.* (2011) and by us in the present study. Besides scalation, the anal-fin position is a useful character to distinguish *M. nudiventris* from *M. hsinglungshanensis*. The former has the anal-fin origin nearer to the pelvic-fin insertion than to the caudal-fin base, but the latter has the anal-fin origin closer to the caudal-fin base than to the pelvic-fin insertion.

See the diagnosis of *M. nudiventris* for differences with *M. yaluensis*, *M. rapidus*, and *M. wulonghensis*. In this study, the data for *M. yaluensis* are from Mori (1928) and Xie (2007). The taxonomy of this species is poorly understood. It was originally described by Mori (1928) based on a single specimen from the Yalu River at Tsao-ho-kou, Korea. Xie (2007) indicated that "Tsao-ho-kou" in Chinese spelling is Cao-He-Kou Town, Benxi County, Liaoning Province, in the upper Ai-He, a tributary of the Yalu-Jiang. Therefore, he concluded that the type locality of *M. yaluensis* is the Yalu-Jiang of China. The original description indicated that this species has a straight distal margin on the dorsal fin, the snout length greater than the postorbital part of the head, and the interorbital width less than the eye diameter. The first character is also illustrated by Xie (2007) in his figure 89, and the last two by his photograph of *M. yaluensis* from North China. The data used herein for *M. wulonghensis* and *M. rapidus* are from Xing *et al.* (2011) and Chae & Yang (1999), respectively.

## Comparative materials

*Microphysogobio kiatingensis*, IHB 2011040075, 2011040106, 2011040110, 2011040126, 2011040133–4, 2011040143, 2011040275, 2011040293, 9, 54.1–88.8 mm SL; China: Hubei Province: Shiyan City: Zhushan County: Du-He, a tributary of Han-Jiang (linked to the middle Chang-Jiang).

*Microphysogobio linghensis*, IHB 82IV1631–3, 3, 33.3–40.3 mm SL; China: Liaoning Province: Fushun City: Liao-He Basin.

*Microphysogobio amurensis*: IHB 58V377–86, 10, 43.1–55.6 mm SL; China: Heilongjiang Province: Heihe City: Heilong-Jiang.

*Microphysogobio chinssuensis*: IHB 80VII1611, 80VII0015, 80VII1641, 80VII1739, 80VII1795, 80VII1784, 6, 36.7–50.2 mm SL; China: Gansu Province: Wushan County: Hejia Village: Huai He basin; IHB 56IX0391–4, 4, 38.9–46.2 mm SL; China: Benxi-City: Taizi-He of Liao-He basin.

*Microphysogobio yaluensis*: IHB 19910501–5, 5, 54.6–67.5 mm SL; South Korea: Taegu City: Yulha-dong: Tong-Gu.

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